

Report in Accordance with BFRC Guidelines and Regulations

Product description: “Rehau S719 – A5 window”

CONFIDENTIAL

Client:	Mr Dean Franklin, Rehau Ltd, Hill Court, Wallford, Ross-on-Wye, Herefordshire, HR9 5QN.
Project:	“Drawing reference - 92273”
Project reference:	CU11234-1
Prepared By:	Clive Cox Test Engineer
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Approved Simulator 047

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1 Introduction

The U-value calculations of the Rehau Ltd, S719-A5 window detailed below were commissioned by Dean Franklin of Rehau Ltd.

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 10077-2:2003.

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)

Rehau S719 A5 Frame Profile	Frame Thermal Transmittance (U_f)
Head / Jamb Top	1.5 W/(m ² ·K)
Meeting Rail	1.6 W/(m ² ·K)
Jamb Bottom	1.7 W/(m ² ·K)
Cill	1.9 W/(m ² ·K)

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

Rehau S719 A5 Frame Profile	Linear Thermal Transmittance (ψ)
Head / Jamb Top	0.032 W/(m·K)
Meeting Rail	0.035 W/(m·K)
Jamb Bottom	0.036 W/(m·K)
Cill	0.021 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)
4-16-4 Low-E 0.05 uncorrected emissivity (Saint Gobain Planitherm total+), 90% Argon 10% Air filled, Float glass outer pane (Saint Gobain Planilux) glazing unit with SGG Swiss Spacer V spacer bar with 3mm Butyl secondary seal.	1.2 W/(m ² ·K)

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

Rehau S719 A5 Frame Profile	Window U-Value
PVCu frame system with steel & Aluminium reinforcement to BFRC requirements with 4-16-4 Low-E 0.05 uncorrected emissivity (Saint Gobain Planitherm total+), 90% Argon 10% Air filled, Float glass outer pane (Saint Gobain Planilux) glazing unit with SGG Swiss Spacer V spacer bar with 3mm Butyl secondary seal.	1.49 W/(m ² ·K)

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

Rehau S719 A5 Frame Profile	Effective L ₅₀
Air permeability at 50 pa	0.01 W/(m ² ·K)

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

Rehau S719 A5 Frame Profile	g _{window}
PVCu frame system with steel & Aluminium reinforcement to BFRC requirements with 4-16-4 Low-E 0.05 uncorrected emissivity (Saint Gobain Planitherm total+), 90% Argon 10% Air filled, Float glass outer pane (Saint Gobain Planilux) glazing unit with SGG Swiss Spacer V spacer bar with 3mm Butyl secondary seal.	0.47


5.0 BFRC Rating

5.1 Rehau S719 – A5 window system

Rehau S719 A5 Frame Profile	Rating
PVCu frame system with steel & Aluminium reinforcement to BFRC requirements with 4-16-4 Low-E 0.05 uncorrected emissivity (Saint Gobain Planitherm total+), 90% Argon 10% Air filled, Float glass outer pane (Saint Gobain Planilux) glazing unit with SGG Swiss Spacer V spacer bar with 3mm Butyl secondary seal.	0 (Rating Scale A)

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6.0 Authorisation

	Prepared by:
Signature:	
Name:	Clive Cox
Title:	Test Engineer

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Profiles	Ref. No.	Material Type/Manufacturer's Name & Density (Timber only)	Dimensions (Height & Width)
Outer Frame	559500	PVCu / Rehau Ltd	66mm x 137mm
Intermediate Sash	559520	PVCu / Rehau Ltd	52.5mm x 57mm
Slim Sash	559510	PVCu / Rehau Ltd	42.5mm x 57mm
Deep Bottom Rail	559540	PVCu / Rehau Ltd	81mm x 57mm
Outer Cill	559570	PVCu / Rehau Ltd	62mm x 149mm
Glazing Bead	559590	PVCu / Rehau Ltd	24.3mm x 14.5mm
24mm Aluminium Glazing Bead Sash Midrail	219140	Aluminium / Rehau Ltd	24.3mm x 14.5mm

Reinforcements	Ref. No.	Material Type/ Manufacturer's Name	Dimensions (Height & Width)
Outer Frame	n/a	n/a	12mm x 35mm
Intermediate Sash	219010	Steel / Rehau Ltd	21.3mm x 39.5mm
Slim Sash	219000	Steel / Rehau Ltd	16.3mm x 39.5mm
Deep Bottom Rail	219040	Aluminium / Rehau Ltd	45mm x 39.5mm
Outer Cill	None		

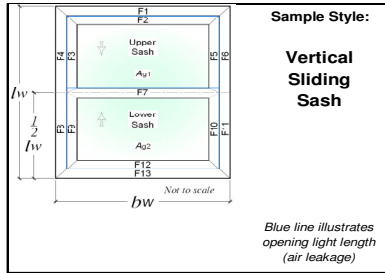
Weather Seals	Ref. No.	Material Type/ Manufacturer's Name	Continuous or Joined @ Corners
Glazing Bead	N/A	Flexible PVC – Co-extruded to beading	
Glazing Rebate	235203	Universal Gasket	
Casement Perimeter Seal	235203	Universal Gasket	
Frame Groove Cover	219180	Polyamid (nylon Brushpile)	

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Glazing Component	Specification
Overall sealed unit: 1. Thickness (mm)	1. 24mm
Outer pane 1. Thickness (mm) 2. Manufacturer 3. Description	1. 4mm 2. Saint Gobain 3. Planilux
Inner pane: 1. Thickness 2. Manufacturer 3. Description	1. 4mm 2. Saint Gobain 3. Planitherm Total +
Spacer bar: 1. Manufacturer 2. Description	1. Saint Gobain 2. Swiss Spacer V
Cavity 1. Distance (mm) 2. Gas %	1. 16mm 2. Argon 90% Air 10%
Edge seal 1. Manufacturer 2. Description	1. N/A 2. Primary : PIB , Secondary : 3mm Butyl.

Additional Notes
<p>Reinforcement is present only in casement members.</p> <p>Air leakage data is taken from Buildcheck Test report ref. W10179-2, Dated:12/07/10</p> <p>Air Leakage result at 50pa : 0.24m³/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 0.71.</p>

BFRC Spreadsheet



Report Number: **U11234-1** Report Issue No.14 (15/07/11)
Report Date: **27/10/2011**

Project Details: **Rehau S719 VSS A5**

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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	l_w	1480 mm
Total window width ODP	b_w	1230 mm

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}	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_{g2}		mm
Gas fill (2/3)		
Thickness of pane 3, d_{p3}		mm
Glazing Trans. - 3DP	U_g	1.195 W/(m ² ·K)
g-value - 2DP	g_L	0.71

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	m	m	m ²	m ²
Upper glazing	0.6138	1.0320	0.6334	0.6311		
Lower glazing	0.5918	1.0320	0.6107	0.6074		
Total of glazing		1.2441	1.2386			
Frame						
F1	1.2300	0.0530	0.0624	0.0624		
F2	1.1240	0.0460	0.0496	0.0506		
F3	0.6870	0.0460	0.0299	0.0305		
F4	0.7400	0.0530	0.0378	0.0378		
F5	0.6870	0.0460	0.0299	0.0305		
F6	0.7400	0.0530	0.0378	0.0378		
F7	1.1240	0.0545	0.0588	0.0598		
F8	0.7400	0.0530	0.0376	0.0376		
F9	0.6780	0.0460	0.0292	0.0298		
F10	0.6780	0.0460	0.0292	0.0298		
F11	0.7400	0.0530	0.0376	0.0376		
F12	1.1240	0.0590	0.0636	0.0646		
F13	1.2300	0.0620	0.0730	0.0730		
Total Frame		0.5763	0.5818			
Total Window, A_w		1.8204	1.8204			
Percentage upper glass area		34.79%	34.67%			
Percentage lower glass area		33.55%	33.37%			
Percentage glass area (total)		68.34%	68.04%			

Solar Factor, g-value:

glazing area A_g (m ²)	1.3470
F_w	0.9
g_w	0.47

U_{window} U_w **1.49** W/(m²·K)

Other parameters needed for calculation, taken from simulations:
Glazing: Panel thickness, $d_p = d_g = 0.024$ m

Frame dimensions (All frame values to nearest 0.5mm, gaskets to 1DP)

Section	Frame height, b_f (mm)			Gasket protrusion (mm)	With gasket (mm)	Total
	Combo	Internal	External			
F1 fixed top rail	99.0	53.0	66.0	n/a	53.0	100.0
F2 moving top rail		46.0	33.0	1.0	47.0	
F3 top (LH) jamb (moving sash)	99.0	46.0	33.0	1.0	47.0	100.0
F4 top (LH) jamb (fixed frame)		53.0	66.0	n/a	53.0	
F5 top (RH) jamb (moving sash)	99.0	46.0	33.0	1.0	47.0	100.0
F6 top (RH) jamb (fixed frame)		53.0	66.0	n/a	53.0	
F7 mid rail (upper)		54.5		1.0	55.5	55.5
F7 mid rail (lower)				1.0		
F8 bottom (LH) jamb (fixed frame)	99.0	53.0	66.0	n/a	53.0	100.0
F9 bottom (LH) jamb (moving sash)		46.0	33.0	1.0	47.0	
F10 bottom (RH) jamb (moving sash)	99.0	46.0	33.0	1.0	47.0	100.0
F11 bottom (RH) jamb (fixed frame)		53.0	66.0	n/a	53.0	
F12 bottom moving rail		59.0		1.0	60.0	122.0
F13 bottom fixed rail		62.0		n/a	62.0	
Total gasket area				0.005501	m ²	

Where a U_w 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 **ODP**

Section	$L_{f,2D}$	$W/(m \cdot K)$	b_f (mm)	$L_{\psi,2D}$	$W/(m \cdot K)$	b_g (mm)
F3+F4 top (LH) jamb	0.3661	190	0.4023	190		
F5+F6 top (RH) jamb	0.3661	190	0.4023	190		
F7 mid rail	0.6183	380	0.6987	380		
F8+F9 bottom (LH) jamb	0.3866	190	0.4271	190		
F10+F11 bottom (RH) jamb	0.3866	190	0.4271	190		
F12+F13 bottom rail	0.4475	190	0.4737	190		

Frame:

Section	b_f	U_f	A_f (no gasket)	Frame heat, HU	ψ	l_g	Junction heat, H_{jg}
	m	W/(m ² ·K)	m ²	W/K	W/(m·K)	m	W/K
F1+F2 top rail	0.0990	1.4602	0.1120	0.1635	0.0322	1.0320	0.0332
F3+F4 top left jamb	0.0990	1.4552	0.0677	0.0986	0.0312	0.6138	0.0191
F5+F6 top right jamb	0.0990	1.4552	0.0677	0.0986	0.0312	0.6138	0.0191
F7 mid rail	0.0545	3.1968	0.0588	0.1878	0.0704	1.0320	0.0726
F8+F9 btm left jamb	0.0990	1.6623	0.0668	0.1110	0.0355	0.5918	0.0210
F10+F11 btm right jamb	0.0990	1.6623	0.0668	0.1110	0.0355	0.5918	0.0210
F12+F13 bottom rail	0.1210	1.8633	0.1366	0.2545	0.0212	1.0320	0.0219
Totals	0.5763	1.0249				Total	0.2080

Air Leakage loss:

Air leakage at 50 Pa per hour & per unit length of opening light (BS 6375-1) - 2DP	0.24	m ³ /(m·h)
Opening light length, $l_{opening}$	6.3500	m
Total air leakage	1.524	m ³ /h
L_{50}	0.84	m ³ /(m ² ·h)
Heat loss = 0.0165 L_{50}	0.01	W/(m ² ·K)

$\lambda_p = 0.035$ W/(m·K) $R_{se} = 0.04$ m²·K/W $R_{se} = 0.13$ m²·K/W
 $R_p = 0.6857$ m²·K/W $R_{tot} = 0.8557$ m²·K/W $U_p = 1.1686$ W/(m²·K)

BFRC Rating	Label index	EWER Rating Scale	Window Rating
≥ 0	0	A	A
-10 to <0		B	
-20 to <-10		C	
-30 to <-20		D	
-50 to <-30		E	
-70 to <-50		F	
<-70		G	

BFRC Rating =
 $218.6g_{window} - 68.5 \times (U_{window} + \text{Effective } L_{50}) =$ **-0.01**

Climate zone is: **UK**

Thermal transmittance, W/(m ² ·K)	U_{window}	1.5
Solar factor	g_{window}	0.47
Window air leakage heat loss, W/(m ² ·K)	L_{factor}	0.01

Simulator Name: **Clive Cox**



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BS EN 673 Spreadsheet

Version 10 22/07/2011. 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; align-items: center; justify-content: center;"> <div style="margin-right: 10px;">Emissivities</div> <div style="border: 1px solid black; padding: 5px;"> <table border="1" style="text-align: center;"> <tr> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">P a n e 1</td> <td style="width: 100px; height: 100px;">90%</td> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">P a n e 2</td> </tr> </table> </div> </div>			P a n e 1	90%	P a n e 2
P a n e 1	90%	P a n e 2			
Calculate					
Gas					
Argon					
Thickness (mm)	4.0	16			
Normal emissivity	0.89	0.05			
$\sum d_i r_i = 0.008$	Uncoated				

For uncoated surfaces input 0.89 for normal emissivity, which corresponds to a corrected emissivity of 0.837

Iteration number	U value		λ_{eff}	
	W/(m ² ·K)	$\sum 1/h_s$ (m ² ·K)/W	W/(mK)	ΔT
1	1.195	0.65864	0.0243	15
2	1.195	0.65864	0.0243	15

Thermal Conductance Values Used

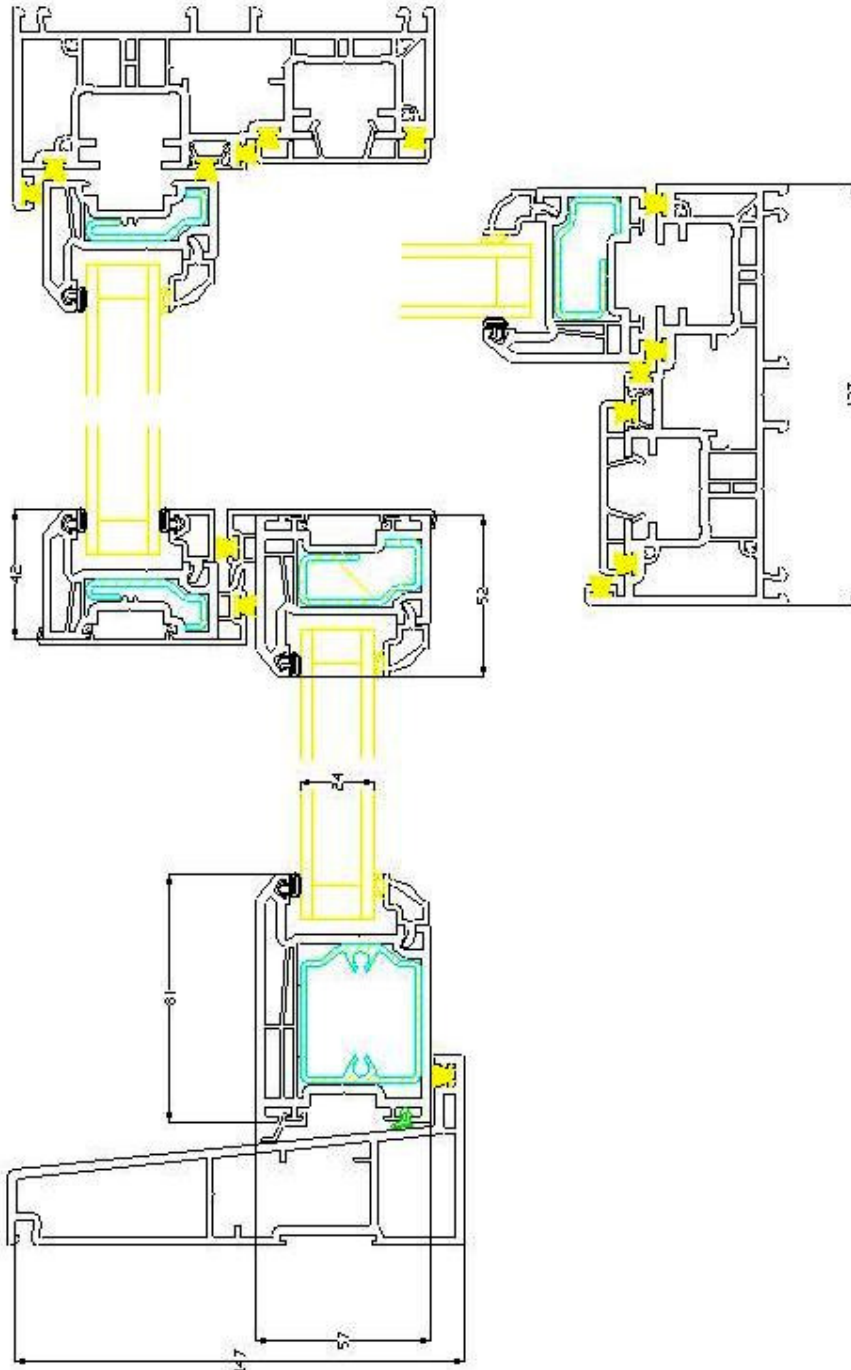
Material/Conductance W/(m.K)	Reference
PVCu / 0.135	Rehau Manufacturer Data
Steel / 50.0	(Annex A BS EN ISO 10077-2)
EPDM / 0.25	(Annex A BS EN ISO 10077-2)
Butyl/ 0.24	(Annex A BS EN ISO 10077-2)
Soda Lime Glass / 1.0	(Annex A BS EN ISO 10077-2)
Aluminium / 160	(Annex A BS EN ISO 10077-2)
Molecular Sieve / 0.10	(Annex A BS EN ISO 10077-2)
Polyamid /0.25	(Annex A BS EN ISO 10077-2)
PVCu / 0.17	(Annex A BS EN ISO 10077-2)
Swisspacer V Plastic / 0.16	SGG Manufacturers Data

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Appendix

Profile Drawings

(See Technical Specification for dimensions)



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