WINDOW & DOOR RATING CONSULTANCY LTD

THERMAL SIMULATION REPORT

Report Number:	DF 13/351
Prepared For:	
Window System:	Royale Aluminium Window System
Fixed Outer Frame:	SW0006-0007
Mullion Frame:	SW009-0010 & SW0019-0020
Sash Frame:	SW0004-0005
I. G. Unit Configuration:	Fixed OF 4.10.4 Planitherm Total+ Diamant 90% Krypton Opening Sash 4.8.4 Plani Total+ Diamant 90% Krypton
Spacer Bar:	Swisspacer V
Notes:	

Results

Thermal Transmittance (U_{window})	1.9	W/m^2K
Solar Factor (g_{window})	0.56	
Window air leakage heat loss	0.01	W/m^2K
BFRC Energy Rating Index	-8	$kWh/m^2/year$
BFRC Energy Rating Band	B	

(Window Configuration as per GGF Document 2.2)
(1230mm wide x 1480mm high – side hung vent next to fixed ligh t)

Report prepared by: David Frost
Window & Door Rating Consultancy Ltd

Signed:

Date: 2nd May 2013

The simulations in this report were performed using Therm 5.2.14 accordi ng to EN ISO 10077-2.

The glazing properties were obtained from SGG Calumen II

The Therm files generated are attached to this report as appendices

British Fenestration Rating Council

BFRC Certified Simulator 050

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THERMAL SIMULATION REPORT

Additional Information:

Frame

Material & finish: Aluminium

Profile: Outer Frame: SW0006-0007

Mullion Frame: SW009-0010 & SW0019-0020

Sash Frame: SW0004-0005

Glazing bead: SW0011 & SW0012 & SW0025

Frame gasket material: TPE

Glazing bead gasket material: TPE

Glazing details

Unit thickness (mm): Fixed outer frame 18mm Opening sash 16mm

EN 673:1998 (A1) Uglass (W/m²K):

External pane 4mm St Gobain Diamant Emissivity ε 0.89

Centre pane n/a Emissivity ε n/a

Internal pane 4mm St Gobain Planitherm Total + Emissivity ε 0.05

Solar factor g ⊥ value 4.10.4 unit - 0.74 4.8.4 unit - 0.73

Spacer bar: Swisspacer V 8mm & 10mm Gas filling : 90% Krypton

Sealants: Primary : Poly-iso-butylene Secondary : Hot melt butyl

Air Leakage

Test result 0.21 (m³/h/m) at 50Pa

Test authority Wintech Engineering

Test report number R12721

Test date 22.03.2013

Comments:

Perimeter Foam used is closed cell polyethylene foam used in Sash Frame,
Thermal Break is Polyamide with 25% glass fibre.

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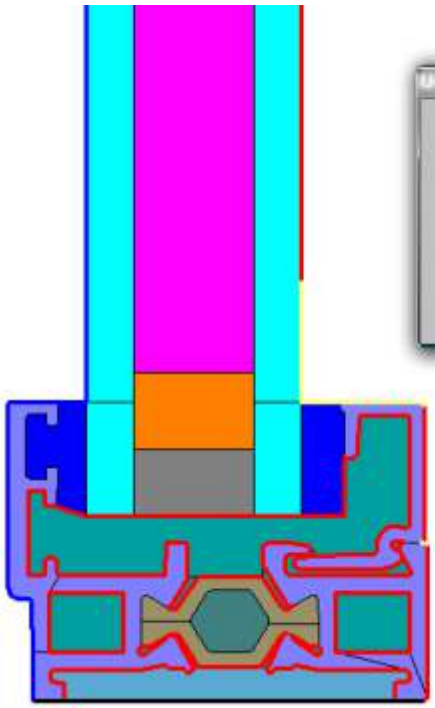
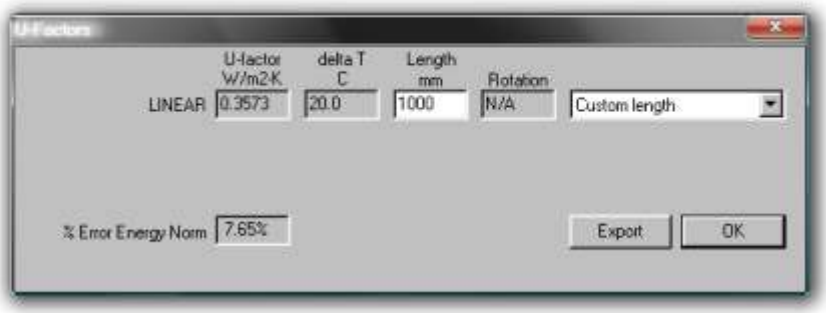
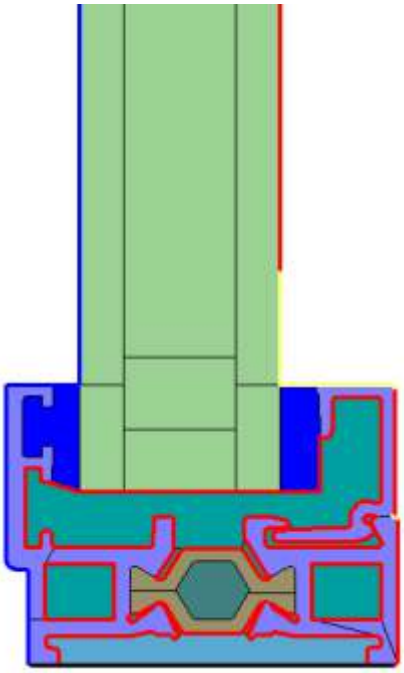
THERMAL SIMULATION REPORT

Simulation Diagram: Fixed Outer Frame Glass





Fixed Outer Frame Panel



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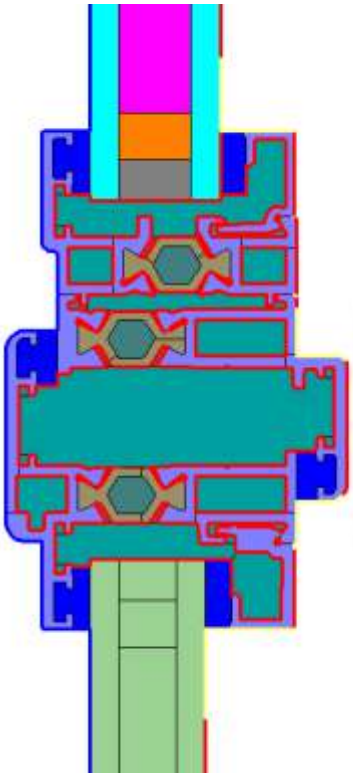
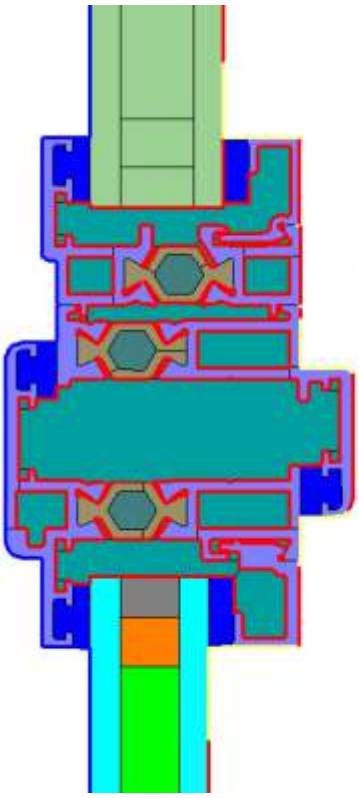
THERMAL SIMULATION REPORT

Simulation Diagram: Mullion Fixed Glass



Mullion Moving Glass



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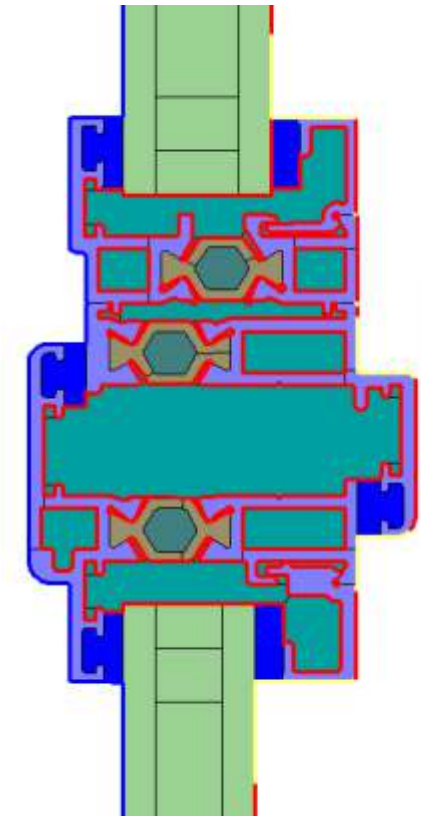
THERMAL SIMULATION REPORT

Mullion Panel



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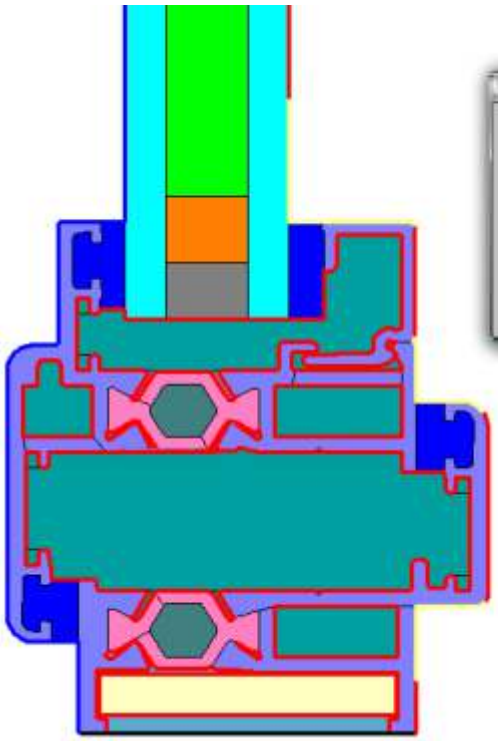
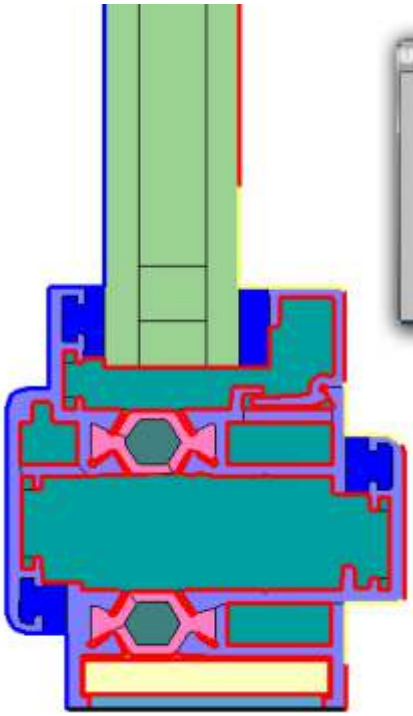
THERMAL SIMULATION REPORT

Simulation Diagram: Sash/Outer Frame Glass



Sash Outer Frame Panel



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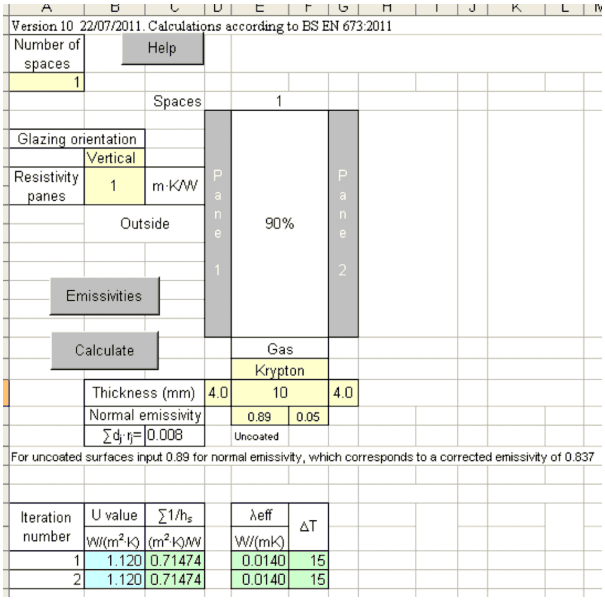
THERMAL SIMULATION REPORT

BS EN 673 Glazing Spreadsheet

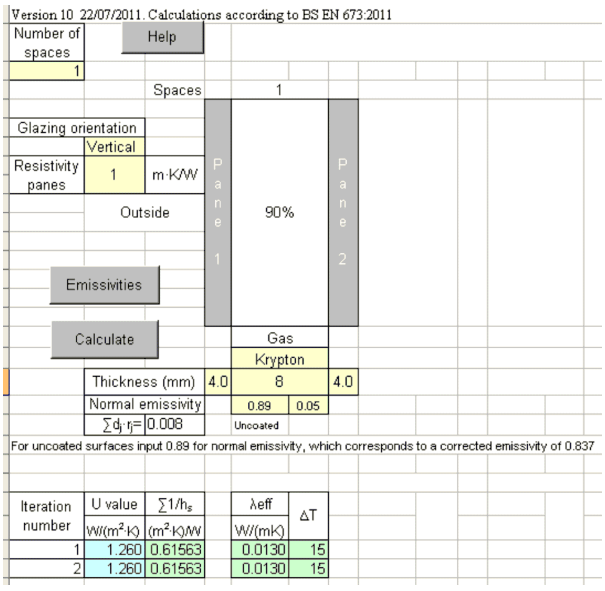


Version 10 22/07/2011. Calculations according to BS EN 673:2011

Number of spaces	Help					
1						
		Spaces		1		
Glazing orientation						
	Vertical					
Resistivity panes	1	m·K/W	Pane 1	90%	Pane 2	
	Outside					
Emissivities						
Calculate				Gas		
				Krypton		
	Thickness (mm)		4.0	10	4.0	
	Normal emissivity			0.89	0.05	
	$\sum d_j \eta_j$=	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 W/(m²·K)	$\sum 1/h_s$ (m²·K)/W	λeff W/(mK)	ΔT
1	1.120	0.71474	0.0140	15
2	1.120	0.71474	0.0140	15



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	Pane 1	90%	Pane 2	
	Outside					
Emissivities						
Calculate				Gas		
				Krypton		
	Thickness (mm)		4.0	8	4.0	
	Normal emissivity			0.89	0.05	
	$\sum d_j \eta_j$=	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 W/(m²·K)	$\sum 1/h_s$ (m²·K)/W	λeff W/(mK)	ΔT
1	1.260	0.61563	0.0130	15
2	1.260	0.61563	0.0130	15

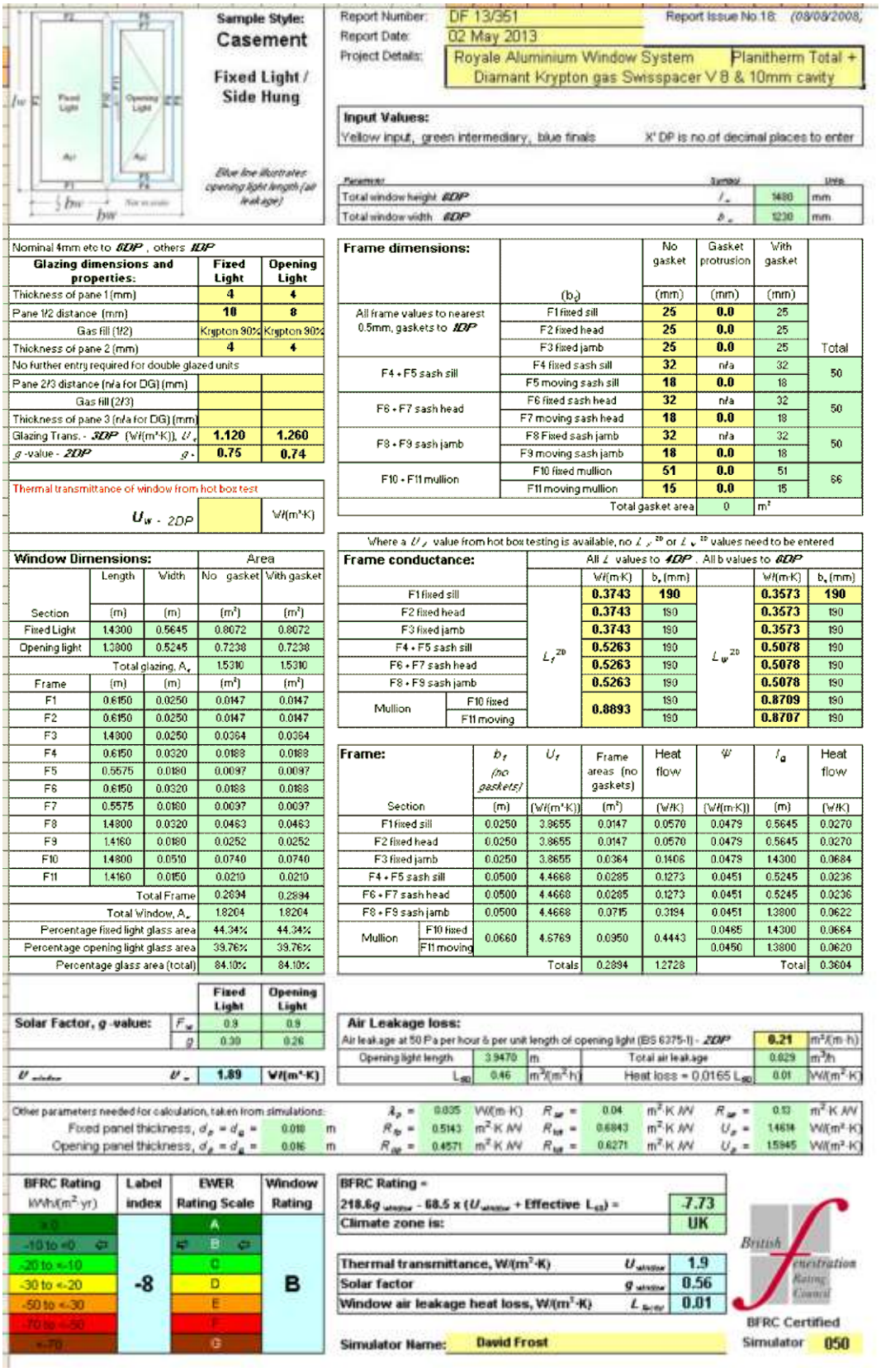
Thermal Conductivity Values Used

Material	Conductivity W/(m·K)	Reference
Aluminium Si Alloys	160	(Annex A BS EN ISO 10077 -2)
Polyamide 25% Glass fibre	0.3	(Annex A BS EN ISO 1007 7-2)
Soda Lime Glass	1.0	(Annex A BS EN ISO 10077-2)
Hot Melt Butyl	0.24	(Annex A BS EN ISO 10077-2)
Swisspacer V Box Method (inc. spacer, desiccant, PIB)	0.175	Manufacturers declared valu e
Perimeter Foam (closed cell polyethylene)	0.05	Manufacturers declared value
PTE Gasket	0.035	Manufacturers declared value

BS EN 410 Glazing Data: Insert

THERMAL SIMULATION REPORT

BFRC Spreadsheet



Sample Style: Casement

Fixed Light / Side Hung

Blue line illustrates opening light length (air leakage)

Report Number: DF 13/351 — Report Issue No.18: *(08/08/2008)*
Report Date: 02 May 2013
Project Details: Royale Aluminium Window System — Planitherm Total + Diamant Krypton gas Swisspacer V 8 & 10mm cavity

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

Parameter	Symbol		Units
Total window height *4DP*	l_w	1480	mm
Total window width *4DP*	b_w	1230	mm

Nominal 4mm etc to *6DP*, others *4DP*

Glazing dimensions and properties:	Fixed Light	Opening Light
Thickness of pane 1 (mm)	4	4
Pane 1/2 distance (mm)	18	8
Gas fill (1/2)	Krypton 90%	Krypton 90%
Thickness of pane 2 (mm)	4	4
No further entry required for double glazed units		
Pane 2/3 distance (n/a for DG) (mm)		
Gas fill (2/3)		
Thickness of pane 3 (n/a for DG) (mm)		
Glazing Trans. - *3DP* ($W/(m^2K)$), U_g	1.120	1.260
g-value - *2DP* g_-	0.75	0.74

Thermal transmittance of window from hot box test

U_w - *2DP* — $W/(m^2K)$

Frame dimensions:		No gasket (b_f) (mm)	Gasket protrusion (mm)	With gasket (mm)	
All frame values to nearest 0.5mm, gaskets to *1DP*	F1 fixed sill	25	0.0	25	
	F2 fixed head	25	0.0	25	
	F3 fixed jamb	25	0.0	25	Total
F4 + F5 sash sill	F4 fixed sash sill	32	n/a	32	50
	F5 moving sash sill	18	0.0	18	
F6 + F7 sash head	F6 fixed sash head	32	n/a	32	50
	F7 moving sash head	18	0.0	18	
F8 + F9 sash jamb	F8 Fixed sash jamb	32	n/a	32	50
	F9 moving sash jamb	18	0.0	18	
F10 + F11 mullion	F10 fixed mullion	51	0.0	51	66
	F11 moving mullion	15	0.0	15	
	Total gasket area		0	m^2	

Window Dimensions:			Area	
	Length	Width	No gasket	With gasket
Section	(m)	(m)	(m^2)	(m^2)
Fixed Light	1.4300	0.5645	0.8072	0.8072
Opening light	1.3800	0.5245	0.7238	0.7238
Total glazing, A_g			1.5310	1.5310
Frame	(m)	(m)	(m^2)	(m^2)
F1	0.6150	0.0250	0.0147	0.0147
F2	0.6150	0.0250	0.0147	0.0147
F3	1.4900	0.0250	0.0364	0.0364
F4	0.6150	0.0320	0.0188	0.0188
F5	0.5575	0.0180	0.0097	0.0097
F6	0.6150	0.0320	0.0188	0.0188
F7	0.5575	0.0180	0.0097	0.0097
F8	1.4800	0.0320	0.0463	0.0463
F9	1.4160	0.0180	0.0252	0.0252
F10	1.4800	0.0510	0.0740	0.0740
F11	1.4160	0.0150	0.0210	0.0210
Total Frame			0.2694	0.2894
Total Window, A_w			1.8204	1.8204
Percentage fixed light glass area			44.34%	44.34%
Percentage opening light glass area			39.76%	39.76%
Percentage glass area (total)			84.10%	84.10%

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

Frame conductance:		All L values to *4DP*. All b values to *6DP*			
		$W/(m·K)$	b_f (mm)	$W/(m·K)$	b_f (mm)
F1 fixed sill	L_f^{2D}	0.3743	190	0.3573	190
F2 fixed head		0.3743	190	0.3573	190
F3 fixed jamb		0.3743	190	0.3573	190
F4 + F5 sash sill		0.5263	190	0.5078	190
F6 + F7 sash head		0.5263	190	0.5078	190
F8 + F9 sash jamb		0.5263	190	0.5078	190
Mullion F10 fixed		0.8693	190	0.8709	190
Mullion F11 moving			190	0.8707	190

Frame:		b_f (no gaskets)	U_f	Frame areas (no gaskets)	Heat flow	Ψ	l_g	Heat flow
Section		(m)	($W/(m^2K)$)	(m^2)	(W/K)	($W/(m·K)$)	(m)	(W/K)
F1 fixed sill		0.0250	3.8655	0.0147	0.0570	0.0479	0.5645	0.0270
F2 fixed head		0.0250	3.8655	0.0147	0.0570	0.0479	0.5645	0.0270
F3 fixed jamb		0.0250	3.8655	0.0364	0.1406	0.0478	1.4300	0.0684
F4 + F5 sash sill		0.0500	4.4668	0.0285	0.1273	0.0451	0.5245	0.0236
F6 + F7 sash head		0.0500	4.4668	0.0285	0.1273	0.0451	0.5245	0.0236
F8 + F9 sash jamb		0.0500	4.4668	0.0715	0.3194	0.0451	1.3800	0.0622
Mullion	F10 fixed	0.0660	4.5769	0.0950	0.4443	0.0465	1.4300	0.0664
	F11 moving					0.0450	1.3800	0.0620
	Totals			0.2894	1.2728		Total	0.3604

Solar Factor, g-value:		Fixed Light	Opening Light
	F_w	0.9	0.9
	g	0.39	0.26
U_w	U_-	1.89	$W/(m^2K)$

Air Leakage loss:
Air leakage at 50 Pa per hour & per unit length of opening light (BS 6375-1) - *2DP*: 0.21 $m^3/(m·h)$
Opening light length: 3.9470 m — Total air leakage: 0.829 m^3/h
L_{50}: 0.46 $m^3/(m^2·h)$ — Heat loss = 0.0165 L_{50}: 0.01 $W/(m^2K)$

Other parameters needed for calculation, taken from simulations:

			λ_p =	0.035	W/(m·K)	R_{sf} =	0.04	m^2K/W	R_{sf} =	0.13	m^2K/W
Fixed panel thickness, $d_p = d_g$ =	0.018	m	R_{fp} =	0.5143	m^2K/W	R_{hf} =	0.6843	m^2K/W	U_g =	1.4614	$W/(m^2K)$
Opening panel thickness, $d_p = d_g$ =	0.016	m	R_{op} =	0.4571	m^2K/W	R_{hf} =	0.6271	m^2K/W	U_g =	1.5945	$W/(m^2K)$

BFRC Rating kWh/(m^2.yr)	Label index	EWER Rating Scale	Window Rating
≥0	-8	A	B
-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 x (U_{window} + Effective L_{50}) = -7.73
Climate zone is: UK

Thermal transmittance, $W/(m^2·K)$	U_{window}	1.9
Solar factor	g_{window}	0.56
Window air leakage heat loss, $W/(m^2·K)$	L_{Bw}	0.01

Simulator Name: David Frost

British Fenestration Rating Council — BFRC Certified Simulator 050

6.1.3.1 INITIAL AIR PERMEABILITY TESTS 1 & 2 (SEE 5.1 TEST SEQUENCE)

AREA

Pressure Differential Pa	Air Permeability Rate - Test 1 (Infiltration) & Test 2 (Exfiltration)		
	Test 1 Temp ° C 21.0	Test 2 Temp ° C 21.0	Average
50	1.28	0.49	0.88
100	1.83	0.85	1.34
150	2.31	0.85	1.58
200	2.74	1.04	1.89
250	3.05	1.22	2.13
300	3.23	1.40	2.31
450	3.78	1.95	2.86
600	4.02	2.50	3.26

LENGTH OF JOINT

Pressure Differential Pa	Air Permeability Rate - Test 1 (Infiltration) & Test 2 (Exfiltration)		
	Test 1 Temp ° C 21.0	Test 2 Temp ° C 21.0	Average
50	0.59	0.23	0.41
100	0.85	0.40	0.62
150	1.08	0.40	0.74
200	1.27	0.48	0.88
250	1.42	0.57	0.99
300	1.50	0.65	1.08
450	1.76	0.91	1.33
600	1.87	1.16	1.52

6.1.3.2 REPEAT AIR PERMEABILITY TESTS 6 & 7 (SEE 5.1 TEST SEQUENCE)

AREA

Pressure Differential Pa	Air Permeability Rate - Test 1 (Infiltration) & Test 2 (Exfiltration)		
	Test 6 Temp ° C 21.0	Test 7 Temp ° C 21.0	Average
50	0.49	0.43	0.46
100	0.55	0.85	0.70
150	0.79	0.97	0.88
200	0.91	1.22	1.07
250	1.16	1.34	1.25

LENGTH OF JOINT

Pressure Differential Pa	Air Permeability Rate - Test 1 (Infiltration) & Test 2 (Exfiltration)		
	Test 6 Temp ° C 21.0	Test 7 Temp ° C 21.0	Average
50	0.23	0.20	0.21
100	0.25	0.40	0.33
150	0.37	0.45	0.41
200	0.42	0.57	0.50
250	0.54	0.62	0.58