Report in Accordance with

BFRC Guidelines and Regulations

Product description:

Legend Intermediate Multi Chambered Outer Frame with Steel Reinforcing – "C" Rated

SYN-00123-8

Client:	Synseal Extrusions Ltd
Project:	Synseal Legend C Rated
Project reference:	SYN-00123-8
Prepared By:	Ryan Shore
Issue date:	20th October 2010

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Approved Simulator 088

The legal validity of this report can only be claimed on presentation of the complete report with supporting electronic information.

1 Introduction

The U values of the Legend window detailed below were commissioned by Andy Ball of Synseal Extrusions 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 on the attached CD or is available on request from Synseal Extrusions Ltd.

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

Synseal Legend Intermediate Frame Profile	Frame Thermal Transmittance (U_f)
Fixed with Steel	1.3 W/(m²·K)
Sash with Steel	1.6 W/(m²·K)
Mullion with Steel	1.8 W/(m²·K)

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

Synseal Legend Intermediate Frame Profile	Linear Thermal Transmittance (ψ)
Fixed with Steel	0.029 W/(m·K)
Sash with Steel	0.027 W/(m·K)
Mullion with Steel	0.055 W/(m·K)

4.3 Centre pane U-value of the glazing calculated in accordance with BS EN 673

Glazing Unit	Centre Pane U-Value (U_g)	Solar Energy Transmittance ($g_\perp$)
4-20-4 Low-E 0.15 uncorrected emissivity (Pilkington K Glass), 100% Air filled, Low Iron Outerpane (Pilkington Optiwhite) glazing unit with Swisspacer V (warm edge) spacer bar with Polysulfide secondary seal to give 12mm spacer sight line.	1.7 W/(m²·K)	0.77

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

Synseal Legend Intermediate Frame Profile	Window U-value
Legend intermediate multi-chamber PVC-u frame with Steel reinforcement with 4-20-4 Low-E 0.15 uncorrected emissivity (Pilkington K Glass), 100% Air filled, Low Iron Outerpane (Pilkington Optiwhite) glazing unit with Swisspacer V (warm edge) spacer bar with Polysulfide secondary seal to give 12mm spacer sight line.	1.78 W/(m²·K)

4.5 The effective L_{50} in accordance with BFRC guidelines and regulations

Synseal Legend Intermediate Frame Profile	Effective L_{50}
Air permeability at 50Pa	0.00 W/(m²·K)

4.6 Total solar energy transmittance (g) in accordance with EN410

Synseal Legend Intermediate Frame Profile	g_{window}
Legend intermediate multi-chamber PVC-u frame with Steel reinforcement with 4-20-4 Low-E 0.15 uncorrected emissivity (Pilkington K Glass), 100% Air filled, Low Iron Outerpane (Pilkington Optiwhite) glazing unit with Swisspacer V (warm edge) spacer bar with Polysulfide secondary seal to give 12mm spacer sight line.	0.47

5 BFRC Rating

5.1 Synseal Shield 6 Window System

Synseal Shield 6 Intermediate Frame Profile	Rating
Legend intermediate multi-chamber PVC-u frame with Steel reinforcement with 4-20-4 Low-E 0.15 uncorrected emissivity (Pilkington K Glass), 100% Air filled, Low Iron Outerpane (Pilkington Optiwhite) glazing unit with Swisspacer V (warm edge) spacer bar with Polysulfide secondary seal to give 12mm spacer sight line.	**-19** (Rating Scale C)

6 Authorisation

Prepared By: Ryan Shore

Signature: 

Date: 20th October 2010

7 Technical Specification

Profiles	Ref. No.	Material type / Manufacturers name	Dimensions (Height x Width)
Outer Frame:	5F5	Synseal - PVC-u	60mm x 70mm
Casement Vent:	5V2	Synseal - PVC-u	77mm x 70mm
Transom/Mullion:	5OL1	Synseal - PVC-u	72mm x 70mm
Glazing Bead:	5OJB28	Synseal - PVC-u	27mm x 15mm
Joint type	N/A	N/A	
Joint Adhesives	N/A	N/A	

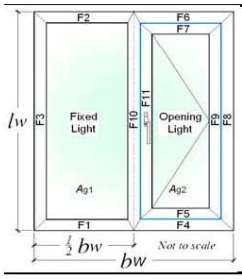
Reinforcements	Ref. No.	Material type / Manufacturers name	Dimensions (Height x Width)
Outer Frame:	5RS-5F5	Synseal - Steel	20.5mm x 12mm
Casement Vent:	5RS-V2	Synseal - Steel	24.5mm x 33mm
Transom/Mullion:	5RS-FT1L	Synseal - Steel	13mm x 41.5mm

Weather Seals	Ref. No.	Material type / Manufacturers name	Continuous or joined at corners
Outer Frame:	N/A	Co-Extruded to bead - PVC-P	
Casement Vent:	N/A	Co-Extruded to bead - PVC-P	
Transom/Mullion:	N/A	Co-Extruded to bead - PVC-P	
Glazing Bead:	N/A	Co-Extruded to bead - PVC-P	

Glazing Component	Specification	
Overall Sealed Unit	Thickness:	28mm
Outer Pane	Thickness:	4mm
	Manufacturer:	Pilkington
	Description:	Optiwhite (Low Iron)
Inner Pane	Thickness:	4mm
	Manufacturer:	Pilkington
	Description:	K Glass (Low-E 0.15)
Spacer Bar	Manufacturer:	Saint Gobain
	Description:	Swisspacer V
Cavity	Distance:	20mm
	Gas %:	Air 100%
Edge Seal	Manufacturer:	N/A
	Description:	Polysulfide secondary seal to give 12mm sightline

Additional Notes:
Metallic reinforcement present in all profiles. Multi-chambered outer frame profile. The secondary sealant used for this simulation (PS) covers the use of polyurethane (PU) and butyl hot melt sealant types to give the same result or marginally better. Air leakage data is taken from BSI Test report ref: 261/005111/1 of 3 dated 17th July 2000 (data at 50Pa pressure = 0.13) 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 0.77

BFRC Spreadsheet



Sample Style:
Casement

Fixed Light / Side Hung

Blue line illustrates opening light length (air leakage)

Report Number: SYN-00123-8 Issue No.21: 04/03/2009
Report Date: 20 October 2010
Project Details: Legend 5F5/5V2/5OL1, RS in all, 4/20/4 Optiwhite / Air / Pilkington K / SwisspacerV

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

Parameter	Symbol		Units
Total window height **0DP**	l_w	1480	mm
Total window width **0DP**	b_w	1230	mm

Nominal 4mm etc to **0DP**, others **1DP**			
Glazing dimensions and properties:			
Thickness of pane 1		4	mm
Pane 1/2 distance		20	mm
Gas fill (1/2)		Air 100%	
Thickness of pane 2		4	mm
Complete next 3 cells for TG IGU			
Pane 2/3 distance			mm
Gas fill (2/3)			
Thickness of pane 3			mm
Glazing Trans. - **3DP**	U_g	1.735	W/(m²·K)
g-value - **2DP**	$g_\perp$	0.77	

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

Frame dimensions:		Without gasket	Gasket protrusion	With gasket	
	(b_f)	(mm)	(mm)	(mm)	
All frame values to nearest 0.5mm, gaskets to **1DP**	F1 fixed sill	60	0.0	60	
	F2 fixed head	60	0.0	60	
	F3 fixed jamb	60	0.0	60	Total
F4 + F5 sash sill	F4 fixed sash sill	60	n/a	60	109
	F5 moving sash sill	49	0.0	49	
F6 + F7 sash head	F6 fixed sash head	60	n/a	60	109
	F7 moving sash head	49	0.0	49	
F8 + F9 sash jamb	F8 Fixed sash jamb	60	n/a	60	109
	F9 moving sash jamb	49	0.0	49	
F10 + F11 mullion	F10 fixed mullion	72	0.0	72	121
	F11 moving mullion	49	0.0	49	
	Total gasket area		0	m²	

Window Dimensions:			Area	
	Length	Width	No gasket	With gasket
Section	(m)	(m)	(m²)	(m²)
Fixed Light	1.3600	0.5190	0.7058	0.7058
Opening light	1.2620	0.4210	0.5313	0.5313
Total glazing, A_g			1.2371	1.2371
Frame	(m)	(m)	(m²)	(m²)
F1	0.6150	0.0600	0.0340	0.0340
F2	0.6150	0.0600	0.0340	0.0340
F3	1.4800	0.0600	0.0852	0.0852
F4	0.6150	0.0600	0.0340	0.0340
F5	0.5190	0.0490	0.0230	0.0230
F6	0.6150	0.0600	0.0340	0.0340
F7	0.5190	0.0490	0.0230	0.0230
F8	1.4800	0.0600	0.0852	0.0852
F9	1.3600	0.0490	0.0642	0.0642
F10	1.4800	0.0720	0.1022	0.1022
F11	1.3600	0.0490	0.0642	0.0642
Total Frame			0.5833	0.5833
Total Window, A_w			1.8204	1.8204
Percentage fixed light glass area			38.77%	38.77%
Percentage opening light glass area			29.19%	29.19%
Percentage glass area (total)			67.96%	67.96%

Where a U_g 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 fixed sill	0.2721	190	0.4349	190
F2 fixed head	0.2721	190	0.4349	190
F3 fixed jamb	0.2721	190	0.4349	190
F4 + F5 sash sill	0.3666	190	0.5275	190
F6 + F7 sash head	0.3666	190	0.5275	190
F8 + F9 sash jamb	0.3666	190	0.5275	190
F10 + F11 mullion	0.6044	380	0.9264	380

(L_f^{2D} / L_ψ^{2D})

Frame:	b_f (no gaskets)	U_f	Frame areas (no gaskets)	Heat flow	Ψ	l_g	Heat flow
Section	(m)	(W/(m²·K))	(m²)	(W/K)	(W/(m·K))	(m)	(W/K)
F1 fixed sill	0.0600	1.2704	0.0340	0.0432	0.0290	0.5190	0.0151
F2 fixed head	0.0600	1.2704	0.0340	0.0432	0.0290	0.5190	0.0151
F3 fixed jamb	0.0600	1.2704	0.0852	0.1082	0.0290	1.3600	0.0395
F4 + F5 sash sill	0.1090	1.5663	0.0571	0.0894	0.0271	0.4210	0.0114
F6 + F7 sash head	0.1090	1.5663	0.0571	0.0894	0.0271	0.4210	0.0114
F8 + F9 sash jamb	0.1090	1.5663	0.1494	0.2341	0.0272	1.2620	0.0343
F10 + F11 mullion	0.1210	1.7574	0.1665	0.2926	0.0545	1.3110	0.0714
		Totals	0.5833	0.9000		Total	0.1981

Solar Factor, *g*-value:		
	F_w	0.9
	g_w	0.47
U_{window}	U_w	1.78 W/(m²·K)

Air Leakage loss:					
Air leakage at 50 Pa per hour & per unit length of opening light (BS 6375-1) - **2DP**				0.13	m³/(m·h)
Opening light length	3.7580	m	Total air leakage	0.489	m³/h
L_{50}	0.27	m³/(m²·h)	Heat loss = 0.0165 L_{50}	0.00	W/(m²·K)

Other parameters needed for calculation, taken from simulations:								
Panel thickness, $d_p = d_g$ =	0.028	m	λ_p =	0.035	W/(m·K)	R_{se} =	0.04	m²·K /W
			R_p =	0.8000	m²·K /W	R_{tot} =	0.9700	m²·K /W
			R_{si} =	0.13	m²·K /W	U_p =	1.0309	W/(m²·K)

BFRC Rating kWh/(m²·yr)	Label index	EWER Rating Scale	Window Rating
≥ 0	-19	A	C
-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}) =	-19.19
Climate zone is:	UK
Thermal transmittance, W/(m²·K) U_{window}	1.8
Solar factor g_{window}	0.47
Window air leakage heat loss, W/(m²·K) L_{factor}	0.00

British Fenestration Rating Council
BFRC Certified Simulator 088

Simulator Name: Ryan Shore

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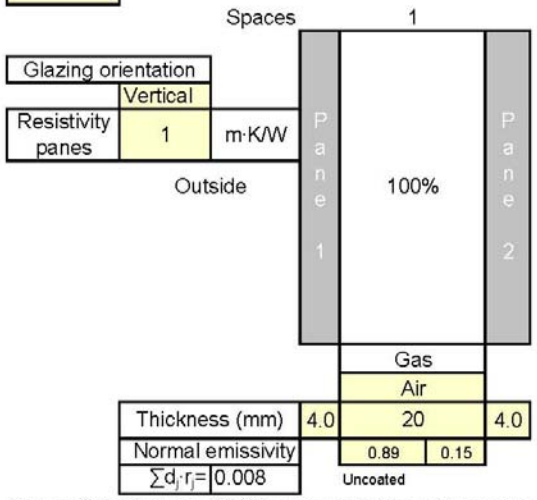
BS EN 673 Spreadsheet

Version 9 July 2010. Calculations according to BS EN 673:1998 (A1)

Number of spaces
1



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

Iteration number	U value	$\sum 1/h_s$	λeff	ΔT
	W/(m²·K)	(m²·K)/W	W/(mK)	
1	1.735	0.39983	0.0500	15
2	1.735	0.39983	0.0500	15

Thermal Conductivity Values Used

Material / Conductivity (W/m.K)	Reference
PVC-u / 0.17	(Annex A BS EN ISO 10077-2)
PVC-P / 0.14	(Annex A BS EN ISO 10077-2)
EPDM / 0.25	(Annex A BS EN ISO 10077-2)
Butyl hot melt / 0.24	(Annex A BS EN ISO 10077-2)
Soda lime glass / 1.0	(Annex A BS EN ISO 10077-2)
Steel / 50.0	(Annex A BS EN ISO 10077-2)
Molecular Sieve / 0.1	(Annex A BS EN ISO 10077-2)
Polyisobutylene / 0.2	(Annex A BS EN ISO 10077-2)
Swisspacer Plastic / 0.16	SGG Manufacturers Data
Swisspacer Stainless Steel (15/12) / 1.25	SGG Manufacturers Data

Appendix

Profile Drawings

(See Technical Specifications for dimensions)