

**Report in Accordance with
BFRC Guidelines and Regulations**

Product description:

**Legend Intermediate Multi Chambered Outer Frame with Thermal
Inserts and Steel reinforcement- "A" Rated**

SYN-00099-1

Client:	Synseal Extrusions Ltd
Project:	Synseal Legend A Rated
Project reference:	SYN-00099-1
Prepared By:	Ryan Shore
Issue date:	22 nd October 2010

Synseal Extrusions Ltd

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Approved Simulator 088

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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/(m ² ·K)
Sash with PTI and Steel	1.5 W/(m ² ·K)
Mullion with PTI and Steel	1.6 W/(m ² ·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 PTI and Steel	0.029 W/(m·K)
Mullion with PTI and Steel	0.058 W/(m·K)

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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 0.05 uncorrected emissivity (Saint Gobain Planitherm Total+), 90% Argon 10% Air filled, Low Iron Outerpane (Saint Gobain Diamant) glazing unit with Swisspacer V (warm edge) spacer bar with butyl hot melt secondary seal to give 12mm spacer sight line.	1.2 W/(m ² ·K)	0.74

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 and Thermal Inserts in vent and transom with 4-20-4 Low-E 0.05 uncorrected emissivity (Saint Gobain Planitherm Total+), 90% Argon 10% Air filled, Low Iron Outerpane (Saint Gobain Diamant) glazing unit with Swisspacer V (warm edge) spacer bar with butyl hot melt secondary seal to give 12mm spacer sight line.	1.41 W/(m ² ·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/(m ² ·K)

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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 and Thermal Inserts in vent and transom with 4-20-4 Low-E 0.05 uncorrected emissivity (Saint Gobain Planitherm Total+), 90% Argon 10% Air filled, Low Iron Outerpane (Saint Gobain Diamant) glazing unit with Swisspacer V (warm edge) spacer bar with butyl hot melt secondary seal to give 12mm spacer sight line.	0.45

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 and Thermal Inserts in vent and transom with 4-20-4 Low-E 0.05 uncorrected emissivity (Saint Gobain Planitherm Total+), 90% Argon 10% Air filled, Low Iron Outerpane (Saint Gobain Diamant) glazing unit with Swisspacer V (warm edge) spacer bar with butyl hot melt secondary seal to give 12mm spacer sight line.	<p style="text-align: center;">+2 (Rating Scale A)</p>

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6 Authorisation

Prepared By: Ryan Shore

Signature: 

Date: 22nd October 2010

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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:	RS-5F5	Synseal - Steel	20.5mm x 12mm
Casement Vent:	RS-PTI3	Synseal - Steel	4.5mm x 33mm
Transom/Mullion:	RS-PTI6	Synseal - Steel	4.5mm x 32.5mm

Thermal Inserts	Ref. No.	Material type / Manufacturers name	Dimensions (Height x Width)
Outer Frame:	N/A	N/A	N/A
Casement Vent:	PTI4	Synseal - PVC-u	23mm x 34mm
Transom/Mullion:	PTI6	Synseal - PVC-u	22.9mm x 41mm

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	

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Glazing Component	Specification	
Overall Sealed Unit	Thickness:	28mm
Outer Pane	Thickness:	4mm
	Manufacturer:	Saint Gobain
	Description:	Diamant (Low Iron)
Inner Pane	Thickness:	4mm
	Manufacturer:	Saint Gobain
	Description:	Planitherm Total+ (Low-E 0.05)
Spacer Bar	Manufacturer:	Saint Gobain
	Description:	Swisspacer V
Cavity	Distance:	20mm
	Gas %:	Argon 90%, Air 10%
Edge Seal	Manufacturer:	N/A
	Description:	Butyl (isobutene) hot melt secondary seal to give 12mm sightline

Additional Notes:

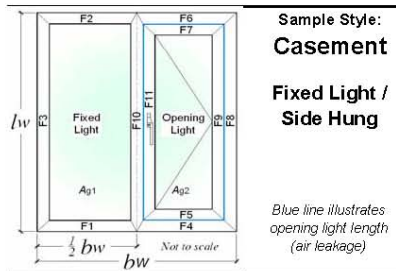
Thermal inserts and steel reinforcement present in all sash (V) and mullion (OL) profiles.

Multi-chambered outer frame profile with steel reinforcement

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 0.74

BFRC Spreadsheet



Report Number: **SYN-00099-1** Issue No.21: 04/03/2009
 Report Date: **22 October 2010**
 Project Details: **Legend 5F5/5V2/5OL1, PTI-S, 4/20/4 Diamant / Argon 90% / Planitherm Total+ / SwisspacerV,**

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

Parameter	Symbol	Units
Total window height ODP	i_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	4 mm
Pane 1/2 distance	20 mm
Gas fill (1/2)	Argon 90%
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 1.221 W/(m ² K)
g-value - 2DP	g 0.74

Frame dimensions:	(b _f)	Without gasket	Gasket protrusion	With gasket	Total
		(mm)	(mm)	(mm)	
All frame values to nearest 0.5mm, gaskets to 1DP	F1 fixed sill	60	0.0	60	109
	F2 fixed head	60	0.0	60	
	F3 fixed jamb	60	0.0	60	
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	m ²

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

Section	Length (m)	Width (m)	Area	
			No gasket (m ²)	With gasket (m ²)
Fixed Light	1.3600	0.5190	0.7058	0.7058
Opening light	1.2820	0.4210	0.5313	0.5313
Total glazing, A _g			1.2371	1.2371
Frame	(m)	(m)	(m ²)	(m ²)
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_w^{2D} values need to be entered

Frame conductance:	All L values to 4DP . All b values to ODP	
	$W/(m^2K)$	b_g (mm)
F1 fixed sill	0.2722	190
F2 fixed head	0.2722	190
F3 fixed jamb	0.2722	190
F4 + F5 sash sill	0.3547	190
F6 + F7 sash head	0.3547	190
F8 + F9 sash jamb	0.3547	190
F10 + F11 mullion	0.5866	380

Frame:	b_f (no gaskets)	U_f	Frame areas (no gaskets)	Heat flow	ψ	l_g	Heat flow
Section	(m)	(W/(m ² K))	(m ²)	(W/K)	(W/(m.K))	(m)	(W/K)
F1 fixed sill	0.0600	1.2721	0.0340	0.0433	0.0291	0.5190	0.0151
F2 fixed head	0.0600	1.2721	0.0340	0.0433	0.0291	0.5190	0.0151
F3 fixed jamb	0.0600	1.2721	0.0852	0.1084	0.0291	1.3600	0.0396
F4 + F5 sash sill	0.1090	1.4571	0.0571	0.0831	0.0288	0.4210	0.0121
F6 + F7 sash head	0.1090	1.4571	0.0571	0.0831	0.0288	0.4210	0.0121
F8 + F9 sash jamb	0.1090	1.4571	0.1494	0.2177	0.0288	1.2620	0.0363
F10 + F11 mullion	0.1210	1.6103	0.1665	0.2681	0.0579	1.3110	0.0759
Totals			0.5833	0.8470		Total	0.2062

Solar Factor, g-value:	F_w	0.9
	g_w	0.45

Air Leakage loss:		Air leakage at 50 Pa per hour & per unit length of opening light (BS 6375-1) - 2DP	0.13	m ³ /(m.h)
Opening light length	3.7580 m	Total air leakage	0.489	m ³ /h
L_{50}	0.27 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:
 Panel thickness, $d_p = d_g = 0.028$ m
 $\lambda_p = 0.035$ W/(m.K) $R_{se} = 0.04$ m².K/W $R_{se} = 0.13$ m².K/W
 $R_p = 0.8000$ m².K/W $R_{tot} = 0.9700$ m².K/W $U_p = 1.0309$ W/(m².K)

BFRC Rating	Label	EWER Rating Scale	Window Rating
> 0	2	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 =	218.6 $g_{window} - 68.5 \times (U_{window} + \text{Effective } L_{50}) =$	1.79
Climate zone is:		UK
Thermal transmittance, W/(m ² .K)	U_{window}	1.4
Solar factor	g_{window}	0.45
Window air leakage heat loss, W/(m ² .K)	L_{factor}	0.00



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BS EN 673 Spreadsheet

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

Number of spaces		1																										
Glazing orientation		Vertical																										
Resistivity panes	1	m-K/W																										
Outside																												
Spaces 1																												
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%; text-align: center;">P a n e 1</td> <td style="width: 80%; text-align: center;">90%</td> <td style="width: 10%; text-align: center;">P a n e 2</td> </tr> <tr> <td colspan="3" style="text-align: center;">Gas</td> </tr> <tr> <td colspan="3" style="text-align: center;">Argon</td> </tr> <tr> <td style="text-align: center;">Thickness (mm)</td> <td style="text-align: center;">4.0</td> <td style="text-align: center;">20</td> <td style="text-align: center;">4.0</td> </tr> <tr> <td style="text-align: center;">Normal emissivity</td> <td style="text-align: center;">0.89</td> <td style="text-align: center;">0.05</td> <td></td> </tr> <tr> <td style="text-align: center;">$\sum d_i r_i =$</td> <td colspan="3" style="text-align: center;">0.008</td> </tr> <tr> <td colspan="4" style="text-align: center;">Uncoated</td> </tr> </table>				P a n e 1	90%	P a n e 2	Gas			Argon			Thickness (mm)	4.0	20	4.0	Normal emissivity	0.89	0.05		$\sum d_i r_i =$	0.008			Uncoated			
P a n e 1	90%	P a n e 2																										
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$\sum d_i r_i =$	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	$\sum 1/h_s$	λ_{eff}	ΔT
	W/(m ² ·K)	(m ² ·K)/W		
1	1.221	0.64228	0.0311	15
2	1.221	0.64228	0.0311	15

Thermal Conductivity Values Used

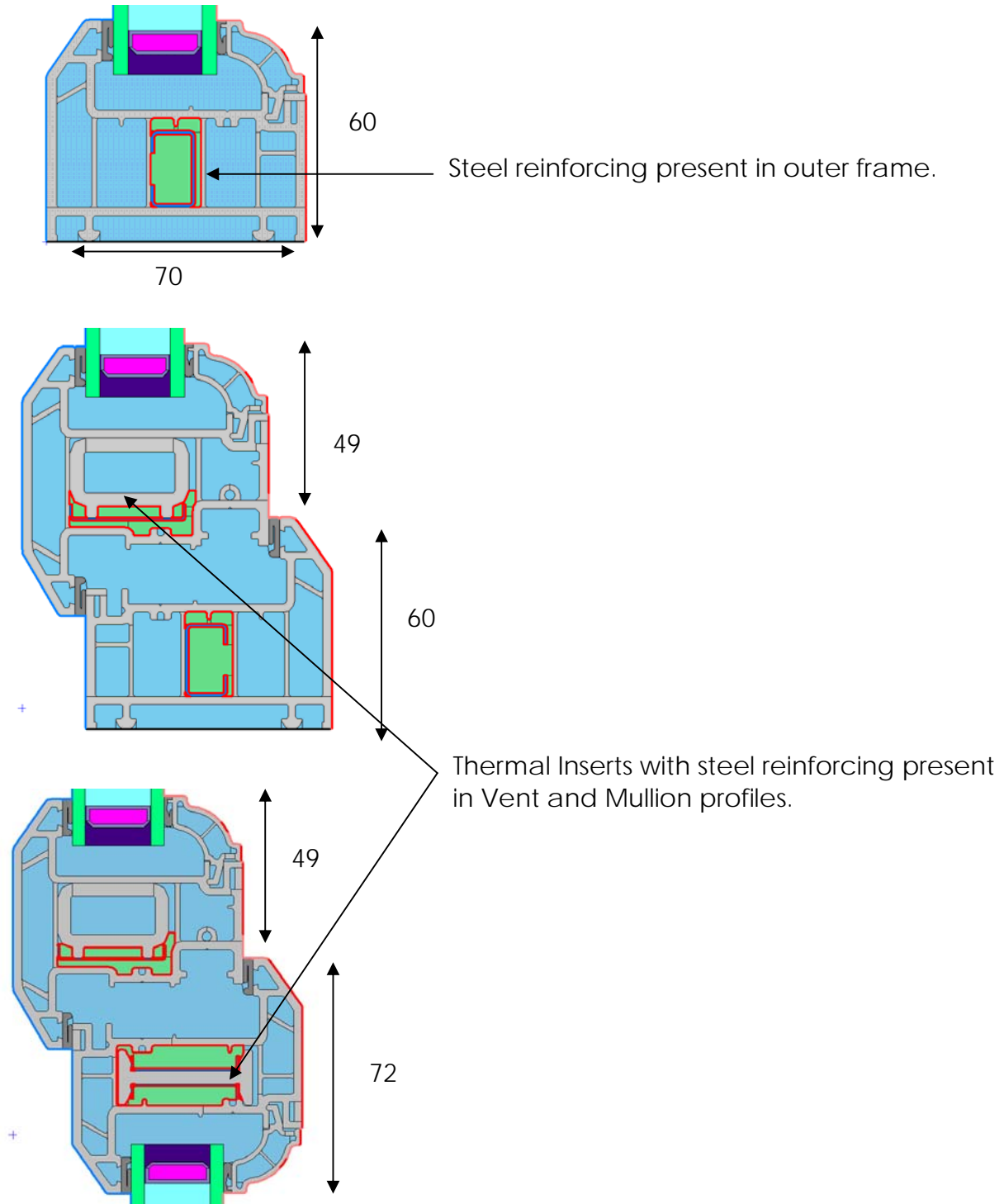
Material / Conductivity (W/m.K)	Reference
PVC-u / 0.17	(Annex A BS EN ISO 10077-2)
PVC-P / 0.14	(Annex A BS EN ISO 10077-2)
EPDM / 0.25	(Annex A BS EN ISO 10077-2)
Steel / 50.0	(Annex A BS EN ISO 10077-2)
Butyl hot melt / 0.24	(Annex A BS EN ISO 10077-2)
Soda lime glass / 1.0	(Annex A BS EN ISO 10077-2)
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

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Appendix

Profile Drawings

(See Technical Specifications for dimensions)



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