

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

Product description:

**Legend Intermediate Outer Frame with Minimum Steel
Reinforcement – “C” Rated**

SYN-00016-10 Rev.1

Client:	Synseal Extrusions Ltd
Project:	Synseal Legend C Rated
Project reference:	SYN-00016-10 Rev.1
Prepared By:	Ryan Shore
Issue date:	6 th September 2010

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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 George Luca 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	1.4 W/(m ² ·K)
Fixed With Steel	1.7 W/(m ² ·K)
Sash with Steel	1.6 W/(m ² ·K)
Sash with Full Steel	1.7 W/(m ² ·K)
Mullion with Steel	1.7 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	0.084 W/(m·K)
Fixed With Steel	0.078 W/(m·K)
Sash with Steel	0.075 W/(m·K)
Sash with Full Steel	0.075 W/(m·K)
Mullion with Steel	0.154 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 Total+), 90% Argon 10% Air filled, Float Outerpane (Saint Gobain Planilux) glazing unit with Aluminium spacer bar with butyl hot melt secondary seal to give 12mm spacer sight line.	1.2 W/(m ² ·K)	0.71

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
PVC-u frame system with minimum steel reinforcements to BFRC requirements with 4-20-4 Low-E 0.05 uncorrected emissivity (Saint Gobain Total+), 90% Argon 10% Air filled, Float Outerpane (Saint Gobain Planilux) glazing unit with Aluminium spacer bar with butyl hot melt secondary seal to give 12mm spacer sight line.	1.67 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}
PVC-u frame system with minimum steel reinforcements to BFRC requirements with 4-20-4 Low-E 0.05 uncorrected emissivity (Saint Gobain Total+), 90% Argon 10% Air filled, Float Outerpane (Saint Gobain Planilux) glazing unit with Aluminium spacer bar with butyl hot melt secondary seal to give 12mm spacer sight line.	0.43

5 BFRC Rating

5.1 Synseal Legend Window System

Synseal Legend Intermediate Frame Profile	Rating
PVC-u frame system with minimum steel reinforcements to BFRC requirements with 4-20-4 Low-E 0.05 uncorrected emissivity (Saint Gobain Total+), 90% Argon 10% Air filled, Float Outerpane (Saint Gobain Planilux) glazing unit with Aluminium spacer bar with butyl hot melt secondary seal to give 12mm spacer sight line.	-20 (Rating Scale C)

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6 Authorisation

Prepared By: Ryan Shore

Signature: *R. Shore*

Date: 6th September 2010

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7 Technical Specification

Profiles	Ref. No.	Material type / Manufacturers name	Dimensions (Height x Width)
Outer Frame:	5F3	Synseal - PVC-u	60mm x 70mm
Casement Vent:	5V2	Synseal - PVC-u	76.5mm x 70mm
Transom/Mullion:	5OL1	Synseal - PVC-u	72mm x 70mm
Glazing Bead:	5OJB28	Synseal - PVC-u	22.5mm x 27 mm
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-F3	Synseal - Steel	41.5mm x 19.5mm
Casement Vent:	5RS-V2	Synseal - Steel	24.7mm 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
Frame Rebate:	N/A	Co-Extruded to bead - PVC-P	
Glazing Rebate:	N/A	Co-Extruded to bead - PVC-P	
Casement Perimeter Seal:	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:	Planilux
Inner Pane	Thickness:	4mm
	Manufacturer:	Saint Gobain
	Description:	Planitherm Total+ (Low-E 0.05)
Spacer Bar	Manufacturer:	N/A
	Description:	Aluminium (Generic)
Cavity	Distance:	20mm
	Gas %:	Argon 90% Air 10%
Edge Seal	Manufacturer:	N/A
	Description:	Butyl (isobutene) hot melt secondary seal to give 12mm sightline

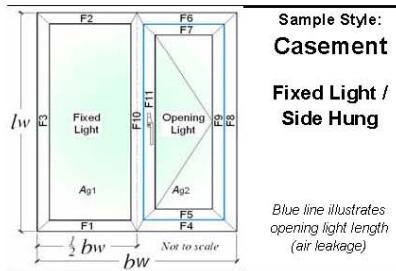
Additional Notes:

Metallic reinforcement present in vertical outer frame profile, vent and mullion profiles only.

Air leakage data is taken from BSI Test report ref: 261/005111/1 (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 0.71

BFRC Spreadsheet



Report Number: **SYN-00016-10** Issue No.21: 04/03/2009
 Report Date: **06 September 2010**
 Project Details: **Legend 5F3/5OL1/5V2 5OJB28 with 4/20/4 Float, Argon 90%, P.Therm Total+, Alu spacer.RS in Vertical OF, V&OL**

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	0.71

Thermal transmittance of window from hot box test

$U_w - 2DP$		W/(m ² K)
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Window Dimensions:

Section	Length		Width		Area	
	(m)	(m)	No gasket (m ²)	With gasket (m ²)	(m ²)	(m ²)
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)	(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%		

Solar Factor, g-value:

F_w	0.9
g_w	0.43

U_{window} U_w **1.67** W/(m²K)

Other parameters needed for calculation, taken from simulations:
 Panel thickness, $d_p = d_g = 0.028$ m
 $\lambda_p = 0.035$ W/(mK) $R_{se} = 0.04$ m²K/W $R_{sp} = 0.13$ m²K/W
 $R_p = 0.8000$ m²K/W $R_{tot} = 0.9700$ m²K/W $U_p = 1.0309$ W/(m²K)

Frame dimensions:

	(b_f)	Without gasket	Gasket protrusion	With gasket	
		(mm)	(mm)	(mm)	
All frame values to nearest 0.5mm, gaskets to 1DP	F1 fixed sill	60	0.0	60	Total
	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

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:

Section	All L values to 4DP . All b values to ODP		L_f^{2D}	L_w^{2D}
	$W/(m^2K)$	b_f (mm)		
F1 fixed sill	0.2799	190	0.4002	190
F2 fixed head	0.2799	190	0.4002	190
F3 fixed jamb	0.2960	190	0.4101	190
F4 + F5 sash sill	0.3719	190	0.4827	190
F6 + F7 sash head	0.3719	190	0.4827	190
F8 + F9 sash jamb	0.3853	190	0.4960	190
F10 + F11 mullion	0.6033	380	0.8294	380

Frame:

Section	b_f (no gaskets)	U_f	Frame areas (no gaskets)	Heat flow	ψ	l_g	Heat flow
	(m)	(W/(m ² K))	(m ²)	(W/K)	(W/(mK))	(m)	(W/K)
F1 fixed sill	0.0600	1.4004	0.0340	0.0476	0.0842	0.5190	0.0437
F2 fixed head	0.0600	1.4004	0.0340	0.0476	0.0842	0.5190	0.0437
F3 fixed jamb	0.0600	1.6887	0.0852	0.1422	0.0760	1.3600	0.1061
F4 + F5 sash sill	0.1090	1.6149	0.0571	0.0921	0.0747	0.4210	0.0314
F6 + F7 sash head	0.1090	1.6149	0.0571	0.0921	0.0747	0.4210	0.0314
F8 + F9 sash jamb	0.1090	1.7378	0.1494	0.2597	0.0746	1.2620	0.0941
F10 + F11 mullion	0.1210	1.7483	0.1665	0.2911	0.1539	1.3110	0.2017
Totals		0.5833	0.9725			Total	0.5522

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 ² /(m ² ·h)	Heat loss = 0.0165 L_{50}	0.00 W/(m ² ·K)

BFRC Rating kWh/(m ² ·yr)	Label index	EWER Rating Scale	Window Rating
> 0	-20	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 = **-20.40**
 $218.6g_{window} - 68.5 \times (U_{window} + \text{Effective } L_{50}) =$

Climate zone is: **UK**

Thermal transmittance, W/(m ² ·K)	U_{window}	1.7
Solar factor	g_{window}	0.43
Window air leakage heat loss, W/(m ² ·K)	L_{factor}	0.00

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	
Glazing orientation	Vertical	
Resistivity panes	1	m ² ·K/W

Spaces	1	
Outside	Pane 1	Pane 2
	90%	
	Gas	
	Argon	
Thickness (mm)	4.0	20
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 0.837

Iteration number	U value	$\sum 1/h_s$	λ_{eff}	ΔT
	W/(m ² ·K)	(m ² ·K)/W	W/(mK)	
1	1.221	0.64228	0.0311	15
2	1.221	0.64228	0.0311	15

Thermal Conductance Values Used

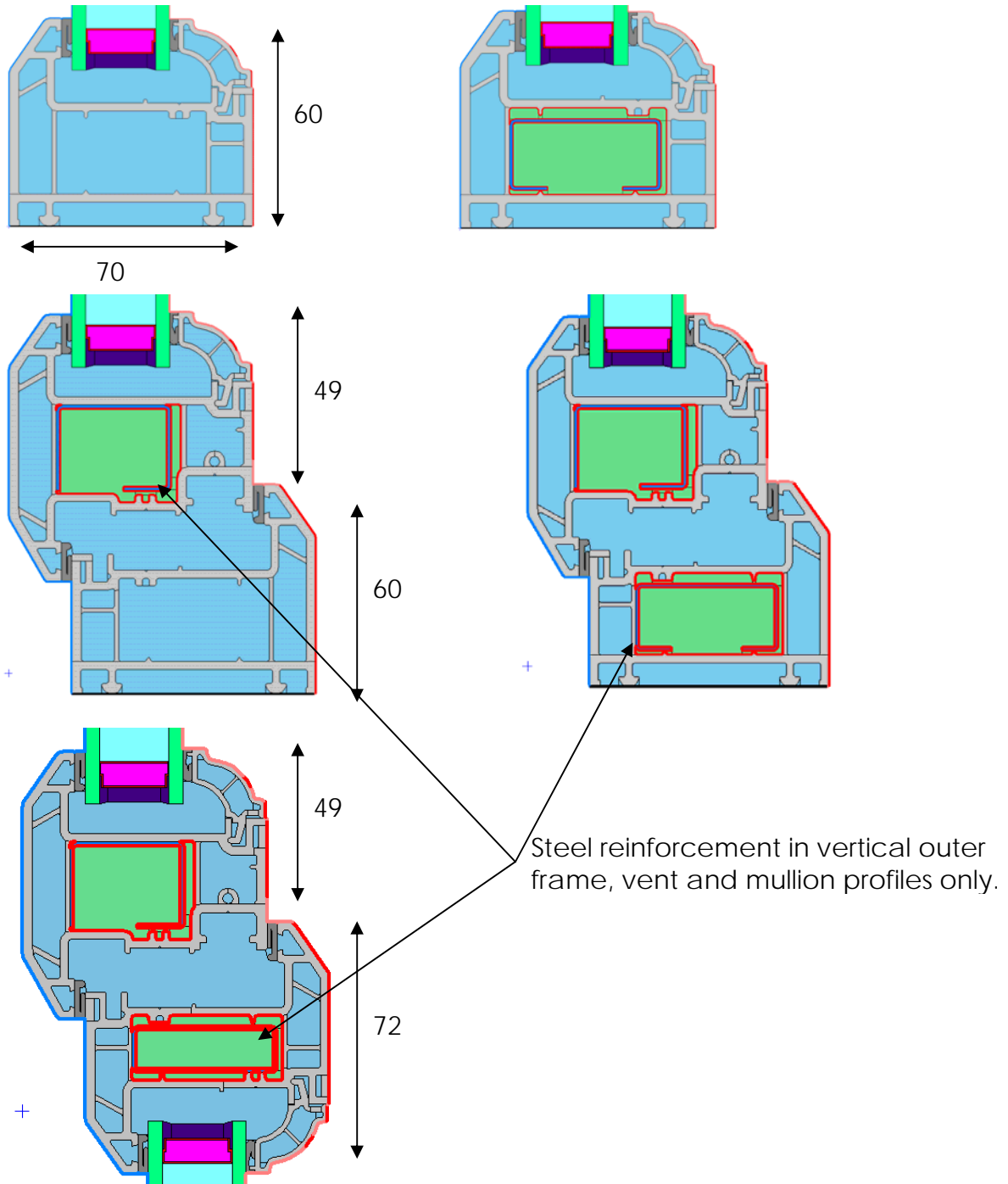
Material / Conductance (W/m.K)	Reference
PVC-u / 0.17	(Annex A BS EN ISO 10077-2)
Steel / 50.0	(Annex A BS EN ISO 10077-2)
PVC-P / 0.14	(Annex A BS EN ISO 10077-2)
Butyl (isobutene) hot melt / 0.24	(Annex A BS EN ISO 10077-2)
Soda lime glass / 1.0	(Annex A BS EN ISO 10077-2)
Molecular Sieve (Desiccant) / 0.10	(Annex A BS EN ISO 10077-2)
Swisspacer V plastic / 0.16	SGG Manufacturers Data
Swisspacer V 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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