THERMAL SIMULATION REPORT

Report Number:	**TCL2014-SWA-001**
Prepared For:	**Steel Window Association 42 Heath Street Tamworth Staffordshire B79 7HJ**
Window System Identifier:	**W30**
Fixed Outer Frame Identifier:	**WX7 (Fixed)**
Transom Frame Identifier:	**W7 (Fixed)**
Vent Frame Identifier:	**WX7 (Moving)**
Glazing System:	**4mm Guardian Float Extra Clear– 10 mm 90% Krypton – 4 mm Climaguard A+ (2014)**
Spacer Bar:	**10mm Edgetech Super Spacer Standard**
Notes:	

Results

Thermal Transmittance (U_{window})	**2.0**	*W/(m²K)*
Solar Factor (g_{window})	**0.57**	
Air Leakage Factor (L_{factor})	**0.00**	*W/(m²K)*
BFRC Energy Rating Index	**-12**	
BFRC Energy rating Band	**C**	

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

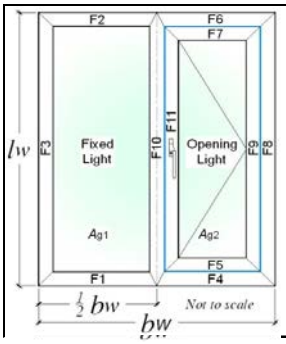
Report Prepared By *Dr Gary Morgan*
Therm Consulting

Signed: *G Morgan*

Date: *17th February 2014*

The simulations in this report were performed using Therm 5.2.14 according to EN ISO 10077 – 2.
The Therm files generated are attached to this report as appendices

British Fenestration Rating Council
BFRC Certified Simulator 016



Sample Style:

Casement

Fixed Light / Side Hung

Blue line illustrates opening light length (air leakage)

Report Number: TCL2014-SWA-001 Issue No 22.1: 11/03/2013

Report Date: 13 February 2014

Project Details: 4 10 4 Guardian Extra Clear - 90% Krypton - Climaguard A+ (2014 Spec) with Edgtech Super Spacer Standard

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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

Frame offset: Yes

Nominal 4mm etc to ***0DP*** , others ***1DP***

Glazing dimensions and properties:

Thickness of pane 1	4	mm
Pane 1/2 distance	10	mm
Gas fill (1/2)	Krypton 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	1.122	W/(m²·K)
g -value - ***2DP*** $g_\perp$	0.73	

Thermal transmittance of window from hot box test

U_{w} - *2DP* W/(m²·K)

Frame dimensions:

	(b_f)	Frame width, b_f (mm)	Frame offset, b_{OF} (mm)	Gasket protrusion, b_{gf} (mm)	Frame & gasket widths (mm)	
All frame values round to neares 1mm, gaskets to ***1DP***	F1 fixed sill	24	2	2.0	26.0	
	F2 fixed head	24	2	2.0	26.0	
	F3 fixed jamb	24	2	2.0	26.0	Total
F4 + F5 sash sill	F4 fixed sash sill	22	n/a	n/a	22.0	40.0
	F5 moving sash sill	16	2	2.0	18.0	
F6 + F7 sash head	F6 fixed sash head	22	n/a	n/a	22.0	40.0
	F7 moving sash head	16	2	2.0	18.0	
F8 + F9 sash jamb	F8 Fixed sash jamb	22	n/a	n/a	22.0	40.0
	F9 moving sash jamb	16	2	2.0	18.0	
F10 + F11 mullion	F10 fixed mullion	37	2	2.0	39.0	57.0
	F11 moving mullion	16	2	2.0	18.0	
	Total gasket area			0.015772	m^2	

Where a *Uw* value from hot box testing is available, ndL $_f^{2D}$ or L $_\psi^{2D}$ values need to be entered

Frame conductance: All *L* values to ***4DP*** . All b values to ***0DP***

	L_f^{2D} W/(m·K)	b_p (mm)	L_ψ^{2D} W/(m·K)	b_g (mm)
F1 fixed sill	**0.4191**	**190**	**0.3962**	**190**
F2 fixed head	**0.4191**	190	**0.3962**	190
F3 fixed jamb	**0.4191**	190	**0.3962**	190
F4 + F5 sash sill	**0.5207**	190	**0.5000**	190
F6 + F7 sash head	**0.5207**	190	**0.5000**	190
F8 + F9 sash jamb	**0.5207**	190	**0.5000**	190
F10 + F11 mullion	**0.9006**	380	**0.8581**	380

Window Dimensions:

Section	Length (m)	Width (m)	Area No gasket (m^2)	Area With gasket (m^2)
Fixed Light	1.4320	0.5725	0.8198	0.8118
Opening light	1.4040	0.5425	0.7617	0.7539
Total glazing, A_g			1.5815	1.5657
Frame	(m)	(m)	(m^2)	(m^2)
F1	0.6150	0.0240	0.0143	0.0154
F2	0.6150	0.0240	0.0143	0.0154
F3	1.4800	0.0240	0.0349	0.0378
F4	0.6150	0.0220	0.0131	0.0131
F5	0.5745	0.0160	0.0089	0.0100
F6	0.6150	0.0220	0.0131	0.0131
F7	0.5745	0.0160	0.0089	0.0100
F8	1.4800	0.0220	0.0321	0.0321
F9	1.4360	0.0160	0.0227	0.0255
F10	1.4800	0.0370	0.0539	0.0568
F11	1.4360	0.0160	0.0227	0.0255
Total Frame			0.2389	0.2547
Total Window, A_w			1.8204	1.8204
Percentage fixed light glass area			45.04%	44.60%
Percentage opening light glass area			41.84%	41.41%
Percentage glass area (tota			86.88%	86.01%

Frame:

Section	Frame width, b_f (m)	Frame U-value, U (W/(m²·K))	Frame areas, A (m^2)	Frame heat flow, HU (W/K)	Linear trans, Ψ (W/(m·K))	Linear length, l_g (m)	Junction heat flow, HΨ (W/K)
F1 fixed sill	0.0240	5.8933	0.0143	0.0840	0.0416	0.5765	0.0240
F2 fixed head	0.0240	5.8933	0.0143	0.0840	0.0416	0.5765	0.0240
F3 fixed jamb	0.0240	5.8933	0.0349	0.2059	0.0416	1.4360	0.0597
F4 + F5 sash sill	0.0380	6.3957	0.0220	0.1408	0.0438	0.5465	0.0239
F6 + F7 sash head	0.0380	6.3957	0.0220	0.1408	0.0438	0.5465	0.0239
F8 + F9 sash jamb	0.0380	6.3957	0.0548	0.3505	0.0438	1.4080	0.0616
F10 + F11 mullion	0.0530	6.5146	0.0766	0.4992	0.0865	1.4220	0.1230
Totals			0.2389	1.5052	Total		0.3401

Air Leakage loss:

Air leakage at 50 Pa per hour & per unit length of opening light (BS 6375-1) ***2DP*** **0.07** $m^3/(m·h)$

Opening light length	4.0210	m	Total air leakage	0.281	m^3/h
L_{50}	0.15	$m^3/(m^2·h)$	Heat loss = 0.0165 L_{50}	0.00	W/(m²·K)

Solar Factor, *g*-value:

F_w	0.9
g_w	0.57

U_{window}		W/(m²·K)
	No bars; or attached bars	1.99
	Single cross bar in IGU	2.1
	Multiple cross bar in IGU	2.2
	Glazing bar (Georgian bar)	2.4

Other parameters needed for calculation, taken from simulations:

λ_p = 0.035 W/(m·K) R_{se} = 0.04 ·K /W $d_p=d_g$= 0.018 m

R_p = 0.5143 m^2·K /W R_{tot} = 0.6843 ·K /W R_{se} = 0.13 m^2·K /W

U_p = 1.4614 W/(m²·K)

BFRC Rating kWh/(m^2·yr)	Label index	EWER Rating Scale	Window Rating
≥10	-12	A+	C
0 to <10		A	
-10 to <0		B	
-20 to <-10 ⇦		⇨ C ⇦	
-30 to <-20		D	
-50 to <-30		E	
-70 to <-50		F	

BFRC Rating =

218.6g_{window} - 68.5 x (U_{window} + Effective L_{50}) = **-11.71**

Climate zone is: **UK**

Thermal transmittance, W/(m²·K)	U_{window}	**2**
Solar factor	g_{window}	**0.57**
Window air leakage heat loss, W/(m²·K)	L_{factor}	**0.00**

British Fenestration Rating Council

Simulator Name: DR Gary Morgan

BFRC Certified Simulator 016

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

Number of spaces
1

Spaces 1

Glazing orientation	
	Vertical
Resistivity panes	1 m·K/W

Outside

		Pane 1	90%	Pane 2
			Gas	
			Krypton	
Thickness (mm)	4.0		10	4.0
Normal emissivity			0.89	0.05
$\sum d_j \cdot r_j$ =	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 W/(m²·K)	$\sum 1/h_s$ (m²·K)/W	λeff W/(mK)	ΔT
1	1.122	0.7147	0.0140	15
2	1.122	0.7147	0.0140	15

GUARDIAN CONFIGURATOR
GLASS PERFORMANCE CALCULATOR

KIWA confirms to have verified the calculation engine of the software Guardian Configurator 4.1 TESTED BY kiwa to be compliant to EN 410 and EN 673

Product code

80 / 75 / 1.1

total thickness = 18 mm

Glazing from external to internal:

	Pane 1		Pane 2
4 mm	Float Glass ExtraClear		ClimaGuard A+
		4 mm	Float Glass ExtraClear

Spacer 1 - 10 mm

10%	Air
90%	Krypton

Results

Visible light (EN 410 - 2011)		**Solar energy (EN 410 - 2011)**	
transmittance [%]	τ_v = 79.6	solar factor [%]	g = 72.9
reflectance external [%]	ρ_v = 13.4	shading coefficient [g/0.87]	sc = 0.84
reflectance internal [%]	ρ_v = 13.4	direct transmittance [%]	τ_e = 63.9
general colour rendering index [%]	R_a = 98.5	direct reflectance external [%]	ρ_e = 19.6
		direct reflectance internal [%]	ρ_e = 18.4
Thermal properties (EN 673 - 2011)		direct absorption [%]	a = 18.5
U-value [W/(m²K)]	U_g = 1.1	UV transmittance [%]	τ_{uv} = 35.9
slope α = 90°		secondary internal heat transfer factor	q_i = 9.0
		Other data	
		estimated sound reduction index [dB] (EN 717-1)	R_w = NPD
			C = NPD
			C_{tr} = NPD

Certificate of Test: Chilt/P10036

Steel Window Association
42 Heath Street
Tamworth
Staffordshire
B79 7HJ

This document confirms that performance testing was conducted on 8 April 2010. Testing was conducted to the following standard:-

- BS 6375 Part 1:2009 Performance of windows and doors - Part 1: Classification for weathertightness and guidance on selection and specification. The following results were achieved.

Product tested	W-30 Side Hung Casement Window		
Summary of testing and classification			Result
	Test Standard	Classification standard	
Air permeability	BS EN 1026: 2000	BS EN 12207: 2000	600Pa (Class 4)
Watertightness	BS EN 1027: 2000	BS EN 12208: 2000	750Pa (E750)
Wind resistance	BS EN 12211: 2000	BS EN 12210: 2000	1600Pa (Class A4)
Exposure category		BS 6375: Part 1: 2009	1600

Air leakage at 50pa was 0.2m^3/h positive pressure and 0.3m^3/h negative pressure. The perimeter length of opening light was 3.42m

The results relate only to the specimen tested, as detailed in technical specification document number Chilt/P10036/tec1

Paul Andrews –
Head of Section Mechanical Testing
Date:

Vincent Kerrigan -
Technical Manager
Date: 19-07-2012

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Air leakage calculation

Chiltern Dynamics report number Chilt /P10036 gives the positive and negative airflows at 50 Pa as 0.2 m3/h and 0.3 m3/h respectively. The opening light length is given as 3.42 m

Thus the average air infiltration rate per m opening light length is given by:

((0.2 + 0.3) /2) / 3.42 = 0.07 m3/(m.h)

Material	Conductivity (W/mK)	Emissivity
Mild Steel	50	0.9
Aluminium	160	0.9
Glass	1.0	0.9
EPDM	0.25	0.9
Butyl (Hot Melt)	0.24	0.9
Super Spacer Standard	0.13	0.9
PVC / PU Foam Elastomer	0.05	0.9
Glazing Gas Space Effective	0.014	0.9
CEN Insulation Panel	0.035	0.9