THERMAL SIMULATION REPORT

Report Number:	**TCL2014-SWA-017**
Prepared For:	**Steel Window Association 42 Heath Street Tamworth Staffordshire B79 7HJ**
Window System Identifier:	**W40**
Meeting Rail Identifier:	**N/A**
Vent Frame Identifier:	**SW5**
Outer Frame Identifier:	**SW8**
Glazing System:	**4mm Planitherm One/4S – 8mm 90% Krypton – 4mm Planilux -8 mm 90% Krypton – 4mm Planitherm One/4S**
Spacer Bar:	**8mm Edgetech Super Spacer Standard with butyl secondary sealant**
Notes:	**Aluminium Bead Reference Drawing SWA-W40-014**

Result

Thermal Transmittance (U_{Window})	**1.6**	*W/(m²K)*

(Window Configuration as defined in BS EN 14351-1 Annex E)
(1230mm wide x 1480 high – single vent)

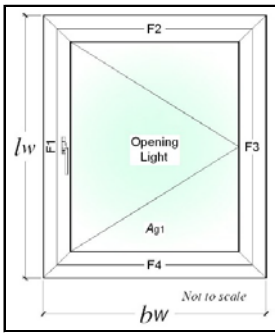
Report Prepared By *Dr Gary Morgan*
Therm Consulting

Signed: *G Morgan*

Date: *22nd May 2014*

The simulations in this report were performed using Win IsoPro 7.80 strictly according to EN ISO 10077 – 2:2012
The files generated are attached to this report as appendices

British Fenestration Rating Council
BFRC Certified Simulator 016



Window Style:
L2
Side Hung Casement

Report Number: TCL2014 SWA017
Report Issue Status: 02 *(04/2008)*
Report Date: 22 May 2014
Project Details: 4-8-4-8-4 Planitherm One / 4S (x2) Clear Float 90% Krypton Super Spacer Standard

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

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

Glazing dimensions and properties:
Nominal 4mm etc to ***0DP***, others ***1DP***

Thickness of pane 1	4	mm
Pane 1/2 distance	8	mm
Krypton Gas fill (1/2)	90	%
Thickness of pane 2	4	mm
No further entry required for double glazed units		
Pane 2/3 distance (n/a for DG)	8	mm
Krypton Gas fill (2/3)	90	%
Thickness of pane 3 (n/a for DG)	4	mm
Thermal transmittance of glazing - ***3DP***		
U_g	**0.602**	W/(m²·K)

Frame dimensions:
All frame values to nearest 0.5mm, gaskets to ***1DP***

	No gasket (b_f) (mm)	Gasket protrusion (mm)	With gasket (mm)
F1 LH jamb	**54**	**0.5**	54.5
F2 head	**54**	**0.5**	54.5
F3 RH jamb	**54**	**0.5**	54.5
F4 sill	**54**	**0.5**	54.5
Total gasket area		0.0025	m^2

Window Dimensions:

Section	Length (mm)	Width (mm)	Area No gasket (m^2)	Area With gasket (m^2)
Window	1372	1122	1.5394	1.5369
Total glazing, A_g			1.5394	1.5369

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 LH jamb	**0.5270**	**190**	**0.5000**	190
F2 head	**0.5270**	190	**0.5000**	190
F3 RH jamb	**0.5270**	190	**0.5000**	190
F4 sill	**0.5270**	190	**0.5000**	190

Frame	(mm)	(mm)	(m^2)	(m^2)
F1	1480	54	0.0770	0.0777
F2	1230	54	0.0635	0.0641
F3	1480	54	0.0770	0.0777
F4	1230	54	0.0635	0.0641
Total Frame			0.2810	0.2835
Total Window, A_w			1.8204	1.8204
Percentage glass area			84.56%	84.43%

Frame:

Section	b_f *(with gaskets)* (m)	U_f W/(m²·K)	Frame areas (with gaskets) m²	Heat flow W/K	ψ W/(m·K)	l_g (m)	Heat flow W/K
F1 LH jamb	0.0545	6.0757	0.0777	0.4720	0.0540	1.3710	0.0740
F2 head	0.0545	6.0757	0.0641	0.3892	0.0540	1.1210	0.0605
F3 RH jamb	0.0545	6.0757	0.0777	0.4720	0.0540	1.3710	0.0740
F4 sill	0.0545	6.0757	0.0641	0.3892	0.0540	1.1210	0.0605
		Totals	0.2835	1.7225		Total	0.2691

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

U_{window}	U_w = **1.60**	W/(m²·K)

Thermal transmittance, W/(m²·K) U_{window}	**1.6**

British Fenestration Rating Council
BFRC Certified Simulator 016

Simulator Name: Dr Gary Morgan

Version 11 23/10/2012. Calculations according to BS EN 673:2011

Number of spaces	Help
2	

			Spaces		1			2	
Glazing orientation				Pane 1	90%	Pane 2	90%		Pane 3
	Vertical								
Resistivity panes	1	m·K/W							
	Outside								
Emissivities									
Calculate					Gas		Gas		
					Krypton		Krypton		
	Thickness (mm)			4.0	8	4.0	8		44
	Normal emissivity				0.01	0.89	0.89	0.01	
	$\sum d_j \cdot r_j =$	0.052				Uncoated	Uncoated		

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

Iteration number	U value	$\sum 1/h_s$	λeff	ΔT	λeff	ΔT
	W/(m²·K)	(m²·K)/W	W/(mK)		W/(mK)	
1	0.602	1.4398	0.0111	7.5	0.0111	7.5
2	0.602	1.4398	0.0111	7.5	0.0111	7.5

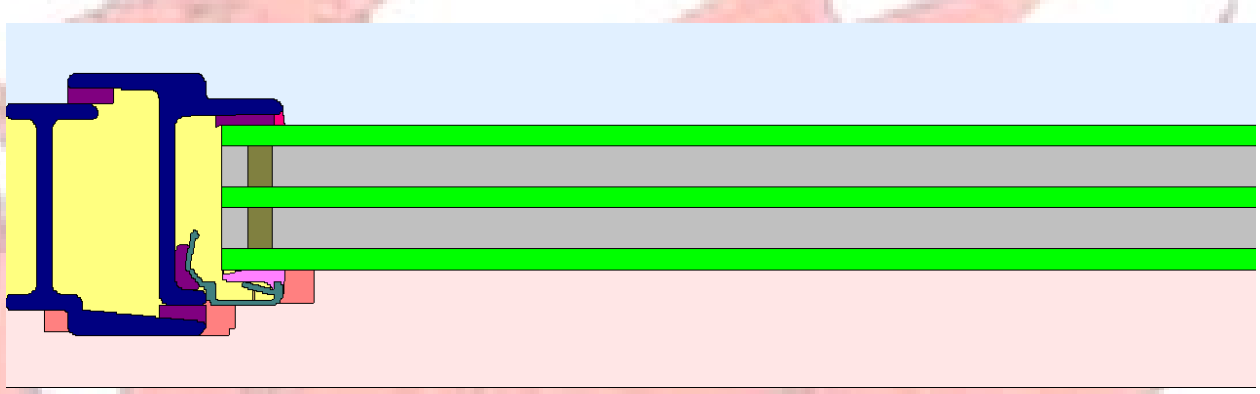
Simulation software: WinIso2D 7.80
Date: 22.05.2014
File: C:\Users\Gary\Documents\MyDocs from Thermbridge\Thermal Simulation Output Files\Steel Window Association\May 2014\W40 - SIMULATIONS Doors and Windows\W40-013\Section 1.f2d

Calculation of the linear thermal transmission coefficient Ψ according to EN ISO 10077-2

Simulation model:

Dimensions (width x height): 243,99 x 70,90 mm

Number of elements in simulation model: X-direction: 217; Y-direction: 131



Boundary conditions:

External:

Temperature Θe:	0,00	°C
Surface resistance Rse:	0,040	m²K/W

Internal:

Temperature Θi:	20,00	°C
Surface resistance Rsi 1:	0,130	m²K/W
Surface resistance Rsi 2:	0,200	m²K/W

Results:

Temperature difference dT:		20,00	K
Total heat flow Q:		10,005	W/m
2D thermal conductance L2D:	0,500	W/mK	
Length top/left:	190,00	mm	
U-value top/left:		0,602	W/m²K
Length bottom/right:		0,00	mm
U-value bottom/right:		0,000	W/m²K
Ψ-value:		0,055	W/mK

Materials:

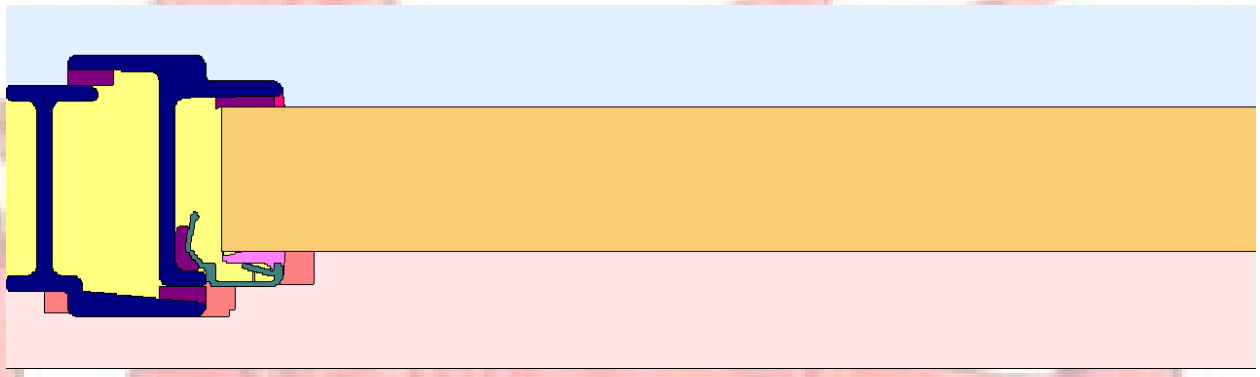
Material	R (m²K/W)	T (°C)	Q(gesamt) (W/m)	10077 konform
****ADIABAT****	0,000	0,000	0,000	
1 boundary condition intside 0,13, 20°C, 50%	0,130	20,000	7,755	X
1 boundary condition outside 0,04, 0°C, 80%	0,040	0,000	-10,005	X
1 boundary condition intside 0,20, 20°C, 50%	0,200	20,000	2,250	X
1 air EN ISO 10077-2 (cavities in profiles)				X
1 air EN ISO 10077-2 (cavities in profiles <=2mm)				X
1 air EN ISO 10077-2 (cavities in profiles, sparse ventilated)				X

Material	L (W/mK)	Emiss	10077 konform
3 structural steel 50	50,000	0,900	X
2 Float Glass 1.0	1,000	0,837	X
5 PVC soft	0,140	0,900	X
6 Silicon, unfilled	0,350	0,900	X
5 Elastomeric Foam Flexible	0,050	0,900	X
6 Super Spacer Standard	0,130	0,900	X
6 butyle	0,240	0,900	X
3 alu (Si-Leg.) 160	160,000	0,900	X
SZR L=0.0108	0,011	0,900	-

Simulation software: WinIso2D 7.80
Date: 22.05.2014
File: C:\Users\Gary\Documents\MyDocs from Thermbridge\Thermal Simulation Output Files\Steel Window Association\May 2014\W40 - SIMULATIONS Doors and Windows\W40-013\Section 1.f2d

Calculation of the thermal transmission coefficient U_f according to EN ISO 10077-2:2003-12
Simulation model:

Dimensions (width x height): 243,99 x 70,90 mm
Number of elements in simulation model: X-direction: 217; Y-direction: 131



Boundary conditions:

External:

Temperature Θe:	0,00	°C
Surface resistance Rse:	0,040	m²K/W

Internal:

Temperature Θi:	20,00	°C
Surface resistance Rsi 1:	0,130	m²K/W
Surface resistance Rsi 2:	0,200	m²K/W

Results:

Temperature difference dT:	20,00	K
Total heat flow Q:	10,536	W/m
2D thermal conductance L2D:	0,527	W/mK
Length 1:	190,00	mm
U-value 1:	1,031	W/m²K
Length 2:	0,00	mm
U-value 2:	0,000	W/m²K
U_f-value:	6,128	W/m²K

Materials:

Material	R (m²K/W)	T (°C)	Q(gesamt) (W/m)	10077 konform
****ADIABAT****	0,000	0,000	0,000	
1 boundary condition intside 0,13, 20°C, 50%	0,130	20,000	7,755	X
1 boundary condition outside 0,04, 0°C, 80%	0,040	0,000	-10,005	X
1 boundary condition intside 0,20, 20°C, 50%	0,200	20,000	2,250	X
1 air EN ISO 10077-2 (cavities in profiles)				X
1 air EN ISO 10077-2 (cavities in profiles <=2mm)				X
1 air EN ISO 10077-2 (cavities in profiles, sparse ventilated)				X

Material	L (W/mK)	Emiss	10077 konform
3 structural steel 50	50,000	0,900	X
2 Float Glass 1.0	1,000	0,837	X
5 PVC soft	0,140	0,900	X
6 Silicon, unfilled	0,350	0,900	X
5 Elastomeric Foam Flexible	0,050	0,900	X
6 Super Spacer Standard	0,130	0,900	X
6 butyle	0,240	0,900	X
3 alu (Si-Leg.) 160	160,000	0,900	X
SZR L=0.0108	0,011	0,900	-