THERMAL SIMULATION REPORT

Report Number:	**TCL2014-SWA-006**
Prepared For:	**Steel Window Association 42 Heath Street Tamworth Staffordshire B79 7HJ**
Window System Identifier:	**W20**
Fixed Outer Frame Identifier:	**W8**
Transom Frame Identifier:	**N/A**
Vent Frame Identifier:	**W5**
Glazing System:	**4mm Planilux – 8 mm 90% Krypton – 4 mm Planitherm One or Planitherm 4S**
Spacer Bar:	**8mm Edgetech Super Spacer Standard with Butyl secondary sealant.**
Notes:	**Mild steel glazing bead. Reference drawing SWA-W20-006**

Results

Thermal Transmittance (U_{window})	**2.1**	*W/(m^2K)*

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

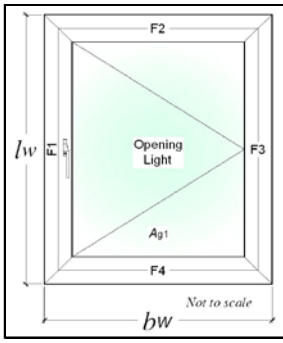
Report Prepared By *Dr Gary Morgan*
Therm Consulting

Signed: G Morgan

Date: *28th April 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-SWA 006
Report Date: 26th April 2014
Report Issue Status: 02 *(04/2008)*
Project Details: W20 Frame 4 mm Float 8mm 90% Krypton 4 mm Planitherm 4S or Planitherm One 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)		mm
Gas fill (2/3)		%
Thickness of pane 3 (n/a for DG)		mm
Thermal transmittance of glazing - ***3DP***		
U_g	**1.114**	W/(m²·K)

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

	(b_f) (mm)	No gasket (mm)	Gasket protrusion (mm)	With gasket (mm)
F1 LH jamb		**55.5**	**0.7**	56.2
F2 head		**55.5**	**0.7**	56.2
F3 RH jamb		**55.5**	**0.7**	56.2
F4 sill		**55.5**	**0.7**	56.2
Total gasket area			0.0035	m²

Window Dimensions:

Section	Length (mm)	Width (mm)	Area No gasket (m²)	Area With gasket (m²)
Window	1369	1119	1.5319	1.5284
Total glazing, A_g			1.5319	1.5284

All *L* values to ***4DP***. All b values to ***0DP***

	$L_f{}^{2D}$ W/(m·K)	b_p (mm)	$L_\psi{}^{2D}$ W/(m·K)	b_g (mm)
F1 LH jamb	**0.6440**	**190**	**0.6090**	190
F2 head	**0.6440**	190	**0.6090**	190
F3 RH jamb	**0.6440**	190	**0.6090**	190
F4 sill	**0.6440**	190	**0.6090**	190

Frame	(mm)	(mm)	(m²)	(m²)
F1	1480	55.5	0.0791	0.0800
F2	1230	55.5	0.0652	0.0660
F3	1480	55.5	0.0791	0.0800
F4	1230	55.5	0.0652	0.0660
Total Frame			0.2885	0.2920
Total Window, A_w			1.8204	1.8204
Percentage glass area			84.15%	83.96%

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	0.0562	6.0683	0.0800	0.4856	0.0560	1.3676	0.0766
F2 head	0.0562	6.0683	0.0660	0.4003	0.0560	1.1176	0.0626
F3 RH jamb	0.0562	6.0683	0.0800	0.4856	0.0560	1.3676	0.0766
F4 sill	0.0562	6.0683	0.0660	0.4003	0.0560	1.1176	0.0626
		Totals	0.2920	1.7718		Total	0.2783

Other parameters needed for calculation, taken from simulations:
Panel thickness, $d_p = d_g$ = 0.016 m U_p = 1.5945 W/(m²·K)
λ_p = 0.035 W/(m·K) R_{se} = 0.04 m²·K/ W R_{tot} = 0.6271 m²·K/ W R_p = 0.4571 m²·K /W R_{si} = 0.13 m²·K /W

U window	U_w = **2.06**	W/(m²·K)

Thermal transmittance, W/(m²·K)	***U window*** **2.1**

British Fenestration Rating Council
BFRC Certified Simulator 016

Simulator Name: **Dr Gary Morgan**

Version 10 22/07/2011. Calculations according to BS EN 673:2011

Number of spaces
1

Spaces 1

Glazing orientation	
	Vertical
Resistivity panes	1 m·K/W

Outside

	Pane 1		Pane 2
		90%	
		Gas	
		Krypton	
Thickness (mm)	4.0	8	4.0
Normal emissivity		0.89 0.01	
?d_i/?$_j$=	0.008	Uncoated	

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

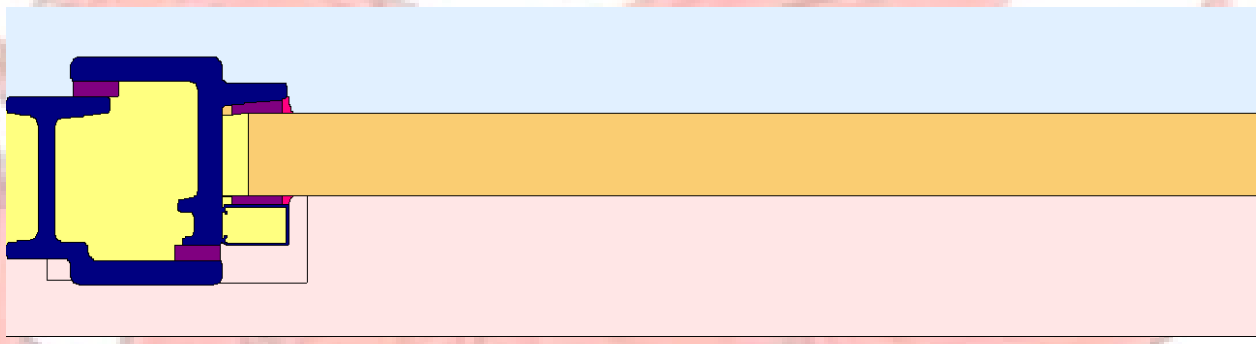
Iteration number	U value W/(m²K)	?1/h_s (m²K)/W	Space 1 λeff W/(mK)	?T
1	1.114	0.71988	0.0111	15
2	1.114	0.71988	0.0111	15

Space 3 λeff W/(mK) ?T | Space 4 λeff W/(mK) ?T | Space 6 λeff ?T

Simulation software: WinIso2D 7.80
Date: 28.04.2014
File: C:\Users\Gary\Documents\MyDocs from Thermbridge\Thermal Simulation Output Files\Steel Window Association\May 2014\W20 - Thermal Simulations\W20 Commercial Mild Steel Bead\W20 Coomercial Mild Steel Bead.f2d

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

Dimensions (width x height): 245,49 x 64,69 mm
Number of elements in simulation model: X-direction: 199; Y-direction: 104



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:	12,876	W/m
2D thermal conductance L2D:	0,644	W/mK
Length 1:	190,00	mm
U-value 1:	1,595	W/m²K
Length 2:	0,00	mm
U-value 2:	0,000	W/m²K
U_f-value:	6,085	W/m²K

Materials:

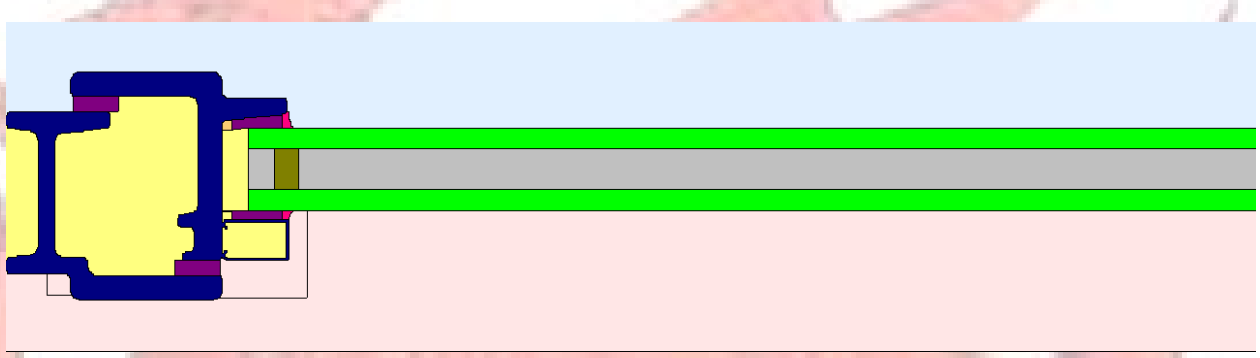
Material	R (m²K/W)	T (°C)	Q(gesamt) (W/m)	10077 konform
****ADIABAT****	0,000	0,000	0,000	
1 boundary condition intside 0,13, 20°C, 50%	0,130	20,000	9,150	X
1 boundary condition outside 0,04, 0°C, 80%	0,040	0,000	-12,188	X
1 boundary condition intside 0,20, 20°C, 50%	0,200	20,000	3,038	X
1 air EN ISO 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
2 float 1.0	1,000	0,837	X
3 structural steel 50	50,000	0,900	X
5 Elastomeric Foam Flexible	0,050	0,900	X
6 Silicon, unfilled	0,350	0,900	X
6 butyle	0,240	0,900	X
6 Super Spacer Standard	0,130	0,900	-
SZR L=0.0111	0,011	0,900	-

Simulation software: WinIso2D 7.80
Date: 28.04.2014
File: C:\Users\Gary\Documents\MyDocs from Thermbridge\Thermal Simulation Output Files\Steel Window Association\May 2014\W20 - Thermal Simulations\W20 Commercial Mild Steel Bead\W20 Coomercial Mild Steel Bead.f2d

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

Dimensions (width x height): 245,49 x 64,69 mm
Number of elements in simulation model: X-direction: 199; Y-direction: 104



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:		12,188	W/m
2D thermal conductance L2D:	0,609	W/mK	
Length top/left:	190,00	mm	
U-value top/left:		1,114	W/m²K
Length bottom/right:		0,00	mm
U-value bottom/right:		0,000	W/m²K
Ψ-value:		0,057	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	9,150	X
1 boundary condition outside 0,04, 0°C, 80%	0,040	0,000	-12,188	X
1 boundary condition intside 0,20, 20°C, 50%	0,200	20,000	3,038	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
2 float 1.0	1,000	0,837	X
3 structural steel 50	50,000	0,900	X
5 Elastomeric Foam Flexible	0,050	0,900	X
6 Silicon, unfilled	0,350	0,900	X
6 butyle	0,240	0,900	X
6 Super Spacer Standard	0,130	0,900	-
SZR L=0.0111	0,011	0,900	-