THERMAL SIMULATION REPORT

Report Number:	**TCL2013-Origin-01**
Prepared For:	**Origin Frames Ltd** **Unit 3 Sunters End** **Hillbottom Road** **Sands Industrial Estate** **High Wycombe** **Bucks** **HP12 4HS**
Window System Identifier:	**Origin Window**
Fixed Outer Frame Identifier:	**Origin Outer Frame**
Mullion Frame Identifier:	**Origin Transom / Mullion**
Vent Frame Identifier:	**Origin Vent**
Glazing System:	**4-20-4 Clear Float – 90% Argon – Planitherm 4S**
Spacer Bar:	**Swiss Spacer Ultimate**
Notes:	

Results

Thermal Transmittance (U_{window})	**1.5**	*$W/(m^2K)$*

(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

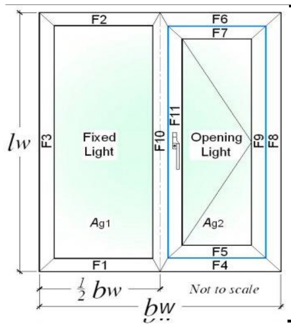
Signed: G Morgan

Date: *2nd December 2013*

The simulations in this report were performed using Win Iso 2D Pro version 7.57, strictly in accordance with the requirements of EN ISO 10077-2:2012
The simulation files generated are attached to this report as appendices

BFRC

BFRC Certified Simulator 016



Sample Style:

Casement

Fixed Light / Side Hung

Blue line illustrates opening light length (air leakage)

Report Number:	TCL2013-Origin01
Issue No 22.1:	11/03/2013
Report Date:	2nd December 2013
Project Details:	Origin Window - Planitherm 4S and Swiss Ultimate

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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:	No

Nominal 4mm etc to ***0DP***, 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	1.070	W/(m²·K)
g -value - ***2DP***	$g_?$		

Thermal transmittance of window from hot box test		
U_w - 2DP		W/(m²·K)

Frame dimensions:		Frame & gasket width, b_f	Gasket protrusion, b_{gf}	Frame widths	
	(b_f)	(mm)	(mm)	(mm)	
All frame values round to nearest 1mm, gaskets to ***1DP***	F1 fixed sill	50	2.5	52.5	
	F2 fixed head	50	2.5	52.5	
F4 + F5 sash sill	F3 fixed jamb	50	2.5	52.5	Total
	F4 fixed sash sill	50	n/a	50.0	91.5
F6 + F7 sash head	F5 moving sash sill	39	2.5	41.5	
	F6 fixed sash head	50	n/a	50.0	91.5
F8 + F9 sash jamb	F7 moving sash head	39	2.5	41.5	
	F8 Fixed sash jamb	50	n/a	50.0	91.5
F10 + F11 mullion	F9 moving sash jamb	39	2.5	41.5	
	F10 fixed mullion	68	2.5	70.5	112.0
	F11 moving mullion	39	2.5	41.5	
	Total gasket area		0.01828	m²	

Where a *Uw* value from hot box testing is available, no L_f^{2D} or L_ψ^{2D} values need to be entered

Frame conductance:		All *L* values to ***4DP***.	All b values to ***0DP***			
		W/(m·K)	b_p (mm)		W/(m·K)	b_g (mm)
F1 fixed sill	L_f^{2D}	0.3180	190	L_ψ^{2D}	0.3640	190
F2 fixed head		0.3180	190		0.3640	190
F3 fixed jamb		0.3180	190		0.3640	190
F4 + F5 sash sill		0.3830	190		0.4240	190
F6 + F7 sash head		0.3830	190		0.4240	190
F8 + F9 sash jamb		0.3830	190		0.4240	190
F10 + F11 mullion		0.6370	380		0.7200	380

Window Dimensions:	Length	Width	Area No gasket	Area With gasket
Section	(m)	(m)	(m²)	(m²)
Fixed Light	1.3800	0.5310	0.7328	0.7233
Opening light	1.3020	0.4530	0.5898	0.5811
Total glazing, A_g			1.3226	1.3043
Frame	(m)	(m)	(m²)	(m²)
F1	0.6150	0.0500	0.0287	0.0300
F2	0.6150	0.0500	0.0287	0.0300
F3	1.4800	0.0500	0.0715	0.0749
F4	0.6150	0.0500	0.0287	0.0287
F5	0.5310	0.0390	0.0192	0.0203
F6	0.6150	0.0500	0.0287	0.0287
F7	0.5310	0.0390	0.0192	0.0203
F8	1.4800	0.0500	0.0715	0.0715
F9	1.3800	0.0390	0.0523	0.0555
F10	1.4800	0.0680	0.0972	0.1007
F11	1.3800	0.0390	0.0523	0.0555
Total Frame			0.4978	0.5161
Total Window, A_w			1.8204	1.8204
Percentage fixed light glass area			40.25%	39.73%
Percentage opening light glass area			32.40%	31.92%
Percentage glass area (total)			72.65%	71.65%

Frame: Section	Frame width, b_f	Frame U-value, U_f	Frame areas, A_f	Frame heat flow, HU	Linear trans,	Linear length, l_g	Junction heat flow, Hψ
	(m)	(W/(m²·K))	(m²)	(W/K)	(W/(m·K))	(m)	(W/K)
F1 fixed sill	0.0500	2.4425	0.0287	0.0700	0.0386	0.5310	0.0205
F2 fixed head	0.0500	2.4425	0.0287	0.0700	0.0386	0.5310	0.0205
F3 fixed jamb	0.0500	2.4425	0.0715	0.1746	0.0386	1.3800	0.0532
F4 + F5 sash sill	0.0890	2.1025	0.0478	0.1006	0.0336	0.4530	0.0152
F6 + F7 sash head	0.0890	2.1025	0.0478	0.1006	0.0336	0.4530	0.0152
F8 + F9 sash jamb	0.0890	2.1025	0.1238	0.2603	0.0336	1.3020	0.0437
F10 + F11 mullion	0.1070	2.2920	0.1495	0.3427	0.0682	1.3410	0.0914
		Totals	0.4978	1.1188		Total	0.2597

Solar Factor, *g* -value:		
	F_w	0.9
	g_w	0.00

Air Leakage loss:					
Air leakage at 50 Pa per hour & per unit length of opening light (BS 6375-1) - ***2DP***					m³/(m·h)
Opening light length	3.8220	m	Total air leakage	0.000	m³/h
L_{50}	0.00	m³/(m²·h)	Heat loss = 0.0165 L_{50}	0.00	W/(m²·K)

U_{window}			
	No bars; or attached bars	1.53	W/(m²·K)
	Single cross bar in IGU	1.6	
	Multiple cross bar in IGU	1.7	
	Glazing bar (Georgian bar)	1.9	

Other parameters needed for calculation, taken from simulations:

λ_p =	0.035	W/(m·K)	R_{se} =	0.04	·K /W	$d_p = d_g$ =	0.028	m
R_p =	0.8000	m²·K /W	R_{tot} =	0.9700	·K /W	R_{se} =	0.13	m²·K /W
						U_p =	1.0309	W/(m²·K)

BFRC Rating kWh/(m²·yr)	Label index	EWER Rating Scale	Window Rating
?10	N/A	A+	N/A
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}) =		N/A
Climate zone is:		UK
Thermal transmittance, W/(m²·K)	U_{window}	1.5
Solar factor	g_{window}	N/A
Window air leakage heat loss, W/(m²·K)	L_{factor}	N/A

British Fenestration Rating Council

Simulator Name: ~~Dr Gary Morgan~~

BFRC Certified Simulator **016**

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

Number of spaces	Help				
1					
		Spaces		1	
Glazing orientation			Pane 1	90%	Pane 2
	Vertical				
Resistivity panes	1	m·K/W			
	Outside				
	Emissivities				
	Calculate			Gas	
				Argon	
	Thickness (mm)		4.0	20	4.0
	Normal emissivity			0.89 / 0.01	
	$\sum d_j \cdot r_j =$	0.008		Uncoated	

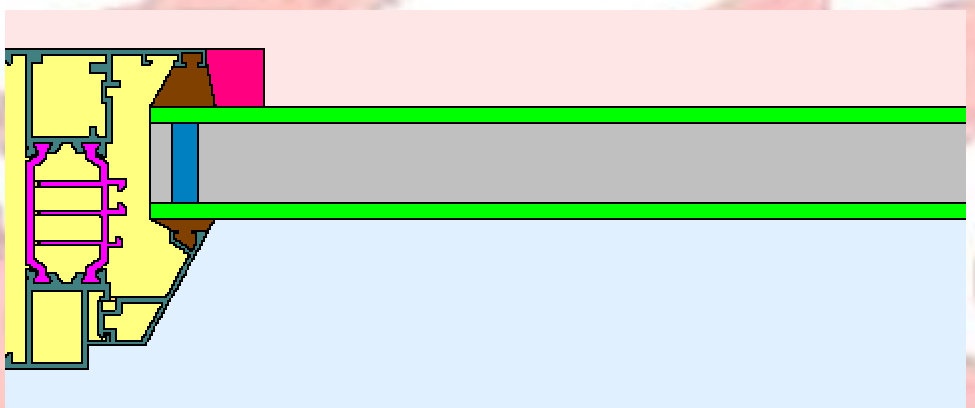
For uncoated surfaces input 0.89 for normal emissivity, which corresponds to a corrected emissivity of 0.837

Iteration number	U value W/(m²·K)	$\sum 1/h_s$ (m²·K)/W	λeff W/(mK)	ΔT
1	1.070	0.7566	0.0264	15
2	1.070	0.7566	0.0264	15

Simulation software: WinIso2D 7.57
Date: 02.12.2013
File: D:\MyDocs from Thermbridge\Therm Output Files\Origin Frames\December 2013\Winiso file\Fixed - U value - Garys Swiss Ultimate.f2d

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

Dimensions (width x height): 240,00 x 100,00 mm
Number of elements in simulation model: X-direction: 259; Y-direction: 228



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:	7,274	W/m
2D thermal conductance L2D:	0,364	W/mK
Length top/left:	190,00	mm
U-value top/left:	1,070	W/m²K
Length bottom/right:	0,00	mm
U-value bottom/right:	0,000	W/m²K
Ψ-value:	0,039	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	6,484	X
1 boundary condition outside 0,04, 0°C, 80%	0,040	0,000	-7,272	X
1 boundary condition intside 0,20, 20°C, 50%	0,200	20,000	0,792	X
1 air EN ISO 10077-2 (cavities in profiles)				X
1 air EN ISO 10077-2 (cavities in profiles <=2mm)				X

Material	L (W/mK)	Emiss	10077 konform
4 polyamide 6.6 25% GF	0,300	0,900	X
5 EPDM	0,250	0,900	X
2 float 1.0	1,000	0,837	-
3 alu (Si-Leg.) 160 copy	160,000	0,900	-
6 butyle	0,240	0,900	X
6 Swiss Ultimate Effective Conductivity	0,140	0,900	X
SZR L=0.0264	0,026	0,900	-

Simulation software: WinIso2D 7.57
Date: 02.12.2013
File: D:\MyDocs from Thermbridge\Therm Output Files\Origin Frames\December 2013\Winiso file\Fixed - U value - Garys Swiss Ultimate.f2d

Sommer Informatik

Calculation of the thermal transmission coefficient U_f according to EN ISO 10077-2:2003-12
Simulation model:
Dimensions (width x height): 240,00 x 100,00 mm
Number of elements in simulation model: X-direction: 259; Y-direction: 228

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:	6,355	W/m
2D thermal conductance L2D:	0,318	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:	2,437	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	6,484	X
1 boundary condition outside 0,04, 0°C, 80%	0,040	0,000	-7,272	X
1 boundary condition intside 0,20, 20°C, 50%	0,200	20,000	0,792	X
1 air EN ISO 10077-2 (cavities in profiles)				X
1 air EN ISO 10077-2 (cavities in profiles <=2mm)				X

Material	L (W/mK)	Emiss	10077 konform
4 polyamide 6.6 25% GF	0,300	0,900	X
5 EPDM	0,250	0,900	X
2 float 1.0	1,000	0,837	-
3 alu (Si-Leg.) 160 copy	160,000	0,900	-
6 butyle	0,240	0,900	X
6 Swiss Ultimate Effective Conductivity	0,140	0,900	X
SZR L=0.0264	0,026	0,900	-

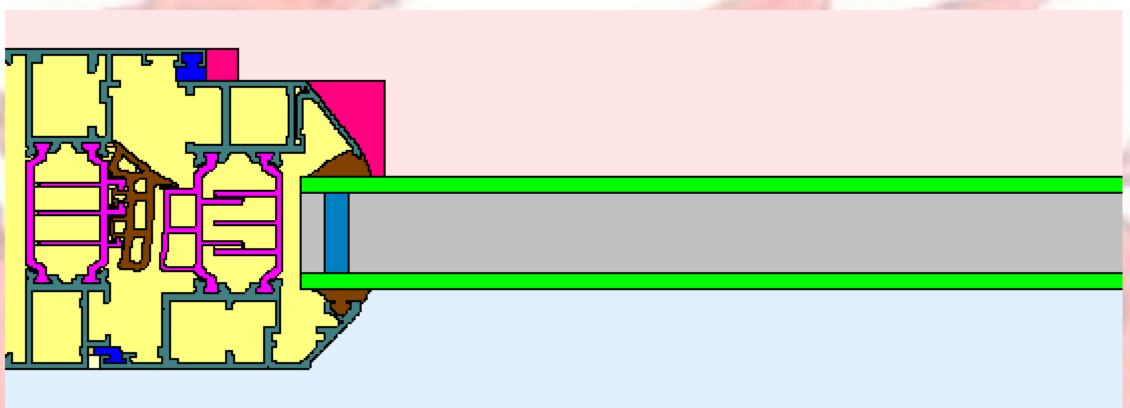
Simulation software: WinIso2D 7.57
Date: 02.12.2013
File: D:\MyDocs from Thermbridge\Therm Output Files\Origin Frames\December 2013\Winiso file\Vent - U value Garys Swiss Ultimate.f2d

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

Simulation model:

Dimensions (width x height): 278,67 x 100,00 mm

Number of elements in simulation model: X-direction: 413; Y-direction: 309



Boundary conditions:

External:

Temperature Θe:	0,00	°C
Surface resistance Rse:	0,040	m^2K/W

Internal:

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

Results:

Temperature difference dT:	20,00	K
Total heat flow Q:	8,479	W/m
2D thermal conductance L2D:	0,424	W/mK
Length top/left:	190,00	mm
U-value top/left:	1,070	W/m^2K
Length bottom/right:	0,00	mm
U-value bottom/right:	0,000	W/m^2K
Ψ-value:	0,033	W/mK

Materials:

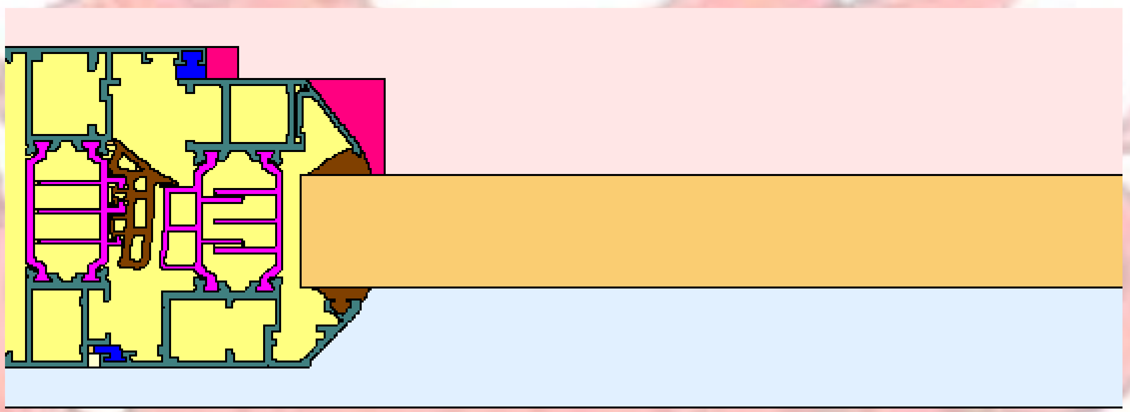
Material	R (m²K/W)	T (°C)	Q(gesamt) (W/m)	10077 konform
****ADIABAT****	0,000	0,000	0,000	
1 boundary condition intside 0,13, 20°C, 50%	0,130	20,000	7,055	X
1 boundary condition outside 0,04, 0°C, 80%	0,040	0,000	-8,477	X
1 boundary condition intside 0,20, 20°C, 50%	0,200	20,000	1,427	X
1 air EN ISO 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 alu (Si-Leg.) 160	160,000	0,900	X
4 polyamide 6.6 25% GF	0,300	0,900	X
5 EPDM	0,250	0,900	X
2 float 1.0	1,000	0,837	-
5 Q-lon	0,060	0,900	-
6 butyle	0,240	0,900	X
6 Swiss Ultimate Effective Conductivity	0,140	0,900	X
SZR L=0.0264	0,026	0,900	-

Simulation software: WinIso2D 7.57
Date: 02.12.2013
File: D:\MyDocs from Thermbridge\Therm Output Files\Origin Frames\December 2013\Winiso file\Vent - U value Garys Swiss Ultimate.f2d

Sommer Informatik

Calculation of the thermal transmission coefficient U_f according to EN ISO 10077-2:2003-12
Simulation model:
Dimensions (width x height): 278,67 x 100,00 mm
Number of elements in simulation model: X-direction: 413; Y-direction: 309



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:	7,667	W/m
2D thermal conductance L2D:	0,383	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:	2,106	W/m²K

Materials:

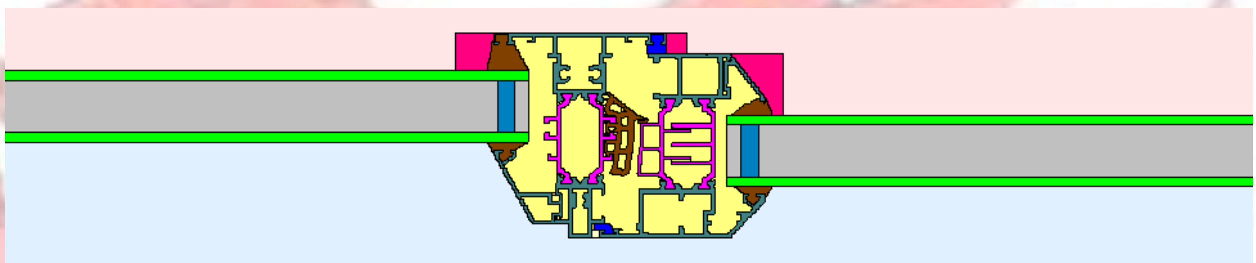
Material	R (m²K/W)	T (°C)	Q(gesamt) (W/m)	10077 konform
****ADIABAT****	0,000	0,000	0,000	
1 boundary condition intside 0,13, 20°C, 50%	0,130	20,000	7,055	X
1 boundary condition outside 0,04, 0°C, 80%	0,040	0,000	-8,477	X
1 boundary condition intside 0,20, 20°C, 50%	0,200	20,000	1,427	X
1 air EN ISO 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 alu (Si-Leg.) 160	160,000	0,900	X
4 polyamide 6.6 25% GF	0,300	0,900	X
5 EPDM	0,250	0,900	X
2 float 1.0	1,000	0,837	-
5 Q-lon	0,060	0,900	-
6 butyle	0,240	0,900	X
6 Swiss Ultimate Effective Conductivity	0,140	0,900	X
SZR L=0.0264	0,026	0,900	-

Simulation software: WinIso2D 7.57
Date: 02.12.2013
File: D:\MyDocs from Thermbridge\Therm Output Files\Origin Frames\December 2013\Winiso file\Mullion - U value Garys Swiss Ultimate.f2d

Sommer Informatik

Calculation of the linear thermal transmission coefficient Ψ according to EN ISO 10077-2
Simulation model:
Dimensions (width x height): 486,01 x 100,00 mm
Number of elements in simulation model: X-direction: 586; Y-direction: 334



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:	14,404	W/m
2D thermal conductance L2D:	0,720	W/mK
Length top/left:	190,00	mm
U-value top/left:	1,071	W/m²K
Length bottom/right:	190,00	mm
U-value bottom/right:	1,070	W/m²K
Ψ-value:	0,068	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	12,167	X
1 boundary condition outside 0,04, 0°C, 80%	0,040	0,000	-14,400	X
1 boundary condition intside 0,20, 20°C, 50%	0,200	20,000	2,241	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

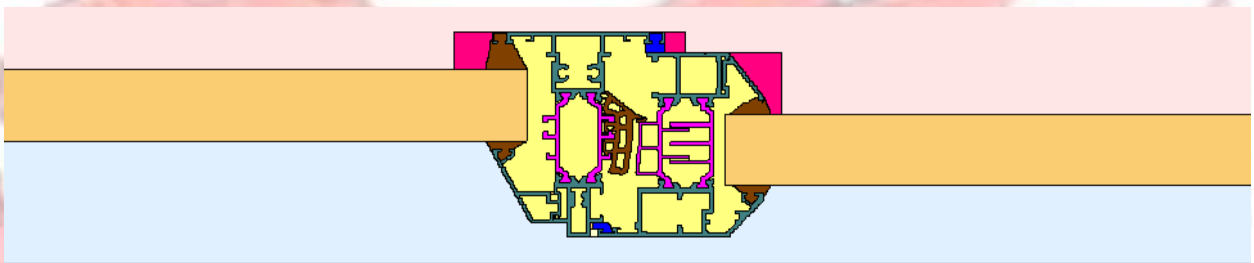
Material	L (W/mK)	Emiss	10077 konform
3 alu (Si-Leg.) 160	160,000	0,900	X
4 polyamide 6.6 25% GF	0,300	0,900	X
5 EPDM	0,250	0,900	X
2 float 1.0	1,000	0,837	-
5 Q-lon	0,060	0,900	-
6 butyle	0,240	0,900	X
6 Super Spacer Standard	0,122	0,900	X
SZR L=0.0257	0,026	0,900	-
4 polyurethane(PUR)-resin - 0.4 Conductivity	0,400	0,900	X
6 Swiss Ultimate Effective Conductivity	0,140	0,900	X
SZR L=0.0264	0,026	0,900	-

Simulation software: WinIso2D 7.57
Date: 02.12.2013
File: D:\MyDocs from Thermbridge\Therm Output Files\Origin Frames\December 2013\Winiso file\Mullion - U value Garys Swiss Ultimate.f2d

Sommer Informatik

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

Dimensions (width x height): 486,01 x 100,00 mm
Number of elements in simulation model: X-direction: 586; Y-direction: 334



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:	12,735	W/m
2D thermal conductance L2D:	0,637	W/mK
Length 1:	190,00	mm
U-value 1:	1,031	W/m²K
Length 2:	190,00	mm
U-value 2:	1,031	W/m²K
U_f-value:	2,289	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	12,167	X
1 boundary condition outside 0,04, 0°C, 80%	0,040	0,000	-14,400	X
1 boundary condition intside 0,20, 20°C, 50%	0,200	20,000	2,241	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 alu (Si-Leg.) 160	160,000	0,900	X
4 polyamide 6.6 25% GF	0,300	0,900	X
5 EPDM	0,250	0,900	X
2 float 1.0	1,000	0,837	-
5 Q-lon	0,060	0,900	-
6 butyle	0,240	0,900	X
6 Super Spacer Standard	0,122	0,900	X
SZR L=0.0257	0,026	0,900	-
4 polyurethane(PUR)-resin - 0.4 Conductivity	0,400	0,900	X
6 Swiss Ultimate Effective Conductivity	0,140	0,900	X
L=0.0264	0,026	0,900	-