# THERMAL SIMULATION REPORT

| | |
|---|---|
| *Report Number:* | **TCL2014-SWA-018** |
| *Prepared For:* | **Steel Window Association<br>42 Heath Street<br>Tamworth<br>Staffordshire<br>B79 7HJ** |
| *Window System Identifier:* | **W40** |
| *Meeting Rail Identifier:* | **SW5/SWX8** |
| *Vent Frame Identifier:* | **SW5/SW8** |
| *Fixed Outer Frame Identifier:* | **SW7** |
| *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:* | **Stainless Steel Bead<br><br>Reference Drawing SWA-W40-015** |

## *Result*

| | | |
|---|---|---|
| *Thermal Transmittance ($U_{Window}$)* | **1.8** | *W/(m²K)* |

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

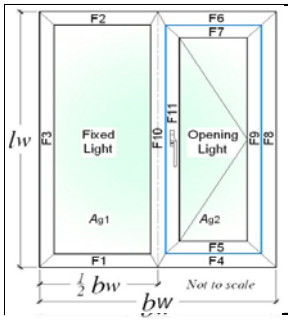
*Report Prepared By* *Dr Gary Morgan*
*Therm Consulting*

*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




**Sample Style:**
**Casement**

**Fixed Light / Side Hung**

*Blue line illustrates opening light length (air leakage)*

Report Number: TCL2014 SWA-018 Issue No 22.1: 11/03/2013
Report Date: 22 May 2014
Project Details: 4-8-4-8-4 Planitherm One / 4S (x2) Clear Float 90% Krypton Super Spacer Standard

**THIS SPREADSHEET IS THE PROPERTY OF THE BFRC AND CAN ONLY BE USED IN CONJUNCTION WITH A BFRC LICENCE**

**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 | 8 | mm |
| Gas fill (1/2) | Krypton 90% | |
| Thickness of pane 2 | 4 | mm |
| Complete next 3 cells for TG IGU | | |
| Pane 2/3 distance | 8 | mm |
| Gas fill (2/3) | Krypton 90% | |
| Thickness of pane 3 | 4.0 | mm |
| Glazing Trans. - ***3DP*** $U_g$ | 0.602 | W/(m²·K) |
| $g$ -value - ***2DP*** $g_\perp$ | | |

Thermal transmittance of window from hot box test

| $U_w$ - *2DP* | | W/(m²·K) |
|---|---|---|

| **Window Dimensions:** | | | Area | |
|---|---|---|---|---|
| | Length | Width | No gasket | With gasket |
| Section | (m) | (m) | ($m^2$) | ($m^2$) |
| Fixed Light | 1.4220 | 0.5590 | 0.7949 | 0.7929 |
| Opening light | 1.3720 | 0.5190 | 0.7121 | 0.7102 |
| Total glazing, $A_g$ | | | 1.5070 | 1.5031 |
| Frame | (m) | (m) | ($m^2$) | ($m^2$) |
| F1 | 0.6150 | 0.0290 | 0.0170 | 0.0173 |
| F2 | 0.6150 | 0.0290 | 0.0170 | 0.0173 |
| F3 | 1.4800 | 0.0290 | 0.0421 | 0.0428 |
| F4 | 0.6150 | 0.0390 | 0.0227 | 0.0227 |
| F5 | 0.5490 | 0.0150 | 0.0080 | 0.0083 |
| F6 | 0.6150 | 0.0390 | 0.0227 | 0.0227 |
| F7 | 0.5490 | 0.0150 | 0.0080 | 0.0083 |
| F8 | 1.4800 | 0.0390 | 0.0562 | 0.0562 |
| F9 | 1.4020 | 0.0150 | 0.0208 | 0.0215 |
| F10 | 1.4800 | 0.0540 | 0.0781 | 0.0788 |
| F11 | 1.4020 | 0.0150 | 0.0208 | 0.0215 |
| Total Frame | | | 0.3134 | 0.3173 |
| Total Window, $A_w$ | | | 1.8204 | 1.8204 |
| Percentage fixed light glass area | | | 43.67% | 43.56% |
| Percentage opening light glass area | | | 39.12% | 39.01% |
| Percentage glass area (total | | | 82.78% | 82.57% |

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

| $U_{window}$ | | | |
|---|---|---|---|
| | No bars; or attached bars | 1.79 | W/(m²·K) |
| | Single cross bar in IGU | 1.9 | |
| | Multiple cross bar in IGU | 2.0 | |
| | Glazing bar (Georgian bar) | 2.2 | |

| BFRC Rating kWh/($m^2$·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 | |

| **Frame dimensions:** | ($b_f$) | Frame width, $b_f$ (mm) | Gasket protrusion, $b_{gf}$ (mm) | Frame & gasket widths (mm) | |
|---|---|---|---|---|---|
| All frame values round to neares 1mm, gaskets to ***1DP*** | F1 fixed sill | 29 | 0.5 | 29.5 | |
| | F2 fixed head | 29 | 0.5 | 29.5 | |
| | F3 fixed jamb | 29 | 0.5 | 29.5 | Total |
| F4 + F5 sash sill | F4 fixed sash sill | 39 | n/a | 39.0 | 54.5 |
| | F5 moving sash sill | 15 | 0.5 | 15.5 | |
| F6 + F7 sash head | F6 fixed sash head | 39 | n/a | 39.0 | 54.5 |
| | F7 moving sash head | 15 | 0.5 | 15.5 | |
| F8 + F9 sash jamb | F8 Fixed sash jamb | 39 | n/a | 39.0 | 54.5 |
| | F9 moving sash jamb | 15 | 0.5 | 15.5 | |
| F10 + F11 mullion | F10 fixed mullion | 54 | 0.5 | 54.5 | 70.0 |
| | F11 moving mullion | 15 | 0.5 | 15.5 | |
| Total gasket area | | | 0.00387 | $m^2$ | |

Where a $U_w$ value from hot box testing is available, nd $L_f{}^{2D}$ or $L_\psi{}^{2D}$ 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 | $L_f{}^{2D}$ | **0.3880** | **190** | $L_\psi{}^{2D}$ | **0.3540** | **190** |
| F2 fixed head | | **0.3880** | 190 | | **0.3540** | 190 |
| F3 fixed jamb | | **0.3880** | 190 | | **0.3540** | 190 |
| F4 + F5 sash sill | | **0.5230** | 190 | | **0.4920** | 190 |
| F6 + F7 sash head | | **0.5230** | 190 | | **0.4920** | 190 |
| F8 + F9 sash jamb | | **0.5230** | 190 | | **0.4920** | 190 |
| F10 + F11 mullion | | **0.8270** | 380 | | **0.7600** | 380 |

| **Frame:** | Frame width, $b_f$ | Frame U-value, U | Frame areas, A | Frame heat flow, HU | linear trans, | Linear length, $l_g$ | Junction heat flow, HΨ |
|---|---|---|---|---|---|---|---|
| Section | (m) | (W/(m²·K)) | ($m^2$) | (W/K) | (W/(m·K)) | (m) | (W/K) |
| F1 fixed sill | 0.0290 | 6.6250 | 0.0170 | 0.1128 | 0.0475 | 0.5590 | 0.0266 |
| F2 fixed head | 0.0290 | 6.6250 | 0.0170 | 0.1128 | 0.0475 | 0.5590 | 0.0266 |
| F3 fixed jamb | 0.0290 | 6.6250 | 0.0421 | 0.2788 | 0.0475 | 1.4220 | 0.0675 |
| F4 + F5 sash sill | 0.0540 | 6.0578 | 0.0307 | 0.1860 | 0.0505 | 0.5190 | 0.0262 |
| F6 + F7 sash head | 0.0540 | 6.0578 | 0.0307 | 0.1860 | 0.0505 | 0.5190 | 0.0262 |
| F8 + F9 sash jamb | 0.0540 | 6.0578 | 0.0770 | 0.4665 | 0.0505 | 1.3720 | 0.0693 |
| F10 + F11 mullion | 0.0690 | 6.3079 | 0.0989 | 0.6238 | 0.0960 | 1.3970 | 0.1341 |
| Totals | | | 0.3134 | 1.9666 | Total | | 0.3764 |

**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 | 3.9020 | m | Total air leakage | 0.000 | $m^3$/h |
|---|---|---|---|---|---|
| $L_{50}$ | 0.00 | $m^3/(m^2 \cdot h)$ | Heat loss = 0.0165 $L_{50}$ | 0.00 | W/(m²·K) |

Other parameters needed for calculation, taken from simulations: $d_p = d_g =$ 0.028 m

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $\lambda_p$ = | 0.035 | W/(m·K) | $R_{se}$ = | 0.04 | ·K /W | $R_{se}$ = | 0.13 m²·K /W |
| $R_p$ = | 0.8000 | m²·K /W | $R_{tot}$ = | 0.9700 | ·K /W | $U_p$ = | 1.0309 W/(m²·K) |

| **BFRC Rating =** | |
|---|---|
| **218.6$g_{window}$ - 68.5 x ($U_{window}$ + Effective $L_{50}$) =** | **N/A** |
| **Climate zone is:** | **UK** |

| **Thermal transmittance, W/(m²·K)** | $U_{window}$ | **1.8** |
|---|---|---|
| **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 |
|---|---|
| 2 | |

| | | | Spaces | 1 | | 2 | |
|---|---|---|---|---|---|---|---|
| Glazing orientation | | | | Pane 1 | Pane 2 | Pane 3 | |
| | Vertical | | | | | | |
| Resistivity panes | 1 | m·K/W | | 90% | | 90% | |
| 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 |

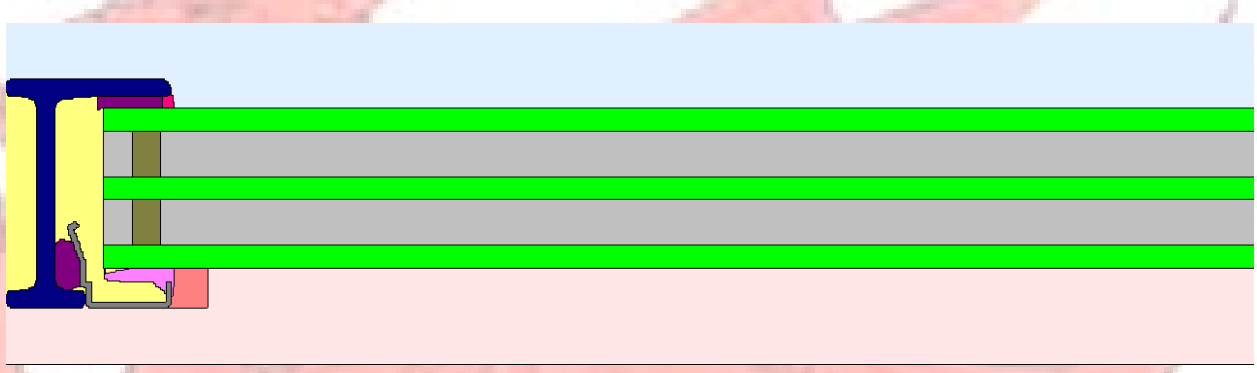
Simulation software: WinIso2D 7.80
Date: 22.05.2014
File: C:\Users\Gary\Documents\MyDocs from Thermbridge\Thermal Simulation Output Files\Steel Window Association\May 2014\W40 - SIMULATIONS Doors and Windows\W40-015\Outer Frame ss bead.f2d

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

Simulation model:

Dimensions (width x height): 219,00 x 60,00 mm

Number of elements in simulation model: X-direction: 156; Y-direction: 86



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: | 7,084 | W/m |
| 2D thermal conductance L2D: | 0,354 | 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: | 0,047 | 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 | 6,391 | X |
| 1 boundary condition outside 0,04, 0°C, 80% | 0,040 | 0,000 | -7,084 | X |
| 1 boundary condition intside 0,20, 20°C, 50% | 0,200 | 20,000 | 0,693 | 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 | - |
| 3 stainless steel 17 | 17,000 | 0,900 | X |

Simulation software: WinIso2D 7.80
Date: 22.05.2014
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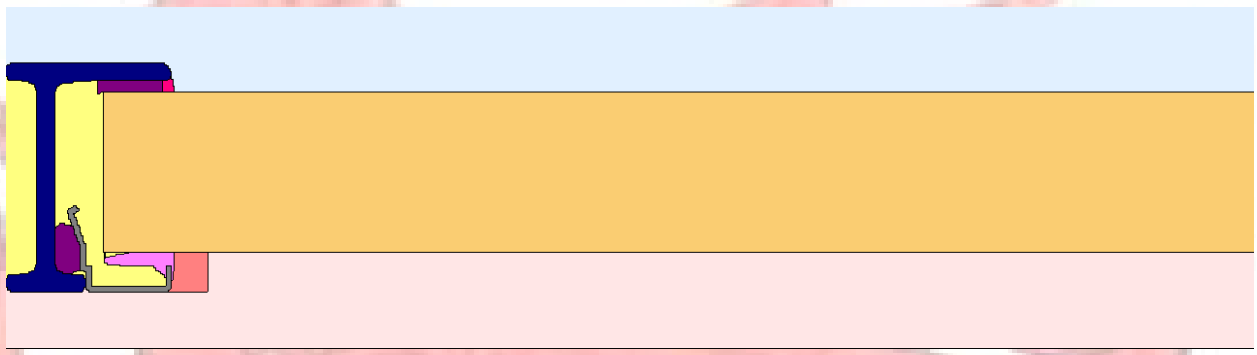
Calculation of the thermal transmission coefficient $U_f$ according to EN ISO 10077-2:2003-12
Simulation model:

Dimensions (width x height): 219,00 x 60,00 mm
Number of elements in simulation model: X-direction: 156; Y-direction: 86



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: | 7,766 | W/m |
| 2D thermal conductance L2D: | 0,388 | 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: | 6,414 | 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 | 6,391 | X |
| 1 boundary condition outside 0,04, 0°C, 80% | 0,040 | 0,000 | -7,084 | X |
| 1 boundary condition intside 0,20, 20°C, 50% | 0,200 | 20,000 | 0,693 | 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 | - |
| 3 stainless steel 17 | 17,000 | 0,900 | X |

Simulation software: WinIso2D 7.80
Date: 21.05.2014
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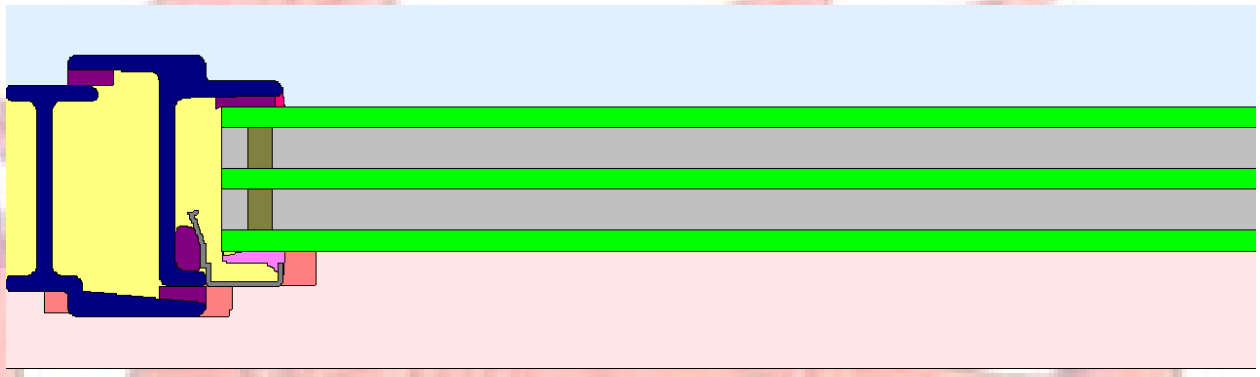
Calculation of the linear thermal transmission coefficient Ψ according to EN ISO 10077-2
Simulation model:

Dimensions (width x height): 243,99 x 70,90 mm
Number of elements in simulation model: X-direction: 207; Y-direction: 133



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: | | 9,842 | W/m |
| 2D thermal conductance L2D: | 0,492 | 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: | | 0,051 | 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 outside 0,04, 0°C, 80% | 0,040 | 0,000 | -9,842 | X |
| 1 boundary condition intside 0,13, 20°C, 50% | 0,130 | 20,000 | 7,673 | X |
| 1 boundary condition intside 0,20, 20°C, 50% | 0,200 | 20,000 | 2,168 | 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 |
| PS 025 (EPS) | 0,025 | 0,900 | - |
| 2 Float Glass 1.0 | 1,000 | 0,837 | X |
| 3 stainless steel 17 | 17,000 | 0,900 | 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 |
| SZR L=0.0108 | 0,011 | 0,900 | - |

Simulation software: WinIso2D 7.80
Date: 21.05.2014
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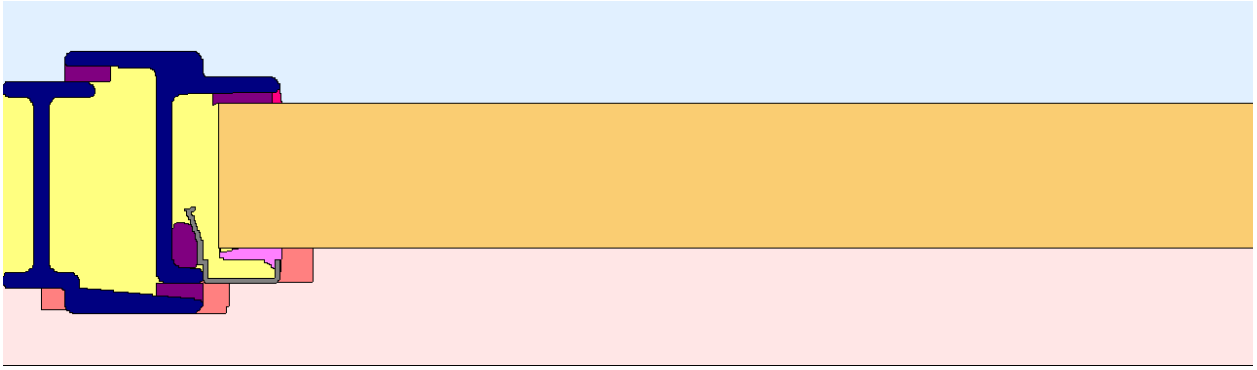
Sommer Informatik

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: 207; Y-direction: 133



Boundary conditions:

External:

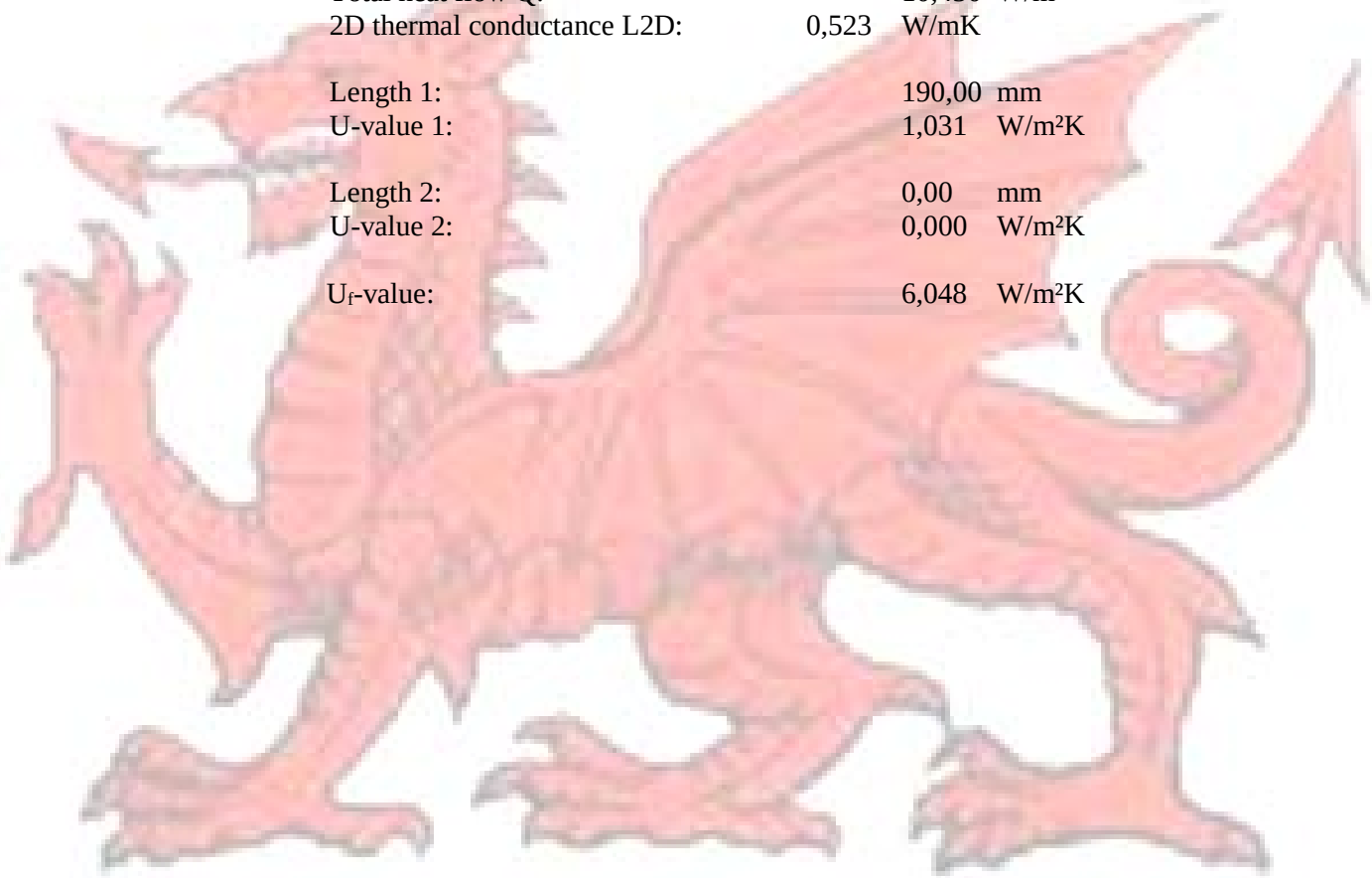
| | | |
|---|---|---|
| Temperature Θe: | 0,00 | °C |
| Surface resistance Rse: | 0,040 | m²K/W |

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: | 10,450 | W/m |
| 2D thermal conductance L2D: | 0,523 | 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: | 6,048 | 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 outside 0,04, 0°C, 80% | 0,040 | 0,000 | -9,842 | X |
| 1 boundary condition intside 0,13, 20°C, 50% | 0,130 | 20,000 | 7,673 | X |
| 1 boundary condition intside 0,20, 20°C, 50% | 0,200 | 20,000 | 2,168 | 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 |

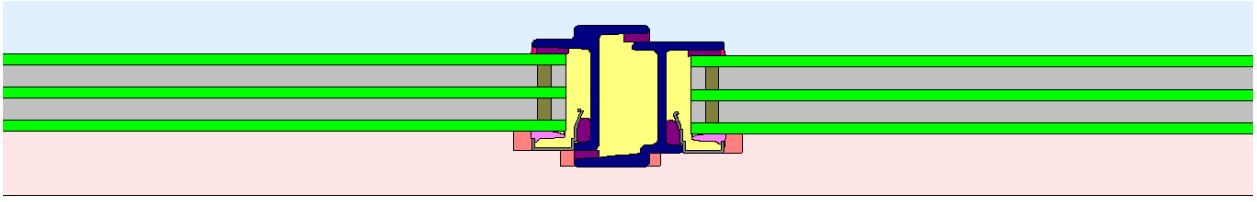
| Material | L (W/mK) | Emiss | 10077 konform |
|---|---|---|---|
| 3 structural steel 50 | 50,000 | 0,900 | X |
| PS 025 (EPS) | 0,025 | 0,900 | - |
| 2 Float Glass 1.0 | 1,000 | 0,837 | X |
| 3 stainless steel 17 | 17,000 | 0,900 | X |
| 5 PVC soft | 0,140 | 0,900 | X |
| 6 Silicon, unfilled | 0,350 | 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 |
| SZR L=0.0108 | 0,011 | 0,900 | - |

Simulation software: WinIso2D 7.80
Date: 21.05.2014
File: C:\Users\Gary\Documents\MyDocs from Thermbridge\Thermal Simulation Output Files\Steel Window Association\May 2014\W40 - SIMULATIONS Doors and Windows\W40-012\Section 4.f2d

Sommer Informatik

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

Dimensions (width x height): 448,98 x 69,99 mm
Number of elements in simulation model: X-direction: 339; Y-direction: 150



Boundary conditions:

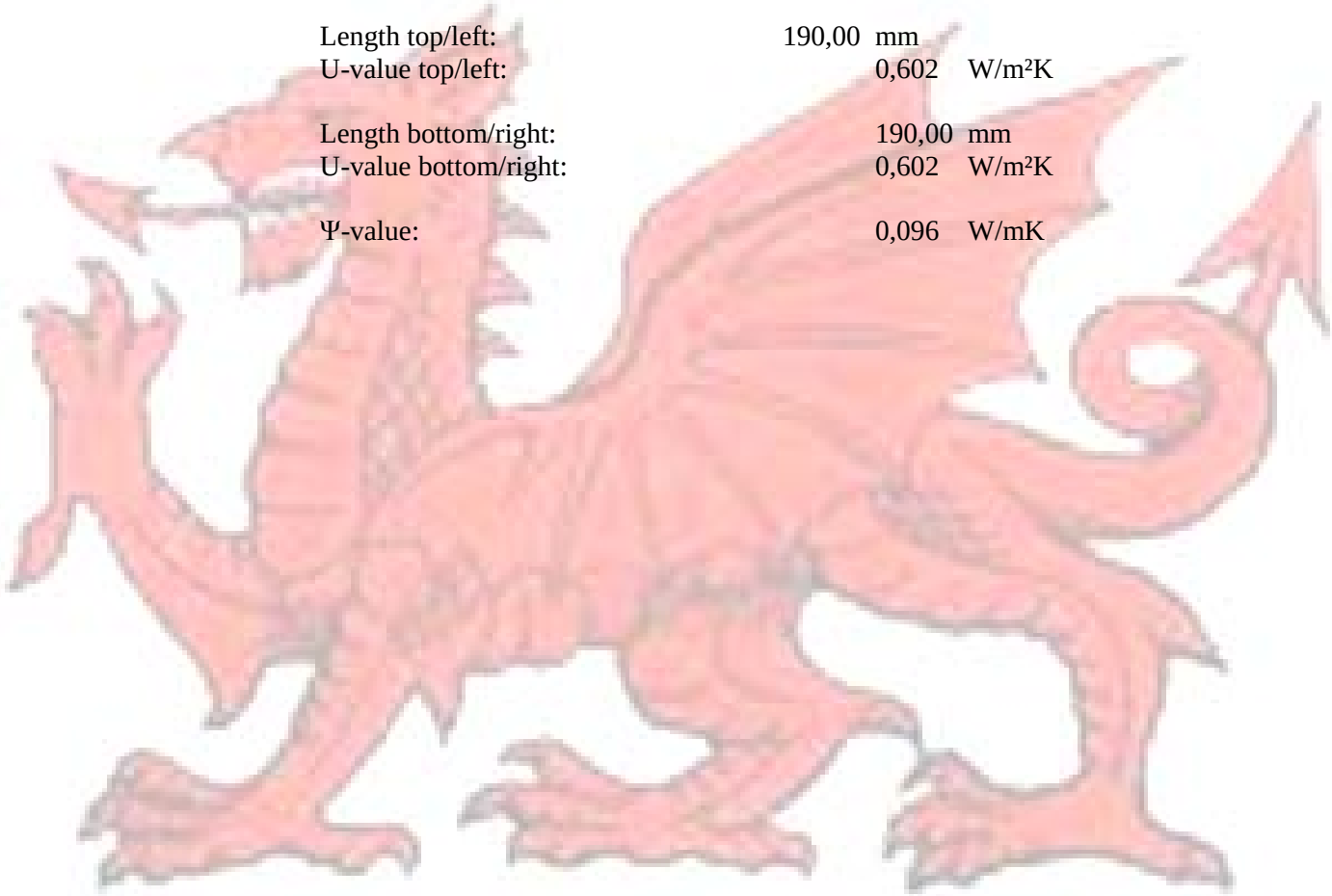
External:

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: | 15,202 | W/m |
| 2D thermal conductance L2D: | 0,760 | W/mK |
| Length top/left: | 190,00 | mm |
| U-value top/left: | 0,602 | W/m²K |
| Length bottom/right: | 190,00 | mm |
| U-value bottom/right: | 0,602 | W/m²K |
| Ψ-value: | 0,096 | W/mK |



Materials:

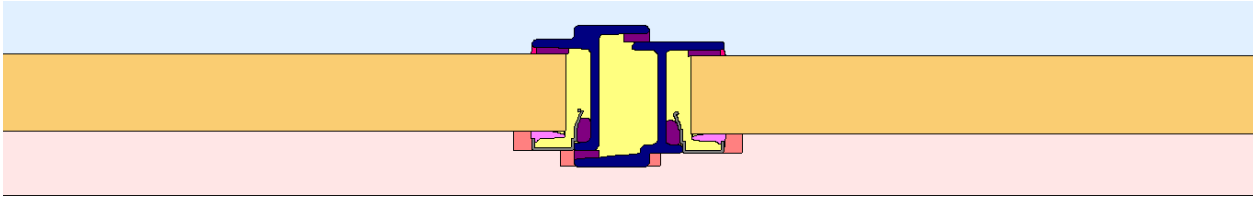
| Material | R (m²K/W) | T (°C) | Q(gesamt) (W/m) | 10077 konform |
|---|---|---|---|---|
| ****ADIABAT**** | 0,000 | 0,000 | 0,000 | |
| 1 boundary condition outside 0,04, 0°C, 80% | 0,040 | 0,000 | -15,202 | X |
| 1 boundary condition intside 0,13, 20°C, 50% | 0,130 | 20,000 | 12,429 | X |
| 1 boundary condition intside 0,20, 20°C, 50% | 0,200 | 20,000 | 2,772 | 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 |
| PS 025 (EPS) | 0,025 | 0,900 | - |
| 2 Float Glass 1.0 | 1,000 | 0,837 | X |
| 3 stainless steel 17 | 17,000 | 0,900 | 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 |
| SZR L=0.0108 | 0,011 | 0,900 | - |

Simulation software: WinIso2D 7.80
Date: 21.05.2014
File: C:\Users\Gary\Documents\MyDocs from Thermbridge\Thermal Simulation Output Files\Steel Window Association\May 2014\W40 - SIMULATIONS Doors and Windows\W40-012\Section 4.f2d

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

Dimensions (width x height): 448,98 x 69,99 mm
Number of elements in simulation model: X-direction: 339; Y-direction: 150



Boundary conditions:

External:

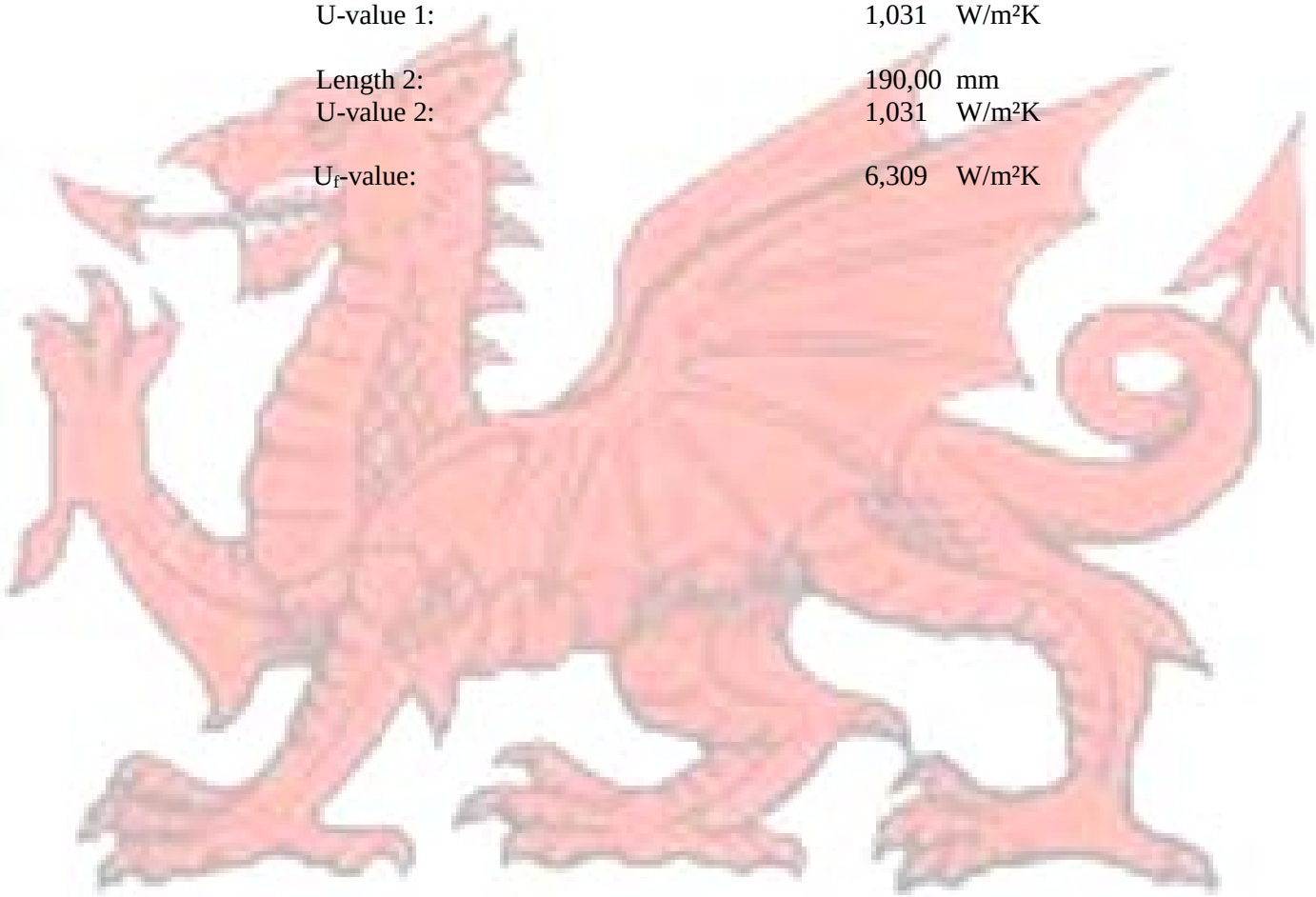
Temperature Θe: 0,00 °C
Surface resistance Rse: 0,040 m²K/W

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: | 16,542 | W/m |
| 2D thermal conductance L2D: | 0,827 | 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: | 6,309 | 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 outside 0,04, 0°C, 80% | 0,040 | 0,000 | -15,202 | X |
| 1 boundary condition intside 0,13, 20°C, 50% | 0,130 | 20,000 | 12,429 | X |
| 1 boundary condition intside 0,20, 20°C, 50% | 0,200 | 20,000 | 2,772 | 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 |
| PS 025 (EPS) | 0,025 | 0,900 | - |
| 2 Float Glass 1.0 | 1,000 | 0,837 | X |
| 3 stainless steel 17 | 17,000 | 0,900 | 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 |
| SZR L=0.0108 | 0,011 | 0,900 | - |