

THERMAL SIMULATION REPORT

| | |
|-------------------------------|---|
| Report Number: | TCL2014-SWA-011 |
| Prepared For: | Steel Window Association 42 Heath Street Tamworth Staffordshire B79 7HJ |
| Window System Identifier: | W20 |
| Fixed Outer Frame Identifier: | W7 |
| Transom Frame Identifier: | W8/W2 |
| Vent Frame Identifier: | W8/W5 |
| Glazing System: | 4 mm Planilux – 8 mm 90% Krypton – 4 mm Planitherm One or Planitherm 4S |
| Spacer Bar: | 8mm Edgetech Super Spacer Standard with butyl secondary sealant |
| Notes: | Aluminium Bead Reference Drawing SWA-W20-011 |

Result

| | | |
|--|-----|----------------------|
| Thermal Transmittance (U_{window}) | 2.2 | W/(m ² K) |
|--|-----|----------------------|

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

Report Prepared By Dr Gary Morgan
 Therm Consulting

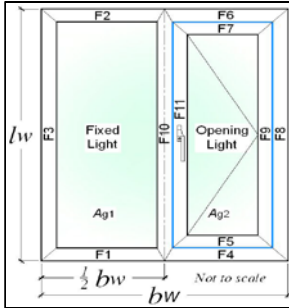
Signed: *G. Morgan*

Date: 2nd 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



**BFRC Certified
Simulator 016**



Sample Style:
Casement
Fixed Light / Side Hung

Blue line illustrates opening light length (air leakage)

Report Number: **TCL2014-SWA-011** Issue No.21: 04/03/2009
 Report Date: **02 May 2014**
 Project Details: **W20 Steel Frame 4mm Planilux 8mm 90% Krypton 4mm Planitherm One / 4S Edgetech Super Spacer Standard**

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

| Parameter | Symbol | Units |
|--------------------------------|--------|---------|
| Total window height ODP | l_w | 1480 mm |
| Total window width ODP | b_w | 1230 mm |

Nominal 4mm etc to **ODP**, 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 | | mm |
| Gas fill (2/3) | | |
| Thickness of pane 3 | | mm |
| Glazing Trans. - 3DP | U_g | 1.114 W/(m ² ·K) |
| g-value - 2DP | g | |

Frame dimensions:

| | (b _f) | Without gasket | Gasket protrusion | With gasket | |
|--|---------------------|----------------|-------------------|-------------------------|-------|
| | | (mm) | (mm) | (mm) | |
| All frame values to nearest 0.5mm, gaskets to 1DP | F1 fixed sill | 23 | 0.7 | 23.7 | |
| | F2 fixed head | 23 | 0.7 | 23.7 | |
| | F3 fixed jamb | 23 | 0.7 | 23.7 | Total |
| F4 + F5 sash sill | F4 fixed sash sill | 43 | n/a | 43 | 56.7 |
| | F5 moving sash sill | 13 | 0.7 | 13.7 | |
| F6 + F7 sash head | F6 fixed sash head | 43 | n/a | 43 | 56.7 |
| | F7 moving sash head | 13 | 0.7 | 13.7 | |
| F8 + F9 sash jamb | F8 Fixed sash jamb | 43 | n/a | 43 | 56.7 |
| | F9 moving sash jamb | 13 | 0.7 | 13.7 | |
| F10 + F11 mullion | F10 fixed mullion | 61 | 0.7 | 61.7 | 75.4 |
| | F11 moving mullion | 13 | 0.7 | 13.7 | |
| Total gasket area | | | | 0.0054267m ² | |

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

Window Dimensions:

| Section | Length (m) | Width (m) | Area | |
|-------------------------------------|------------|-----------|-----------------------------|-------------------------------|
| | | | No gasket (m ²) | With gasket (m ²) |
| Fixed Light | 1.4340 | 0.5615 | 0.8052 | 0.8024 |
| Opening light | 1.3680 | 0.5155 | 0.7052 | 0.7026 |
| Total glazing, A _g | | | 1.5104 | 1.5050 |
| Frame | | | | |
| F1 | 0.6150 | 0.0230 | 0.0135 | 0.0139 |
| F2 | 0.6150 | 0.0230 | 0.0135 | 0.0139 |
| F3 | 1.4800 | 0.0230 | 0.0335 | 0.0345 |
| F4 | 0.6150 | 0.0430 | 0.0249 | 0.0249 |
| F5 | 0.5415 | 0.0130 | 0.0069 | 0.0072 |
| F6 | 0.6150 | 0.0430 | 0.0249 | 0.0249 |
| F7 | 0.5415 | 0.0130 | 0.0069 | 0.0072 |
| F8 | 1.4800 | 0.0430 | 0.0618 | 0.0618 |
| F9 | 1.3940 | 0.0130 | 0.0180 | 0.0189 |
| F10 | 1.4800 | 0.0610 | 0.0883 | 0.0893 |
| F11 | 1.3940 | 0.0130 | 0.0180 | 0.0189 |
| Total Frame | | | 0.3100 | 0.3154 |
| Total Window, A _w | | | 1.8204 | 1.8204 |
| Percentage fixed light glass area | | | 44.23% | 44.08% |
| Percentage opening light glass area | | | 38.74% | 38.59% |
| Percentage glass area (total) | | | 82.97% | 82.67% |

Where a U_g value from hot box testing is available, n.c. L_f^{2D} or L_ψ^{2D} values need to be entered

Frame conductance:

| Section | All L values to 4DP | | All b values to ODP | |
|-------------------|----------------------------|---------------------|----------------------------|---------------------|
| | W/(m·K) | b _p (mm) | W/(m·K) | b _g (mm) |
| F1 fixed sill | 0.4540 | 190 | 0.4140 | 190 |
| F2 fixed head | 0.4540 | 190 | 0.4140 | 190 |
| F3 fixed jamb | 0.4540 | 190 | 0.4140 | 190 |
| F4 + F5 sash sill | 0.6330 | 190 | 0.5990 | 190 |
| F6 + F7 sash head | 0.6330 | 190 | 0.5990 | 190 |
| F8 + F9 sash jamb | 0.6330 | 190 | 0.5990 | 190 |
| F10 + F11 mullion | 1.0750 | 380 | 1.0000 | 380 |

Frame:

| Section | b _f (no gaskets) (m) | U _f (W/(m ² ·K)) | Frame areas (no gaskets) (m ²) | Heat flow (W/K) | ψ (W/(m·K)) | l _g (m) | Heat flow (W/K) |
|-------------------|---------------------------------|--|--|-----------------|-------------|--------------------|-----------------|
| F1 fixed sill | 0.0230 | 6.5669 | 0.0135 | 0.0888 | 0.0513 | 0.5615 | 0.0288 |
| F2 fixed head | 0.0230 | 6.5669 | 0.0135 | 0.0888 | 0.0513 | 0.5615 | 0.0288 |
| F3 fixed jamb | 0.0230 | 6.5669 | 0.0335 | 0.2201 | 0.0513 | 1.4340 | 0.0736 |
| F4 + F5 sash sill | 0.0560 | 5.8935 | 0.0317 | 0.1870 | 0.0573 | 0.5155 | 0.0295 |
| F6 + F7 sash head | 0.0560 | 5.8935 | 0.0317 | 0.1870 | 0.0573 | 0.5155 | 0.0295 |
| F8 + F9 sash jamb | 0.0560 | 5.8935 | 0.0797 | 0.4700 | 0.0573 | 1.3680 | 0.0784 |
| F10 + F11 mullion | 0.0740 | 6.3389 | 0.1062 | 0.6733 | 0.1076 | 1.4010 | 0.1508 |
| Totals | | | 0.3100 | 1.9151 | | Total | 0.4194 |

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 | | | | | m ³ /(m·h) |
| Opening light length | 3.8710 | m | Total air leakage | 0.000 | m ³ /h |
| L ₅₀ | 0.00 | m ³ /(m ² ·h) | Heat loss = 0.0165 L ₅₀ | 0.00 | W/(m ² ·K) |

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

| BFRC Rating kWh/(m ² ·yr) | Label index | EWER Rating Scale | Window Rating |
|--------------------------------------|-------------|-------------------|---------------|
| ≥ 0 | N/A | A | N/A |
| -10 to <-10 | | B | |
| -20 to <-20 | | C | |
| -30 to <-30 | | D | |
| -50 to <-50 | | E | |
| -70 to <-70 | | F | |
| <-70 | | G | |

BFRC Rating =
 218.6g_{window} - 68.5 × (U_{window} + Effective L₅₀) = **N/A**

Climate zone is: **UK**

| | | |
|---|---------------------|------------|
| Thermal transmittance, W/(m ² ·K) | U _{window} | 2.2 |
| Solar factor | g _{window} | N/A |
| Window air leakage heat loss, W/(m ² ·K) | L _{factor} | N/A |



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 | | | P a n e 1 | 90% | P a n e 2 |
| | Vertical | | | | |
| Resistivity panes | 1 | m·K/W | | | |
| | Outside | | | | |
| Emissivities | | | | | |
| Calculate | | | | | |
| | | | Gas | | |
| | | | Krypton | | |
| | Thickness (mm) | 4.0 | 8 | 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 | $\sum 1/h_s$ | λ_{eff} | ΔT |
|------------------|-----------------------|-----------------------|-----------------|------------|
| | W/(m ² ·K) | (m ² ·K)/W | W/(mK) | |
| 1 | 1.114 | 0.7199 | 0.0111 | 15 |
| 2 | 1.114 | 0.7199 | 0.0111 | 15 |

Simulation software: WinIso2D 7.80

Date: 02.05.2014

File: C:\Users\Gary\Documents\MyDocs from Thermbridge\Thermal Simulation Output Files\Steel Window Association\May 2014\W20 - Thermal Simulations\W20 Domestic Aluminium Bead - double gaskets\Mullion.f2d

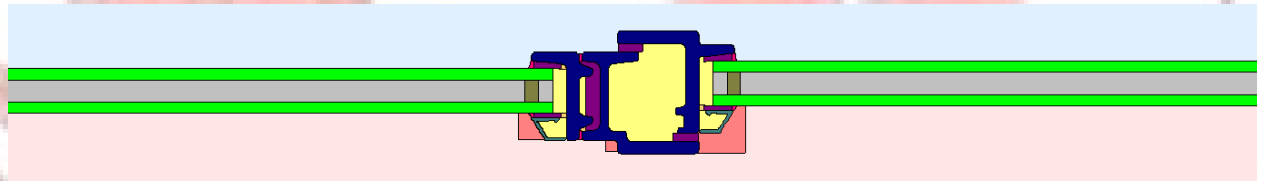


Calculation of the linear thermal transmission coefficient Ψ according to EN ISO 10077-2

Simulation model:

Dimensions (width x height): 453,64 x 64,69 mm

Number of elements in simulation model: X-direction: 371; Y-direction: 144



Boundary conditions:

External:

Temperature Θ_e : 0,00 °C

Surface resistance R_{se} : 0,040 m²K/W

Internal:

Temperature Θ_i : 20,00 °C

Surface resistance R_{si} 1: 0,130 m²K/W

Surface resistance R_{si} 2: 0,200 m²K/W

Results:

Temperature difference dT : 20,00 K

Total heat flow Q : 19,994 W/m

2D thermal conductance L_{2D} : 1,000 W/mK

Length top/left: 190,00 mm

U-value top/left: 1,114 W/m²K

Length bottom/right: 190,00 mm

U-value bottom/right: 1,114 W/m²K

Ψ -value: 0,108 W/mK

Materials:

| Material | R (m ² K/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 | -19,994 | X |
| 1 boundary condition inside 0,13, 20°C, 50% | 0,130 | 20,000 | 16,128 | X |
| 1 boundary condition inside 0,20, 20°C, 50% | 0,200 | 20,000 | 3,865 | 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 |
| 1 calibrating panel | 0,035 | 0,900 | X |
| 2 Float Glass 1.0 | 1,000 | 0,837 | X |
| 3 alu (Si-Leg.) 160 - bead | 160,000 | 0,900 | X |
| 3 PVC-U Rigid | 0,170 | 0,900 | X |
| 3 stainless steel 17 | 17,000 | 0,900 | X |
| 3 structural steel 50 | 50,000 | 0,900 | X |
| 3 structural steel 50 (2) | 50,000 | 0,900 | X |
| 5 Elastomeric Foam Flexible | 0,050 | 0,900 | X |
| 5 EPDM | 0,250 | 0,900 | X |
| 5 PVC soft | 0,140 | 0,900 | X |
| 6 butyle | 0,240 | 0,900 | X |
| 6 Super Spacer Standard | 0,130 | 0,900 | - |
| 6 Silicon, unfilled | 0,350 | 0,900 | X |
| SZR L=0.0111 | 0,011 | 0,900 | - |

Simulation software: WinIso2D 7.80

Date: 02.05.2014

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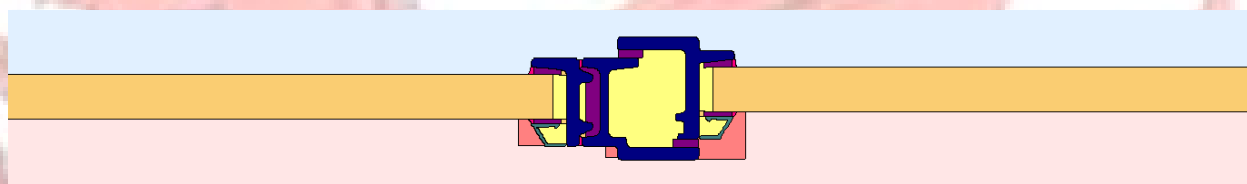


Calculation of the thermal transmission coefficient U_f according to EN ISO 10077-2:2003-12

Simulation model:

Dimensions (width x height): 453,64 x 64,69 mm

Number of elements in simulation model: X-direction: 371; Y-direction: 144



Boundary conditions:

External:

Temperature Θ_e : 0,00 °C

Surface resistance R_{se} : 0,040 m²K/W

Internal:

Temperature Θ_i : 20,00 °C

Surface resistance R_{si} 1: 0,130 m²K/W

Surface resistance R_{si} 2: 0,200 m²K/W

Results:

Temperature difference dT : 20,00 K

Total heat flow Q : 21,496 W/m

2D thermal conductance L_{2D} : 1,075 W/mK

Length 1: 190,00 mm

U-value 1: 1,595 W/m²K

Length 2: 190,00 mm

U-value 2: 1,595 W/m²K

U_f -value: 6,167 W/m²K

Materials:

| Material | R (m ² K/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 | -19,994 | X |
| 1 boundary condition inside 0,13, 20°C, 50% | 0,130 | 20,000 | 16,128 | X |
| 1 boundary condition inside 0,20, 20°C, 50% | 0,200 | 20,000 | 3,865 | 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 |
| 1 calibrating panel | 0,035 | 0,900 | X |
| 2 Float Glass 1.0 | 1,000 | 0,837 | X |
| 3 alu (Si-Leg.) 160 - bead | 160,000 | 0,900 | X |
| 3 PVC-U Rigid | 0,170 | 0,900 | X |
| 3 stainless steel 17 | 17,000 | 0,900 | X |
| 3 structural steel 50 | 50,000 | 0,900 | X |
| 3 structural steel 50 (2) | 50,000 | 0,900 | X |
| 5 Elastomeric Foam Flexible | 0,050 | 0,900 | X |
| 5 EPDM | 0,250 | 0,900 | X |
| 5 PVC soft | 0,140 | 0,900 | X |
| 6 butyle | 0,240 | 0,900 | X |
| 6 Super Spacer Standard | 0,130 | 0,900 | - |
| 6 Silicon, unfilled | 0,350 | 0,900 | X |
| SZR L=0.0111 | 0,011 | 0,900 | - |

Simulation software: WinIso2D 7.80

Date: 02.05.2014

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

Simulation model:

Dimensions (width x height): 212,18 x 51,79 mm

Number of elements in simulation model: X-direction: 153; Y-direction: 77



Boundary conditions:

External:

Temperature Θ_e : 0,00 °C

Surface resistance R_{se} : 0,040 m²K/W

Internal:

Temperature Θ_i : 20,00 °C

Surface resistance R_{si} 1: 0,130 m²K/W

Surface resistance R_{si} 2: 0,200 m²K/W

Results:

Temperature difference dT : 20,00 K

Total heat flow Q : 8,277 W/m

2D thermal conductance L_{2D} : 0,414 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: 0,051 W/mK

Materials:

| Material | R (m ² K/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 | -8,277 | X |
| 1 boundary condition inside 0,13, 20°C, 50% | 0,130 | 20,000 | 7,248 | X |
| 1 boundary condition inside 0,20, 20°C, 50% | 0,200 | 20,000 | 1,029 | 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 |
| 2 Float Glass 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 butyle | 0,240 | 0,900 | | X |
| 6 Super Spacer Standard | 0,130 | 0,900 | | - |
| 6 Silicon, unfilled | 0,350 | 0,900 | | X |
| SZR L=0.0111 | 0,011 | 0,900 | | - |

Simulation software: WinIso2D 7.80

Date: 02.05.2014

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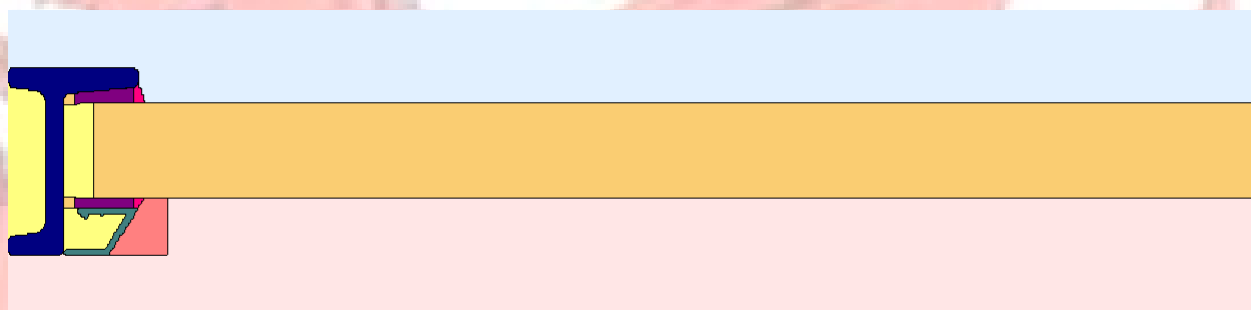


Calculation of the thermal transmission coefficient U_f according to EN ISO 10077-2:2003-12

Simulation model:

Dimensions (width x height): 212,18 x 51,79 mm

Number of elements in simulation model: X-direction: 153; Y-direction: 77



Boundary conditions:

External:

Temperature Θ_e : 0,00 °C

Surface resistance R_{se} : 0,040 m²K/W

Internal:

Temperature Θ_i : 20,00 °C

Surface resistance R_{si} 1: 0,130 m²K/W

Surface resistance R_{si} 2: 0,200 m²K/W

Results:

Temperature difference dT : 20,00 K

Total heat flow Q : 9,088 W/m

2D thermal conductance L_{2D} : 0,454 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: 6,580 W/m²K

Materials:

| Material | R (m ² K/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 | -8,277 | X |
| 1 boundary condition inside 0,13, 20°C, 50% | 0,130 | 20,000 | 7,248 | X |
| 1 boundary condition inside 0,20, 20°C, 50% | 0,200 | 20,000 | 1,029 | 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 |
| 2 Float Glass 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 butyle | 0,240 | 0,900 | | X |
| 6 Super Spacer Standard | 0,130 | 0,900 | | - |
| 6 Silicon, unfilled | 0,350 | 0,900 | | X |
| SZR L=0.0111 | 0,011 | 0,900 | | - |

Simulation software: WinIso2D 7.80

Date: 02.05.2014

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

Simulation model:

Dimensions (width x height): 245,20 x 64,69 mm

Number of elements in simulation model: X-direction: 219; Y-direction: 121



Boundary conditions:

External:

Temperature Θ_e : 0,00 °C

Surface resistance R_{se} : 0,040 m²K/W

Internal:

Temperature Θ_i : 20,00 °C

Surface resistance R_{si} 1: 0,130 m²K/W

Surface resistance R_{si} 2: 0,200 m²K/W

Results:

Temperature difference dT : 20,00 K

Total heat flow Q : 11,973 W/m

2D thermal conductance $L2D$: 0,599 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 (m ² K/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 | -11,973 | X |
| 1 boundary condition inside 0,13, 20°C, 50% | 0,130 | 20,000 | 9,155 | X |
| 1 boundary condition inside 0,20, 20°C, 50% | 0,200 | 20,000 | 2,818 | 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 |
| 2 Float Glass 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 butyle | 0,240 | 0,900 | | X |
| 6 Super Spacer Standard | 0,130 | 0,900 | | - |
| 6 Silicon, unfilled | 0,350 | 0,900 | | X |
| SZR L=0.0111 | 0,011 | 0,900 | | - |

Simulation software: WinIso2D 7.80

Date: 02.05.2014

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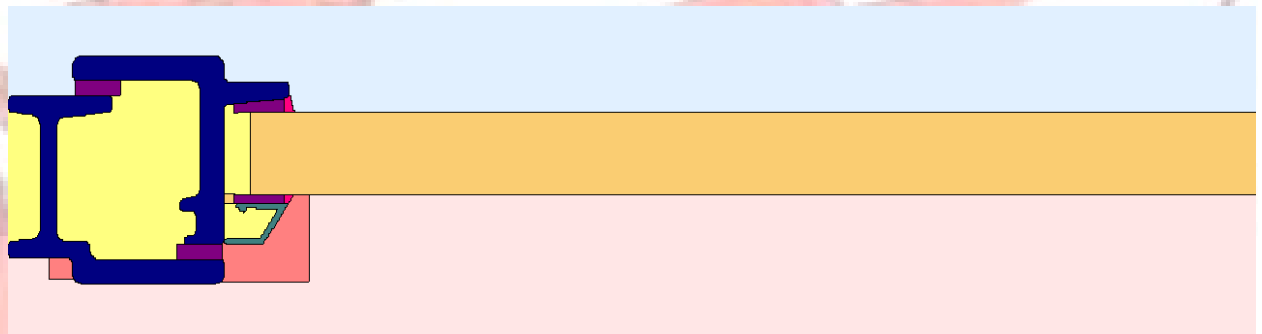


Calculation of the thermal transmission coefficient U_f according to EN ISO 10077-2:2003-12

Simulation model:

Dimensions (width x height): 245,20 x 64,69 mm

Number of elements in simulation model: X-direction: 219; Y-direction: 121



Boundary conditions:

External:

Temperature Θ_e : 0,00 °C

Surface resistance R_{se} : 0,040 m²K/W

Internal:

Temperature Θ_i : 20,00 °C

Surface resistance R_{si} 1: 0,130 m²K/W

Surface resistance R_{si} 2: 0,200 m²K/W

Results:

Temperature difference dT : 20,00 K

Total heat flow Q : 12,658 W/m

2D thermal conductance $L2D$: 0,633 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: 5,890 W/m²K

Materials:

| Material | R (m ² K/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 | -11,973 | X |
| 1 boundary condition inside 0,13, 20°C, 50% | 0,130 | 20,000 | 9,155 | X |
| 1 boundary condition inside 0,20, 20°C, 50% | 0,200 | 20,000 | 2,818 | 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 |
| 2 Float Glass 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 butyle | 0,240 | 0,900 | | X |
| 6 Super Spacer Standard | 0,130 | 0,900 | | - |
| 6 Silicon, unfilled | 0,350 | 0,900 | | X |
| SZR L=0.0111 | 0,011 | 0,900 | | - |