# VEKA Group
# Thermal Simulation Report
# VTSR334

| | |
|---|---|
| Date | 25/10/2023 |
| Client | DL Window Fabrication |
| Company/Address | Clonalvy |
| | Garristown |
| | Co. Dublin |

| | |
|---|---|
| Report No | VTSR334 |
| Date | 25/10/2023 |
| Client | DL Window Fabrication |
| Company/Address | Clonalvy |
| | Garristown |
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| | |
|---|---|
| Profile System | VEKA M70 Casement |
| Profile & Reinforcements | 101309 Outerframe / 113426 Steel G Section |
| Profile & Reinforcements | 103365 Sash / 113411 Steel P Section |
| Profile & Reinforcements | 102298 Z Mullion / 113412 Reinforcement |
| Profile & Reinforcements | n/a |
| Profile & Reinforcements | n/a |
| Glazing Bead | 107154 28mm Glazing Bead |
| Sash Gasket Material | PVC - Soft |
| Glazing Bead Gasket Material | PVC - Soft |

| Glazing Details | | | |
|---|---|---|---|
| Unit Thickness (mm) | 28mm | | |
| EN 673:2011 $U_{glass}$ (W/m$^2$K) | 1.219 | Source | BFRC BS EN673 Calculator : Issue 12 |
| External Pane | Pilkington Optiwhite | Emissivity | 0.89 |
| Centre Pane | n/a | Emissivity | n/a |
| Internal Pane | Pilkington K Glass S | Emissivity | 0.05 |
| Solar Factor g Value | 0.74 | Source | https://spectrum.pilkington.com/ |
| Spacer Bar & Gas Filling | Swisspacer Ultimate | Gas Filling | Argon 90% |
| Sealants | Polysulfide | Secondary | n/a |
| Sealant Depth | 3mm | Source | https://www.bundesverband-flachglas.de/en/downloads/ |

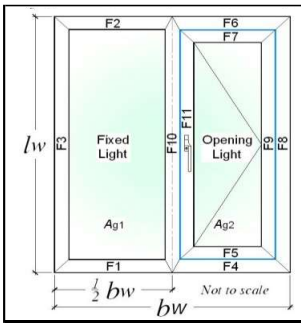
| | |
|---|---|
| Air Permeability at 50 Pa | 0.03 |
| Test Results | 6375 Part 1 |
| Test Authority | BSi |
| Test Report No | 8292997 |
| Test Date | 23/08/2016 |

| WER Results | |
|---|---|
| Window U-value - $U_{window}$(W/m$^2$K) | 1.3 |
| Solar Factor - $g_{window}$ | 0.44 |
| Effective Air Leakage - $L_{factor}$ (W/m$^2$K) | 0.00 |
| Energy Index (kWh/m$^2$/year) | 5 |
| WER Band | A |

| | |
|---|---|
| Thermal Conductivities | BS EN ISO 10077-2 : 2017, BS EN ISO 10456 |
| Simulator Programme | WinIso R version 2.7.8 - Sommer Informatik |
| Cavity Modelling | Radiosity |

Simulation Details This simulation was carried-out in accordance with BS EN ISO 10077-2 : 2017 by

Kirsten Moore Certified Simulator 160




**Sample Style:**

**Casement**

**Fixed Light / Side Hung**

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

Report Number: VTSR334 Issue No 22.3: *04/01/2016*

Report Date: 25 October 2023

Project Details: VEKA M70 - 28mm

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

**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*** $U_g$ | **1.219** | W/(m²·K) |
| *g*-value - ***2DP*** $g_\perp$ | **0.74** | |

Thermal transmittance of window from hot box test

$U_w$ - *2DP* W/(m²·K)

**Frame dimensions:**

| ($b_f$) | | Frame width, $b_f$ (mm) | Gasket protrusion, $b_{gf}$ (mm) | Frame & gasket widths (mm) | |
|---|---|---|---|---|---|
| All frame values round to nearest 1mm, gaskets to ***1DP*** | F1 fixed sill | **67** | **0.0** | 67.0 | |
| | F2 fixed head | **67** | **0.0** | 67.0 | |
| | F3 fixed jamb | **67** | **0.0** | 67.0 | Total |
| F4 + F5 sash sill | F4 fixed sash sill | **67** | n/a | 67.0 | 115.0 |
| | F5 moving sash sill | **48** | **0.0** | 48.0 | |
| F6 + F7 sash head | F6 fixed sash head | **67** | n/a | 67.0 | 115.0 |
| | F7 moving sash head | **48** | **0.0** | 48.0 | |
| F8 + F9 sash jamb | F8 Fixed sash jamb | **67** | n/a | 67.0 | 115.0 |
| | F9 moving sash jamb | **48** | **0.0** | 48.0 | |
| F10 + F11 mullion | F10 fixed mullion | **68** | **0.0** | 68.0 | 116.0 |
| | F11 moving mullion | **48** | **0.0** | 48.0 | |
| | Total gasket area | | 0 | m² | |

**Window Dimensions:**

| Section | Length (m) | Width (m) | Area No gasket ($m^2$) | Area With gasket ($m^2$) |
|---|---|---|---|---|
| Fixed Light | 1.3460 | 0.5140 | 0.6918 | 0.6918 |
| Opening light | 1.2500 | 0.4180 | 0.5225 | 0.5225 |
| Total glazing, $A_g$ | | | 1.2143 | 1.2143 |
| Frame | (m) | (m) | ($m^2$) | ($m^2$) |
| F1 | 0.6150 | 0.0670 | 0.0378 | 0.0378 |
| F2 | 0.6150 | 0.0670 | 0.0378 | 0.0378 |
| F3 | 1.4800 | 0.0670 | 0.0947 | 0.0947 |
| F4 | 0.6150 | 0.0670 | 0.0378 | 0.0378 |
| F5 | 0.5140 | 0.0480 | 0.0224 | 0.0224 |
| F6 | 0.6150 | 0.0670 | 0.0378 | 0.0378 |
| F7 | 0.5140 | 0.0480 | 0.0224 | 0.0224 |
| F8 | 1.4800 | 0.0670 | 0.0947 | 0.0947 |
| F9 | 1.3460 | 0.0480 | 0.0623 | 0.0623 |
| F10 | 1.4800 | 0.0680 | 0.0961 | 0.0961 |
| F11 | 1.3460 | 0.0480 | 0.0623 | 0.0623 |
| Total Frame | | | 0.6061 | 0.6061 |
| Total Window, $A_w$ | | | 1.8204 | 1.8204 |
| Percentage fixed light glass area | | | 38.01% | 38.01% |
| Percentage opening light glass area | | | 28.70% | 28.70% |
| Percentage glass area (total) | | | 66.71% | 66.71% |

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

**Frame conductance:** 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 fixed sill | **0.2720** | **190** | **0.3349** | **190** |
| F2 fixed head | **0.2720** | 190 | **0.3349** | 190 |
| F3 fixed jamb | **0.2720** | 190 | **0.3349** | 190 |
| F4 + F5 sash sill | **0.3400** | 190 | **0.4029** | 190 |
| F6 + F7 sash head | **0.3400** | 190 | **0.4029** | 190 |
| F8 + F9 sash jamb | **0.3400** | 190 | **0.4029** | 190 |
| F10 + F11 mullion | **0.5551** | 380 | **0.6810** | 380 |

**Frame:**

| Section | Frame width, $b_f$ (m) | Frame U-value, $U_f$ (W/(m²·K)) | Frame areas, $A_f$ ($m^2$) | Frame heat flow, HU (W/K) | Linear trans, Ψ (W/(m·K)) | Linear length, $l_g$ (m) | Junction heat flow, HΨ (W/K) |
|---|---|---|---|---|---|---|---|
| F1 fixed sill | 0.0670 | 1.1362 | 0.0378 | 0.0430 | 0.0272 | 0.5140 | 0.0140 |
| F2 fixed head | 0.0670 | 1.1362 | 0.0378 | 0.0430 | 0.0272 | 0.5140 | 0.0140 |
| F3 fixed jamb | 0.0670 | 1.1362 | 0.0947 | 0.1076 | 0.0272 | 1.3460 | 0.0366 |
| F4 + F5 sash sill | 0.1150 | 1.2532 | 0.0602 | 0.0754 | 0.0272 | 0.4180 | 0.0114 |
| F6 + F7 sash head | 0.1150 | 1.2532 | 0.0602 | 0.0754 | 0.0272 | 0.4180 | 0.0114 |
| F8 + F9 sash jamb | 0.1150 | 1.2532 | 0.1570 | 0.1967 | 0.0272 | 1.2500 | 0.0340 |
| F10 + F11 mullion | 0.1160 | 1.4082 | 0.1584 | 0.2230 | 0.0544 | 1.2980 | 0.0707 |
| | | Totals | 0.6061 | 0.7641 | | Total | 0.1918 |

Other parameters needed for calculation, taken from simulations:

$\lambda_p$ = 0.035 W/(m·K) $R_{se}$ = 0.04 m²·K/W $d_p = d_g$ = 0.028 m

$R_p$ = 0.8000 m²·K/W $R_{tot}$ = 0.9700 m²·K/W $R_{se}$ = 0.13 m²·K/W

$U_p$ = 1.0309 W/(m²·K)

**Solar Factor, *g*-value:**

| | |
|---|---|
| $F_w$ | 0.9 |
| $g_w$ | 0.44 |

**Air Leakage loss:**

Air leakage at 50 Pa per hour & per unit length of opening light (BS 6375-1) - ***2DP*** **0.03** m³/(m·h)

Opening light length 3.7200 m — Total air leakage 0.112 m³/h

$L_{50}$ 0.06 m³/(m²·h) — Heat loss = 0.0165 $L_{50}$ 0.00 W/(m²·K)

| $U_{window}$ | | |
|---|---|---|
| | No bars; or attached bars | **1.34** |
| | Single cross bar in IGU | **1.4** |
| | Multiple cross bar in IGU | **1.5** |
| | Glazing bar (Georgian bar) | **1.7** |

W/(m²·K)

**Energy Window**

Energy Index

**5**

Window Rating

**A**

**BFRC Rating**

kWh/(m²·yr)

| | | |
|---|---|---|
| ≥20 | A | ++ |
| >10 to 20 | A | + |
| 0 to <10 | A | ✓ |
| -10 to <0 | B | |
| -20 to <-10 | C | |
| -30 to <-20 | D | |
| -50 to <-30 | E | |

**BFRC Rating =**

**218.6$g_{window}$ - 68.5 x ($U_{window}$ + Effective $L_{50}$) =** **5.26**

**Climate zone is:** **UK**

| | | |
|---|---|---|
| **Thermal transmittance, W/(m²·K)** | $U_{window}$ | **1.3** |
| **Solar factor** | $g_{window}$ | **0.44** |
| **Window air leakage heat loss, W/(m²·K)** | $L_{factor}$ | **0.00** |

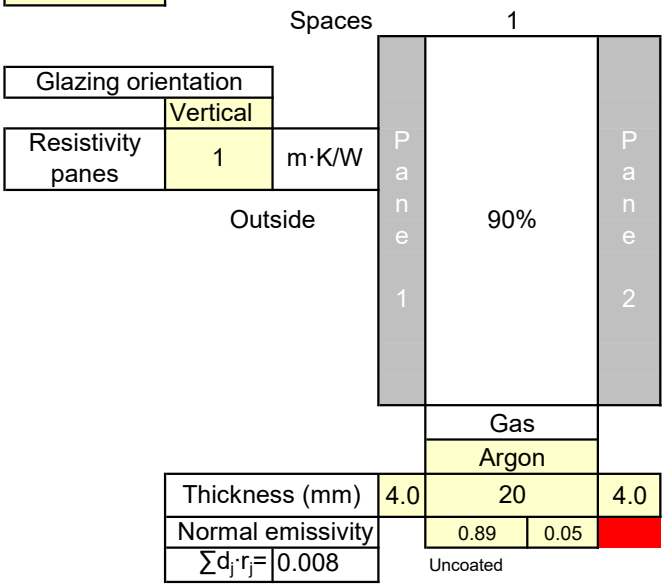
BFRC

**BFRC Certified Simulator No** **160**

**Simulator Name:** **Kirsten Moore**

Version 12 18/06/2015. Calculations according to BS EN 673:2011

| Number of spaces |
|---|
| 1 |




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

| | | |
|---|---|---|
| External, $R_{se}$ | 0.04 | $(m^2 \cdot K)/W$ |
| Internal, $R_{si}$ | 0.13 | $(m^2 \cdot K)/W$ |

| Iteration number | U value | $\sum 1/h_s$ | λeff | ΔT |
|---|---|---|---|---|
| | $W/(m^2 \cdot K)$ | $(m^2 \cdot K)/W$ | W/(mK) | |
| 1 | 1.219 | 0.6423 | 0.0311 | 15 |
| 2 | 1.219 | 0.6423 | 0.0311 | 15 |

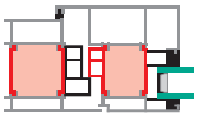
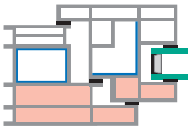
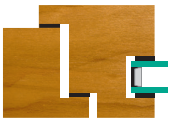
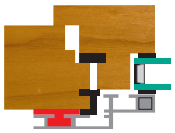
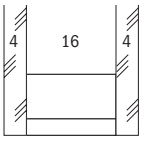
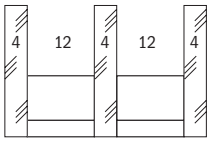
# Data sheet Psi values for windows

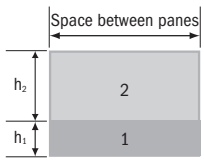
***based on determination of the equivalent thermal conductivity of spacers by measurement***

SWISSPACER

SWISSPACER
Vetrotech Saint-Gobain (International) AG
Zweigniederlassung Kreuzlingen
Sonnenwiesenstrasse 15
CH-8280 Kreuzlingen

| | Product name | Spacer height in mm | Material | Thickness d in mm |
|---|---|---|---|---|
| Profile description | ULTIMATE SWISSPACER  | 6.5<br>Spacer category C | Metalized multilayer polyester film "High Tech Gas Barrier Foil"/ SAN-GF | ~ 0.05<br>1.0 |

| | Representative glass constructions | Metal with thermal break | Plastic | Wood | Wood/Metal |
|---|---|---|---|---|---|
| Representative frame profiles | |  |  |  |  |
| Representative psi value double-sheet thermally insulating glass W/mK |   Double-sheet insulating glass $U_g$=1.1 W/m²K | 0.036 | 0.032 | 0.031 | 0.032 |
| Representative psi value triple-sheet thermally insulating glass W/mK |   Triple-sheet insulating glass $U_g$=0.7 W/m²K | 0.031 | 0.030 | 0.029 | 0.030 |

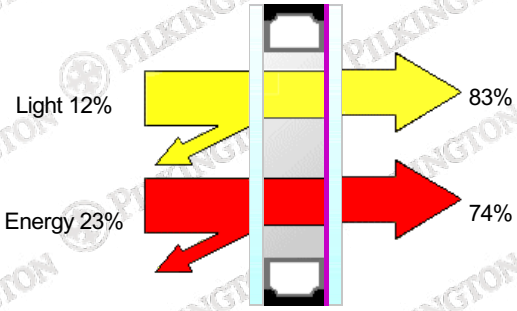
| | | Space between panes in mm | $\lambda_{eq,2B}$ in W/mK | |
|---|---|---|---|---|
| | | | Box 1 · $h_1$ = 3 mm | Box 2 · $h_2$ = 6.5 mm |
| Two Box model Characteristic values |   | Can be used for all spacer widths | 0.40 | 0.14 |

**Explanations**

The equivalent thermal conductivity has been determined in accordance with the ift guideline WA-17engl/1 "Thermally improved spacers – Determination of the equivalent thermal conductivity by measurement". The representative linear heat transfer coefficients calculated in this way (representative psi values) apply to typical frame profiles and glazing for the determination of the heat transfer coefficient $U_W$ of windows. They have been determined under the boundary conditions (frame profiles, glazing, glass mounting depth, back covering, primary and secondary sealant) defined in the ift guideline WA-08engl/3 "Thermally improved spacers – Part 1: Determination of the representative Psi value for window frame profiles". This guideline also governs the area of validity and application of the representative psi values. In order to avoid rounding errors, the psi values in the data sheet have been given at 0.001 W/mK. The method for the arithmetical determination of the psi values has an accuracy of ± 0.003 W/mK. Differences of less than 0.005 W/mK are not significant. For further information, refer to the Bulletin 004/2008 "Guide to Warm Edge" of Bundesverband Flachglas.

Characteristic values determined by:

ift ROSENHEIM




## DESCRIPTION

| Position | Product | Process | Thickness (nominal) mm | Weight kg/m² |
|---|---|---|---|---|
| Pilkington **Insulight™** Therm | | | | |
| Glass 1 | Pilkington **Optiwhite™** | Annealed | 4.0 | |
| Cavity 1 | Argon (90%) | | 20.0 | |
| Glass 2 | Pilkington **K Glass™** S | Annealed | 4.0 | |
| Product Code | 4w-20Ar-KS4 | | 28.0 | 20.00 |

## PERFORMANCE

| Light | | |
|---|---|---|
| Transmittance | LT | 83% |
| | UV % | 41% |
| Reflectance Out | LR out | 12% |
| Reflectance In | LR in | 13% |

| Performance Code | |
|---|---|
| $U_g$-value/Light/Energy | 1.22 / 83 / 74 |
| Ra | 99 |

The values of some of characteristics are displayed as NPD. This stands for No Performance Determined.

| Energy | | |
|---|---|---|
| Direct Transmittance | ET | 64% |
| Reflectance | ER | 23% |
| Absorptance | EA | 13% |
| Total Transmittance | g | 74% |
| Shading Coefficient Total | | 0.85 |
| Shading Coefficient Shortwave | | 0.74 |
| Sound Reduction | $R_w$ (C;$C_{tr}$) dB | 31 (-2; -5) |
| Thermal Transmittance | W/m²K | 1.22 |

Pilkington Spectrum allows you to combine a wide range of products available from Pilkington and determine their key properties such as light transmittance, g value and U value. The program includes restrictions that prevent some combinations being selected that may be considered unwise or impractical. Even with these restrictions, it is still possible to create product combinations that may not be available from your supplier. Please check with your supplier that your chosen product combination is possible, available in the sizes required and in a timescale appropriate to your project. Furthermore, it is essential that you check that your product combination is appropriate for satisfying local, regional, national and other project-specific requirements.

Calculations are made according to EN standards 410 and 673/12898

Pilkington Spectrum Version UK:7.3.1 25/10/2023

# Declaration of Performance

## CE DoP 2/328933/5

The undersigned, representing the following:

Company placing on the market:
NSG Group, Haydnstraße 19, Gelsenkirchen 45884, Germany

Manufacturing Plant:
See Product Matrix Report No: P2012 AT101 (Technical File)

Product
Pilkington **K Glass™** S, Annealed, 4 mm

The performance of the product identified above is in conformity with the set of detailed performance(s). This declaration of performance is issued, in accordance with Regulation (EU) No. 305/2011, under the sole responsibility of the manufacturer identified above.

Harmonised standard : EN 1096-4: 2018

Intended use : Coated glass, intended to be used in buildings and construction works

Declared Performance

| Essential Characteristics | AVCP Systems | Performance |
|---|---|---|
| Resistance to Fire | 1 | NPD |
| Reaction to Fire | 3,4 | A1 |
| External Fire Performance | 3,4 | NPD |
| Bullet Resistance | 1 | NPD |
| Explosion Resistance | 1 | NPD |
| Burglar Resistance | 3 | NPD |
| Pendulum Body Impact Resistance | 3 | NPD |
| Resistance Against Sudden Temperature Changes and Temperature Differentials | 4 | 40 K |
| Wind, Snow, Permanent and Imposed Load Resistance | 4 | 45 MPa |
| Direct Airborne Sound Insulation | 3 | 29 (-2; 3) dB |
| Thermal Properties | 3 | 3.3 W/m2K |
| Radiation Properties | | |
| Light Transmittance / Reflectance | 3 | 0.90/0.06/0.04 |
| Solar Transmittance / Reflectance | 3 | 0.70/0.16/0.18 |
| g Value | 3 | 0.72 |
| Durability | 3,4 | Pass |
| Normal Emissivity | 3 | 0.89 / 0.05 |

Notified Bodies 0757

Alessandro Michetti
Commercial Director - Architectural Glass Europe
03/12/2021

Christian Quenett
Head of Architectural Glass Europe
03/12/2021

# Test Report 8292997.

## Veka Plc



...making excellence a habit.

**AIR PERMEABILITY TEST RESULTS - BS 6375-1:2015 Clause 6 / BS EN 1026:2000**

**Clause 6 After resistance to wind tests**

Three positive pressure pulses of 660Pa were applied prior to testing

**Table 4**

| Air Pressure [Pa] | Average rate of air leakage [m³/h] | Average rate of air leakage per meter length of opening joint [m³/h.m] | Average rate of air leakage relative to area of sample [m³/h.m²] |
|---|---|---|---|
| 50 | 0.1 | 0.03 | 0.11 |
| 100 | 0.1 | 0.02 | 0.07 |
| 150 | 0.2 | 0.05 | 0.18 |
| 200 | 0.1 | 0.03 | 0.11 |
| 250 | 0.3 | 0.07 | 0.22 |
| 300 | 0.4 | 0.10 | 0.33 |
| 450 | 0.3 | 0.07 | 0.22 |
| 600 | 0.3 | 0.08 | 0.25 |

Note: The figures in the table above give the leakage as an average of the leakage at positive pressure and the leakage at negative pressure

Total opening perimeter = 4.36m

Overall area = 1.32175m²

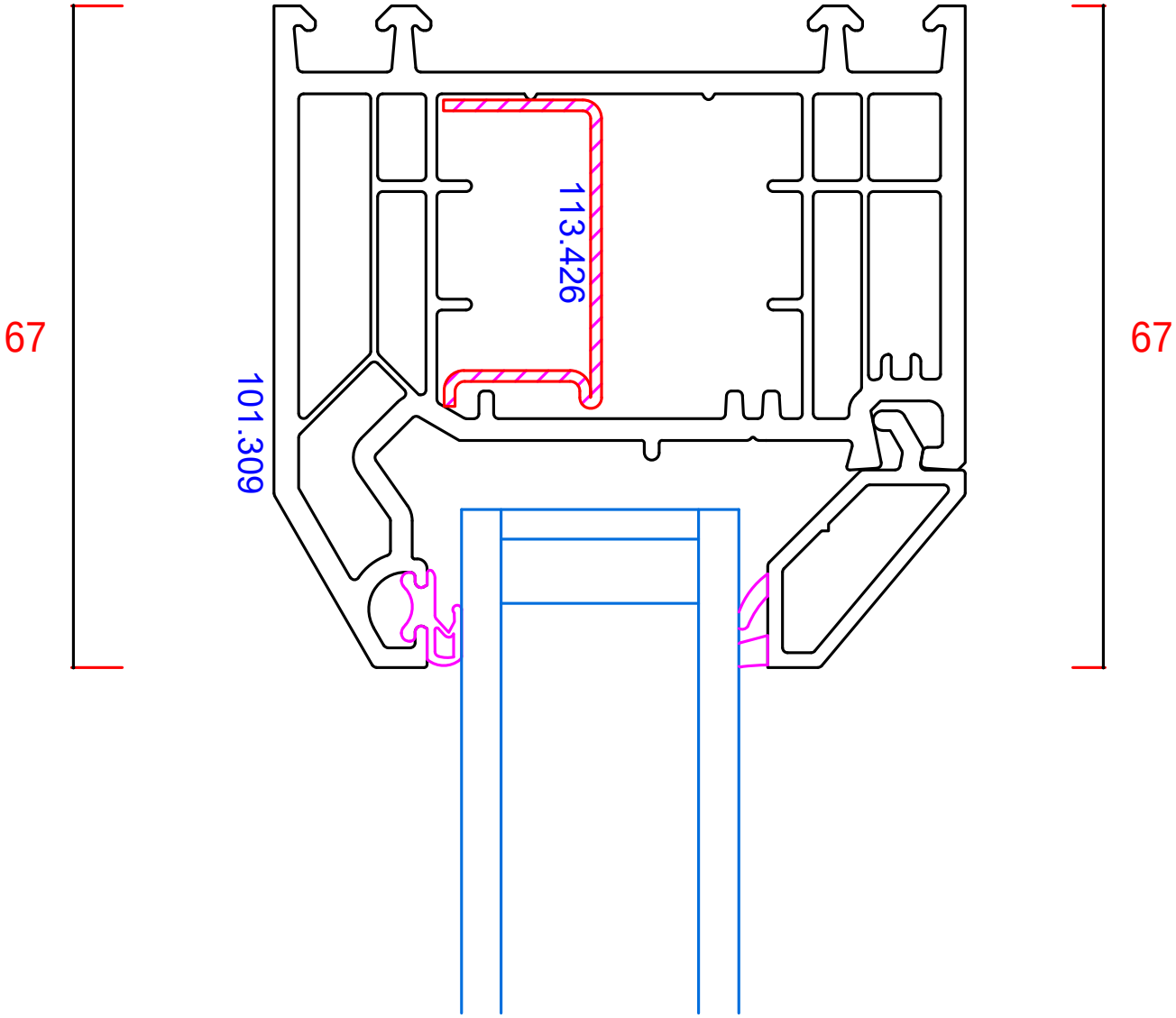
BS 6375-1:2015 Clause 6.5 - Joint class = 4

BS 6375-1:2015 Clause 6.5 - Area class = 4

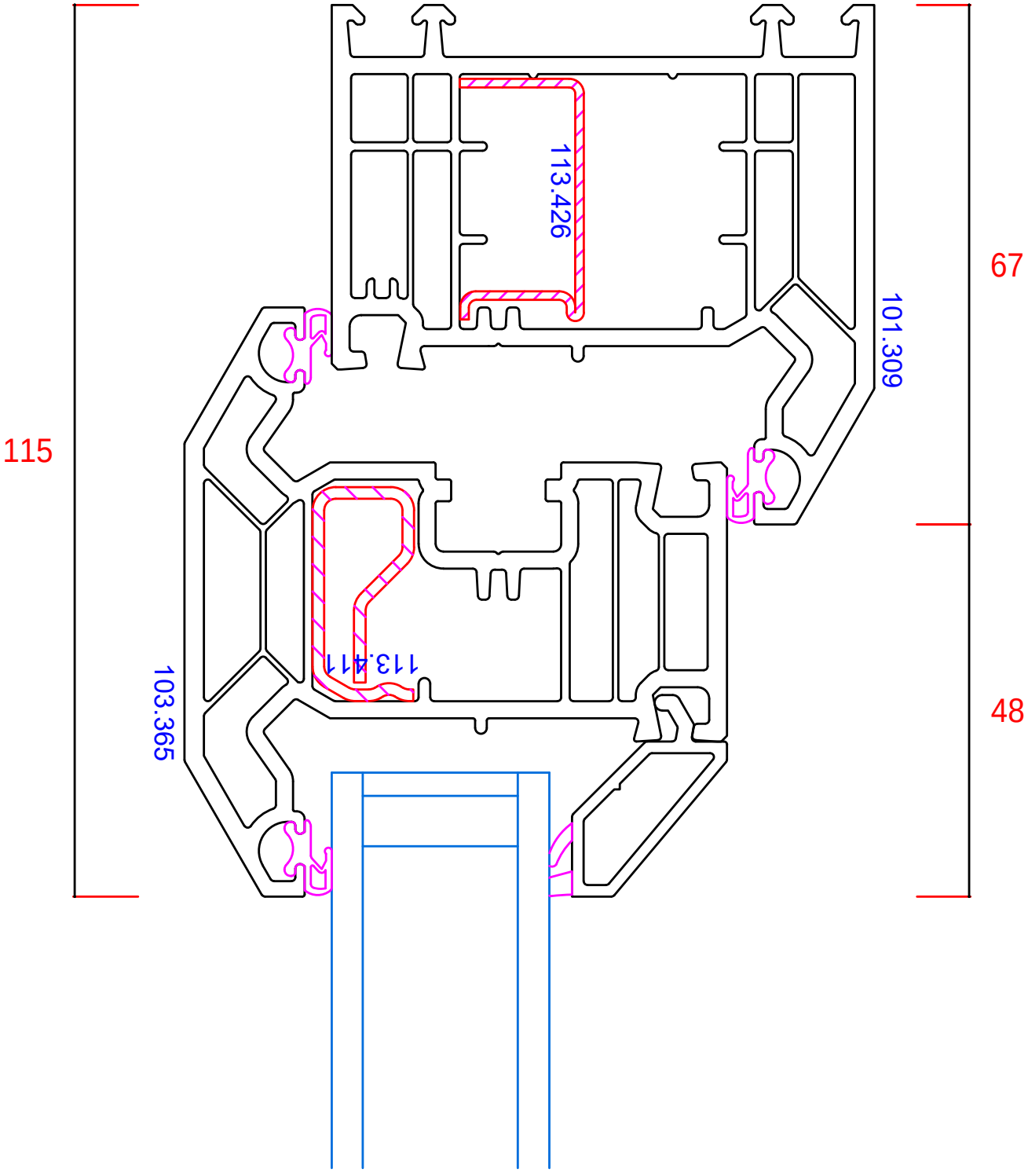
BS 6375-1:2015 Clause 6.5 - Overall class = 4

In accordance with BS 6375-1:2015 Clause 6.5, as the classification after the resistance to wind load tests is the same as the classification before the resistance to wind load tests, the resulting classification for the sample is Class 4.

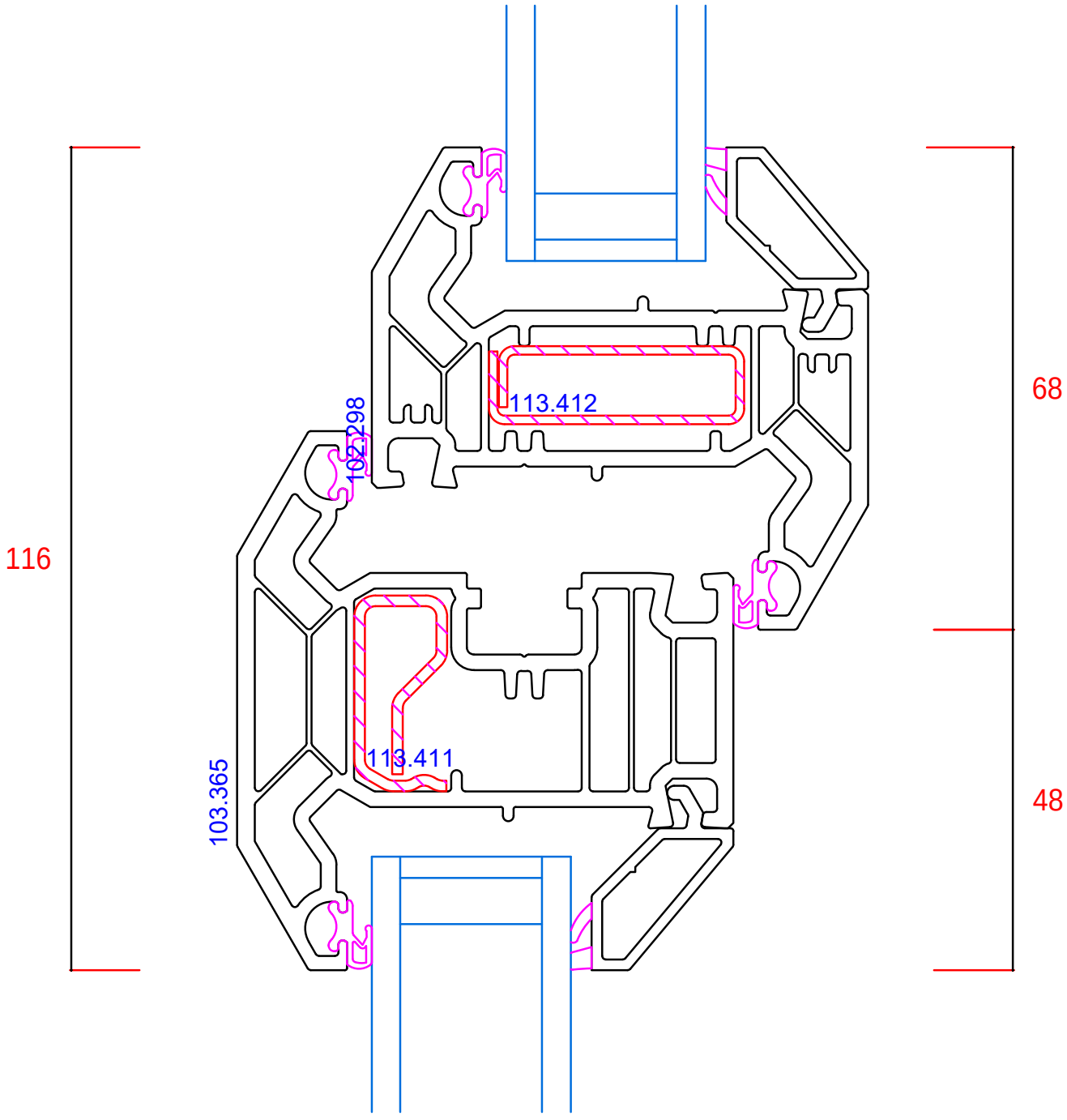
# F1, F2, F3



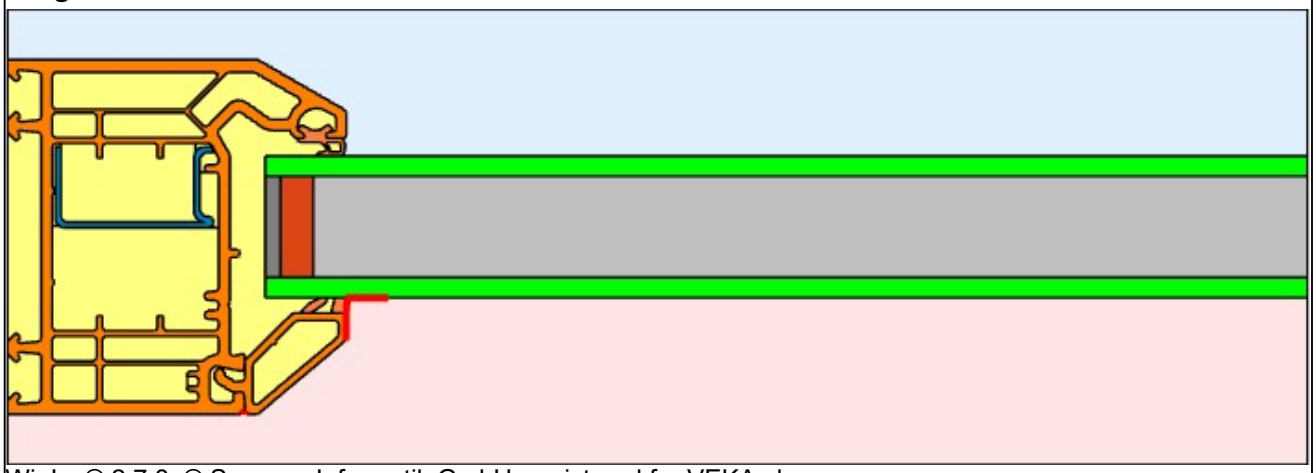
# F4, F5, F6, F7, F8, F9



# F10, F11



## Image: Material fields



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### Ψ-Value

$Q_{tot} = 6.698 \ \frac{W}{m}$ $\quad \Delta T = 20 \ K$ $\quad L^{2D} = \frac{Q_{tot}}{\Delta T} = 0.3349 \ \frac{W}{m \cdot K}$

$U_g = 1.219 \ \frac{W}{m^2K}$ $\quad$ Width of glass = 190 mm ($b_g$)

$U_f = 1.136 \ \frac{W}{m^2K}$ $\quad$ Width of frame = 67 mm (bf)

$$U_f = \frac{L^{2D} - U_p \cdot b_p}{b_f} = \frac{0.2720 - 1.0309 \cdot 0.19000}{0.06700} = 1.1 \ (1.1361) \ \frac{W}{m^2K}$$

$$\Psi_g = L^{2D} - U_f \cdot b_f - U_g \cdot b_g = 0.3349 - 1.1361 \cdot 0.06700 - 1.2190 \cdot 0.19000 = 0.027 \ (0.0271) \ \frac{W}{mK}$$

## Boundaries

| Name | R [m²K/W] | T [°C] | Qtot [W/m] |
|---|---|---|---|
| Boundary condition external 0.04, 0°C, 80% | 0.040 | 0.000 | -6.698 |
| Boundary condition internal 0.13, 20°C, 50% | 0.130 | 20.000 | 6.242 |
| Boundary condition internal 20°C 0.20 | 0.200 | 20.000 | 0.456 |

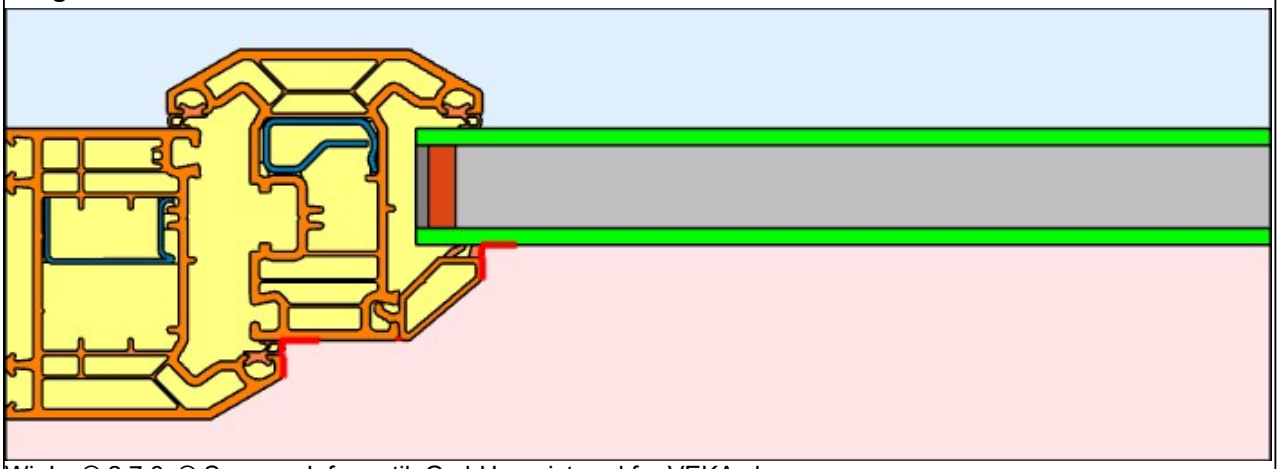
## Solids

| Name | A [mm²] | λ [W/(mK)] | ε [-] |
|---|---|---|---|
| 019 Saint-Gobain Glass Solutions Swisspacer Ultimate 2018-10, 6.5 mm | 130.00 | 0.140 | 0.900 |
| 2 float 1.0 | 1648.00 | 1.000 | 0.900 |
| 3 steel galvanized 50 e = 0.3 | 71.20 | 50.000 | 0.300 |
| 3 PVC-U Hard | 966.43 | 0.170 | 0.900 |
| 5 PVC soft | 41.01 | 0.140 | 0.900 |
| 6 polysulfide | 60.00 | 0.400 | 0.900 |
| SZR 0.031136 | 3930.00 | 0.031 | 0.000 |

## Cavities

| Name | A [mm²] |
|---|---|
| Unventilated air cavity - EN ISO 10077-2 | 2944.80 |

## Image: Material fields



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### Ψ-Value

$Q_{tot} = 8.058 \ \frac{W}{m}$ $\quad \Delta T = 20 \ K$ $\quad L^{2D} = \frac{Q_{tot}}{\Delta T} = 0.4029 \ \frac{W}{m \cdot K}$

$U_g = 1.219 \ \frac{W}{m^2K}$ $\quad$ Width of glass = 190 mm (bg)

$U_f = 1.253 \ \frac{W}{m^2K}$ $\quad$ Width of frame = 115 mm (bf)

$$U_f = \frac{L^{2D} - U_p \cdot b_p}{b_f} = \frac{0.3400 - 1.0309 \cdot 0.19000}{0.11500} = 1.3 \ (1.2534) \ \frac{W}{m^2K}$$

$$\Psi_g = L^{2D} - U_f \cdot b_f - U_g \cdot b_g = 0.4029 - 1.2534 \cdot 0.11500 - 1.2190 \cdot 0.19000 = 0.027 \ (0.0271) \ \frac{W}{mK}$$

## Boundaries

| Name | R [m²K/W] | T [°C] | Qtot [W/m] |
|---|---|---|---|
| Boundary condition external 0.04, 0°C, 80% | 0.040 | 0.000 | -8.058 |
| Boundary condition internal 0.13, 20°C, 50% | 0.130 | 20.000 | 7.173 |
| Boundary condition internal 20°C 0.20 | 0.200 | 20.000 | 0.885 |

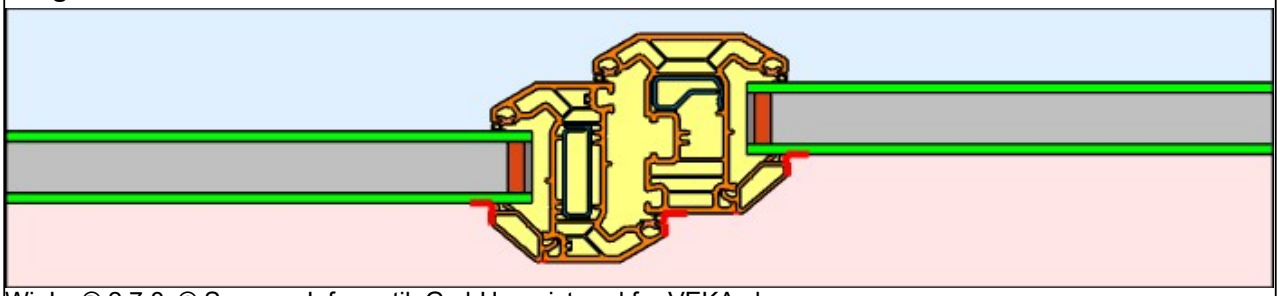
## Solids

| Name | A [mm²] | λ [W/(mK)] | ε [-] |
|---|---|---|---|
| 019 Saint-Gobain Glass Solutions Swisspacer Ultimate 2018-10, 6.5 mm | 130.00 | 0.140 | 0.900 |
| 2 float 1.0 | 1648.00 | 1.000 | 0.900 |
| 3 steel galvanized 50 e = 0.3 | 181.15 | 50.000 | 0.300 |
| 3 PVC-U Hard | 1849.96 | 0.170 | 0.900 |
| 5 PVC soft | 91.04 | 0.140 | 0.900 |
| 6 polysulfide | 60.00 | 0.400 | 0.900 |
| SZR 0.031136 | 3930.00 | 0.031 | 0.000 |

## Cavities

| Name | A [mm²] |
|---|---|
| Unventilated air cavity - EN ISO 10077-2 | 5612.64 |

## Image: Material fields



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### Ψ-Value

$Q_{tot} = 13.621 \ \frac{W}{m}$ $\quad \Delta T = 20$ K $\quad L^{2D} = \frac{Q_{tot}}{\Delta T} = 0.6810 \ \frac{W}{m \cdot K}$

$U_g = 1.219 \ \frac{W}{m^2K}$ $\quad$ Width of glass = 190 mm ($b_g$)

$U_f = 1.408 \ \frac{W}{m^2K}$ $\quad$ Width of frame = 116 mm (bf)

$$U_f = \frac{L^{2D} - U_p \cdot b_p}{b_f} = \frac{0.5551 - 1.0309 \cdot 0.19000 - 1.0309 \cdot 0.19000}{0.11600} = 1.4 \ (1.4082) \ \frac{W}{m^2K}$$

$$\Psi_g = L^{2D} - U_f \cdot b_f - U_g \cdot b_g = 0.6810 - 1.4082 \cdot 0.11600 - 1.2190 \cdot 0.19000 - 1.2190 \cdot 0.19000$$
$$= 0.054 \ (0.0545) \ \frac{W}{mK}$$

## Boundaries

| Name | R [m²K/W] | T [°C] | Qtot [W/m] |
|---|---|---|---|
| Boundary condition external 0.04, 0°C, 80% | 0.040 | 0.000 | -13.621 |
| Boundary condition internal 0.13, 20°C, 50% | 0.130 | 20.000 | 12.231 |
| Boundary condition internal 20°C 0.20 | 0.200 | 20.000 | 1.389 |

## Solids

| Name | A [mm²] | λ [W/(mK)] | ε [-] |
|---|---|---|---|
| 019 Saint-Gobain Glass Solutions Swisspacer Ultimate 2018-10, 6.5 mm | 260.00 | 0.140 | 0.900 |
| 2 float 1.0 | 3296.00 | 1.000 | 0.900 |
| 3 steel galvanized 50 e = 0.3 | 222.59 | 50.000 | 0.300 |
| 3 PVC-U Hard | 1868.14 | 0.170 | 0.900 |
| 5 PVC soft | 132.08 | 0.140 | 0.900 |
| 6 polysulfide | 120.00 | 0.400 | 0.900 |
| SZR 0.031136 | 7860.00 | 0.031 | 0.000 |

## Cavities

| Name | A [mm²] |
|---|---|
| Unventilated air cavity - EN ISO 10077-2 | 4913.33 |

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The VEKA Uk Group
Farrington Rd
Rossendale Rd Ind Est
Burnley
Lancs
BB11 5DA

T: 01282716611
F: 01282 725257
www.vekauk.com/technical.

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