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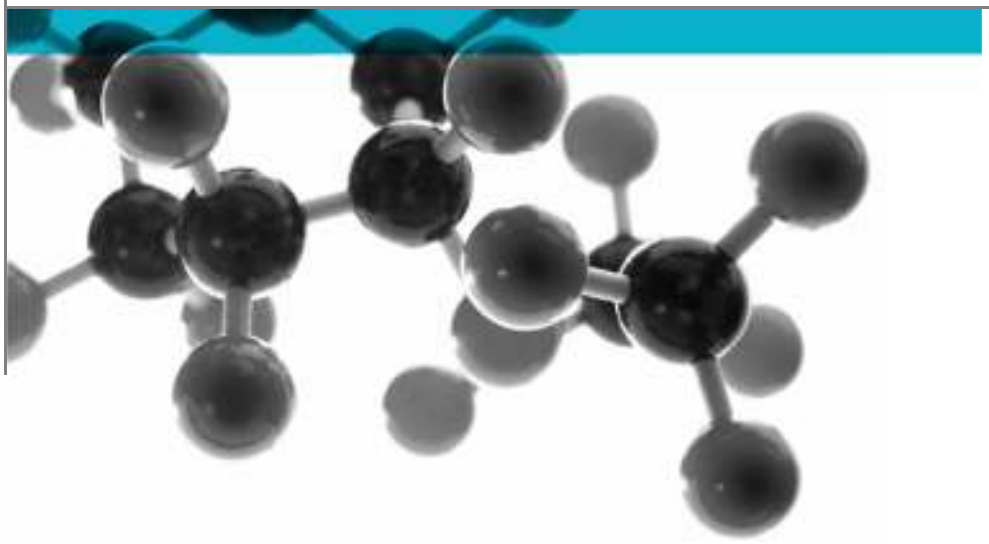
# BS EN ISO 10077-1:2006



**Calculation of: UK Door U Value**

**Thermal Performance of Windows, Doors & Shutters – Calculation of Thermal Resistance**

A Report To:
Debar Ltd

Whitehall Properties, Towngate, Wyke, Bradford, BD12 9JQ

Document Reference:
WIL 365055

**Date:** 15/06/2016

**Copy: 1**

**Issue No.: 1**



Testing
Advising
Assuring

# CONCLUSIONS

Drawings of:
Manufacturer Debar Ltd
Product DeWall A1
Model 3 Panel Slide Fold Doorset, Aluminium

Have been submitted for thermal performance calculation in accordance with BS EN ISO 10077-1:2006.
By Christian Adams, of Exova (UK) Ltd, a UKAS accredited Testing Laboratory (No. 0621) and EC Notified Body number (No. 1104)

At Key Industrial Park, Fernside Rd, Willenhall, West Midlands, WV13 3YA.
Results and comments as detailed below:

| **Description** | **$U_D$ value W/(m$^2$.K)** |
|---|---|
| Doorset 1 – 3 Panel Slide Fold Doorset 2500 x 2180mm | **1.7** |

No inferences can be made regarding performance against other requirements of this standard

# AUTHORISATION

Calculations performed by: Christian Adams, Thermal Test Engineer

Report issued by: Christian Adams, Thermal Test Engineer

Signed 

Date 13th June 2016

For and on behalf of Exova (UK) Ltd

Report authorised by: Mark West, Door & Window Laboratory Manager

Signed 

Date 13th June 2016

For and on behalf of Exova (UK) Ltd

Report issued: 15 June 2016

UKAS TESTING
0621

NOTE.
Tests marked “Not UKAS Accredited” are not covered by the Laboratory UKAS accreditation schedule.

Tests marked NT were not tested
Tests marked NA are not applicable to the product on test.

Exova (UK) Ltd is an EC Notified Body Number 1104

**CONTENTS** **PAGE NO.**

# CALCULATION DETAILS

## CLIENT DETAILS

| | |
|---|---|
| Client | Debar Ltd |
| Address | Whitehall Properties<br>Towngate<br>Wyke<br>Bradford<br>BD12 9JQ |
| Contact | Marjanas Petraitis |

## ORDER DETAILS

| | |
|---|---|
| Order no. | 2008 |
| Dated | 30/03/2016 |

## PRODUCT DETAILS

| | |
|---|---|
| Product | DeWall A1 |
| Model | 3 Panel Slide Fold Doorset |
| Manufacturer | Debar Ltd |
| Material | Aluminium |

## CALCULATION DETAILS

| | |
|---|---|
| Specification | BS EN ISO 10077-1:2006 |
| Clauses | N/a |
| Calculation methods | BS EN ISO 10077-1:2006 Thermal performance of windows, doors & shutters – Calculation of thermal transmittance – Part 1: General<br>BS EN ISO 10077-2:2012 Thermal performance of windows, doors & shutters – Calculation of thermal transmittance – Part 2: Numerical method for frames<br>BS EN 673:2011 Glass in building – Determination of thermal transmittance (U-value) – Calculation method |
| Simulation software & spreadsheet versions used | Thermal transmittance models obtained by computer simulation using Therm Finite Element Simulator V5.2.14 provided by LBNL. Software validated in accordance with Annex D of BS EN ISO 10077-2.<br>Exova BS EN 673 Ug spreadsheet TR099 version 1 issue 7<br>Exova BS EN ISO 10077 doorset U-value spreadsheet TR094_1 issue 2 |

# PROCEDURE

**Introduction**

This report should be read in conjunction with the Standard BS EN ISO 10077-1:2006 Thermal performance of windows, doors and shutters – Calculation of thermal transmittance – Part 1: General, BS EN ISO 10077-2:2012 performance of windows, doors and shutters – Calculation of thermal resistance – Part 2: Numerical method for frames & BS EN 673:2011 Glass in building – Determination of thermal transmittance (U value) – Calculation method

Drawings in DXF format were submitted for calculation of thermal transmittance in accordance with BS EN ISO 10077-1.

**Instruction**

The calculations were conducted on the 31st May – 1st June 2016 on behalf of Debar Ltd.

**Calculation method**

Calculation was carried out in accordance with Clause 5.4 of BS EN ISO 10077-1 using an area weighted average of $U_f$, and $U_g$ shown in equation 8, plus the edge effect of the glazing perimeter $\Psi_g$.

As per Clause 6 of BS EN ISO 10077-1 Input Data the thermal transmittance of the frame $U_f$ and the linear thermal transmittance of the glazing junction were carried out by simulation in accordance with Annex C of BS EN ISO 10077-2 using THERM finite element analysis software version 5.2.14 provided by LBNL. Simulations were produced both with the glazing in place, and the glazing replaced with an insulation panel of thermal conductivity 0.035.

Values used for the design thermal conductivity of materials in this calculation were taken from Annex A of BS EN ISO 10077-2:2012 unless specified otherwise, and are listed in Annex C of this report.

As such the result contained in this report is partly derived from tabulated values and should be considered indicative and not definitive.

# CONCLUSIONS

| | |
|---|---|
| **Evaluation against objective** | The sectional drawings of the doorsets as provided by the client were subjected to thermal performance calculations in accordance with BS EN ISO 10077-1 |
| **Observations & comments** | |

# LIMITATIONS

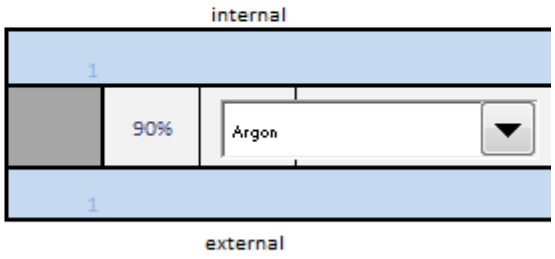
| | |
|---|---|
| **Limitations** | The results relate only to the behaviour of the specimens of the element of construction under the particular conditions of the calculation. They are not intended to be the sole criteria for assessing the potential performance of the element in use, nor do they reflect the actual behaviour in use. |
| **Range of assemblies covered by this report** | Table E.2 of BS EN 14351-1:2006 +A1:2010 states that the range of direct application (providing similar design) of doorset assemblies covered by this report is limited to the following:<br>▪ Doorsets with overall area ≤3.6m$^2$ for doorsets simulated at 1.23m x 2.18m.<br>▪ Doorsets with overall area >3.6m$^2$ for doorsets simulated at 2.0m x 2.18m<br><br>Height and width of simulated assemblies subject to a tolerance of ±25%. |
| **Uncertainty of Measurement** | The uncertainties of measurements calculated for a confidence level of 95% throughout these tests are within the limits of these tolerances.<br><br>The user and the simulation software have been validated in accordance with Annex D of BS EN ISO 10077-2:2012, giving the following accuracies:<br><br>▪ Thermal transmittance ± 5%<br>▪ Linear thermal transmittance ± 5% |

# ANNEX A: SIMULATION RESULTS & CALCULATIONS

**BS EN 673:2011 calculation for 4-20-4 90% Argon filled unit**
**4mm toughened / 20mm Argon fill / 4mm toughened**
**(Planitherm One ε=0.01 coating position 3)**

| | | | |
|---|---|---|---|
| Title: | Exova Warringtonfire Willenhall<br>BS EN 673 Thermal transmittance of double glazing spreadsheet | | |
| Reference : | TR099 | | |
| Standard issue: | BS EN 673:2011 | | |
| Author: | Mark West | Client: | Debar |
| Version: | 1 issue 7 | Inclination of glazing: | Vertical |
| Issue date: | 2nd December 2015 | Calculation date: | 31/05/2016 |

| | thickness (mm) | ε normal | |
|---|---|---|---|
| internal pane ($d_i2$) = | 4 | 0.89 | uncoated |
| | | 0.01 | |
| air space (s1) = | 20 | | |
| external pane ($d_i1$) = | 4 | 0.89 | uncoated |
| | | 0.89 | uncoated |
| Σ $d_i.r_i$ = | 0.008 | | |




| Ug W/(m².K) | | Σ1/hs (m².K)/W | | λ eff W/(m.K) |
|---|---|---|---|---|
| 1.070 | | 0.75659 | | 0.0264 |

| | | | |
|---|---|---|---|
| **Title:** | Exova Willenhall<br>U-value calculation for bi-folding doorset | **Carried out for :** | Debar |
| | | **Product :** | DeWall A1 |
| **Reference:** | TR094 | **Model :** | 3 Panel Slide Fold Doorset |
| **Standard issue:** | BS EN ISO 10077-2:2012 | **Glazing config :** | 4-20-4 90% Argon, low emissivity coating position 3 (e=0.01) |
| **Author:** | Christian Adams | | |
| **Version:** | TR094 Iss 1 | **Calculation date :** | 01/06/2016 |
| **Issue date:** | 01/06/2016 | **Carried out by :** | Christian Adams |

| Section detail | Lf2d | Up | bp | bf | Uf |
|---|---|---|---|---|---|
| 1 Head | 0.5510 | 1.0309 | 0.1900 | 0.1000 | 3.5512 |
| 2 Left jamb | 0.5271 | 1.0309 | 0.1900 | 0.1000 | 3.3122 |
| 3 Right jamb | 0.6154 | 1.0309 | 0.1900 | 0.1250 | 3.3562 |
| 4 Meeting stile | 0.6441 | 1.0309 | 0.3800 | 0.1200 | 2.1029 |
| 5 Meeting stile | 0.6441 | 1.0309 | 0.3800 | 0.1200 | 2.1029 |
| 5 Cill | 0.6310 | 1.0309 | 0.1900 | 0.1230 | 3.5376 |

U of insulating panel = 1.0309

Glass thickness = 0.028 m
Centre pane U-value Ug = 1.07

| Section detail | Lψ2d | Uf | bf | Ug | bd | ψi |
|---|---|---|---|---|---|---|
| 1 Head | 0.5843 | 3.5512 | 0.1000 | 1.0700 | 0.1900 | 0.0259 |
| 2 Left jamb | 0.5611 | 3.3122 | 0.1000 | 1.0700 | 0.1900 | 0.0266 |
| 3 Right jamb | 0.6479 | 3.3562 | 0.1250 | 1.0700 | 0.1900 | 0.0251 |
| 4 Meeting stile | 0.7213 | 2.1029 | 0.1200 | 1.0700 | 0.3800 | 0.0624 |
| 5 Meeting Stile | 0.7213 | 2.1029 | 0.1200 | 1.0700 | 0.3800 | 0.0624 |
| 6 Cill | 0.6639 | 3.5376 | 0.1230 | 1.0700 | 0.1900 | 0.0255 |

Overall width = 2.50 m
Overall height = 2.18 m
Overall area $A_p$ = 5.45 m2

| Frame area | Af | Uf | Af.Uf |
|---|---|---|---|
| 1 Head | 0.2500 | 3.5512 | 0.8878 |
| 2 Left jamb | 0.1957 | 3.3122 | 0.6482 |
| 3 Right jamb | 0.2446 | 3.3562 | 0.8210 |
| 4 Meeting stile | 0.2348 | 2.1029 | 0.4938 |
| 5 Meeting stile | 0.2348 | 2.1029 | 0.4938 |
| 6 Cill | 0.3075 | 3.5376 | 1.0878 |
| Σaf= | 1.4675 | ΣAf.Uf= | 4.4325 |

Frame width bf

| | | |
|---|---|---|
| 1 Head | 0.1 | m |
| 2 Left jamb | 0.1 | m |
| 3 Right jamb | 0.125 | m |
| 4 Meeting stile | 0.12 | m |
| 5 Meeting stile | 0.12 | m |
| 5 Cill | 0.123 | m |

largest of the visible areas of both sides, to nearest mm

| Panel length | lg | ψg | lg.ψg |
|---|---|---|---|
| 1 Head | 2.0350 | 0.0259 | 0.0527 |
| 2 Left jamb | 1.9570 | 0.0266 | 0.0520 |
| 3 Right jamb | 1.9570 | 0.0251 | 0.0491 |
| 4 Meeting stile | 1.9570 | 0.0624 | 0.1220 |
| 5 Meeting stile | 1.9570 | 0.0624 | 0.1220 |
| 6 Cill | 2.0350 | 0.0255 | 0.0518 |
| Σlg= | 11.8980 | Σlg.ψg = | 0.4496 |

| | Ag | Ug | Ag.Ug |
|---|---|---|---|
| Glass | 3.9825 | 1.0700 | 4.2613 |

$$U_p = \frac{\Sigma\, Af \times Uf + \Sigma\, Ag \times Ug + \Sigma\, lg \times \psi g}{Ag + Ap + Af}$$

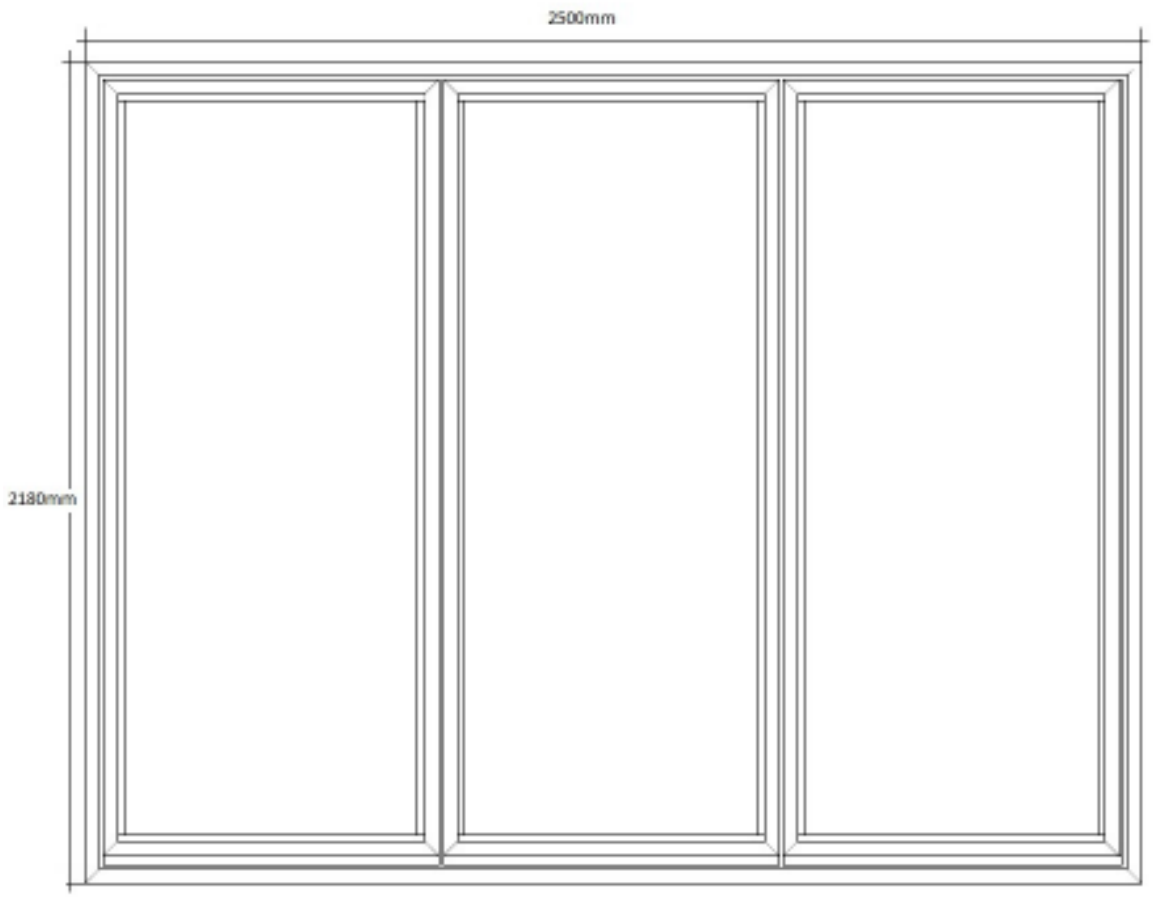
$$U_p = \frac{4.4325 + 4.2613 + 0.4496}{5.45}$$

$$U_p = 1.678 \ W/m^2 \cdot K$$

Reported Value **1.7** $W/m^2 \cdot K$ (to 1 decimal place)

# ANNEX B: DOORSET DRAWINGS

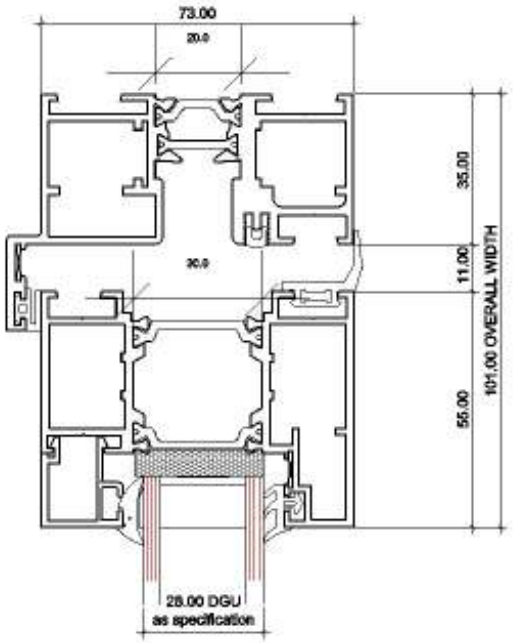
**Door set external elevation**



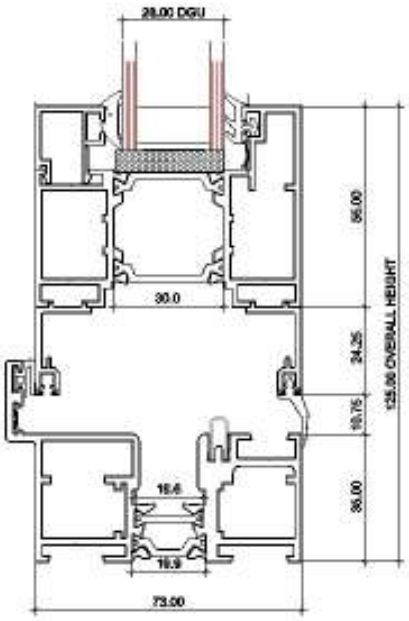

**Frame area $A_f$ = 1.47 m$^2$**

## Head Section & Cill Sections

HEAD DETAIL

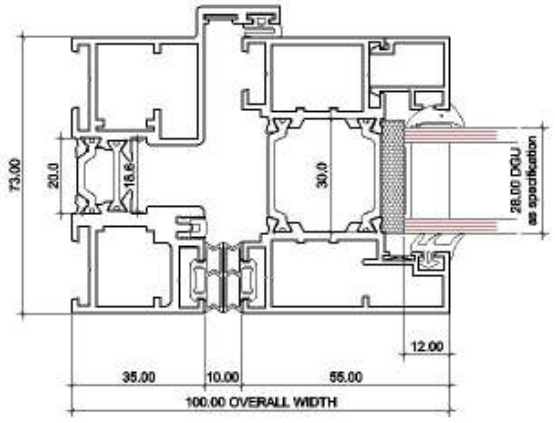



CILL DETAIL

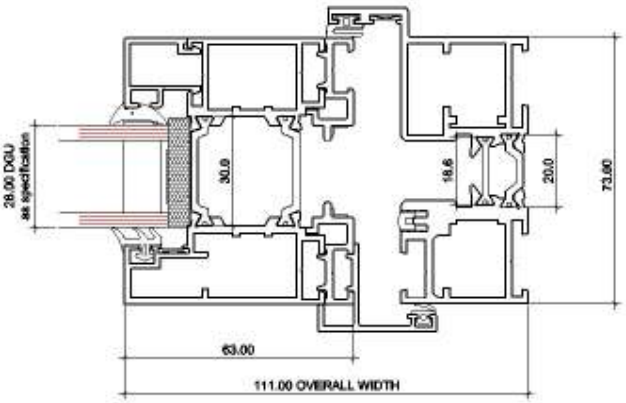



## Hinge & Locking Jamb Sections

HINGE JAMB DETAIL

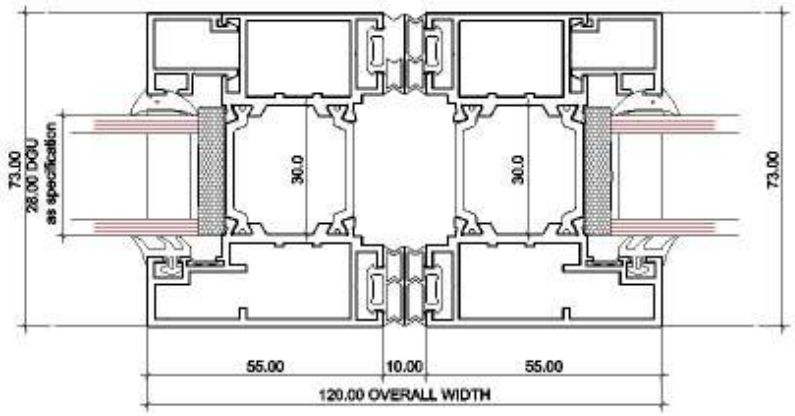



LOCK JAMB DETAIL



## Mullion Section

MULLION DETAIL



# ANNEX C: SOURCE DATA

## Materials used

Design thermal conductivity of materials used in the simulation

| Material | | Conductivity (W/ m.K) | Emissivity | Source |
|---|---|---|---|---|
| Aluminium (painted)<br>*Frame & leaf profiles* | | 160 | 0.9 | ISO 10077-2:2012 Table A.1 & A.4 |
| Steel (painted)<br>*Frame insert* | | 50 | 0.9 | ISO 10077-2:2012 Table A.1 & A.4 |
| Glass<br>*Infill panel* | | 1.0 | 0.9 | ISO 10077-2:2012 Table A.1 |
| Polysuphide<br>*Spacer bar box 1* | | 0.40 | 0.9 | ISO 10077-2:2012 Table A.1 |
| Polyamide 6.6 25% glass fibre<br>*Thermal break* | | 0.30 | 0.9 | ISO 10077-2:2012 Table A.1 |
| EPDM<br>*Weatherseal & glazing gasket* | | 0.25 | 0.9 | ISO 10077-2:2012 Table A.1 |
| PVC-U (rigid)<br>*Frame gasket* | | 0.17 | 0.9 | ISO 10077-2:2012 Table A.1 |
| Thermobar Spacer<br>*Spacer bar box2* | | 0.14 | 0.9 | Bundesverband Flachglas Data Sheet – Nov 2014 – No.27 Rev 0 |
| Elastomeric foam<br>*Glazing packer* | | 0.05 | 0.9 | ISO 10077-2:2012 Table A.1 |

| Cavities | | Conductivity (W/ m.K) | Emissivity | Source |
|---|---|---|---|---|
| Unventilated cavity 0.9 0.9<br>Unventilated cavity 0.3 0.3<br>Slightly ventilated cavity | | Various | | ISO 10077-2:2012 Clause 6 |
| λeff for 20mm cavity<br>4-**20**-4 90% Argon filled unit,<br>internal pane 0.01 low-ε coating | | 0.0264 | 0.90 | By calculation according to BS EN 673:2011 |

## Spacer bar data

November 2014 – No. 27 – Revision Index 0

'WARM EDGE' WORKING PARTY

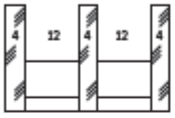
# Data sheet Psi values for windows

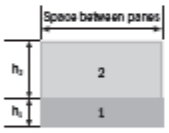
**based on determination of the equivalent thermal conductivity of spacers by measurement**

THERMOSEAL GROUP
Dedicated to Insulated Glass

*Thermoseal Group Ltd*
Gavin Way, Nexus Point,
Off Holford Drive
Birmingham B6 7AF, United Kingdom

| | Product name | Spacer height in mm | Material | Thickness d in mm |
|---|---|---|---|---|
| Cross-section | Thermobar™  | 6.5 | modified polypropylene glass filled / modified polyester film | 1.0 / 1.2<br>0.027 |

| | | Metal with thermal break | Plastic | Wood | Wood / Metal |
|---|---|---|---|---|---|
| Representative frame profile | |  |  |  |  |
| 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 |

| Two Box model Characteristic values | Space between panes in mm | $\lambda_{eq,28}$ in W/mK | |
|---|---|---|---|
| | | Box 1 · $h_1$ = 3 mm | Box 2 · $h_2$ = 6.5 mm |
|  | Can be used for all spacer widths | 0.40 | 0.14 |

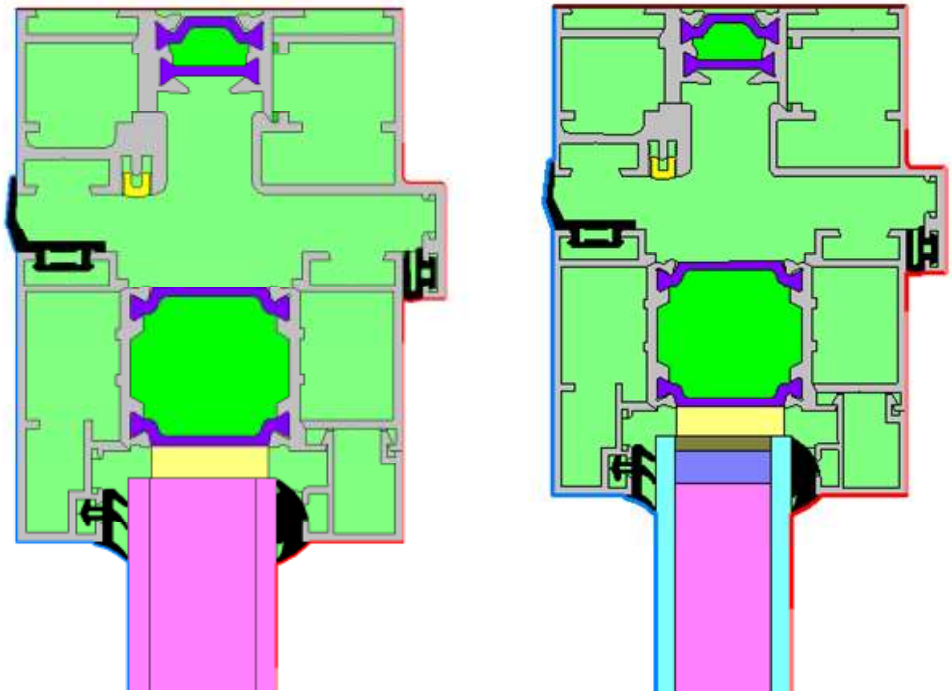
**Explanations**

The equivalent thermal conductivity has been determined in accordance with the ift guideline WA-17/1 "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 UW 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-08/2 "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 "Compass 'Warm Edge' for Windows" of Bundesverband Flachglas.

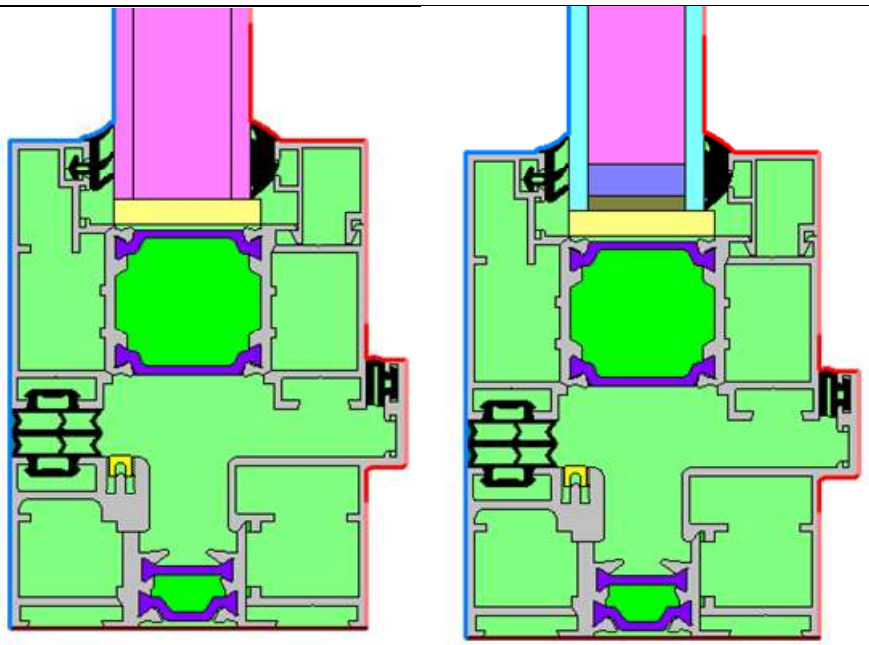
Characteristic values determined by:
Hochschule Rosenheim University of Applied Sciences
ift

# ANNEX D: THERM MODELS

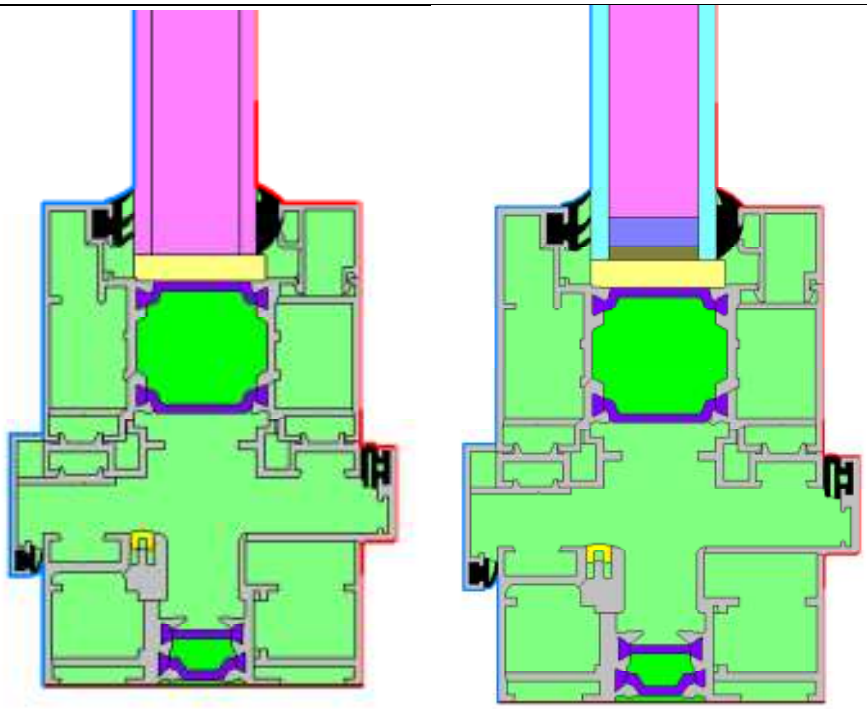
**Head rail models (for $L_f^{2d}$ and $L_\psi^{2d}$ respectively)**



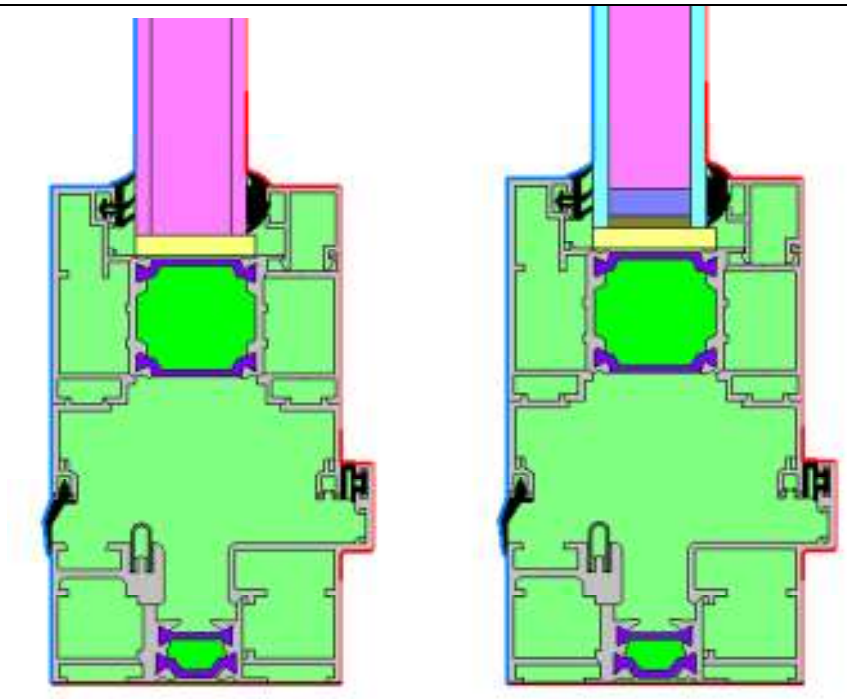
**Hinge Jamb models (for $L_f^{2d}$ and $L_\psi^{2d}$ respectively)**



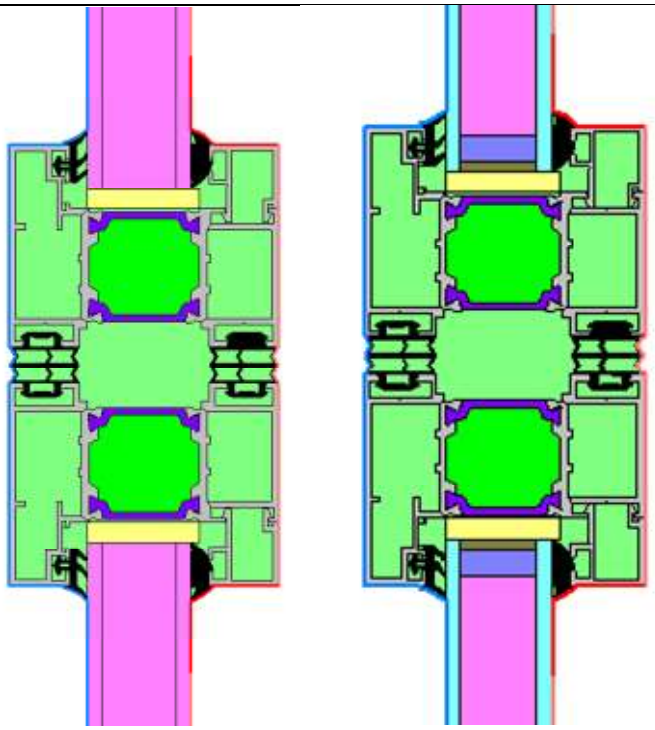
**Locking Jamb models (for Lf2d and $L_\psi$2d respectively)**



**Cill model (for $L_f^{2d}$ and $L_\psi^{2d}$ respectively)**



## Mullion model (for $L_f^{2d}$ and $L_\psi^{2d}$ respectively)



# REVISION HISTORY

| | |
|---|---|
| **Issue No : 2** | **Re - Issue Date :** |
| **Revised By:** | **Approved By:** |
| **Reason for Revision:** | |

| | |
|---|---|
| **Issue No :** | **Re - Issue Date :** |
| **Revised By:** | **Approved By:** |
| **Reason for Revision:** | |

**END OF REPORT**