

Report in Accordance with BFRC Guidelines and Regulations

Product description: “Montanstahl W20 steel window”

CONFIDENTIAL

Client:	Fabco Sanctuary Ltd Unit 1 Hobbs New Barn Climping Littlehampton West Sussex BN17 5RE
Project:	W20 steel window
Project reference:	CU16248-2
Prepared By:	Richard Bate Technical Director
Issue date:	29 June 2016

Build Check Ltd
Montrose House,
Lancaster Road,
Cressex Business Park,
High Wycombe,
Bucks, HP12 3PY

Tel: 01494 452713
Fax: 0870 2101013
E-mail: info@buildcheck.co.uk



Approved Simulator 001

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1 Introduction

The U-value calculations of the Montanstahl W20 steel window detailed below were commissioned by David Cane of Fabco Sanctuary Ltd.

2 Validation of Program

The Therm 5.2 analysis software has been validated against proofs in Annex D (D1 to D10) of BS EN ISO 10077-2:2012.

3 Analysis Method

The frame profile results detailed below are provided by computer simulation using LBL software program THERM 5.2 and BFRC guidelines and regulations.

4 Summary of Results

A summary of results are detailed in the following sections. The details supplied for the analysis as well as all information required to verify the analysis can be found in the attached CD.

4.1 Frame thermal transmittance (following the principles of BS EN ISO 10077-2)

Montanstahl W20 Frame Profile	Frame Thermal Transmittance (U_f)
Fixed	6.8 W/(m ² ·K)
Sash	6.7 W/(m ² ·K)
Mullion	6.4 W/(m ² ·K)

4.2 Linear thermal transmittance (following the principles of BS EN ISO 10077-2)

Montanstahl W20 Frame Profile	Linear Thermal Transmittance (ψ)
Fixed	0.050 W/(m·K)
Sash	0.052 W/(m·K)
Mullion	0.095 W/(m·K)

4.3 Centre pane U-Value of glazing calculated in accordance with BS EN 673.

Glazing Unit	Centre Pane U-value (U_g)
4-10-4 Low-E 0.05 uncorrected emissivity (Guardian Climaguard A+), 90% krypton, 10% air filled, low iron (Guardian UltraClear) glazing unit with Swisspacer Ultimate spacer bar with 3mm polysulfide/polyurethane secondary seal.	1.1 W/(m ² ·K)

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4.4 The thermal performance of the windows (Uw) in accordance with BFRC guidelines and regulations:

Montanstahl W20 Frame Profile	Window U-Value
Steel frame system with 4-10-4 Low-E 0.05 uncorrected emissivity (Guardian Climaguard A+), 90% krypton, 10% air filled, low iron (Guardian UltraClear) glazing unit with Swisspacer Ultimate spacer bar with 3mm polysulfide/polyurethane secondary seal.	2.0 W/(m ² ·K)

4.5 The Effective L₅₀ in accordance with BFRC guidelines and regulations:

Montanstahl SMW Frame Profile	Effective L ₅₀
Air permeability at 50 pa	0.01 W/(m ² ·K)

4.6 Total solar energy transmittance (g) in accordance with EN 410

Montanstahl W20 Frame Profile	g _{window}
Steel frame system with 4-10-4 Low-E 0.05 uncorrected emissivity (Guardian Climaguard A+), 90% krypton, 10% air filled, low iron (Guardian UltraClear) glazing unit with Swisspacer Ultimate spacer bar with 3mm polysulfide/polyurethane secondary seal.	0.59


5.0 BFRC Rating

5.1 Montanstahl W20 window system

Montanstahl W20 Frame Profile	Rating
Steel frame system with 4-10-4 Low-E 0.05 uncorrected emissivity (Guardian Climaguard A+), 90% krypton, 10% air filled, low iron (Guardian UltraClear) glazing unit with Swisspacer Ultimate spacer bar with 3mm polysulfide/polyurethane secondary seal.	- 9 (Rating Scale B)

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6.0 Authorisation

	Prepared by:
Signature:	
Name:	Richard Bate
Title:	Technical Director

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Technical Specification

Profiles	Ref. No.	Material Type/Manufacturer's Name & Density (Timber only)	Dimensions (Height & Width)
Outer Frame *	649	Steel – Montanstahl	35mm x 32mm
Transom/ Mullion	641	Steel – Montanstahl (polyethylene foam was fitted in the cavity between the glazing unit and mullion)	35mm x 32mm
Casement Vent	649	Steel – Montanstahl	35mm x 32mm
Glazing Bead	N/A	Bedded on silicone	-

* In accordance with EN 10077-2, the odd leg steel section of the profile where it overlaps the wall, was disregarded in the simulation

Weather Seals	Ref. No.	Material Type/ Manufacturer's Name	Continuous or Joined @ Corners
Glazing Bead	N/A	N/A	
Glazing Rebate	68130 K1	PVC – UK Industrial Tapes Ltd	
Casement Perimeter Seal	Kiso 141	EPDM	
Frame Rebate	Kiso 141	EPDM	

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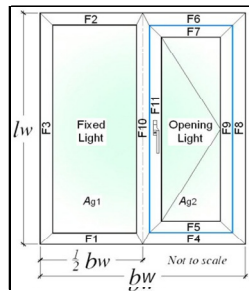
Glazing Component	Specification
Overall sealed unit: 1. Thickness (mm)	1. 18mm
Outer pane 1. Thickness (mm) 2. Manufacturer 3. Description	1. 4mm 2. Guardian 3. UltraClear
Inner pane: 1. Thickness 2. Manufacturer 3. Description	1. 4mm 2. Guardian 3. Climaguard A+
Spacer bar: 1. Manufacturer 2. Description	1. SGG 2. Swisspacer Ultimate
Cavity 1. Distance (mm) 2. Gas %	1. 10mm 2. Krypton 90% Air 10%
Edge seal 1. Manufacturer 2. Description	1. N/A 2. 3mm Polysulfide/Polyurethane secondary seal

Additional Notes

Air leakage data is taken from Build Check Ltd Test report ref. W13129-1 dated 4 June 2013 (data at 50Pa pressure = 0.26).

Solar heat gain figures are calculated from g-values supplied by the product manufacturer from EN 410 calculations for the glass units used in this simulation. The value used is 0.75.

BFRC Spreadsheet



Sample Style:
Casement
Fixed Light / Side Hung

Blue line illustrates opening light length (air leakage)

Frame offset: Yes No

Nominal 4mm etc to ODP , others 1DP	
Glazing dimensions and properties:	
Thickness of pane 1	4 mm
Pane 1/2 distance	10 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 1.120 W/(m ² ·K)
g-value - 2DP	g_{\perp} 0.75

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

Section	Window Dimensions:		Area	
	Length (m)	Width (m)	No gasket (m ²)	With gasket (m ²)
Fixed Light	1.4360	0.5755	0.8264	0.8264
Opening light	1.4100	0.5495	0.7748	0.7748
Total glazing, A_g			1.6012	1.6012
Frame			(m ²)	(m ²)
F1	0.6150	0.0220	0.0131	0.0131
F2	0.6150	0.0220	0.0131	0.0131
F3	1.4800	0.0220	0.0321	0.0321
F4	0.6150	0.0220	0.0131	0.0131
F5	0.5755	0.0130	0.0073	0.0073
F6	0.6150	0.0220	0.0131	0.0131
F7	0.5755	0.0130	0.0073	0.0073
F8	1.4800	0.0220	0.0321	0.0321
F9	1.4360	0.0130	0.0185	0.0185
F10	1.4800	0.0350	0.0510	0.0510
F11	1.4360	0.0130	0.0185	0.0185
Total Frame			0.2192	0.2192
Total Window, A_w			1.8204	1.8204
Percentage fixed light glass area			45.40%	45.40%
Percentage opening light glass area			42.56%	42.56%
Percentage glass area (total)			87.96%	87.96%

Solar Factor, g-value:		F_w	0.9
		g_w	0.59

U_{window}	No bars; or attached bars	2.00	W/(m ² ·K)
	Single cross bar in IGU	2.1	
	Multiple cross bar in IGU	2.2	
	Glazing bar (Georgian bar)	2.4	

BFRC Rating kWh/(m ² ·yr)	Label index	EWER Rating Scale	Window Rating
≥10	-9	A+	B
0 to <10		A	
-10 to <-0		B	
-20 to <-10		C	
-30 to <-20		D	
-50 to <-30		E	
-70 to <-50	F		

Report Number: **U16248-2** Issue No 22.1: 11/03/2013
 Report Date: **10 June 2016**
 Project Details: **W20 Steel Window**

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

Parameter	Symbol	Value	Units
Total window height ODP	I_w	1480	mm
Total window width ODP	b_w	1230	mm

Frame dimensions:	(b _i)	Frame width, b _i	Frame offset, b _{OF}	Gasket protrusion, b _{gf}	Frame & gasket widths	Total
		(mm)	(mm)	(mm)	(mm)	
All frame values round to nearest 1mm, gaskets to 1DP	F1 fixed sill	22	1	0.0	22.0	
	F2 fixed head	22	1	0.0	22.0	
	F3 fixed jamb	22	1	0.0	22.0	
F4 + F5 sash sill	F4 fixed sash sill	22	n/a	n/a	22.0	35.0
	F5 moving sash sill	13	1	0.0	13.0	
F6 + F7 sash head	F6 fixed sash head	22	n/a	n/a	22.0	35.0
	F7 moving sash head	13	1	0.0	13.0	
F8 + F9 sash jamb	F8 Fixed sash jamb	22	n/a	n/a	22.0	35.0
	F9 moving sash jamb	13	1	0.0	13.0	
F10 + F11 mullion	F10 fixed mullion	35	1	0.0	35.0	48.0
	F11 moving mullion	13	1	0.0	13.0	
Total gasket area				0	m ²	

Where a U_w 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 ODP			
	L_f^{2D}	W/(m ² ·K)	b _p (mm)	L_{ψ}^{2D}
F1 fixed sill		0.4267	190	0.4122
F2 fixed head		0.4267	190	0.4122
F3 fixed jamb		0.4267	190	0.4122
F4 + F5 sash sill		0.5118	190	0.4991
F6 + F7 sash head		0.5118	190	0.4991
F8 + F9 sash jamb		0.5118	190	0.4991
F10 + F11 mullion		0.8623	380	0.8277

Frame:	Frame width, b _i	Frame U-value, U _i	Frame areas, A _i	Frame heat flow, HU	Linear trans, Ψ	Linear length, l _g	Junction heat flow, H ψ
Section	(m)	(W/(m ² ·K))	(m ²)	(W/K)	(W/(m·K))	(m)	(W/K)
F1 fixed sill	0.0220	6.7745	0.0131	0.0887	0.0504	0.5775	0.0291
F2 fixed head	0.0220	6.7745	0.0131	0.0887	0.0504	0.5775	0.0291
F3 fixed jamb	0.0220	6.7745	0.0321	0.2173	0.0504	1.4380	0.0724
F4 + F5 sash sill	0.0350	6.6897	0.0204	0.1365	0.0522	0.5515	0.0288
F6 + F7 sash head	0.0350	6.6897	0.0204	0.1365	0.0522	0.5515	0.0288
F8 + F9 sash jamb	0.0350	6.6897	0.0506	0.3383	0.0522	1.4120	0.0737
F10 + F11 mullion	0.0480	6.3953	0.0695	0.4447	0.0951	1.4250	0.1356
Totals				0.2192	1.4508		0.3973

Air Leakage loss:			
Air leakage at 50 Pa per hour & per unit length of opening light (BS 6375-1) - 2DP		0.26	m ³ /(m·h)
Opening light length	4.0230 m	Total air leakage	1.046 m ³ /h
L_{50}	0.57 m ³ /(m ² ·h)	Heat loss = 0.0165 L ₅₀	0.01 W/(m ² ·K)

Other parameters needed for calculation, taken from simulations:
 $\lambda_p = 0.035$ W/(m·K) $R_{se} = 0.04$ m²·K/W $d_p = d_g = 0.018$ m
 $R_p = 0.5143$ m²·K/W $R_{tot} = 0.6843$ m²·K/W $R_{se} = 0.13$ m²·K/W
 $U_p = 1.4614$ W/(m²·K)

BFRC Rating =	218.6g_{window} - 68.5 x (U_{window} + Effective L₅₀) =	-8.71
Climate zone is:		UK
Thermal transmittance, W/(m²·K)	U_{window}	2
Solar factor	g_{window}	0.59
Window air leakage heat loss, W/(m²·K)	L_{factor}	0.01



Simulator Name: **Richard Bate** **BFRC Certified Simulator 001**

BS EN 673 Spreadsheet

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

Number of spaces		Help	
1			

Spaces 1

Glazing orientation		90%
Vertical		
Resistivity panes	1	m·K/W

Outside

Calculate

Gas	
Krypton	
Thickness (mm)	4.0 10 4.0
Normal emissivity	0.89 0.05
$\sum d_j \cdot r_j =$	0.008

Uncoated

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

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

Iteration number	U value	$\sum 1/h_s$
	$W/(m^2 \cdot K)$	$(m^2 \cdot K)/W$
1	1.120	0.71474
2	1.120	0.71474

λ_{eff}	ΔT
$W/(mK)$	
0.0140	15
0.0140	15

Thermal Conductance Values Used

Material/Conductance $W/(m \cdot K)$	Reference
PVC Flexible / 0.14	(Annex A BS EN ISO 10077-2)
Steel / 50.0	(Annex A BS EN ISO 10077-2)
EPDM / 0.25	(Annex A BS EN ISO 10077-2)
Soda Lime Glass / 1.0	(Annex A BS EN ISO 10077-2)
Polysulfide/Polyurethane / 0.40	(Annex A BS EN ISO 10077-2)
Polyethylene foam / 0.05	(Annex A BS EN ISO 10077-2)
Silicone / 0.35	(Annex A BS EN ISO 10077-2)
Swisspacer Ultimate / 0.14	BF Datasheet – 2-box method

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Spacer Conductivity

April 2013 – No.19 – 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

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

	Product name	Spacer height in mm	Material	Thickness d in mm
Cross-section	Ultimate SWISSPACER	6.5	Plastic / Multilayer – polyester coated film "High Tech Gas Barrier Foil"	1.0 0.097

Representative frame profile		Metal with thermal break	Plastic	Wood	Wood / Metal
Representative psi value outside sheet thermally insulating glass W/mK	 Double-sheet insulating glass $U_g = 1.1 \text{ W/m}^2\text{K}$	0.036	0.032	0.031	0.032
Representative psi value inside sheet thermally insulating glass W/mK	 Triple-sheet insulating glass $U_g = 0.7 \text{ W/m}^2\text{K}$	0.031	0.030	0.029	0.030

Two Box model Characteristic values	Space between panes in mm	$\lambda_{eq,2B}$ in W/mK	
		Box 1 - $h_1 = 3 \text{ mm}$	Box 2 - $h_2 = 6.5 \text{ mm}$
	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 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-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.

Ermittlung der Kennwerte durch:

Metrische Messmethode
 Verfahren der Luftschicht



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G-Value Source



Product code

80 / 75 / 1.1



total thickness = 18 mm

Glazing from external to internal:

Pane 1		Pane 2	
4 mm	Float Glass Guardian UltraClear	4 mm	ClimaGuard A+ Float Glass ExtraClear
Spacer 1 - 10 mm			
10%	Air		
90%	Krypton		

Results

Visible light (EN 410 - 2011)

transmittance [%]	$\tau_v = 79.8$
reflectance external [%]	$\rho_v = 13.3$
reflectance internal [%]	$\rho_{iv} = 13.3$
general colour rendering index [%]	$R_a = 99.1$

Thermal properties (EN 673 - 2011)

U-value [W/(m ² K)]	$U_g = 1.1$
slope $\alpha = 90^\circ$	

Solar energy (EN 410 - 2011)

solar factor [%]	$g = 75.2$
shading coefficient [g/0.87]	$sc = 0.86$
direct transmittance [%]	$\tau_{d,e} = 65.8$
direct reflectance external [%]	$\rho_{d,e} = 20.9$
direct reflectance internal [%]	$\rho_{d,i} = 18.4$
direct absorption [%]	$a = 13.3$
UV transmittance [%]	$\tau_{uv} = 37.9$
secondary internal heat transfer factor [%]	$q_i = 9.4$

Other data

estimated sound reduction index [dB] (EN 717-1)	$R_w = \text{NPD}$ $C = \text{NPD}$ $C_T = \text{NPD}$
-------------------------------------------------	--------------------------------------------------------------

The calculated values are for orientation only and do not offer any guarantee regarding the fabrication of the un-intended end-product. Glass configurations do not amount to a guarantee of product availability.

BUILD CHECK Ltd
BUILD CHECK@sue.peatey

Date: 07/06/2016
Database version: 20160606
Program version: 4.1.181

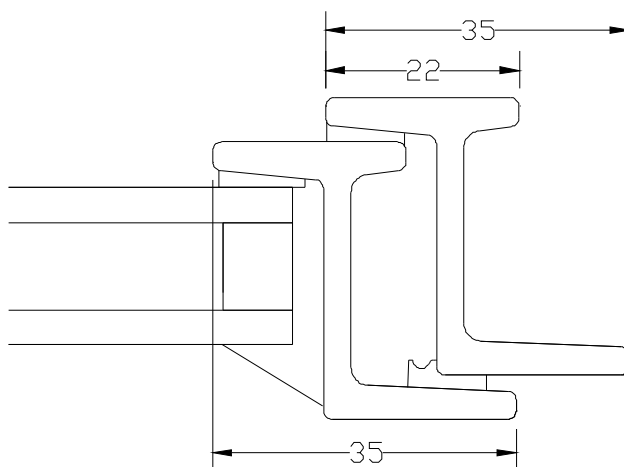
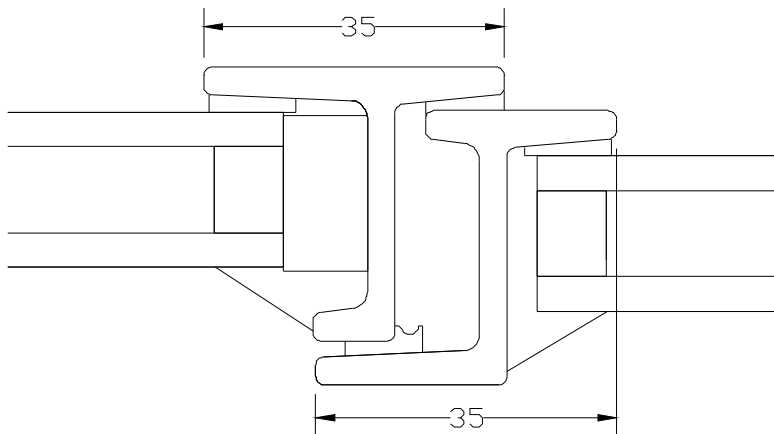
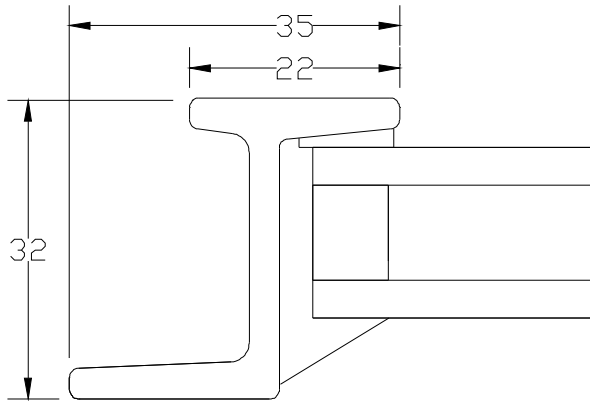
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Appendix

Profile Drawings

(See Technical Specification for dimensions)



* In accordance with EN 10077-2, the odd leg steel section of the outer frame profile where it overlaps the wall, was disregarded in the simulation

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