BUILDCHECK

Report in Accordance with
BS EN ISO 10077-1:2006

Thermal Performance of Windows, Doors & Shutters

Calculation of Thermal Transmittance
Part 1: Simplified Method

CONFIDENTIAL

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Project:	SMW steel window – Dual opening
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1 Introduction

This document details the thermal performance calculation of the Montanstahl SMW steel window with two opening lights configuration as detailed below.

The frame profile results detailed below are provided by computer simulation using LBL software program THERM 5.2 and validated against proofs in Annex D (D1 to D10) of BS EN ISO 10077-2:2012. The frame profile results detailed below are provided from methods contained in BS EN ISO 10077-1:2006.

2 Summary of Results

2.1 Frame thermal transmittance (in accordance with BS EN ISO 10077-1: 2006)

Frame Profile	Frame Thermal Transmittance (U_f)
Head	6.1 W/m^{2}K
Sill	6.1 W/m^{2}K
Jamb	6.1 W/m^{2}K
Mullion	6.2 W/m^{2}K

2.2 Linear thermal transmittance (in accordance with BS EN ISO 10077-1: 2006)

Frame Profile	Linear Thermal Transmittance (ψ)
Head	0.085 W/m.K
Sill	0.085 W/m.K
Jamb	0.085 W/m.K
Mullion	0.17 W/m.K

2.5 Centre pane U-Value of glazing calculated in accordance with BS EN 673: 2011

Glazing unit	Centre pane U-value (U_g)
Nominal dimensions 4-8-4 90% krypton 10% air filled, normal emissivity 0.01 (4mm float, 8mm cavity, 4mm Planitherm One) with aluminium spacer	1.114 W/m^{2}K

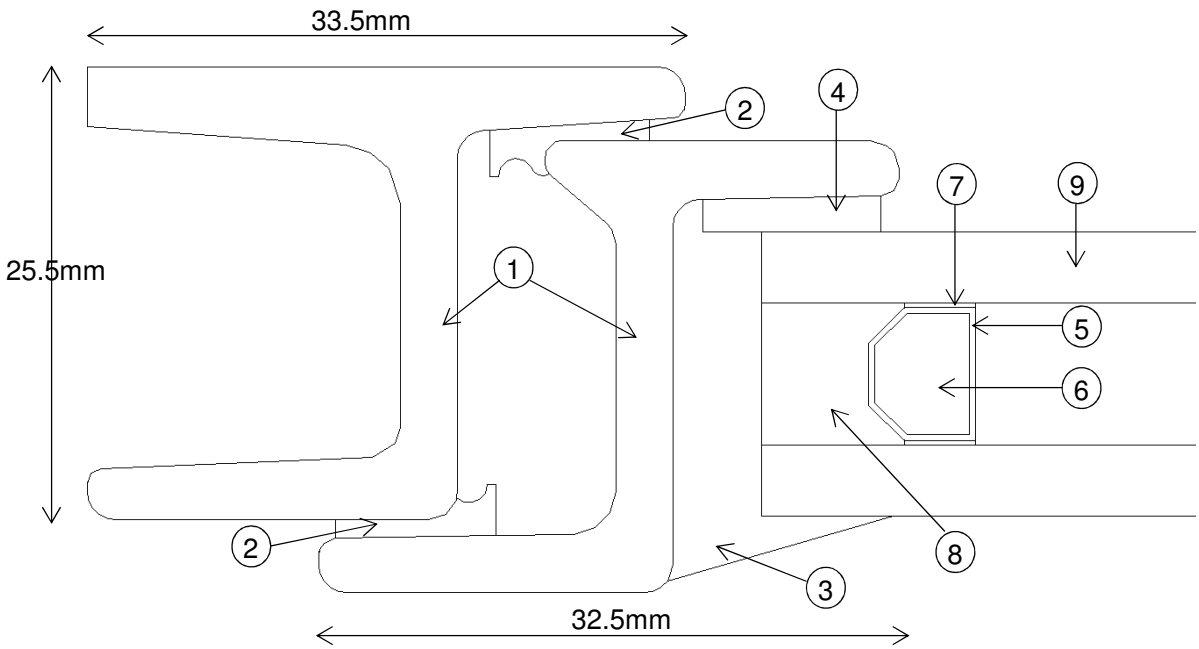
2.6 U-Value

The thermal performance of the window (U_W) in accordance with EN ISO 10077-1:2006 is:

2.4 W/m^{2}K

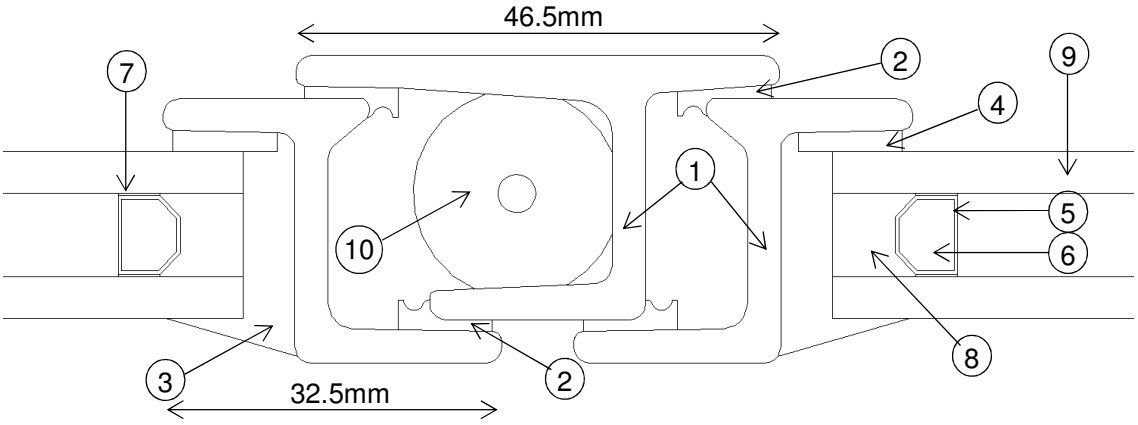
All profile calculations based on BS EN ISO 10077-2:2012

Figure 1. Technical drawing of Head/Jamb/Sill profile.



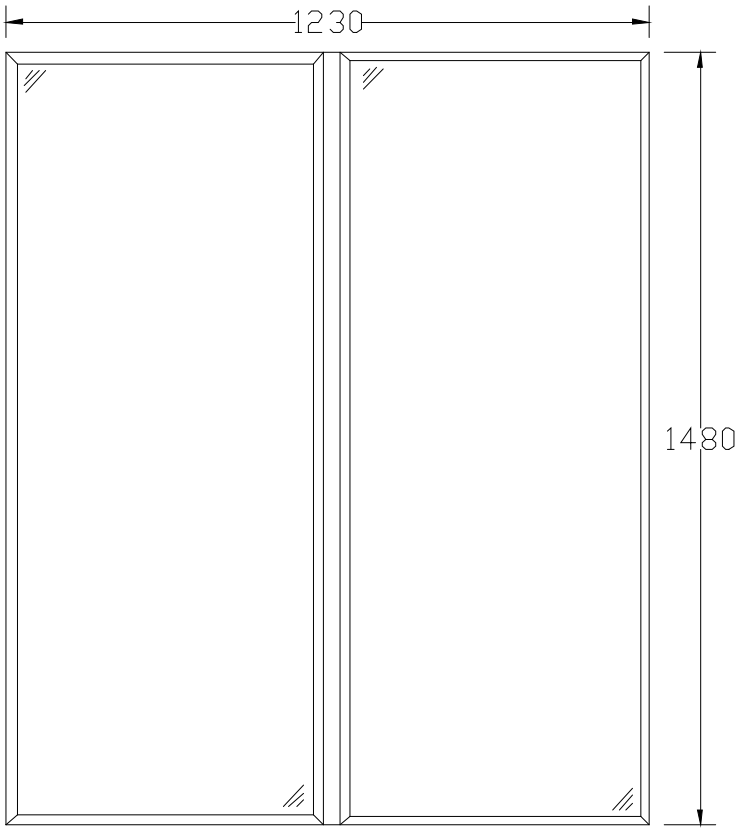
Material		Thermal Conductivity W/(m.K)
1	Steel, Annex A of BS 10077-2	50.0
2	EPDM, Annex A of BS 10077-2	0.24
3	Silicone, Annex A of BS 10077-2	0.35
4	PVC flexible, Annex A of BS 10077-2	0.14
5	Aluminium, Annex A of BS 10077-2	160.0
6	Molecular sieve desiccant, Annex A of BS 10077-2	0.10
7	Polyisobutylene, Annex A of BS 10077-2	0.20
8	Polysulfide/polyurethane, Annex A of BS 10077-2	0.40
9	Soda lime glass, Annex A of BS 10077-2	1.0

Figure 2. Technical drawing of Mullion profile.



Material		Thermal Conductivity W/(m.K)
1	Steel, Annex A of BS 10077-2	50.0
2	EPDM, Annex A of BS 10077-2	0.24
3	Silicone, Annex A of BS 10077-2	0.35
4	PVC flexible, Annex A of BS 10077-2	0.14
5	Aluminium, Annex A of BS 10077-2	160.0
6	Molecular sieve desiccant, Annex A of BS 10077-2	0.10
7	Polyisobutylene, Annex A of BS 10077-2	0.20
8	Polysulfide/polyurethane, Annex A of BS 10077-2	0.40
9	Soda lime glass, Annex A of BS 10077-2	1.0
10	Polyethylene foam, Annex A of BS 10077-2	0.05

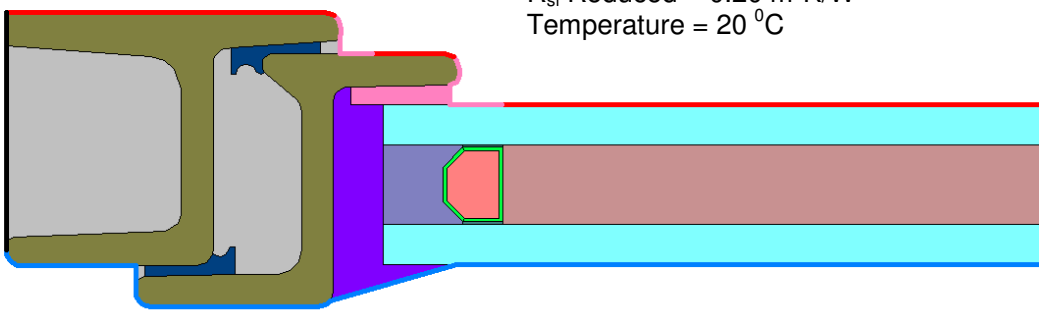
Figure 3. Drawing of the window configuration and overall dimensions (from the internal face)



Internal projected frame area ($A_{f,i}$)	0.341 m^2
External projected frame area ($A_{f,e}$)	0.341 m^2
Glazed area of configuration (A_g)	1.480 m^2
Frame area of configuration (A_f)	0.341 m^2
Perimeter length of the glazing (l_g)	7.698 m

Figure 4. Head/Jamb/Sill profile simulation

Internal Environment
R_{si} Normal = 0.13 m^2K/W
R_{si} Reduced = 0.20 m^2K/W
Temperature = 20 ^0C

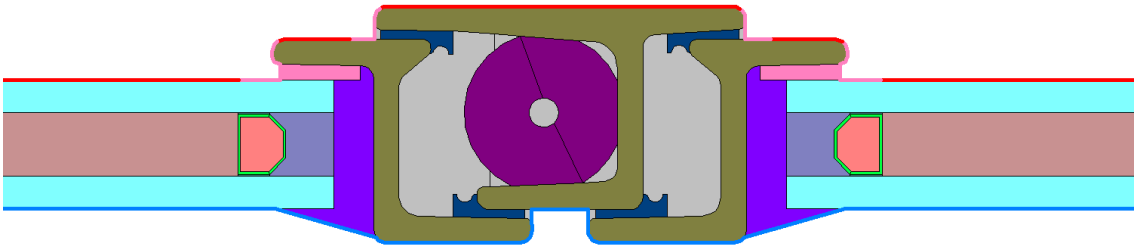


Quad Tree Mesh Parameter 9

External Environment
R_{se} Normal = 0.04 m^2K/W
R_{se} Reduced = 0.04 m^2K/W
Temperature = 0^0C

Figure 5. Mullion profile simulation

Internal Environment
R_{si} Normal = 0.13 m^2K/W
R_{si} Reduced = 0.20 m^2K/W
Temperature = 20 ^0C



External Environment
R_{se} Normal = 0.04 m^2K/W
R_{se} Reduced = 0.04 m^2K/W
Temperature = 0^0C

Quad Tree Mesh Parameter 9

Glazing unit 4-8-4 Low E 0.01 uncorrected 90% krypton 10% air filled

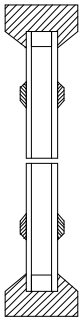
BS EN 673:2011 Glass in building- Determination of thermal transmittance (*U* value)-Calculation method.								
Standardised boundary conditions (section 8)								
r		1	m.K/w		Thermal resistivity of soda lime glass			
ε glass		0.837			Corrected emissivity of uncoated soda lime and borosilicate glass surface			
delta T		15	K		Temperature difference between bounding glass surface			
Tm		283	K		Mean temperature of gas space			
σ		5.67E-08	W/(m2K4)		Stefan-Boltzmann's constant			
he		25	W/(m2K)		External heat transfer coeff. for uncoated soda lime glass surfaces			
hi		7.7	W(m2K)		Internal heat transfer coeff. for uncoated soda lime glass surfaces			
A		0.035			Constant			
n		0.38			Exponent			
Gas properties (section 6)								
Density: ρ		3.3272	kg/m3					
Dynamic viscosity: μ		2.34E-05	kg/(ms)					
Thermal conductance: λ		0.010596	W/(m.K)					
Specific Heat Capacity: c		321.3	J/(kg.K)					
s		0.008	m		width of gas space			
ε 1		0.837			corrected emissivity of surface 1			
ε 2		0.013			corrected emissivity of surface 2	or 0.18		
Glass pane 1 d		0.004	m		thickness of glass 1			
Glass pane 2 d		0.004	m		thickness of glass 2			
Calculated values								
Pr		7.08E-01						
Gr		5.40E+03						
Nu		8.04E-01	1	1.00E+00	If Nu is less than 1, use Nu = 1.			
hr		6.48E-02						
hg		1.32E+00						
hs = hr + hg		1.39E+00						
1/ht		7.28E-01						
1/U = 1/he + 1/ht + 1/hi		8.98E-01						
Centre pane U value		**1.1140E+00**						

Appendix – Thermal transmittance for windows with bars

Where the window is fitted with bars the following thermal transmittance values will apply, in accordance with Annex J of BS EN 14351-1:2006+A1:2010.

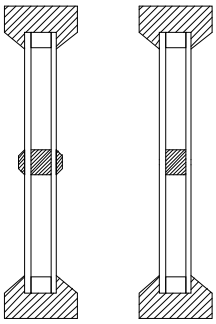
1. Attached bar(s)

Window with attached bar(s)	**2.4 W/m^{2}K**



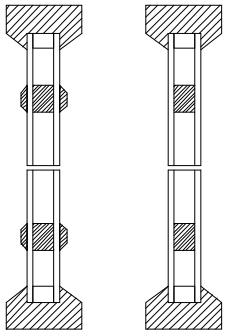
2. Single cross bar in the IGU with or without attached bars

Window with single cross bar in the IGU with or without attached bars	**2.5 W/m^{2}K**



3. Multiple cross bars in the IGU with or without attached bars

Window with multiple cross bars in the IGU with or without attached multiple bars	**2.6 W/m^{2}K**



4. Glazing bar (Georgian bar)

Window with glazing bar (Georgian bar)	2.8 W/m^{2}K