TECHNICKÝ A SKÚŠOBNÝ ÚSTAV STAVEBNY, n. o.
BUILDING TESTING AND RESEARCH INSTITUTE, Slovak Republic
Studená 3, 821 04 Bratislava
Testing laboratory
Testing workplace Nitra, Braneckého 2, 949 01 Nitra, Phone +421 37 6924 920, E-mail: lab.nr@tsus.sk

SNAS
Reg. No. 004/S-045

Calculation protocol No. 40-21-0056

ORDER

Number: 40210021
Customer: HEGE s.r.o.
Martovce 385
947 01 Martovce

SUBJECT OF CALCULATION

Product: Wooden window system EURO IV 78
Producer: HEGE s.r.o., 947 01 Martovce 385
Production plant: HEGE s.r.o., 947 01 Martovce 385
Technical specification: EN 14351-1:2006+A2:2016 Windows and doors. Standard for products, functional characteristics. Part 1: Windows and exterior doors.

PRODUCT SAMPLE

Table 1 - Description of the sample Single-leaf wooden window EURO IV 78

Frame size (WxH)	(1230 x1480) mm	Surface	1.82 m^2
Frame profile	Glued lamellar profile EURO IV 78, corner joints tapped and glued with glue for stress group D4 according to EN 204. In the bottom part of the window frame and balcony door, there is a gutter strip with an interrupted thermal bridge from the manufacturer Gutmann Spree 24 OF.		
Wing profile	Glued lamellar profile EURO IV 78, corner joints tapped and glued with glue for stress group D4 according to EN 204.		
Sealing	in the inner and central zone with a sealing profile made of EPDM.		
Glazing	Insulating triple-glazed glass with declared Ug = 0.6 W/(m2K), of total thickness 36 mm.		
Distance frame	SWISSPACER ULTIMATE with a linear heat transfer coefficient of glazing ψg = 0.029 (W/mK). Data source: Datenblatt Psi-werte Fenster, April 2013-Nr.W19-Änderungsindex 2-10/2018, ARBEITSKREIS "WARME KANTE" BF.		

CALCULATIONS

Table 2 - Properties

Property	Calculation procedure
Heat transfer coefficient of profiles Uf - accredited	EN ISO 10077-2:2017 Thermal technical properties of windows, doors and shutters. Calculation of the heat transfer coefficient. Part 2: Numerical method for frames (ISO 10077-2:2017)
Heat transfer coefficient of windows Uw - accredited	EN ISO 10077-1:2017 Thermal technical properties of windows, doors and shutters. Calculation of the heat transfer coefficient. Part 1. General (ISO 10077-1:2017)

RESULTS:

Calculation of the heat transfer coefficient of profiles U_f from entry data

The heat transfer coefficient of the profile combination is calculated by the Winiso® 2.7.3 program according to EN ISO 10077-2. The program is validated according to Annex D of the mentioned standard.

Calculation conditions:
Used calculation method for cavities: radiometric method according to STN EN 10077-2 Art. 6.4.2

Table No. 3 – Entry data (bottom detail)

	Boundary conditions	R_S (m^2K/W)	T (°C)		Data source
	Air ext. 0.04; 0°C, 80%	0.040	0°C		**)
	Air ext. 0.30; 0°C	0.300	0°C		**)
	Air int. 0.13; 20°C; 20°C; 50%	0.130	20°C		**)
	Air int. SVC 0.30; 20°C	0.300	20°C		**)
	Air int. 0.20; 20°C	0.200	20°C		**)
	Cavities			**Surface A (mm^2)**	**Data source**
	Unventilated air cavities			599.01	**)
	Material	**Λ (W/(mK))**	**ε (emissivity)**	**Surface A (mm^2)**	**Data source**
	Soft wood ABAL, PCAB, PCST, PNCN, THPL	0.110	0.900	8091.93	**)
	Aluminium Si leg	160.000	0.900	167.05	**)
	Calibration panel	0.035	0.900	7377.48	**)
	Sealing TPE	0.230	0.900	98.98	**)
	silicone filled	0.400	0.900	25.360	**)

*) Cross-section drawing – Annex No. 1

**) Unless otherwise stated, data are taken from EN ISO 10077-2:2017

Figure No. 1 - Profile combination frame - wing - bottom detail

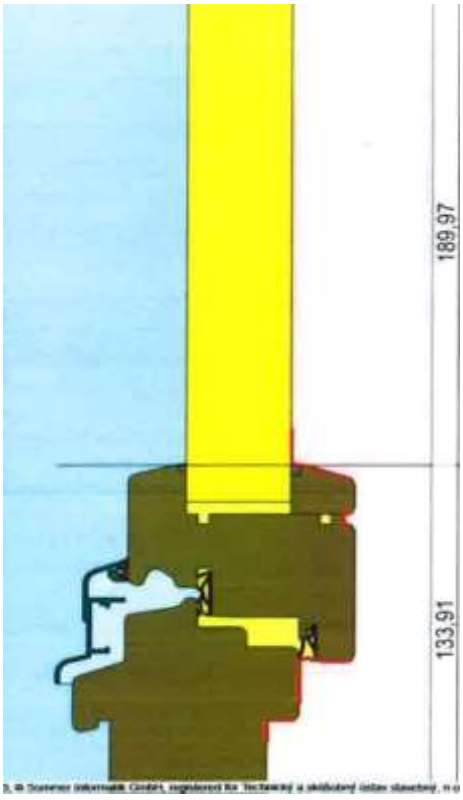


Table No. 4 – U_{f1} calculation

Temperature difference ΔT	20 K
Heat flow	6.542 W/m
Thermal permeability of the L2D section	0.3271
View width of the profile combination	134 mm
U_{f1} calculated	1.26 W/(m2K)

Table No. 5 – Entry data (top detail)

	Boundary conditions	R_S (m^2K/W)	T (°C)		Data source
	Air ext. 0.04; 0°C, 80%	0.040	0°C		**)
	Air ext. 0.30; 0°C	0.300	0°C		**)
	Air int. 0.13; 20°C; 20°C; 50%	0.130	20°C		**)
	Air int. SVC 0.30; 20°C	0.300	20°C		**)
	Air int. 0.20; 20°C	0.200	20°C		**)
	Cavities			**Surface A (mm^2)**	**Data source**
	Unventilated air cavities			1067.61	**)
	Material	**Λ (W/(mK))**	**ε (emissivity)**	**Surface A (mm^2)**	**Data source**
	Soft wood ABAL, PCAB, PCST, PNCN, THPL	0.110	0.900	8172.51	**)
	Calibration panel	0.035	0.900	7384.46	**)
	Sealing TPE	0.230	0.900	109.71	**)
	silicone filled	0.400	0.900	26.560	**)

*) Cross-section drawing – Annex No. 1

**) Unless otherwise stated, data are taken from EN ISO 10077-2:2017

Figure No. 1 - Profile combination frame - wing - top detail

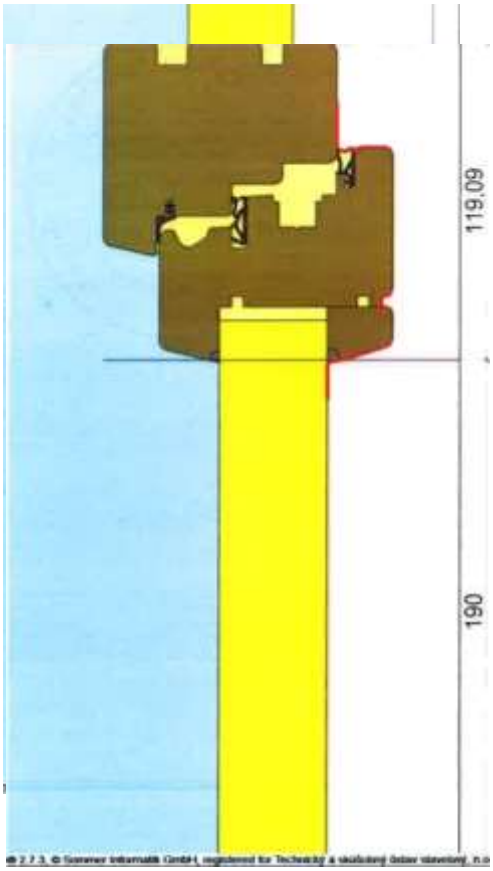


Table No. 6 – U_{f2} calculation

Temperature difference ΔT	20 K
Heat flow	5.745 W/m
Thermal permeability of the L2D section	0.2872
View width of the profile combination	119 mm
U_f calculated	1.08 W/(m2K)

Calculation of the heat transfer coefficient of the window U_w

Table No. 7: Single-leaf window EURO IV 78, with glazing with declared Ug = 0.6 W/(m².K)

Window dimensions (WxH) in m	1.230	x	1.480	Window surface A_D	1.82 m²
Glazing dimensions (WxH) in m	0.992	x	1.227	Glazing surface A_g	1.22 m²
Length of the visible perimeter of the glazing l_g					4.438 m
View width of profile combination in m			0.119	Frame surface A_{f2}	0.47 m²
View width of the profile combination of the lower frieze in m			0.134	Frame surface A_{f1}	0.13 m²
Proportion of frame surface from window surface					25.8 %
Glazing heat transfer coefficient U_g (declared by the manufacturer of glass, filling)					0.6 W/(m².K)
Linear coefficient of heat transfer of glazing ψ_g					0.029 W/mK
Frame heat transfer coefficient U_{f1} – bottom detail					1.3 W/(m².K)
Frame heat transfer coefficient U_{f2} – top detail					1.1 W/(m².K)
Calculated window heat transfer coefficient U_w					0.84 W/(m².K)
Declared window heat transfer coefficient U_w					**0.84 W/(m².K)**

Date of processing: 4.2.2021

Processed by: Mgr. Tibor Skákala

(Illegible signature)

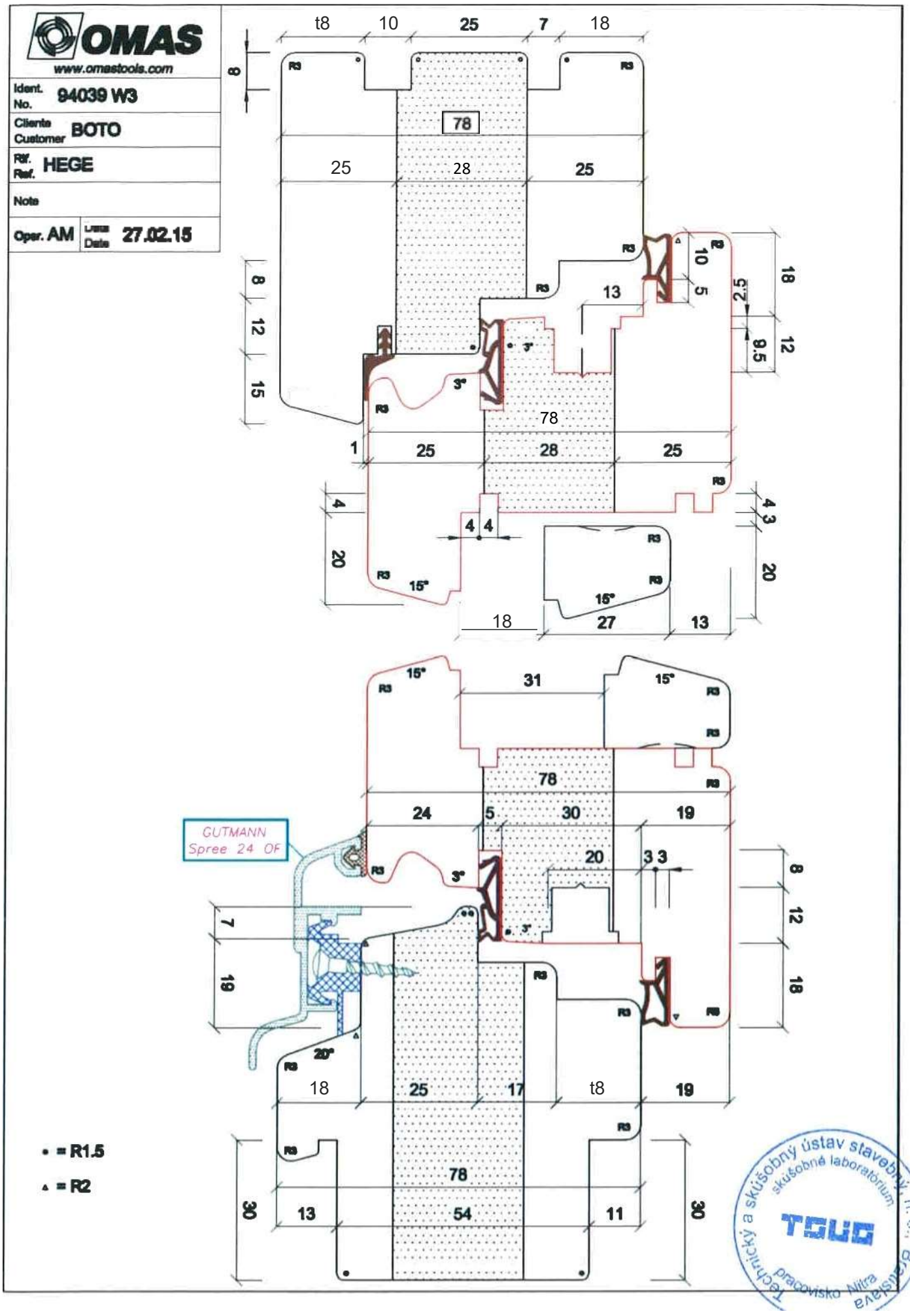
(Imprint of round rubber stamp)
Technický a skúšobný ústav stavebný, n.o., Bratislava
testing laboratory
TSÚS
workplace Nitra

Approved by: Ing. Stanislav Horský
Head of the testing workplace

List of annexes:
1. Vertical cut through the window

Notes:
- The calculations were carried out in accordance with the mentioned test procedures.
- The results found refer only to the product sample.
- The calculation protocol can only be reproduced in its entirety without the written consent of the testing laboratory.

---------- End of the calculation protocol ----------



Annex no. 1 to the Calculation protocol No. 40-21-0056

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SNAS
Reg. No. 004/S-045

Calculation protocol No. 40-21-0057

ORDER

Number: 40210021
Customer: HEGE s.r.o.
Martovce 385
947 01 Martovce

SUBJECT OF CALCULATION

Product: Wooden window system EURO IV 95
Producer: HEGE s.r.o., 947 01 Martovce 385
Production plant: HEGE s.r.o., 947 01 Martovce 385
Technical specification: EN 14351-1:2006+A2:2016 Windows and doors. Standard for products, functional characteristics. Part 1: Windows and exterior doors.

PRODUCT SAMPLE

Table 1 - Description of the sample

Single-leaf wooden window EURO IV 95

Frame size (WxH)	(1230 x1480) mm	Surface	1.82 m^2
Frame profile	Glued lamellar profile EURO IV 95, corner joints tapped and glued with glue for stress group D4 according to EN 204. In the bottom part of the window frame and balcony door, there is a gutter strip with an interrupted thermal bridge from the manufacturer Gutmann Spree 24 OF.		
Wing profile	Glued lamellar profile EURO IV 95, corner joints tapped and glued with glue for stress group D4 according to EN 204.		
Sealing	in the inner and central zone with a sealing profile made of EPDM		
	Insulating triple-glazed glass with declared Ug = 0.6 W/(m^2K), of total thickness 36 mm.		
Glazing	Insulating triple-glazed glass with declared Ug = 0.5 W/(m^2K), of total thickness 48 mm.		
Distance frame	SWISSPACER ULTIMATE with a linear heat transfer coefficient of glazing ψg = 0.029 (W/mK). Data source: Datenblatt Psi-werte Fenster, April 2013-Nr.W19-Änderungsindex 2-10/2018, ARBEITSKREIS "WARME KANTE" BF		

CALCULATIONS

Table 2 - Properties

Property	Calculation procedure
Heat transfer coefficient of profiles Uf - accredited	EN ISO 10077-2:2017 Thermal technical properties of windows, doors and shutters. Calculation of the heat transfer coefficient. Part 2: Numerical method for frames (ISO 10077-2:2017)
Heat transfer coefficient of windows Uw - accredited	EN ISO 10077-1:2017 Thermal technical properties of windows, doors and shutters. Calculation of the heat transfer coefficient. Part 1. General (ISO 10077-1:2017)

RESULTS:

Calculation of the heat transfer coefficient of profiles U_f from entry data

The heat transfer coefficient of the profile combination is calculated by the Winiso@ 2.7.3 program according to EN ISO 10077-2. The program is validated according to Annex D of the mentioned standard.

Calculation conditions:

Used calculation method for cavities: radiometric method according to STN EN 10077-2 Art. 6.4.2

Table No. 3 – Entry data (bottom detail)

	Boundary conditions	R_S (m^2K/W)	T (°C)		Data source
	Air ext. 0.04; 0°C, 80%	0.040	0°C		**)
	Air ext. 0.30; 0°C	0.300	0°C		**)
	Air int. 0.13; 20°C; 20°C; 50%	0.130	20°C		**)
	Air int. SVC 0.30; 20°C	0.300	20°C		**)
	Air int. 0.20; 20°C	0.200	20°C		**)
	Cavities			**Surface A (mm*)**	**Data source**
	Unventilated air cavities			864.54	**)
	Material	**Λ (W/(mK))**	**ε (emissivity)**	**Surface A (mm^2)**	**Data source**
	Soft wood ABAL, PCAB, PCST, PNCN, THPL	0.110	0.900	9910.19	**)
	Aluminium Si leg	160.000	0.900	176.05	**)
	Calibration panel	0.035	0.900	9836.64	**)
	Sealing TPE	0.230	0.900	98.98	**)
	silicone filled	0.400	0.900	25.360	**)

*) Cross-section drawing – Annex No. 1
**) Unless otherwise stated, data are taken from EN ISO 10077-2:2017

Figure No. 1 - Profile combination frame - wing - bottom detail

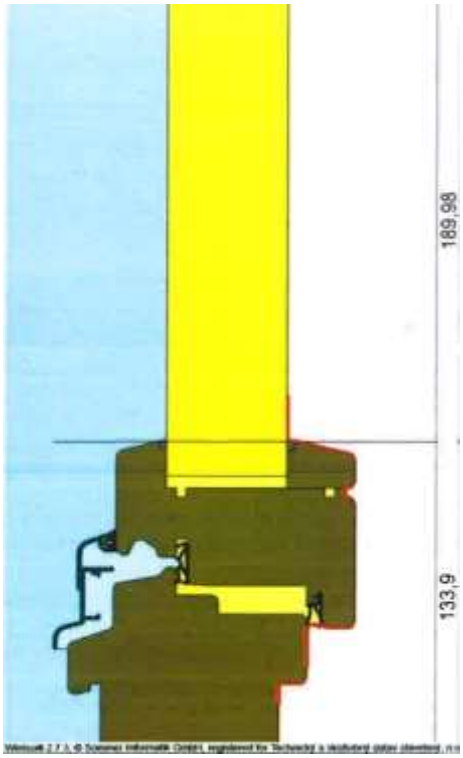

Table No. 4 – U_{f1} calculation

Temperature difference ΔT	20 K
Heat flow	5.335 W/m
Thermal permeability of the L2D section	0.2667
View width of the profile combination	134 mm
U_{f1} calculated	1.07 W/(m2K)

Table No. 5 – Entry data (top detail)

	Boundary conditions	R_S (m^2K/W)	T (°C)		Data source
	Air ext. 0.04; 0°C, 80%	0.040	0°C		**)
	Air ext. 0.30; 0°C	0.300	0°C		**)
	Air int. 0.13; 20°C; 20°C; 50%	0.130	20°C		**)
	Air int. SVC 0.30; 20°C	0.300	20°C		**)
	Air int. 0.20; 20°C	0.200	20°C		**)
	Cavities			**Surface A (mm^2)**	**Data source**
	Unventilated air cavities			1196.95	**)
	Material	**Λ (W/(mK))**	**ε (emissivity)**	**Surface A (mm^2)**	**Data source**
	Soft wood ABAL, PCAB, PCST, PNCN, THPL	0.110	0.900	9874.75	**)
	Calibration panel	0.035	0.900	9840.48	**)
	Sealing TPE	0.230	0.900	109.71	**)
	silicone filled	0.400	0.900	26.560	**)

*) Cross-section drawing – Annex No. 1

**) Unless otherwise stated, data are taken from EN ISO 10077-2:2017

Figure No. 2 - Profile combination frame - wing - top detail

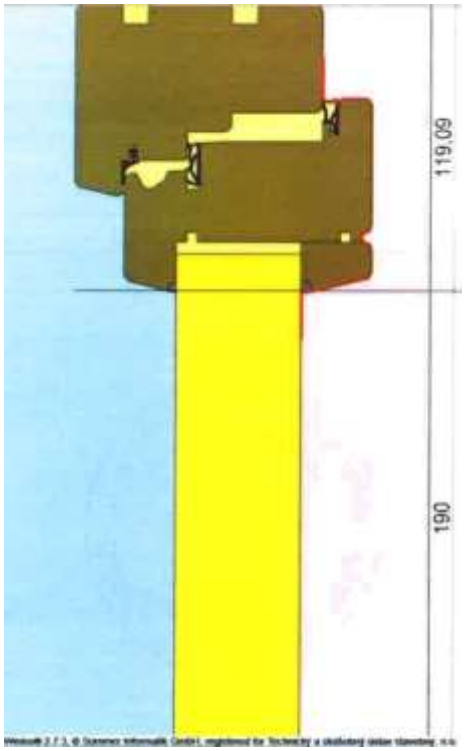

Table No. 6 – U_{f2} calculation

Temperature difference ΔT	20 K
Heat flow	4.714 W/m
Thermal permeability of the L2D section	0.2357
View width of the profile combination	119 mm
U_f calculated	0.94 W/(m2K)

Calculation of the heat transfer coefficient of the window U_w

Table No. 7: Single-leaf window EURO IV 95, with glazing with declared Ug = 0.6 W/(m².K)

Window dimensions (WxH) in m	1.230 x 1.480	Window surface A_D		1.82 m²
Glazing dimensions (WxH) in m	0.992 x 1.227	Glazing surface A_g		1.22 m²
Length of the visible perimeter of the glazing l_g				4.438 m
View width of profile combination in m		0.119	Frame surface A_{f2}	0.47 m²
View width of the profile combination of the lower frieze in m		0.134	Frame surface A_{f1}	0.13 m²
Proportion of frame surface from window surface				25.8 %
Glazing heat transfer coefficient U_g (declared by the manufacturer of glass, filling)				0.6 W/(m².K)
Linear coefficient of heat transfer of glazing g				0.029 W/mK
Frame heat transfer coefficient U_{f1} – bottom detail				1.1 W/(m².K)
Frame heat transfer coefficient U_{f2} – top detail				0.9 W/(m².K)
Calculated window heat transfer coefficient U_w				0.79 W/(m².K)
Declared window heat transfer coefficient U_w				**0.79 W/(m².K)**

Table No. 8: Single-leaf window EURO IV 95, with glazing with declared Ug = 0.5 W/(m².K)

Window dimensions (WxH) in m	1.230 x 1.480	Window surface A_D		1.82 m²
Glazing dimensions (WxH) in m	0.992 x 1.227	Glazing surface A_g		1.22 m²
Length of the visible perimeter of the glazing l_g				4.438 m
View width of profile combination in m		0.119	Frame surface A_{f2}	0.47 m²
View width of the profile combination of the lower frieze in m		0.134	Frame surface A_{f1}	0.13 m²
Proportion of frame surface from window surface				25.8 %
Glazing heat transfer coefficient U_g (declared by the manufacturer of glass, filling)				0.5 W/(m².K)
Linear coefficient of heat transfer of glazing ψ_g				0.029 W/(m².K)
Frame heat transfer coefficient U_{f1} – bottom detail				1.1 W/(m².K)
Frame heat transfer coefficient U_{f2} – top detail				0.9 W/(m².K)
Calculated window heat transfer coefficient U_w				0.73 W/(m².K)
Declared window heat transfer coefficient U_w				**0.73 W/(m².K)**

Date of processing: 4.2.2021

Processed by: Mgr. Tibor Skákala

(Illegible signature)

(Imprint of round rubber stamp)
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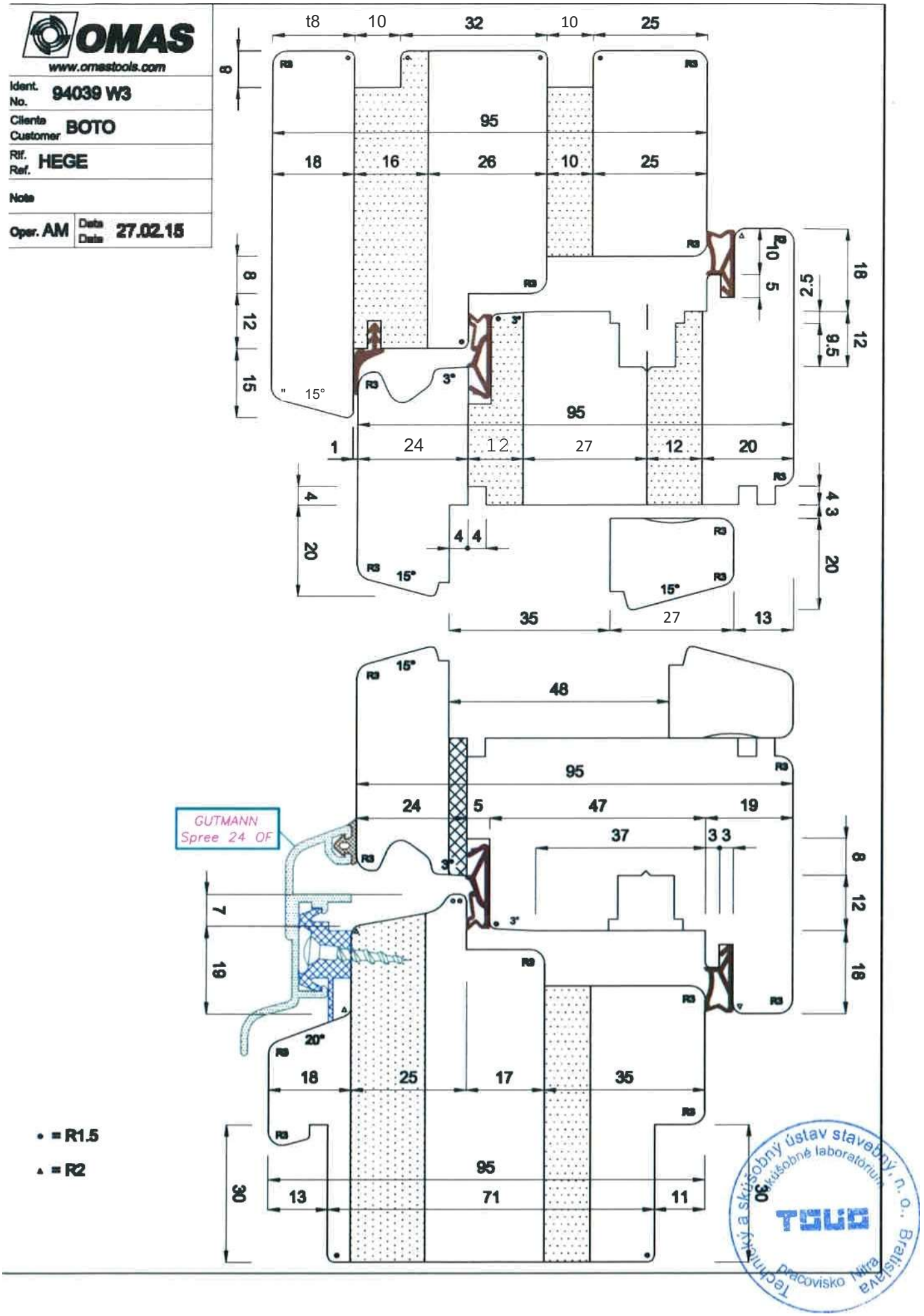

Annex no. 1 to the Calculation protocol No. 40-21-0057