TEST REPORT No. 364360/12546/CPR

issued by Istituto Giordano in the capacity of notified test laboratory (No. 0407) pursuant to Regulation 305/2011/EU of the European Parliament and of the Council of 9 March 2011

Customer

METALOUMIN S.A.

20 Ag. Fanouriou Str., Ktipito - 13671 ACHARNE - Greece

Item*

frames constructed from aluminium profiles with thermal break named "ENERGY"

Activity

calculation of thermal transmittance in accordance with standard EN ISO 10077-2:2017, with reference to harmonised standard UNI EN 14351-1:2016

Results

Section	Thermal transmittance "U_f" [W/(m² · K)]	Section	Thermal transmittance "U_f" [W/(m² · K)]
Energy 16-1	**4,0**	Energy 22-7	**3,1**
Energy 16-2	**4,3**	Energy 22-8	**2,9**
Energy 16-3	**4,2**	Energy 22-9	**2,9**
Energy 16-4	**5,4**	Energy 22s-1	**2,4**
Energy 16-5	**5,3**	Energy 22s-2	**2,5**
Energy 16-6	**2,6**	Energy 22s-3	**2,7**
Energy 16-7	**3,2**	Energy 22s-4	**2,8**
Energy 16-8	**2,6**	Energy 22s-5	**2,5**
Energy 16-9	**5,5**	Energy 22s-6	**2,8**
Energy 16-10	**4,6**	Energy 22s-7	**2,7**
Energy 16-11	**3,3**	Energy 45-1	**4,1**
Energy 22-1	**2,5**	Energy 45-2	**5,7**
Energy 22-2	**2,5**	Energy 45-3	**5,5**
Energy 22-3	**2,8**	Energy 45-4	**4,1**
Energy 22-4	**2,8**	Energy 45-5	**4,1**
Energy 22-5	**3,7**	Energy 45-6	**4,4**
Energy 22-6	**2,7**		

(*) according to that stated by the customer.

Bellaria-Igea Marina - Italy, 30 August 2019

Chief Executive Officer
(Dott. Arch. Sara Lorenza Giordano)

Firmato digitalmente da SARA LORENZA GIORDANO

Order:
81423

Technical documentation origin:
supplied by the customer

Technical documentation received date:
from 5 August 2019 to 30 August 2019

Activity date:
from 29 August 2019 to 30 August 2019

Activity site:
Istituto Giordano S.p.A. - Blocco 2 - Via Gioacchino Rossini, 2 - 47814 Bellaria-Igea Marina (RN) - Italy

Contents **Page**

Chief Test Technician:
Dott. Corrado Colagiacomo
Head of Heat Transfer Laboratory - Calculations:
Dott. Corrado Colagiacomo
Direttore Tecnico della Sezione CPD:
Dott. Ing. Giuseppe Persano Adorno

Compiler: Agostino Vasini
Reviewer: Dott. Corrado Colagiacomo

Istituto Giordano S.p.A.
Via Gioacchino Rossini, 2
47814 Bellaria-Igea Marina (RN) - Italia

Tel. +39 0541 343030 - Fax +39 0541 345540
www.giordano.it
istitutogiordano@giordano.it
PEC: ist-giordano@legalmail.it

Codice fiscale/Partita IVA: 00 549 540 409
Capitale sociale € 1.500.000 i.v.
R.E.A. c/o C.C.I.A.A. (RN) 156766
Registro Imprese della Romagna - Forlì-Cesena e Rimini n. 00 549 540 409

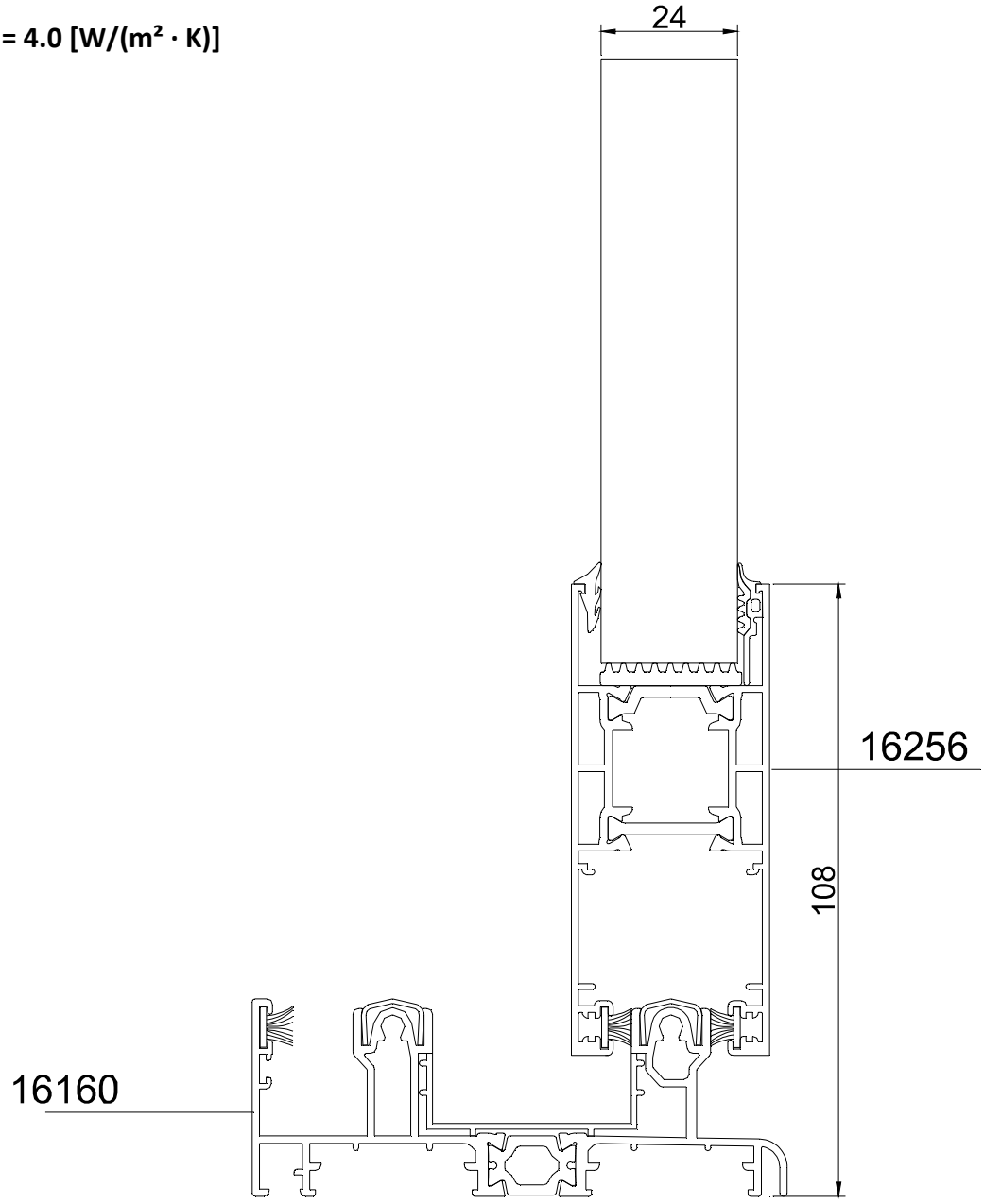
Description of item*

The item under examination consists of frames having aluminium profiles with polyamide strips to provide thermal break.

The cavities between the polyamide strips could be filled with EPS and in the cavity of the junction with the glazing there is a strip of elastomeric foam.

DRAWINGS OF THE SECTIONS CONSIDERED

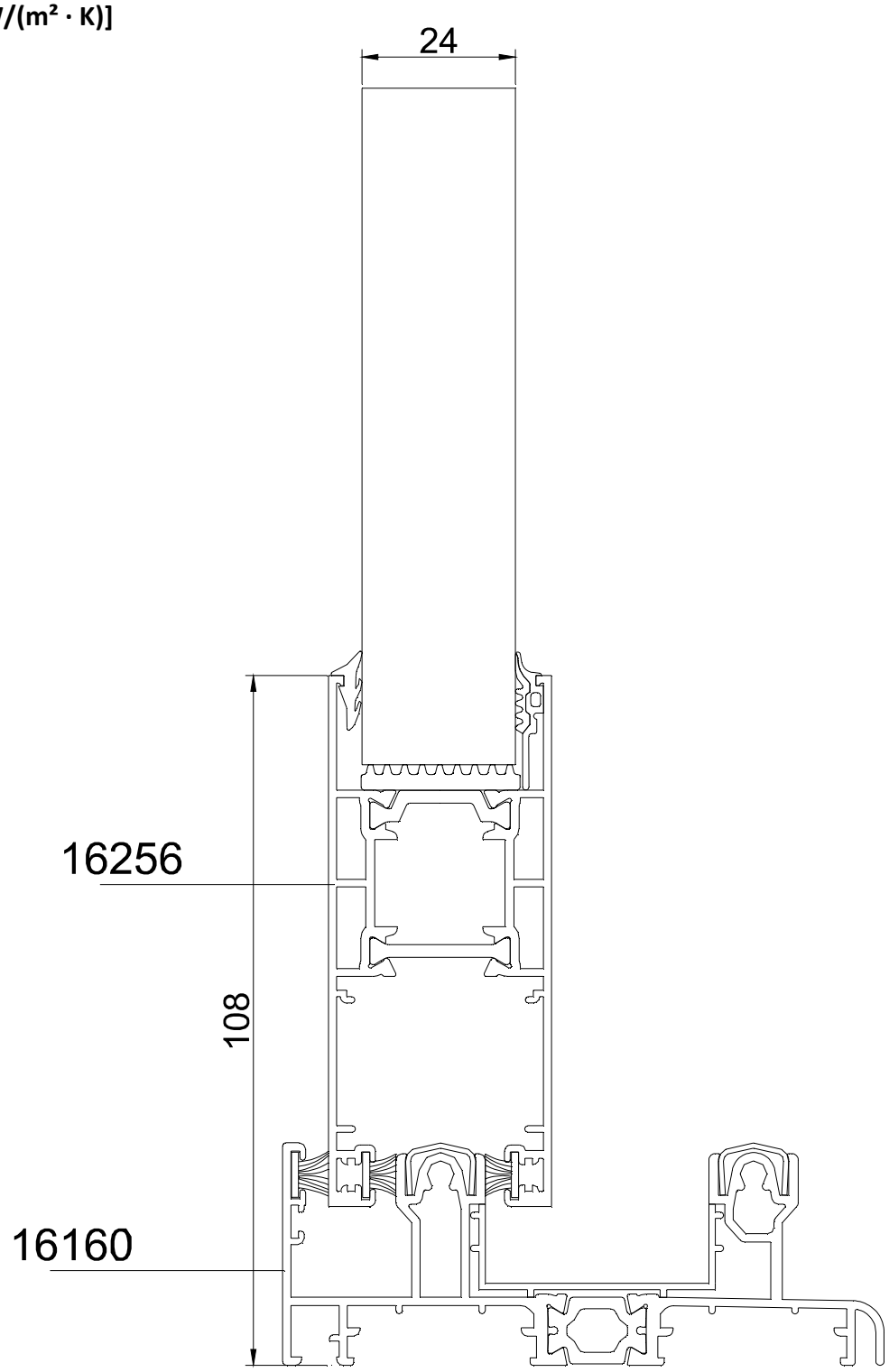
Uf = 4.0 [W/(m² · K)]



Section ENERGY 16-1

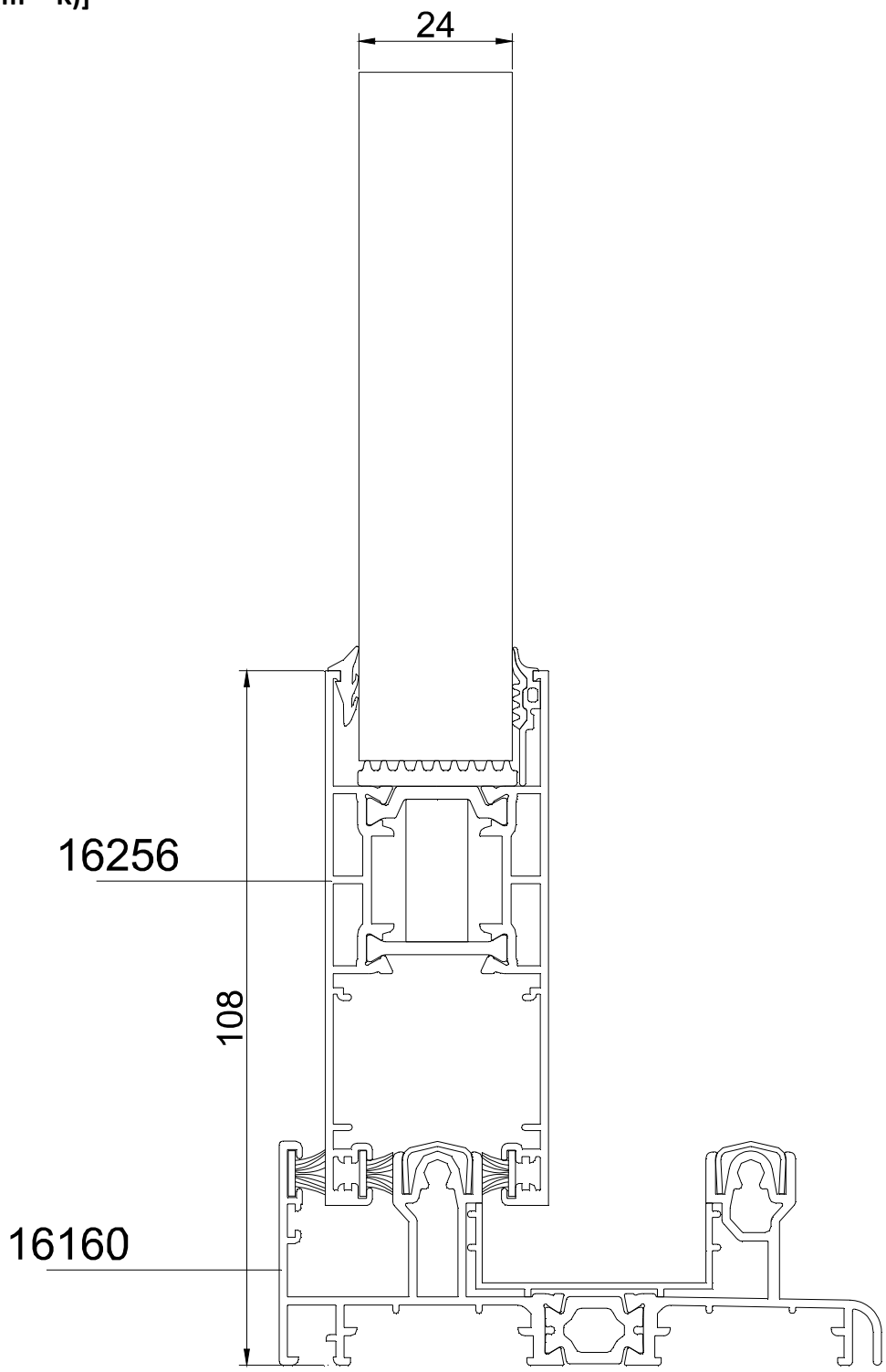
(*) according to that stated by the customer, apart from characteristics specifically stated to be measurements. Istituto Giordano declines all responsibility for the information and data provided by the client that may influence the results.

Uf = 4.3 [W/(m² · K)]



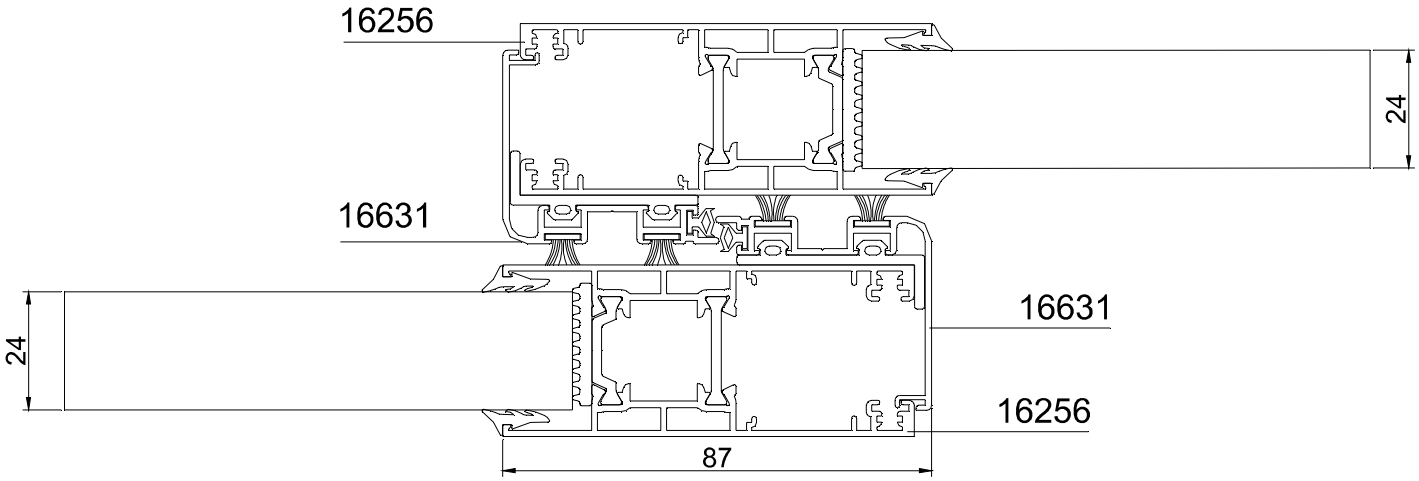
Section ENERGY 16-2

Uf = 4.2[W/(m² · K)]

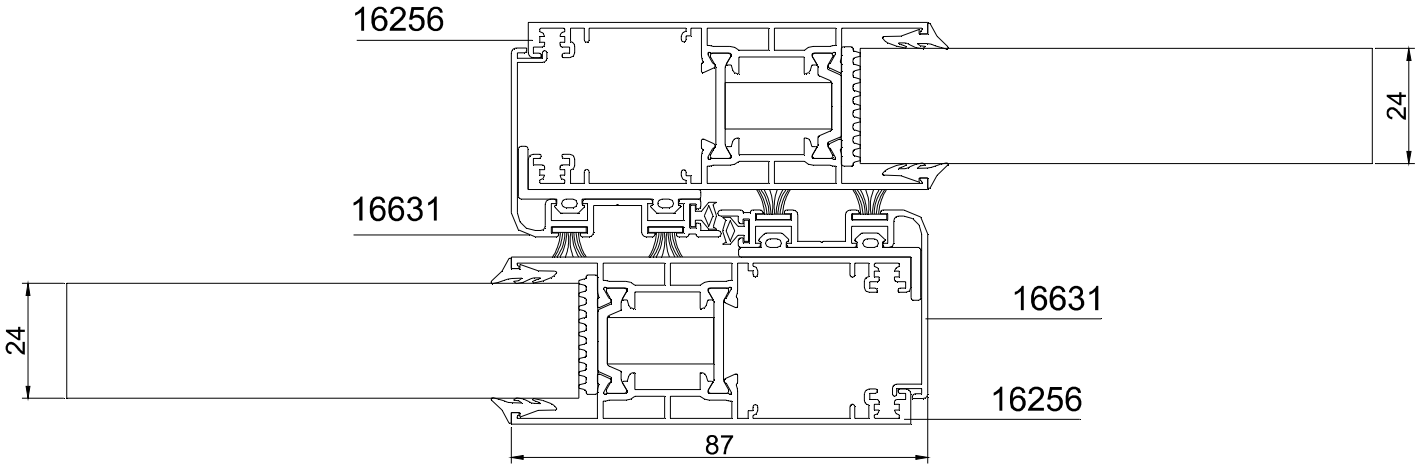


Section ENERGY 16-3

Uf = 5.3[W/(m² · K)]

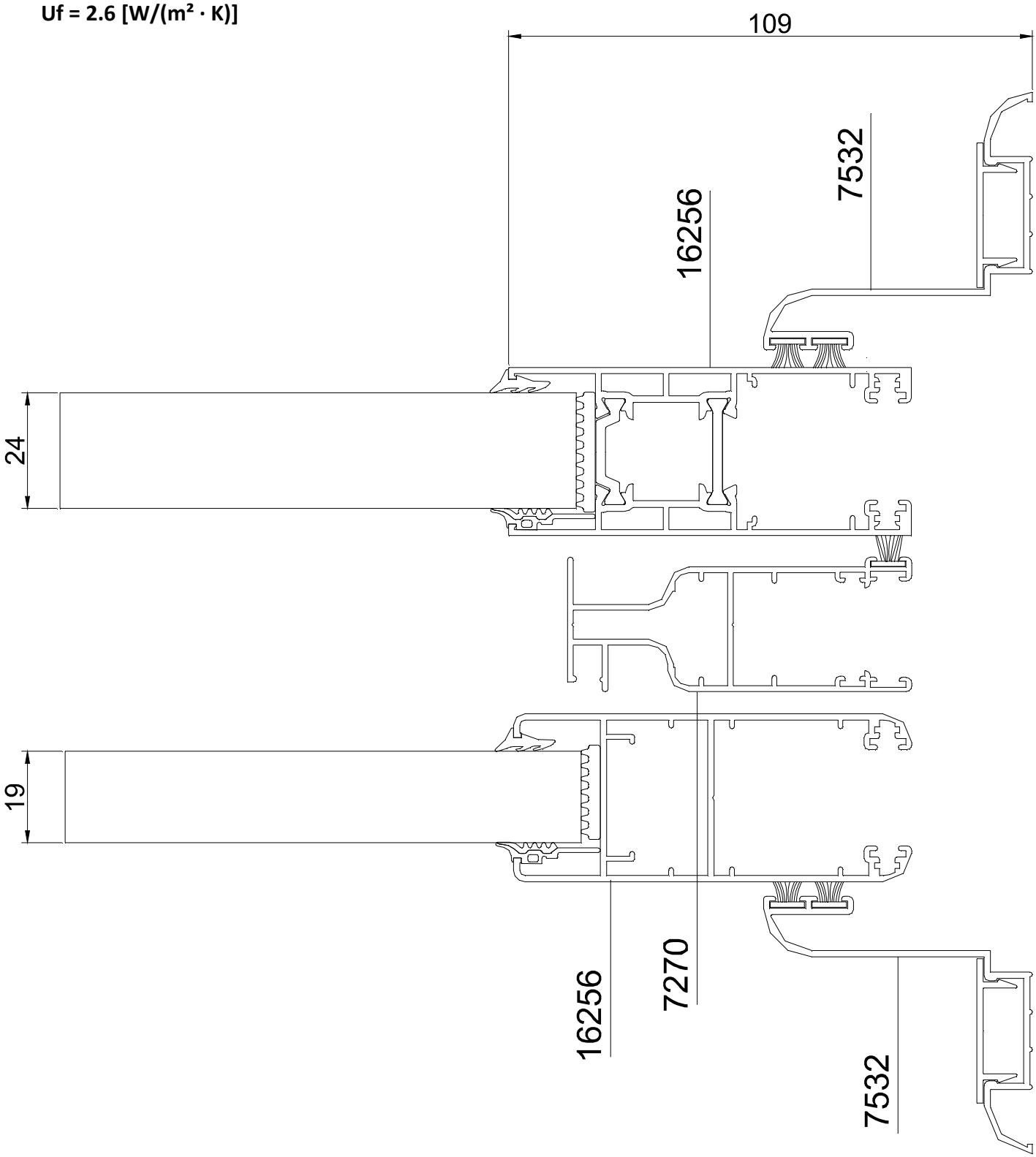


Section ENERGY 16-4



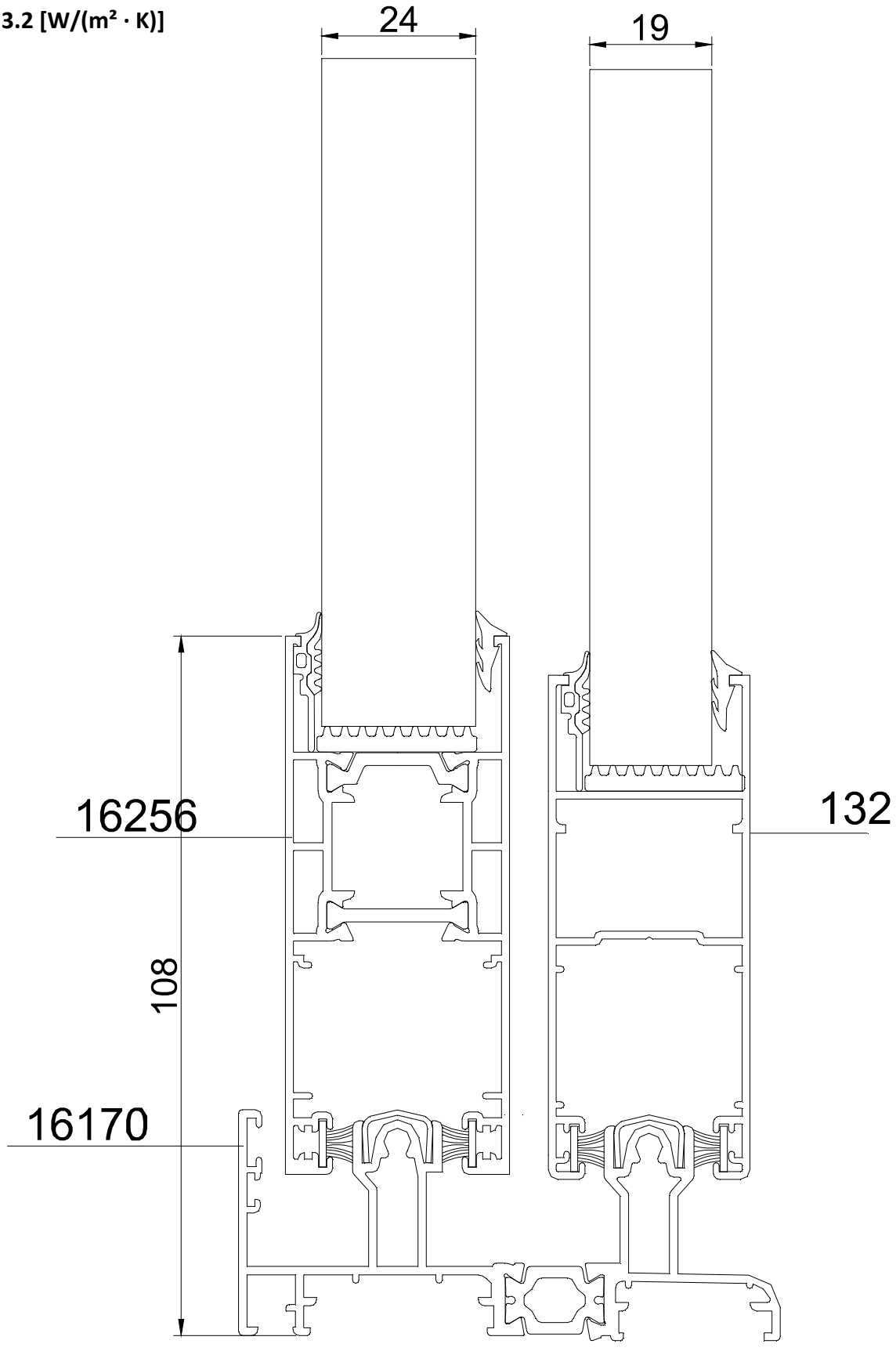
Section ENERGY 16-5

Uf = 2.6 [W/(m² · K)]



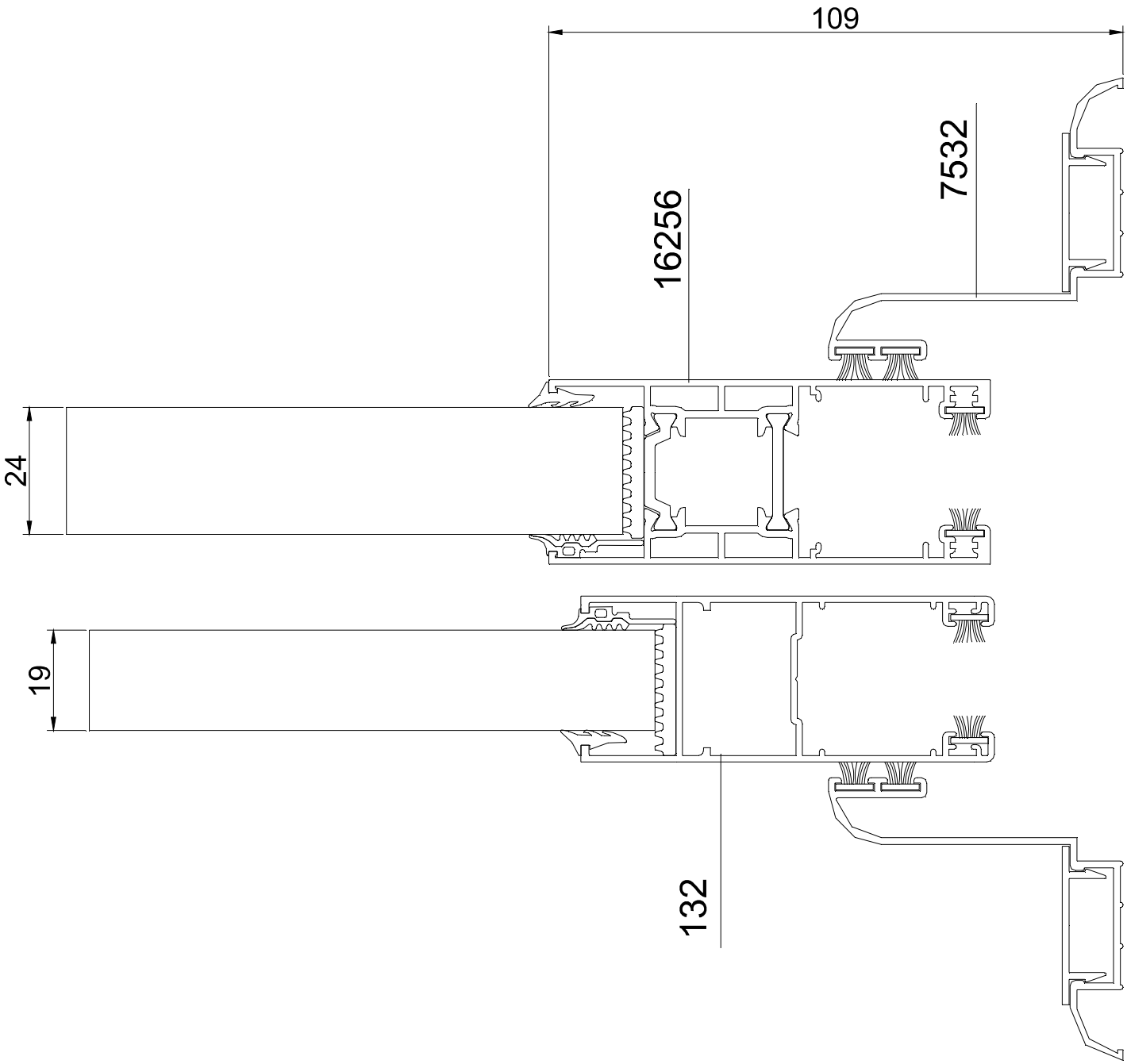
Section ENERGY 16-6

Uf = 3.2 [W/(m² · K)]



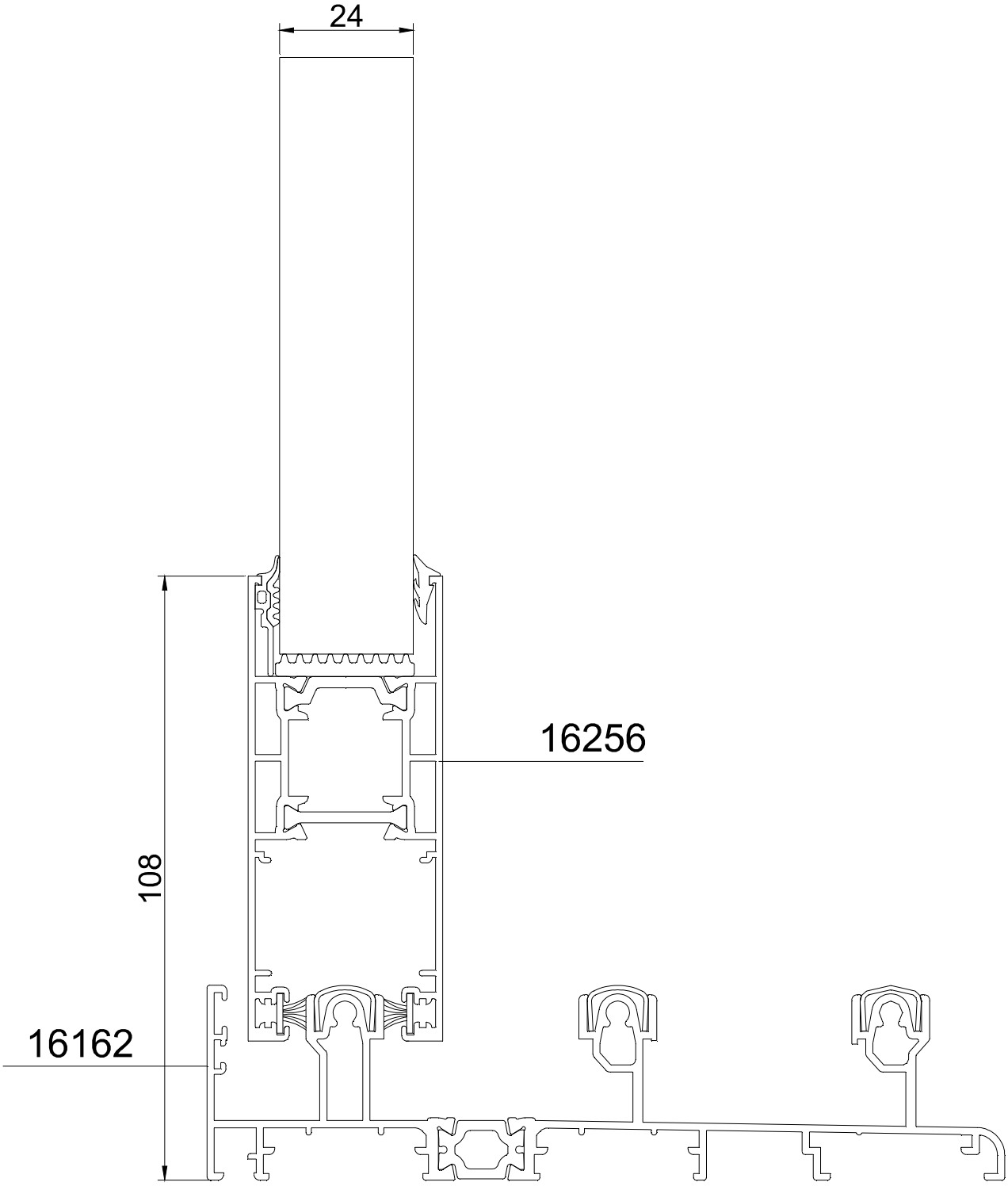
Section ENERGY 16-7

Uf = 2.6 [W/(m² · K)]



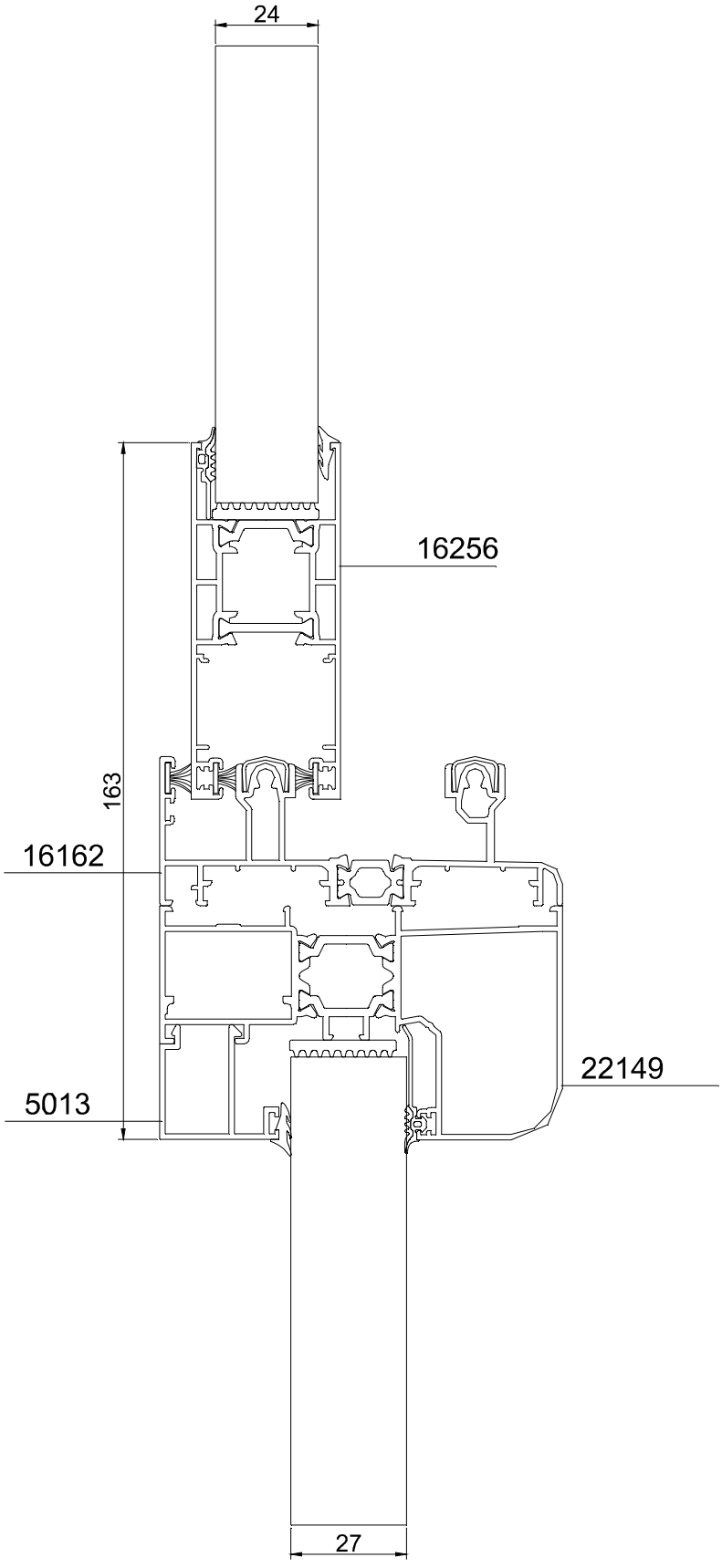
Section ENERGY 16-8

Uf = 5.5 [W/(m² · K)]



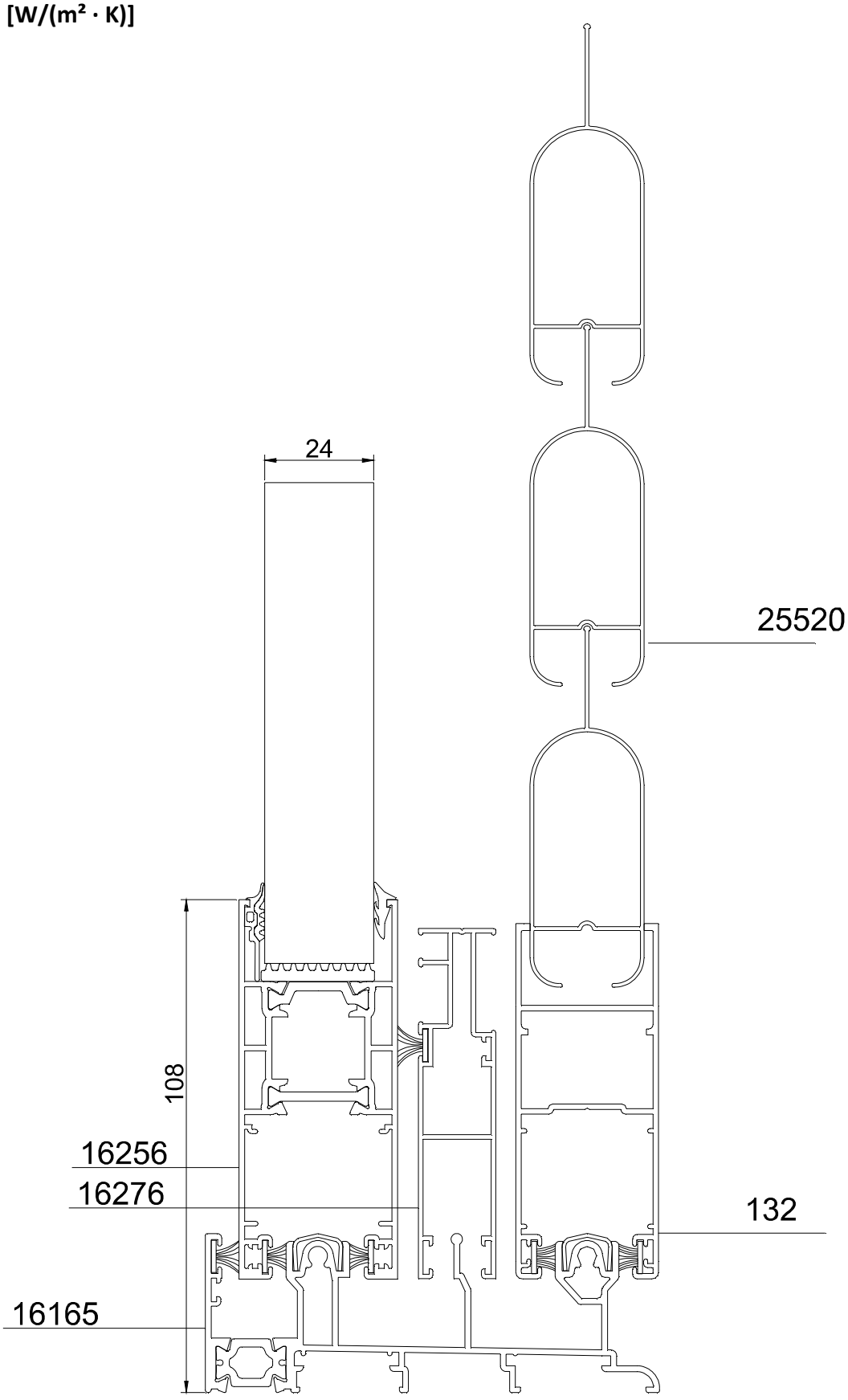
Section ENERGY 16-9

Uf = 4.6 [W/(m² · K)]



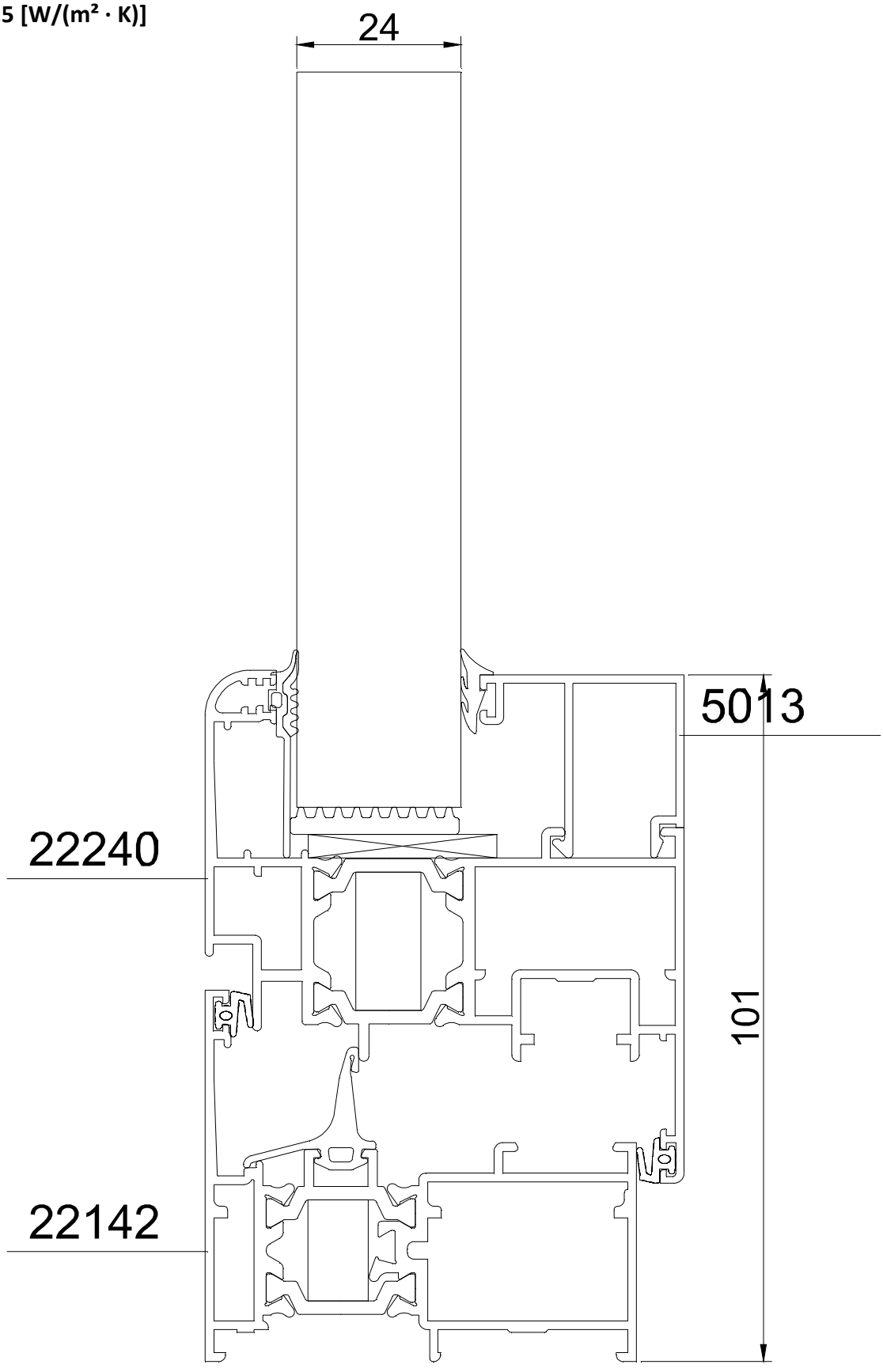
Section ENERGY 16-10

Uf = 3.3 [W/(m² · K)]



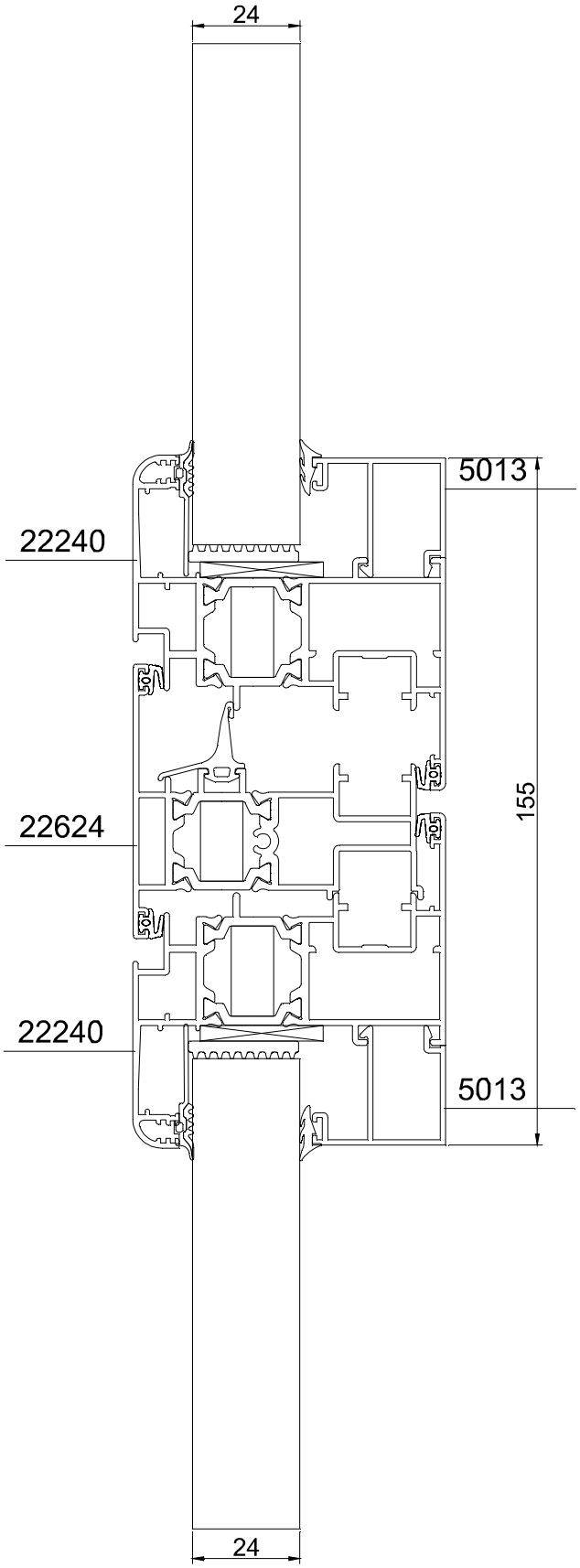
Section ENERGY 16-11

Uf = 2.5 [W/(m² · K)]



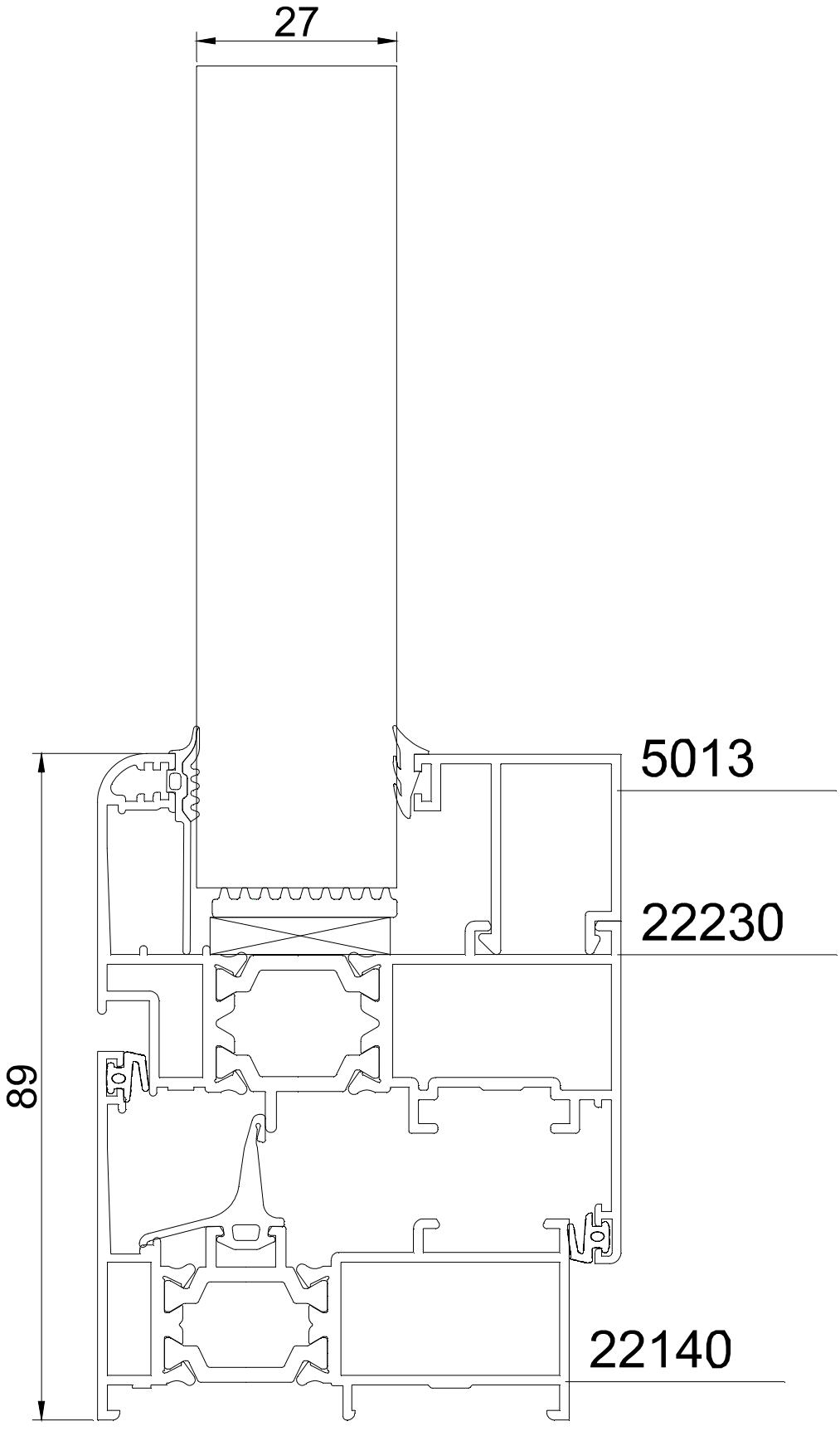
Section ENERGY 22-1

Uf = 2.5 [W/(m² · K)]



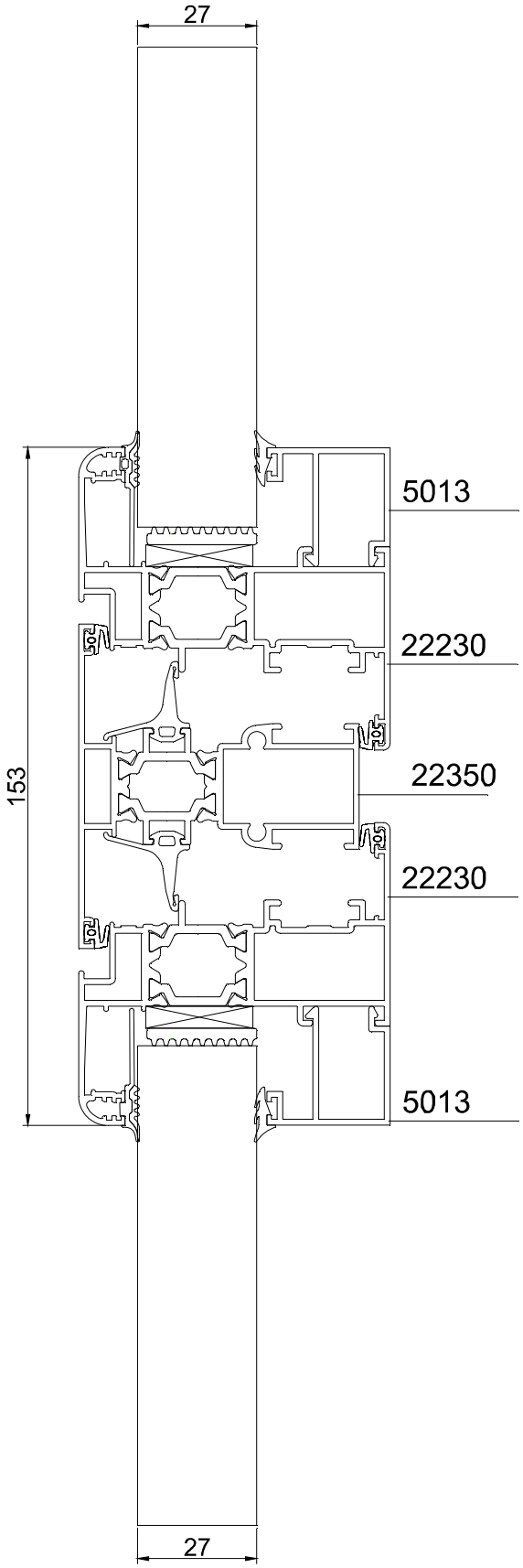
Section ENERGY 22-2

Uf = 2.8 [W/(m² · K)]



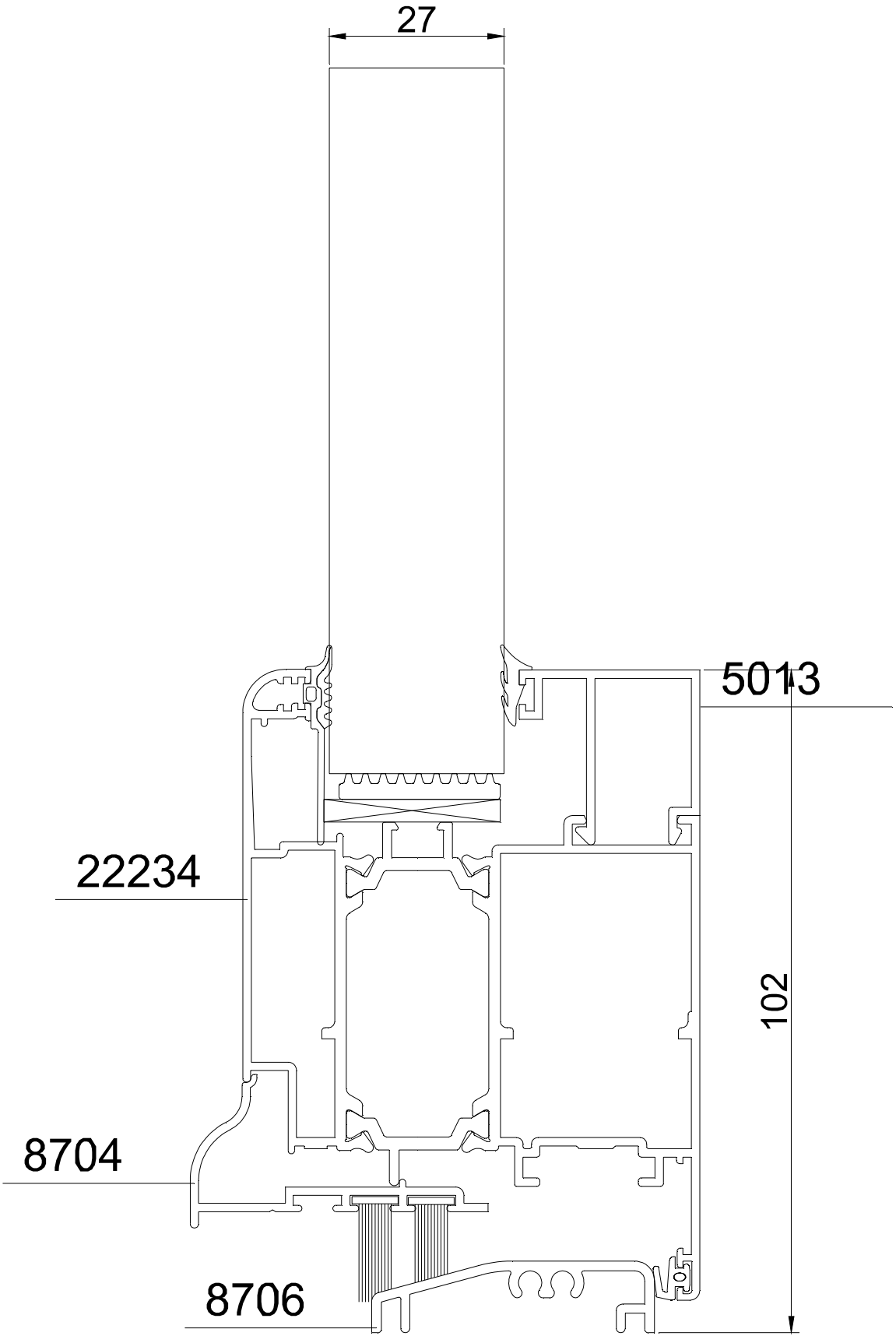
Section ENERGY 22-3

Uf = 2.8 [W/(m² · K)]



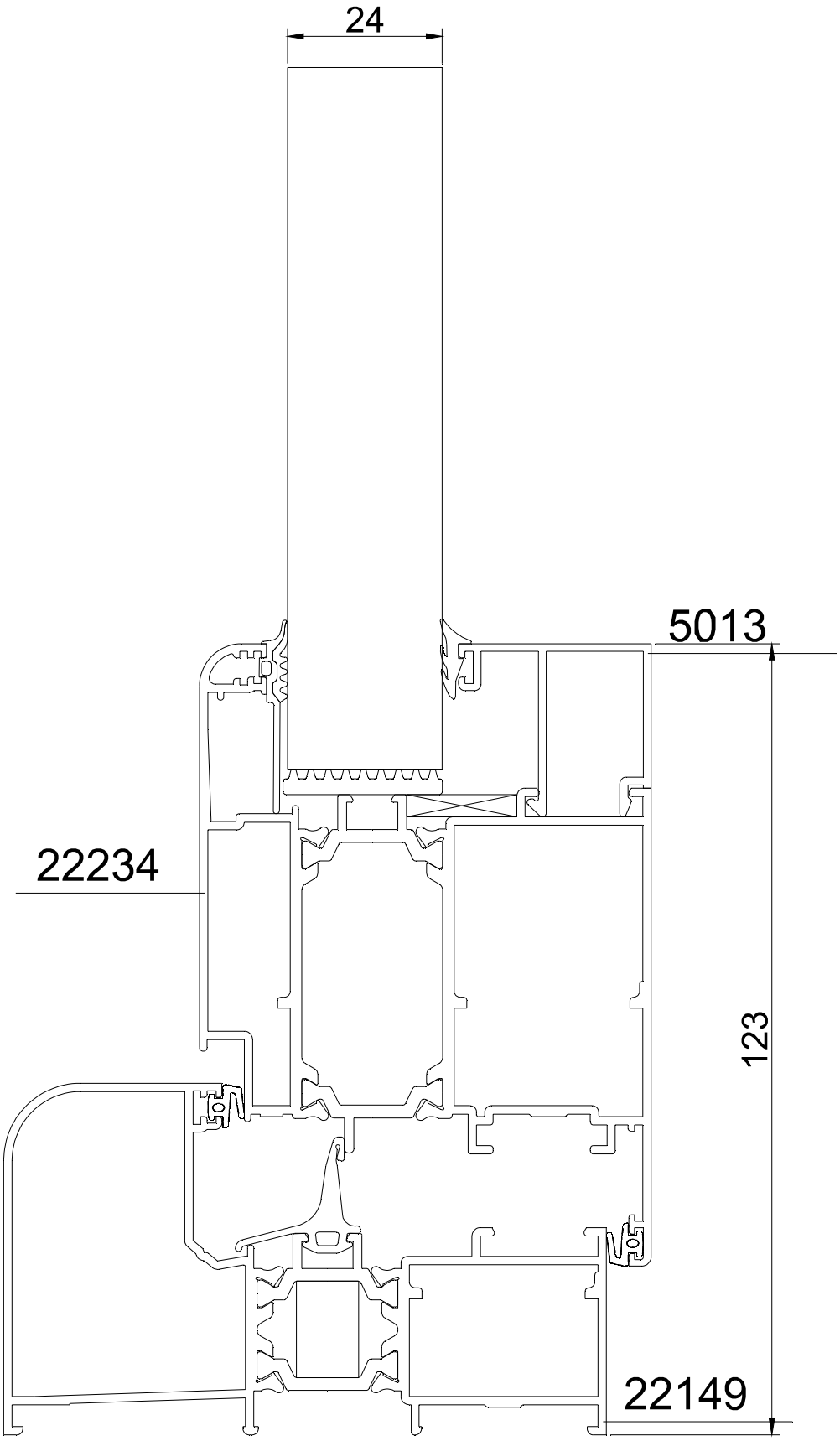
Section ENERGY 22-4

Uf = 3.7[W/(m² · K)]



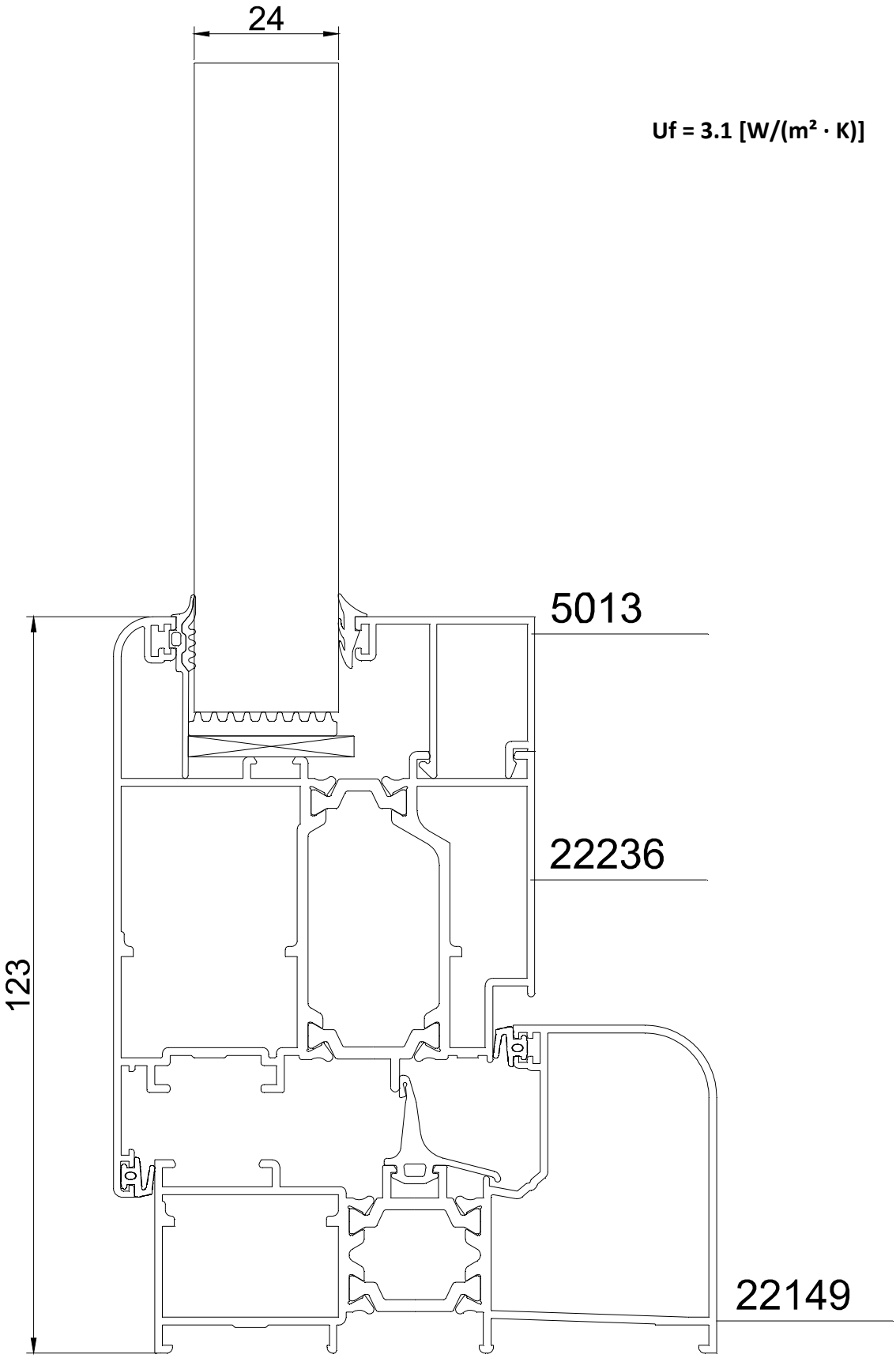
Section ENERGY 22-5

Uf = 2.7 [W/(m² · K)]



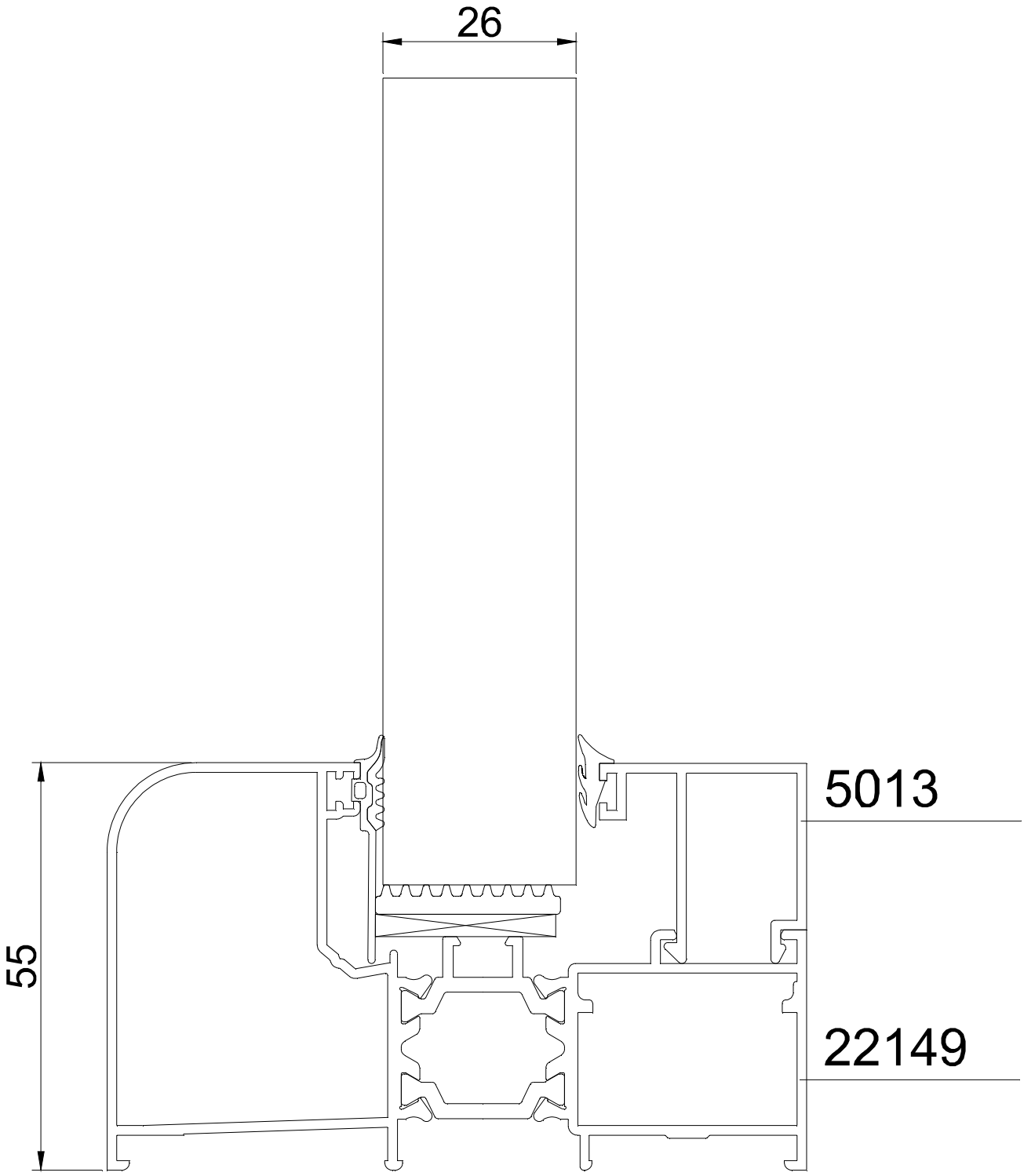
Section ENERGY 22-6

Uf = 3.1 [W/(m² · K)]



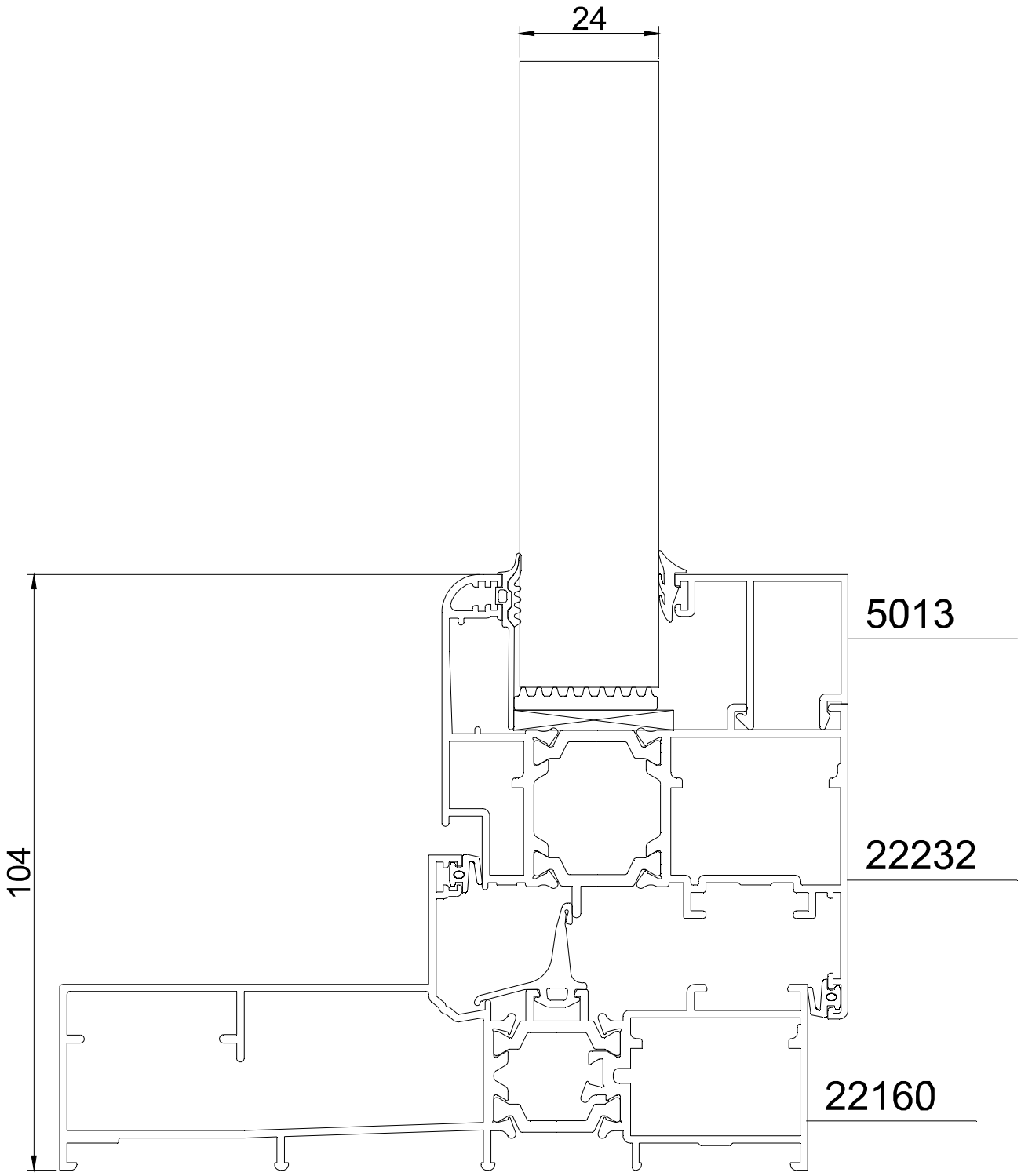
Section ENERGY 22-7

Uf = 2.9[W/(m² · K)]



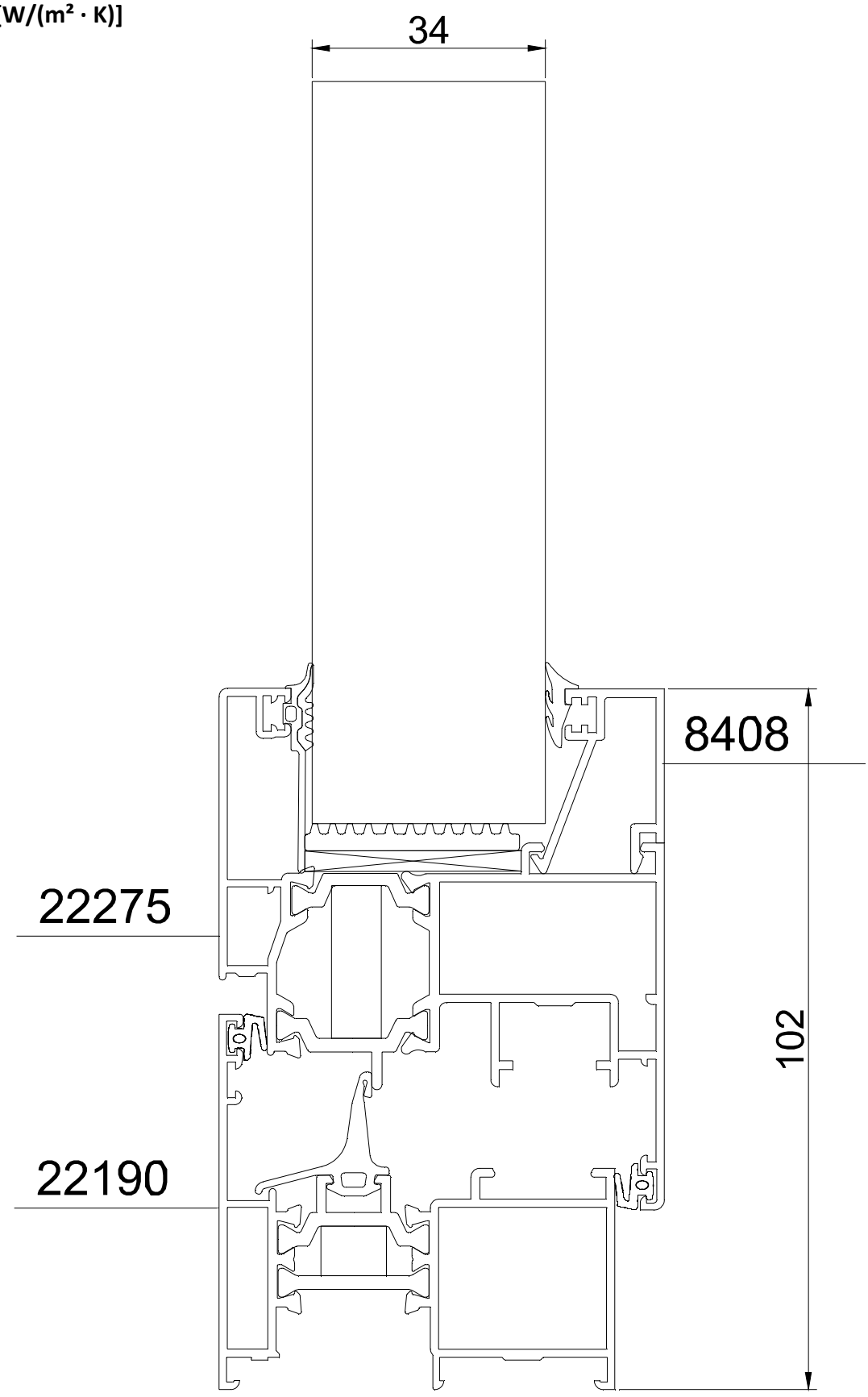
Section ENERGY 22-8

Uf = 2.4 [W/(m² · K)]



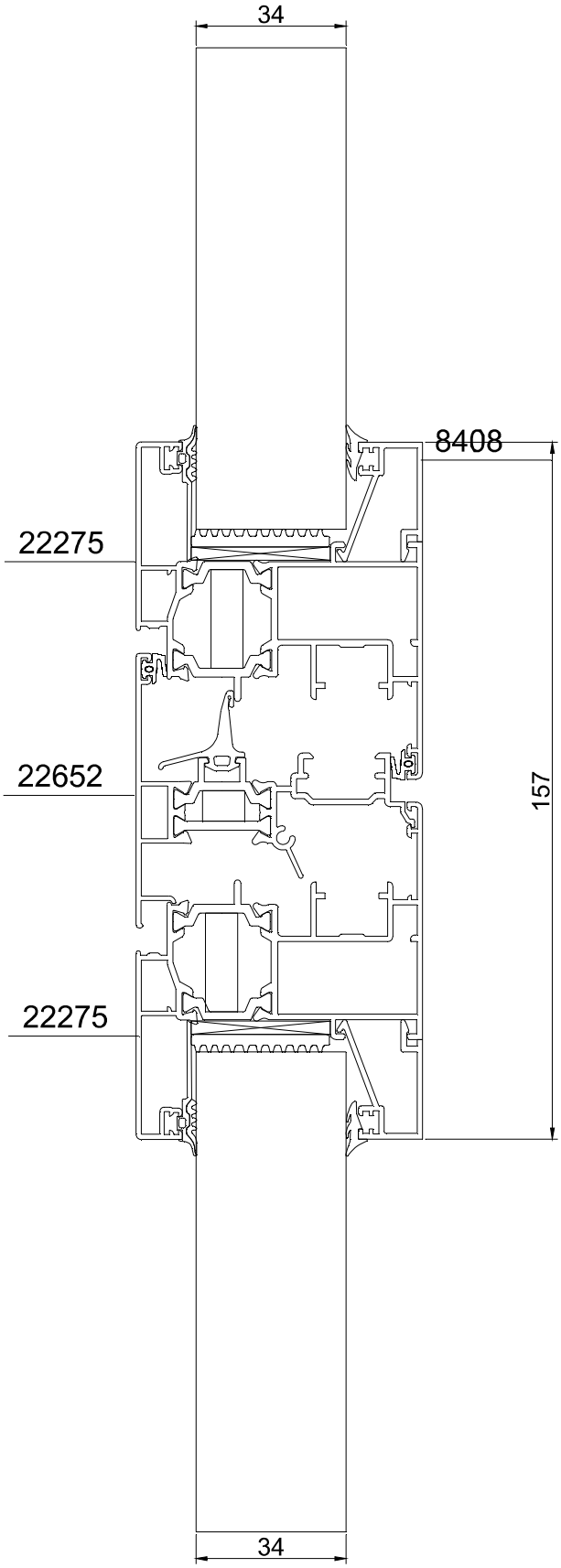
Section ENERGY 22-9

Uf = 2.4 [W/(m² · K)]



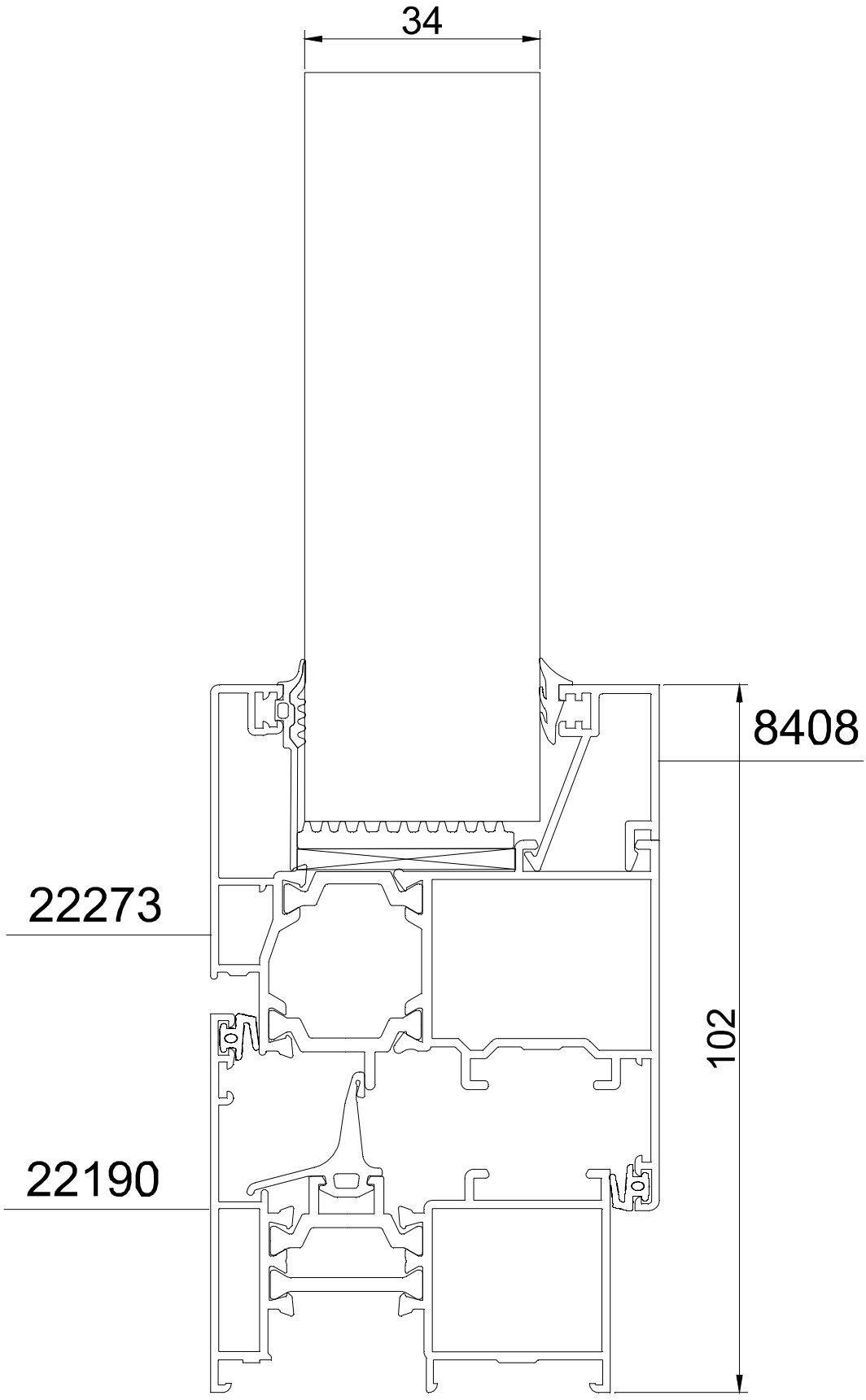
Section ENERGY 22s-1

Uf = 2.5 [W/(m² · K)]



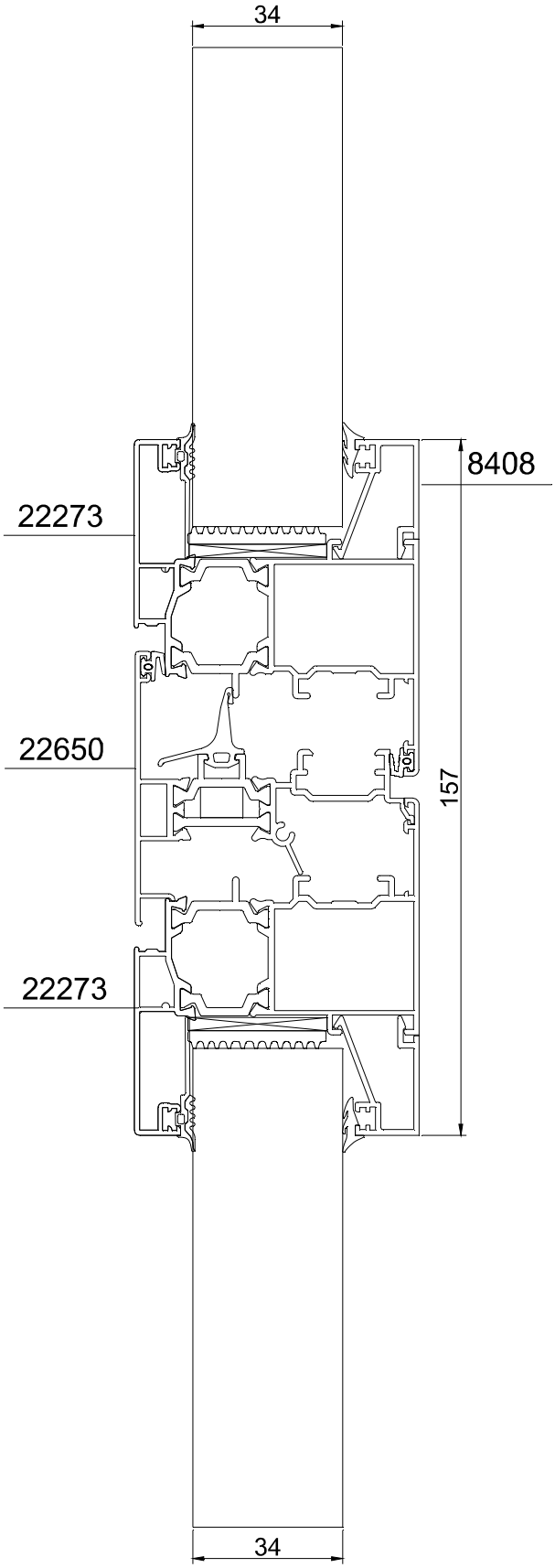
Section ENERGY 22s-2

Uf = 2.7 [W/(m² · K)]



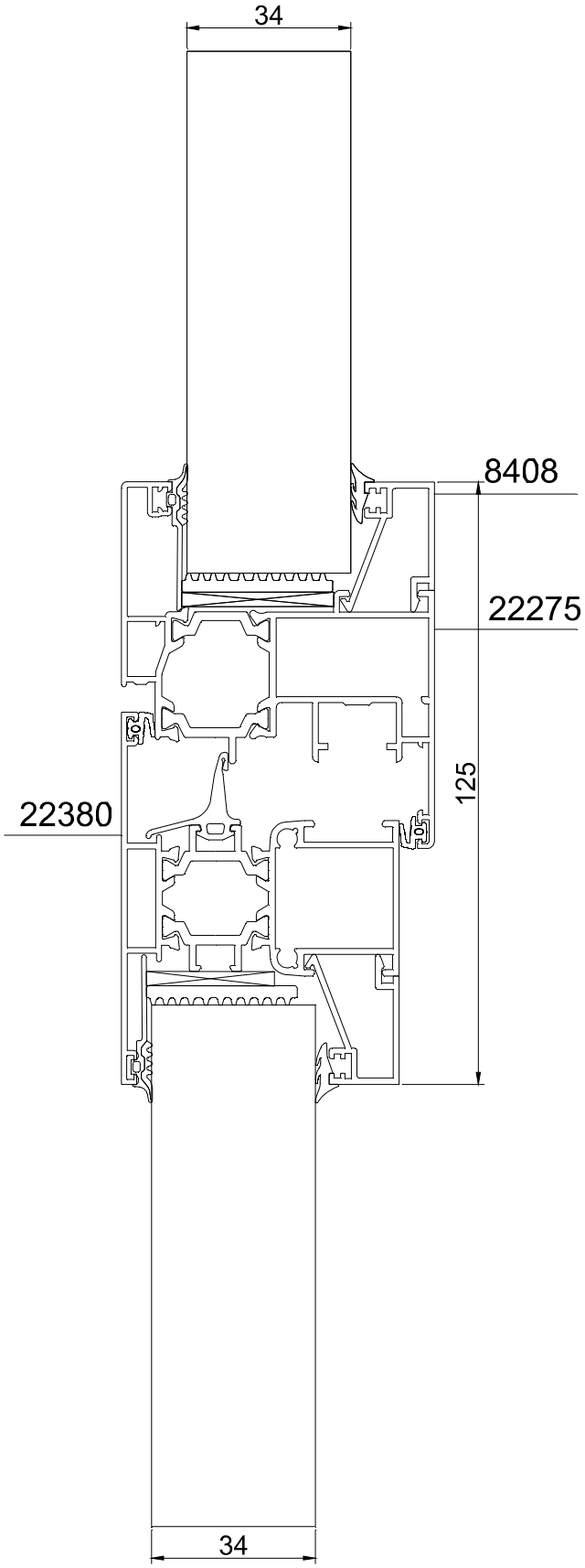
Section ENERGY 22s-3

Uf = 2.8 [W/(m² · K)]



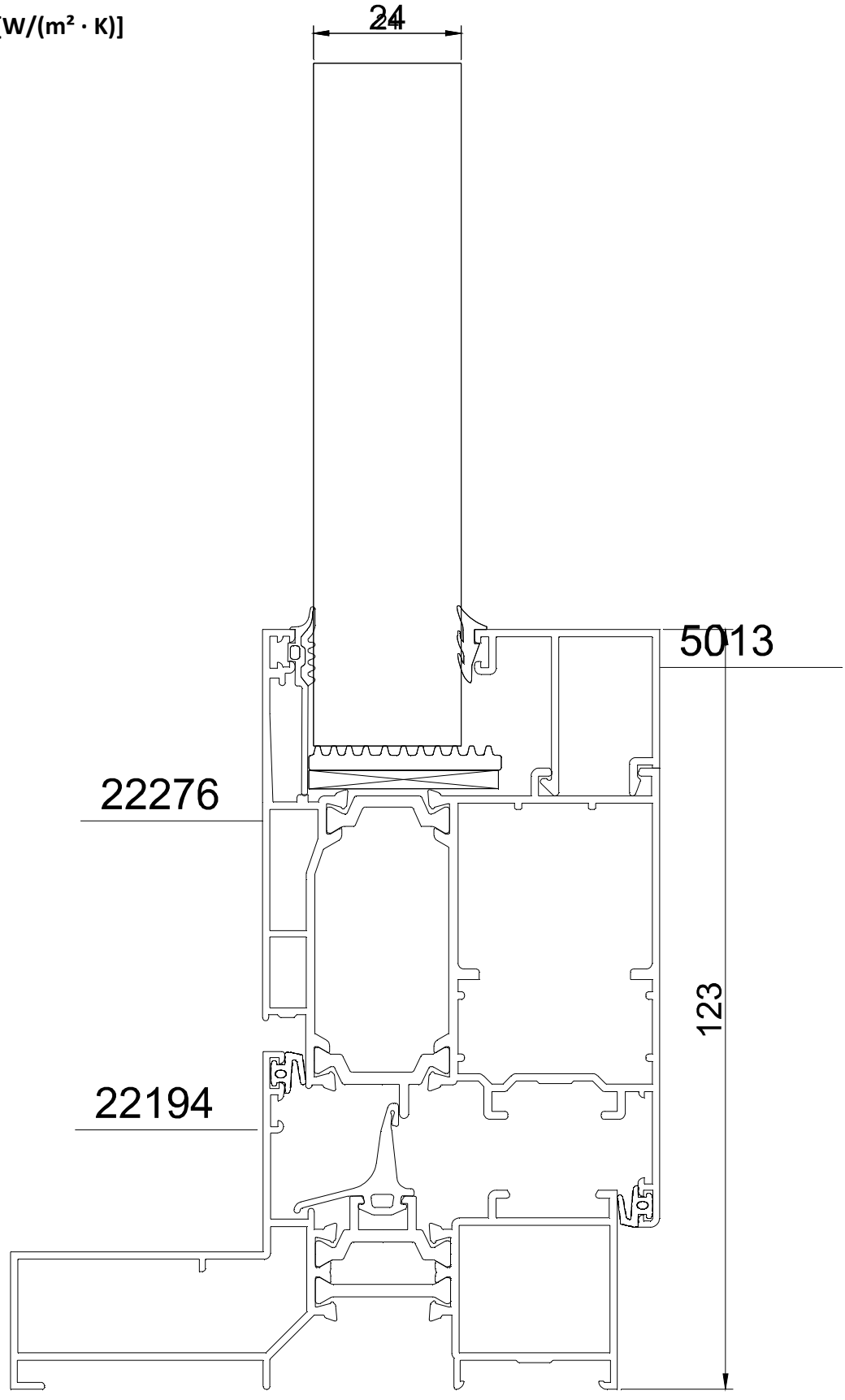
Section ENERGY 22s-4

Uf = 2.5 [W/(m² · K)]



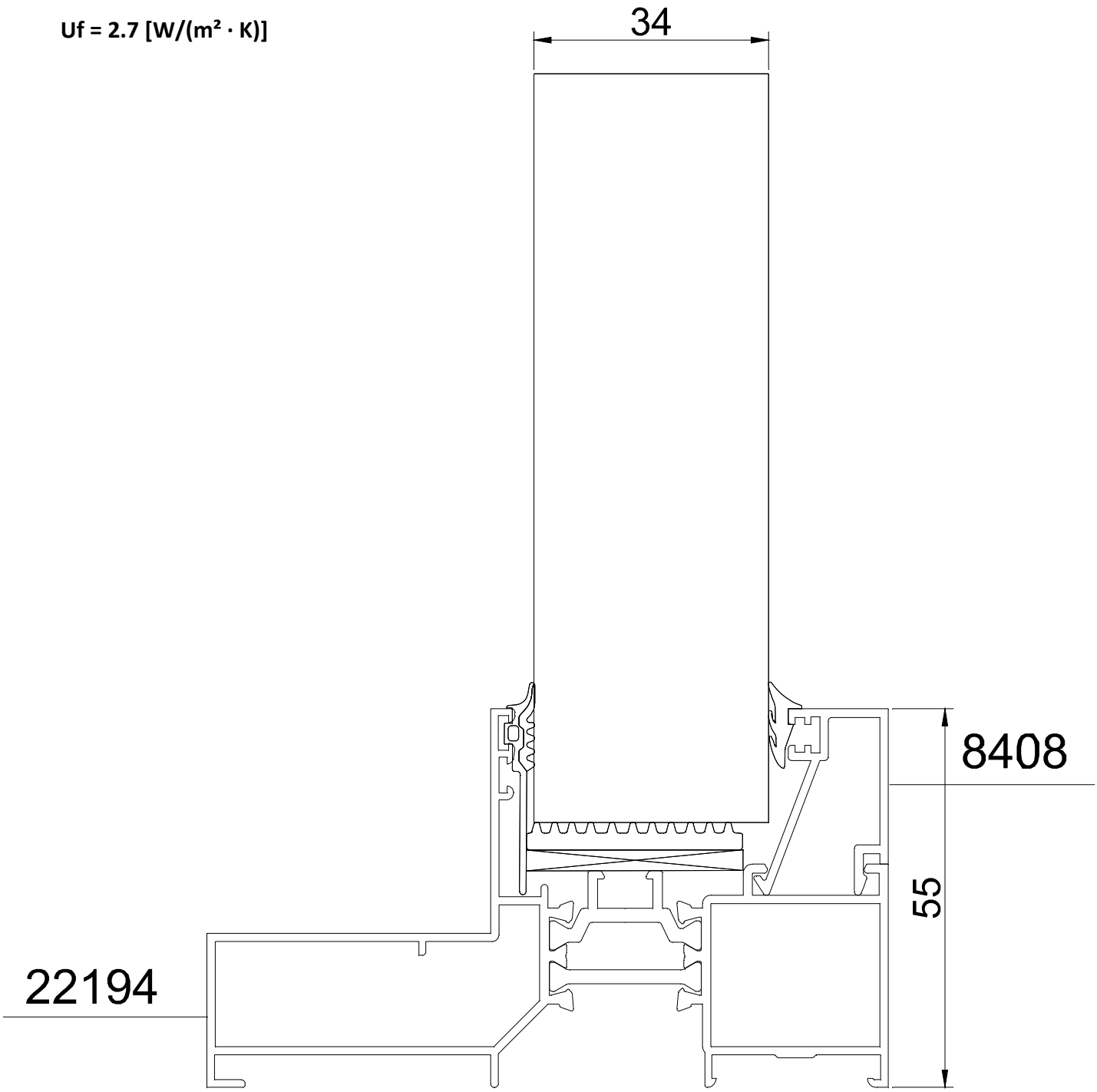
Section ENERGY 22s-5

Uf = 2.8[W/(m² · K)]



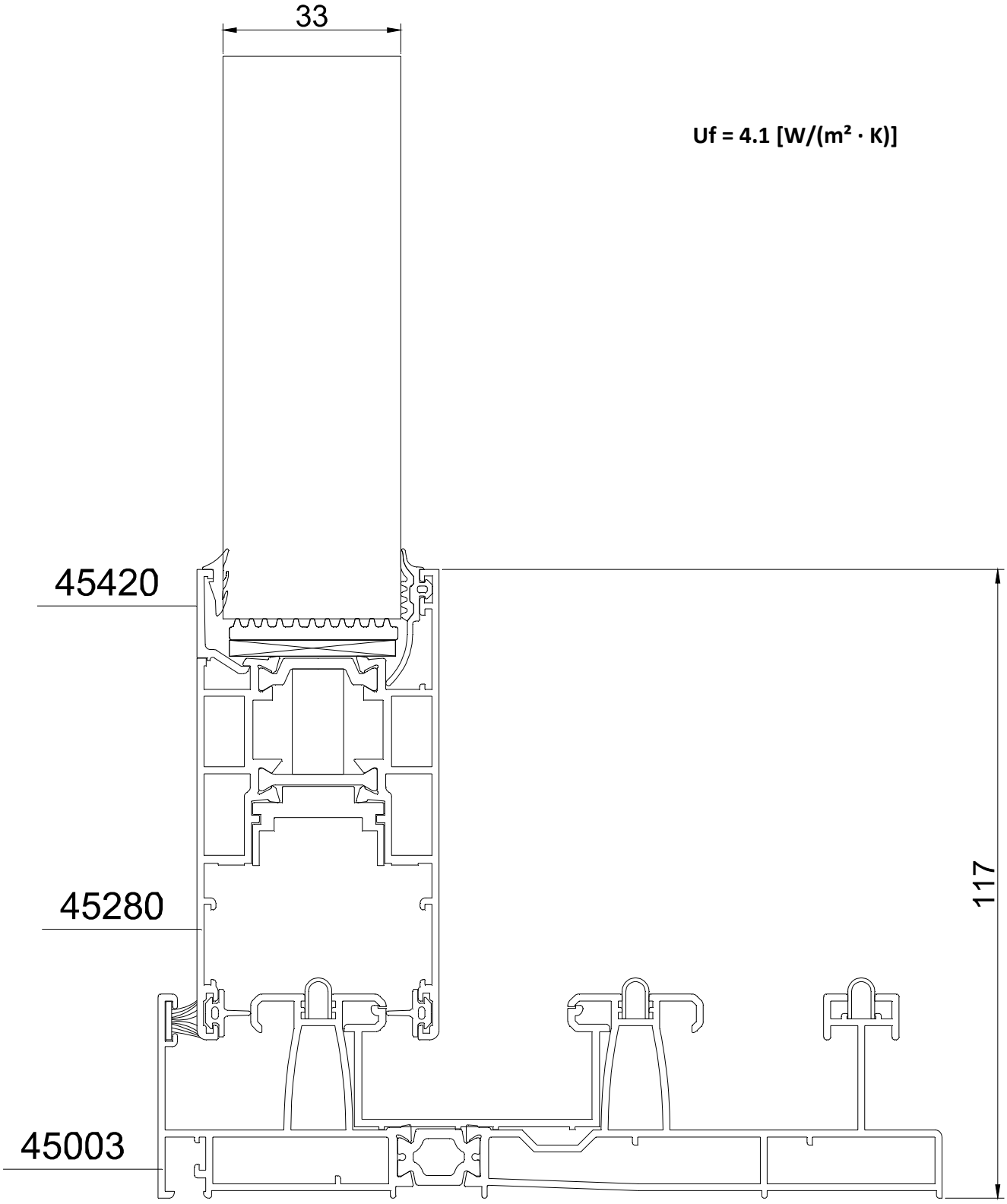
Section ENERGY 22s-6

Uf = 2.7 [W/(m² · K)]



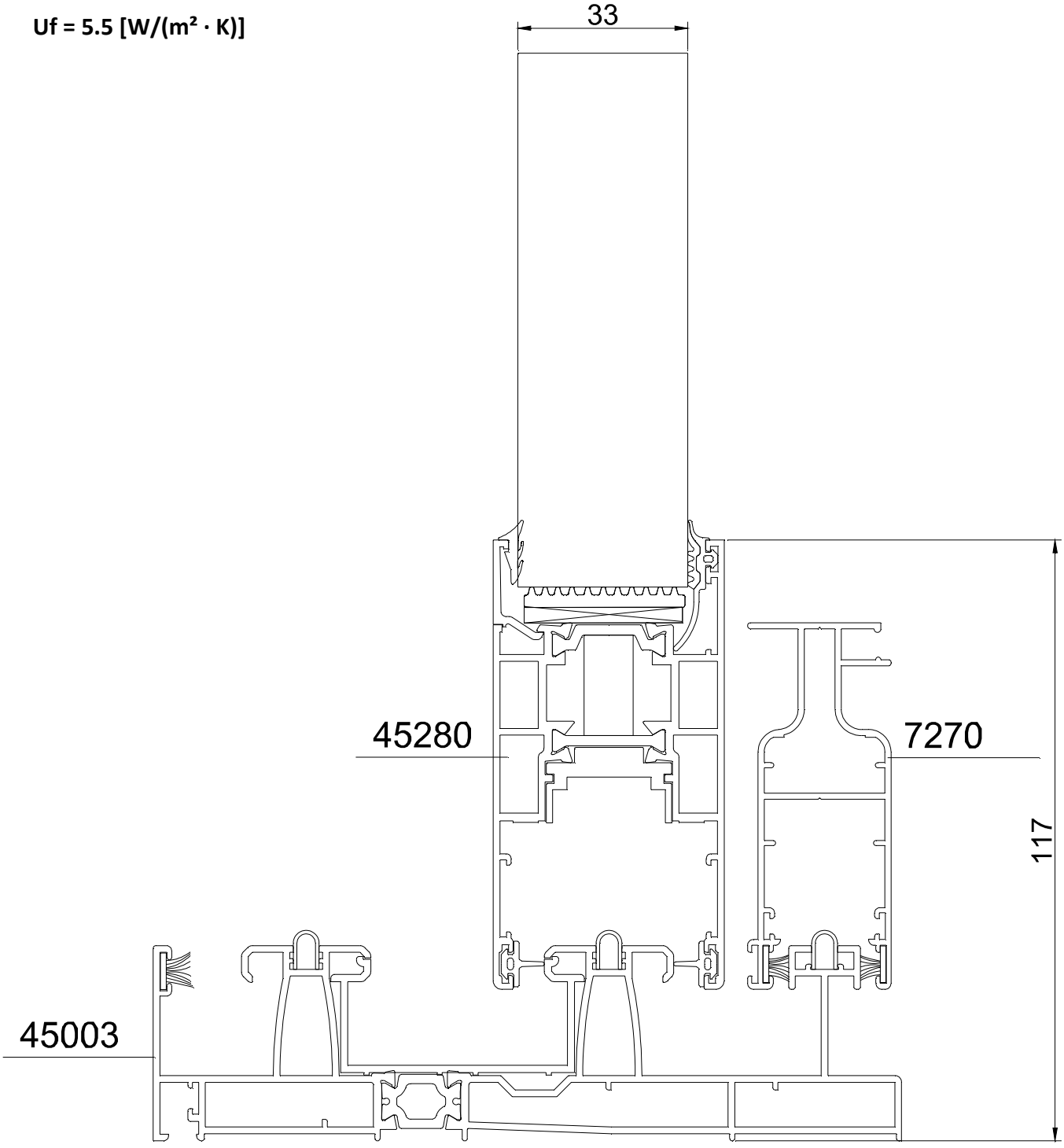
Section ENERGY 22s-7

Uf = 4.1 [W/(m² · K)]



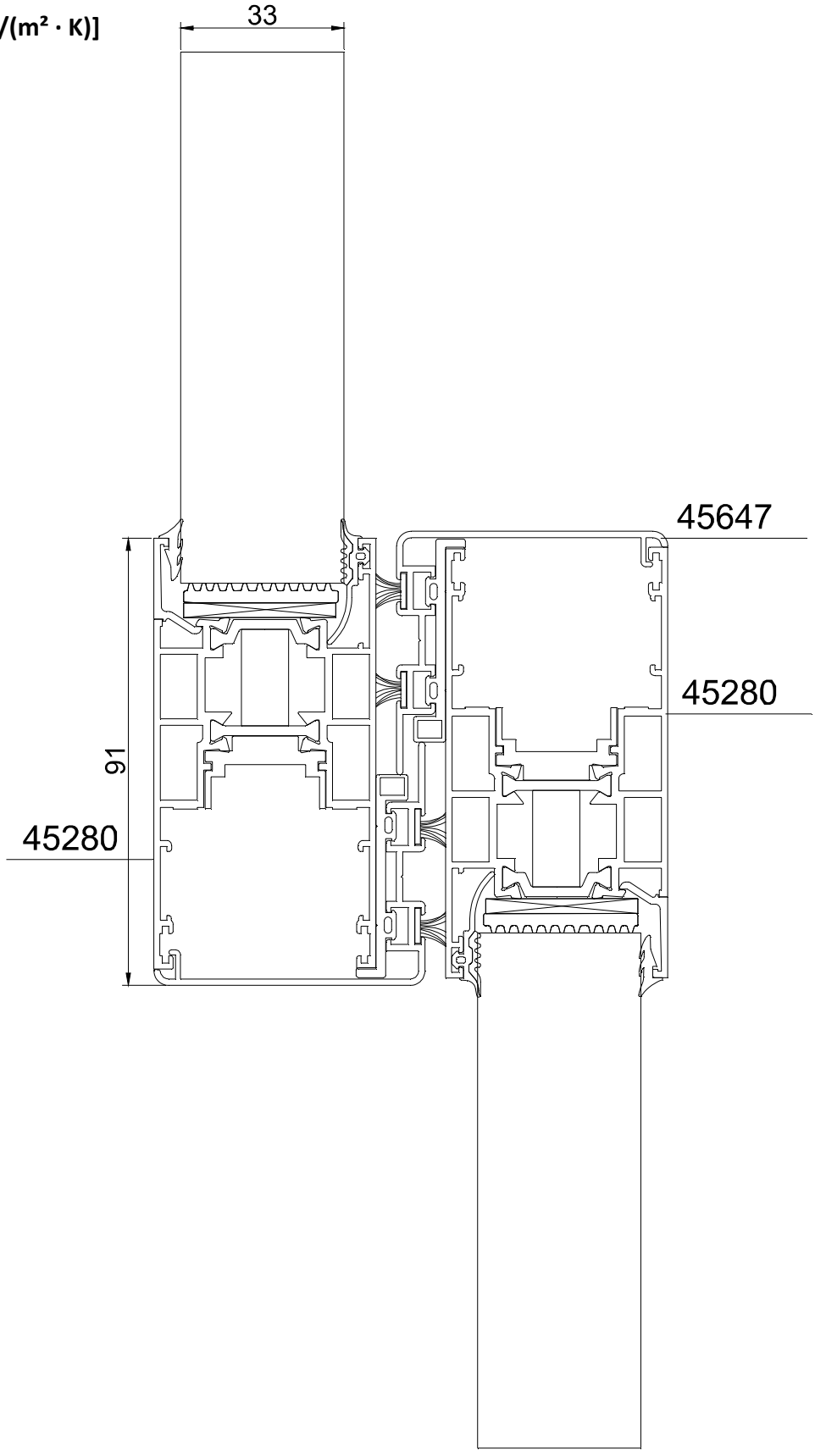
Section ENERGY 45-1

Uf = 5.5 [W/(m² · K)]



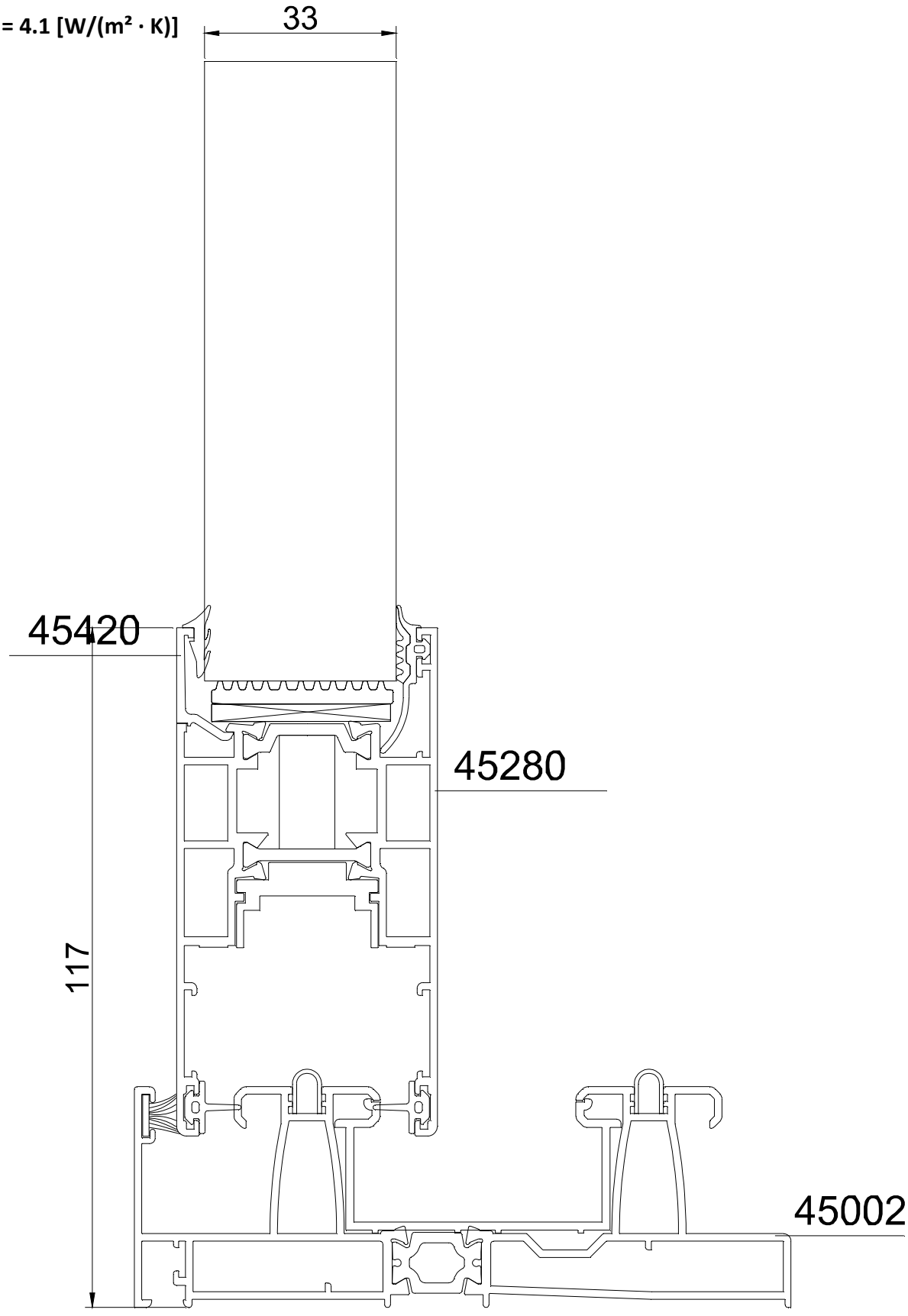
Section ENERGY 45-2

Uf = 5.5 [W/(m² · K)]



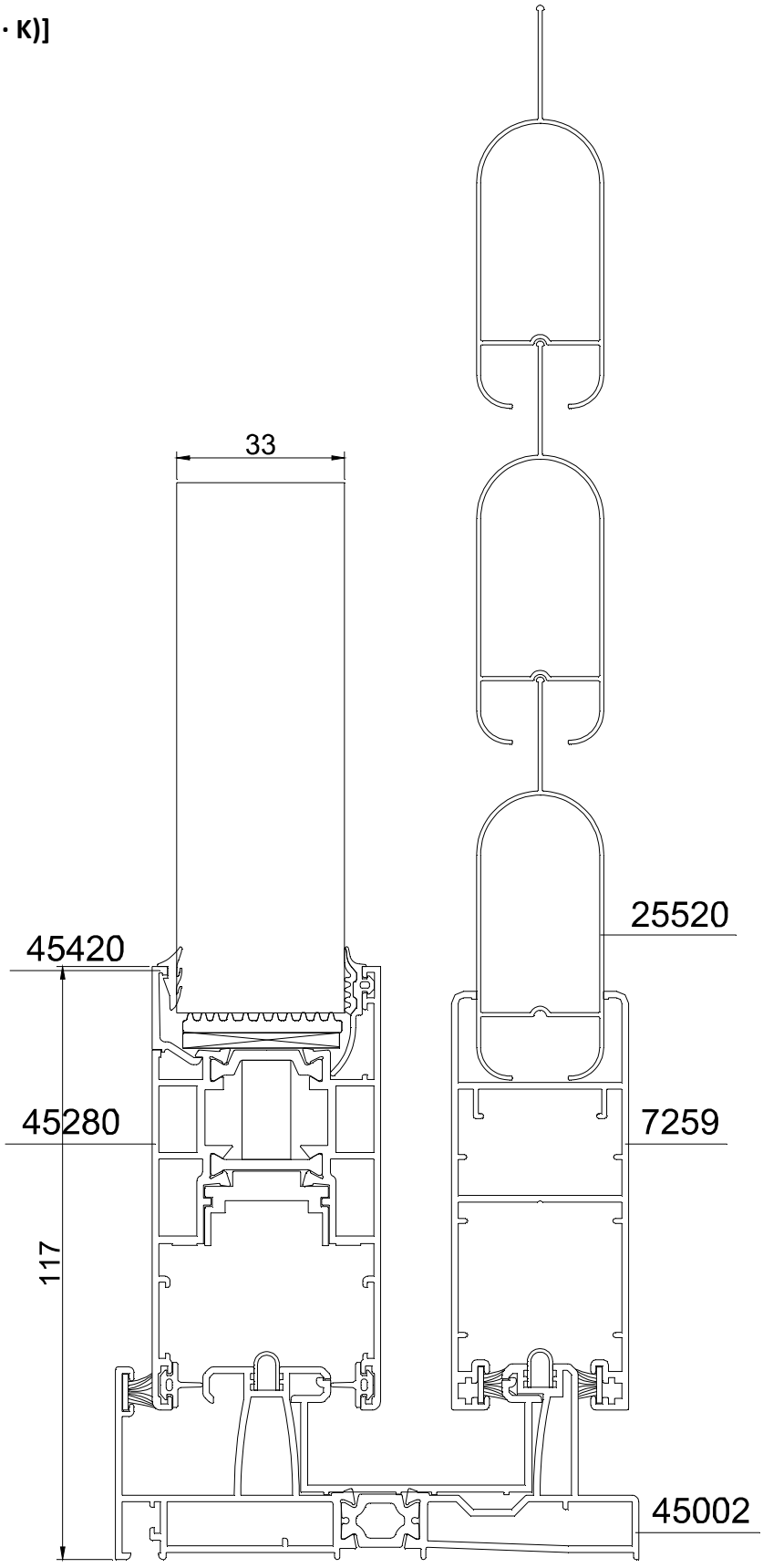
Section ENERGY 45-3

Uf = 4.1 [W/(m² · K)]



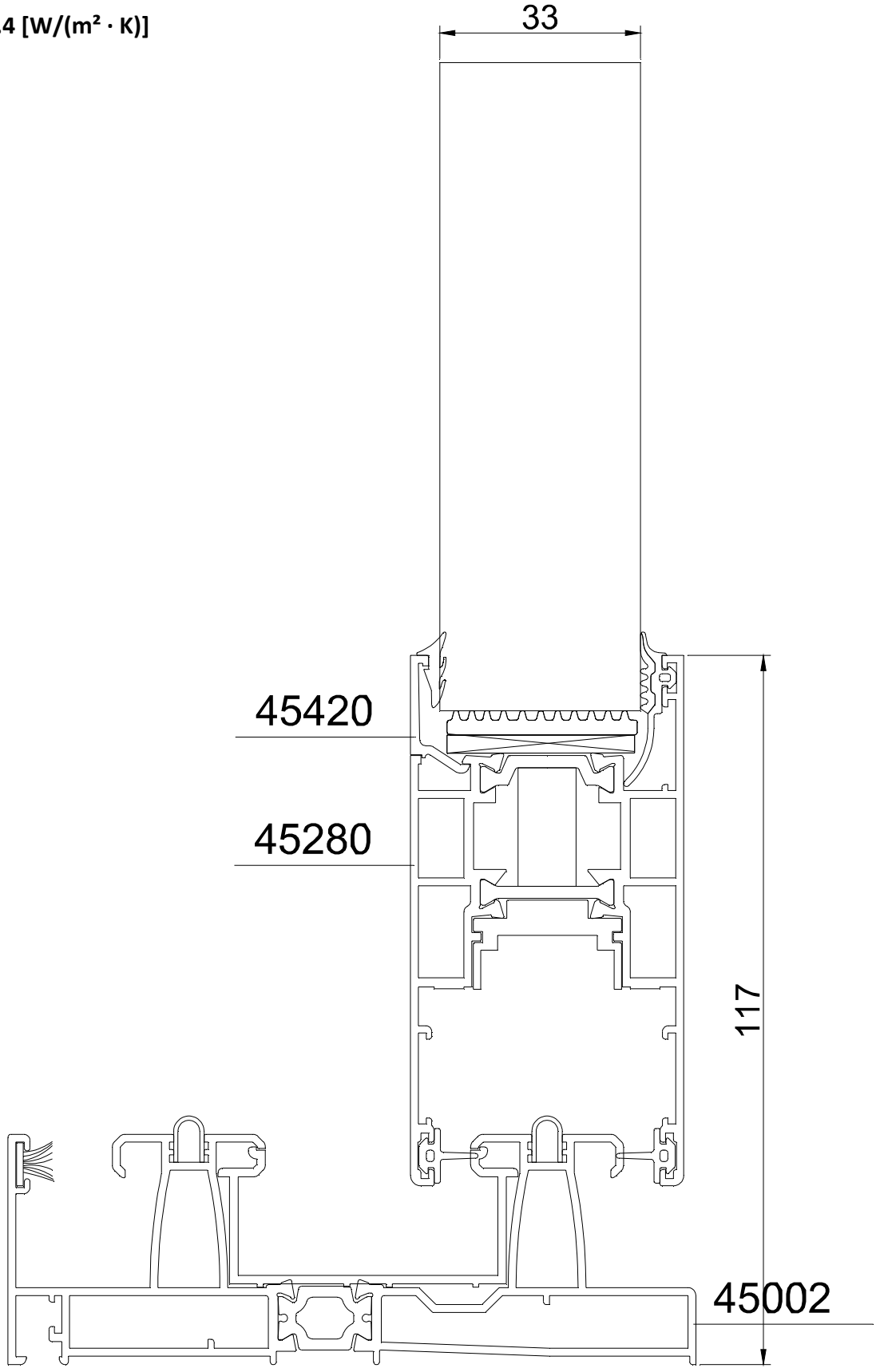
Section ENERGY 45-4

Uf = 4.1 [W/(m² · K)]



Section ENERGY 45-5

Uf = 4.4 [W/(m² · K)]



Section ENERGY 45-6

Manufacturing site*

METALOUMIN S.A. - 20 Ag. Fanouriou Str., Ktipito - 13671 ACHARNE - Greece.

Normative references

Standard	Title
UNI EN 14351-1:2016	Windows and doors - Product standard, performance characteristics - Part 1: Windows and external pedestrian doorsets*
EN ISO 10077-2:2017	Thermal performance of windows, doors and shutters - Calculation of thermal transmittance - Part 2: Numerical method for frames (ISO 10077-2:2017)

(*) subclause 4.12 "Thermal transmittance" and annex E "Determination of characteristics".

Method

Calculation procedure and conditions

The calculation was performed using detailed internal procedure PP072 in its current revision at testing date, on the basis of the drawings provided by the customer, using a numerical finite-element program, complying with standard EN ISO 10077-2, with a triangular discretization with the maximum side 0,5 mm, of 45798 and 155937 points. Air spaces were calculated in accordance with clause 6.4.2 of standard EN ISO 10077-2 (radiosity method), assuming that the emissivity of materials is 0,9. The frame thermal transmittance value "U_f" was calculated by inserting an insulation panel of thermal conductivity $\lambda = 0{,}035$ W/(m² · K) in place of the glazing, as specified by annex F of standard EN ISO 10077-2. The frame thermal transmittance value "U_f", expressed in W/(m² · K), was calculated using the following equation:

$$U_f = \frac{L_f^{2D} - U_p b_p}{b_f}$$

where: L_f^{2D} = thermal conductance of the section, expressed in W/(m · K);
U_p = thermal transmittance of the central area of the panel, expressed in W/(m² · K);
b_p = visible width of the panel, expressed in m;
b_f = projected width of the frame section (without protrudine gaskets), expressed in m.

(*) according to that stated by the customer.

Calculation data

		Value	Data source
Temperature	External temperature	0 °C	EN ISO 10077-2, clause 6.3.4
	Internal temperature	20 °C	
Surface thermal resistance	External surface thermal resistance "R_{se}"	0,04 m² · K/W	EN ISO 10077-2, table E.1
	Internal surface thermal resistance for surfaces with standard view factor "R_{si}"	0,13 m² · K/W	
	Internal surface thermal resistance for surfaces with reduced view factor	0,20 m² · K/W	
Characteristics of the frames used for the calculation of the parameter "U_f"	Thermal conductivity of aluminium	160 W/(m · K)	EN ISO 10077-2, table D.1
	Thermal conductivity of steel	50 W/(m · K)	
	Thermal conductivity of EPDM	0,25 W/(m · K)	
	Thermal conductivity of polyamide reinforced	0,30 W/(m · K)	
	Thermal conductivity of polypropylene reinforced	0,25 W/(m · K)	
	Thermal conductivity of elastomeric foam	0,05 W/(m · K)	
	Thermal conductivity of rigid PVC	0,17 W/(m · K)	
	Thermal conductivity of EPS	0,031 W/(m · K)	Manufacturer's data sheet provided by the costumer
	Materials emissivity	0,9	EN ISO 10077-2, table D.3