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CALCULATION REPORT No. 325935/9273/CPR

**issued by Istituto Giordano in the capacity of notified testing laboratory (No. 0407)
pursuant to Regulation 305/2011/UE of the European Parliament and of the Council of 09/03/2011**

Place and date of issue: Bellaria-Igea Marina - Italy, 30/06/2015

Customer: EXALCO S.A. R&D Dept. - 5th km Old Nat. Road Larisas-Athinas - 41110 LARISA - Greece

Date calculation requested: 17/04/2015

Order number and date: 66278, 17/04/2015

Date drawing received: 16/03/2015

Date calculation performed: 30/04/2015

Purpose of calculation: calculation of thermal transmittance of a frame constructed from alumini-
um profiles with thermal break in accordance with standard UNI EN ISO
10077-2:2012 with reference to product standard UNI EN 14351-1:2010

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

Drawing origin: supplied by Customer

Name of window assembly*

The window assembly for which the calculation is performed is called "ALBIO 127C".

(*) according to that stated by the Customer.

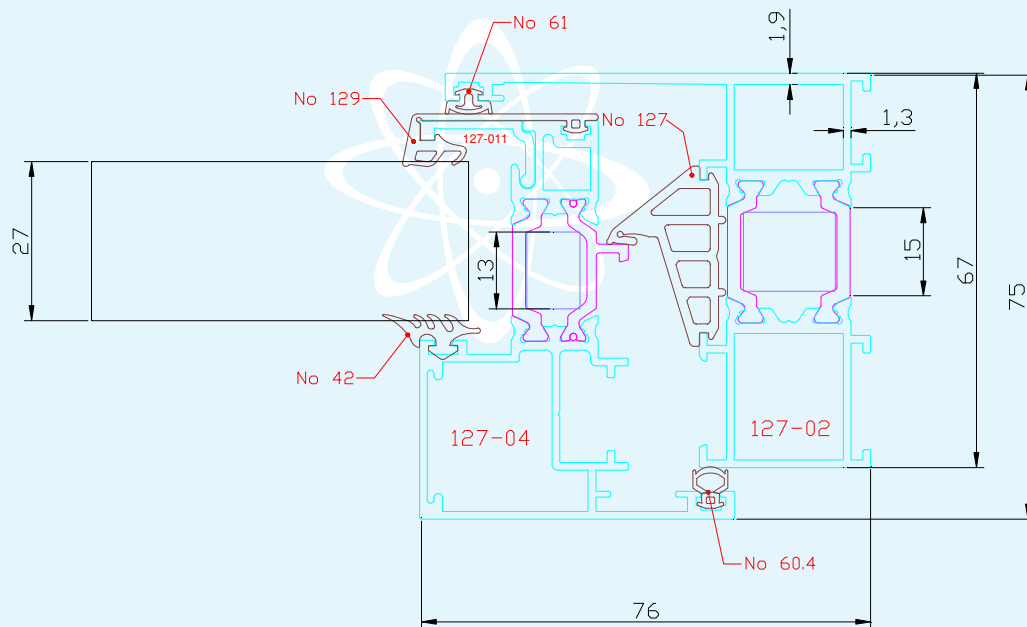| Comp. AV Revis. CB	This calculation report consists of 11 sheets.	Sheet 1 of 11

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Description of window*

The frame assembly for which the calculation is performed consists of aluminium profiles with polyamide strips of length 15 mm to provide thermal break. The cavities between the polyamide bars are filled with NOMATEC XPE038 .
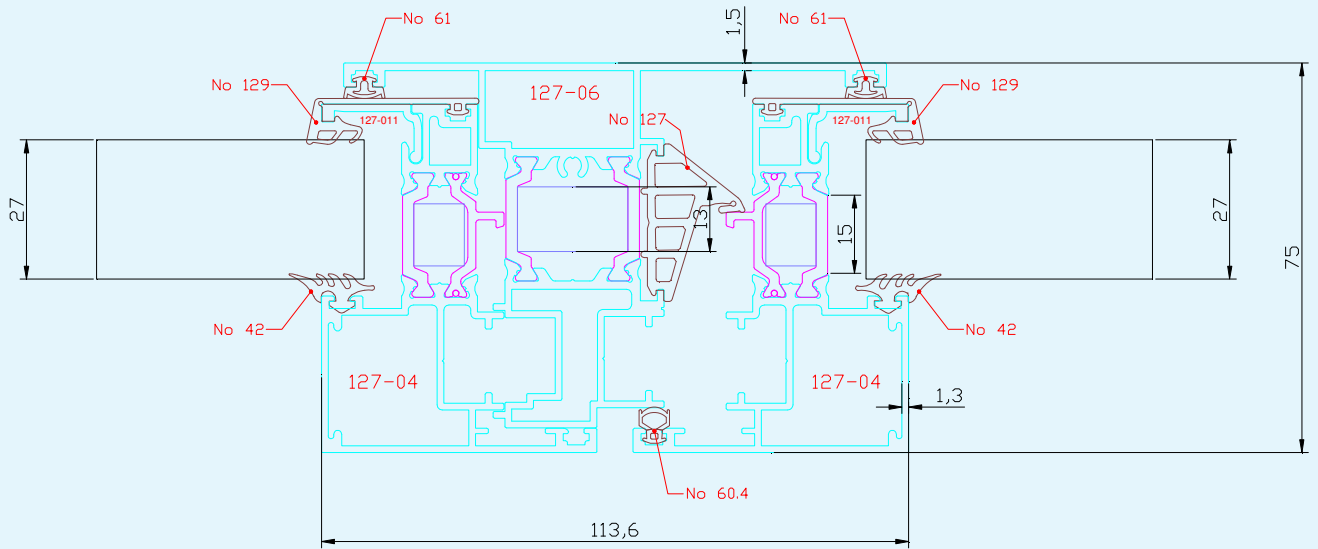
The calculation was performed on the basis of Customer-supplied drawings using the glazing with thickness 27 mm.
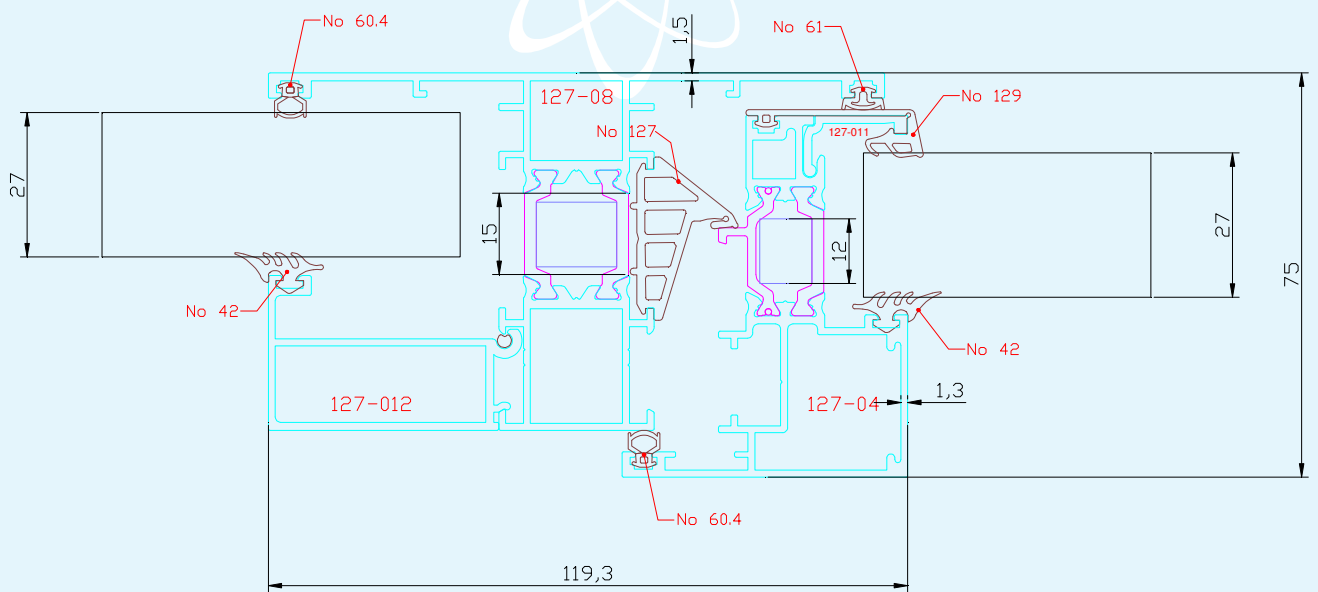
DRAWINGS OF THE SECTIONS CONSIDERED
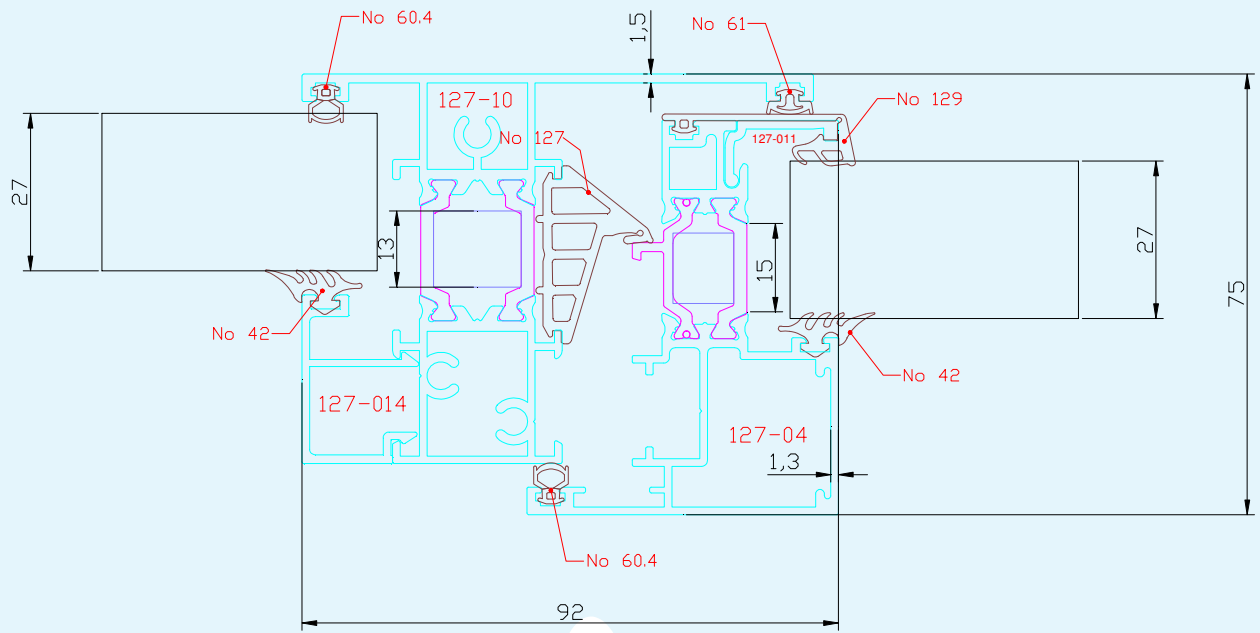

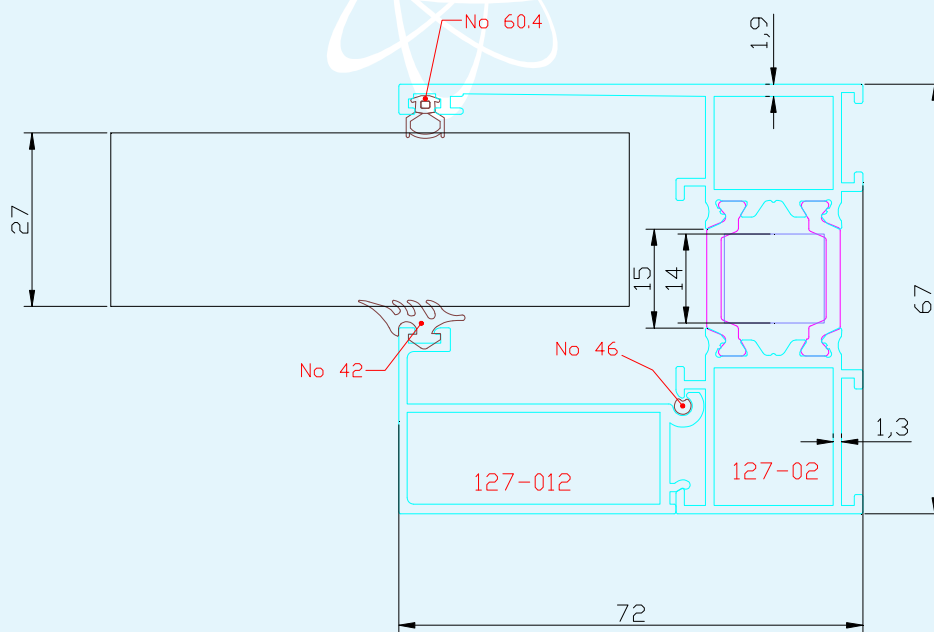**Section 1**

(*) according to that stated by the Customer.

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No 61
No 129
127-011
127-06
No 127
1,5
No 61
No 129
127-011
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13
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No 42
No 42
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127-04
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No 60.4
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Section 2

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No 129
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No 42
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Section 3

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No 60.4
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127-10
No 127
No 129
127-011
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No 42
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127-014
127-04
No 42
1,3
No 60.4
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Section 4

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1,9
27
15
14
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127-02
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Section 5

Normative references

The calculation was carried out in accordance with the requirements of the following standards:

- UNI EN ISO 10077-2:2012 del 12/04/2012 "Prestazione termica di finestre, porte e chiusure - Calcolo della trasmittanza termica - Metodo numerico per i telai" *("Thermal performance of windows, doors and shutters - Calculation of thermal transmittance - Numerical method for frames")*;

- UNI EN 14351-1:2010 del 15/04/2010 "Finestre e porte - Norma di prodotto, caratteristiche prestazionali. Parte 1: Finestre e porte esterne pedonali senza caratteristiche di resistenza al fuoco e/o di tenuta al fumo" *("Windows and doors - Product standard, performance characteristics. Part 1: Windows and external pedestrian doorsets without resistance to fire and/or smoke leakage characteristics")*, subclause 4.12 "Trasmittanza termica" *("Thermal transmittance")* and Annex E "Determinazione delle caratteristiche" *("Determination of characteristics")*.

Calculation method and conditions
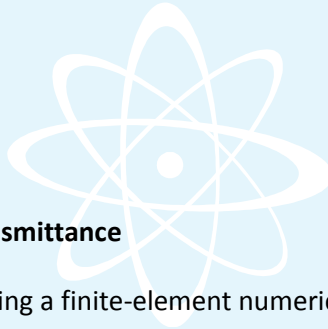
Calculation of frame thermal transmittance

The calculation was performed using a finite-element numerical programme complying with standard UNI EN ISO 10077-2 and with a discretisation, with the maximum side 0,5 mm, with a number of points from 46253 to 88101 points. Air spaces were calculated by assigning each one an equivalent thermal conductivity calculated in accordance with the equation specified by standard UNI EN ISO 10077-2, 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 C of standard UNI EN ISO 10077-2. This value does not include the additional heat flow caused by the interaction of the frame and the glass edge, including the effect of the spacer. This effect is represented by the value of the linear thermal transmittance, "Ψ_g".

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Calculation data

Data for determining frame thermal transmittance

Frame thermal transmittance was calculated under the following conditions:

Temperature	External temperature	0 °C
	Internal temperature	20 °C
Surface thermal resistance	External surface thermal resistance "R_{se}"	0,04 m² · K/W
	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
Thermal characteristics of frame	Thermal conductivity of aluminium	160 W/(m · K)
	Thermal conductivity of polyamide	0,30 W/(m · K)
	Thermal conductivity of EPDM	0,25 W/(m · K)
	Thermal conductivity of NOMATEC XPE038*	0,038 W/(m · K)

(*) data provided by the Customer using manufacturer's data sheet.

## Calculation result

Frame thermal transmittance

Frame thermal transmittance value calculated in accordance with standard UNI EN ISO 10077-2 is:

Section	Width considered b_f [mm]	Thermal transmittance U_f [W/(m² · K)]
1	76	2,96
2	114	2,93
3	119	2,67
4	92	3,01
5	72	2,42

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ISOTHERMS AND FLOW LINES FOR THE SECTIONS CONSIDERED
SECTION 1

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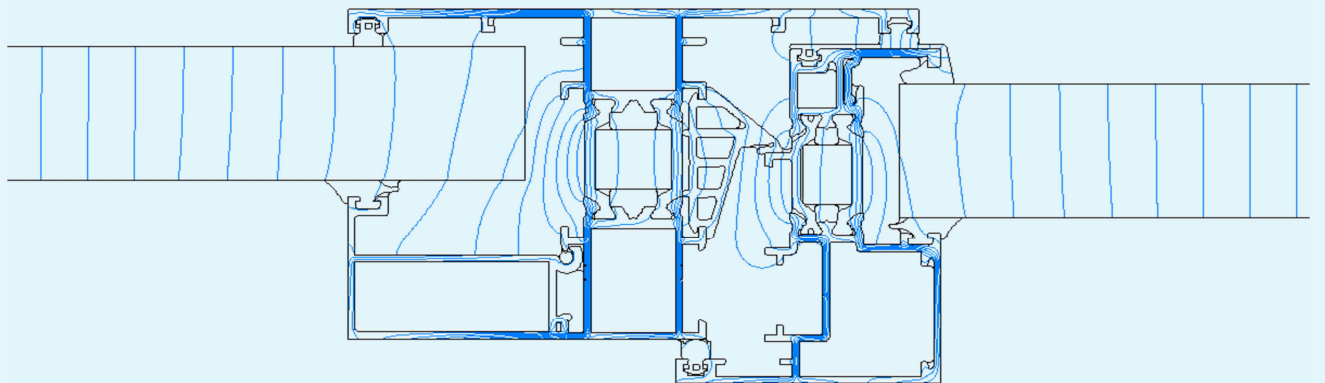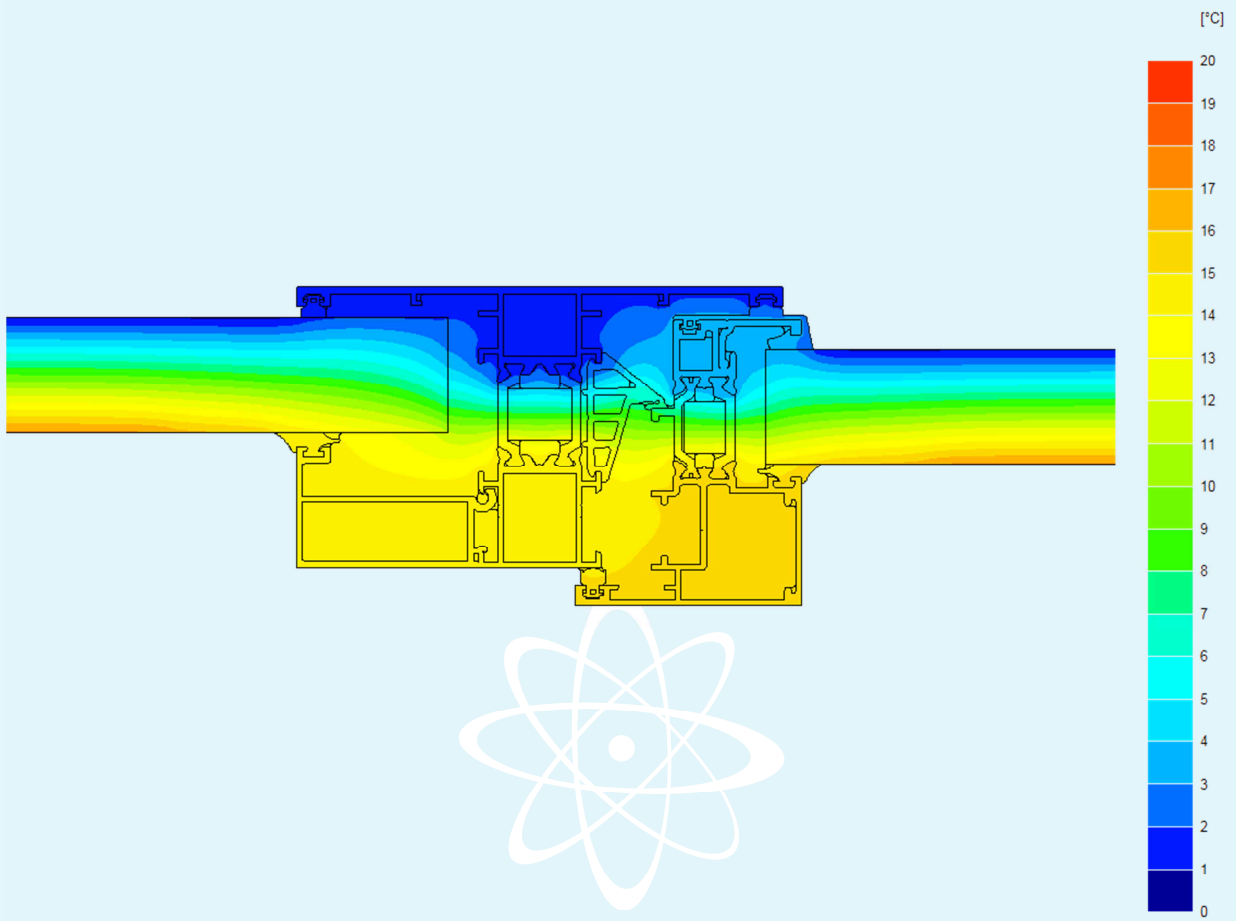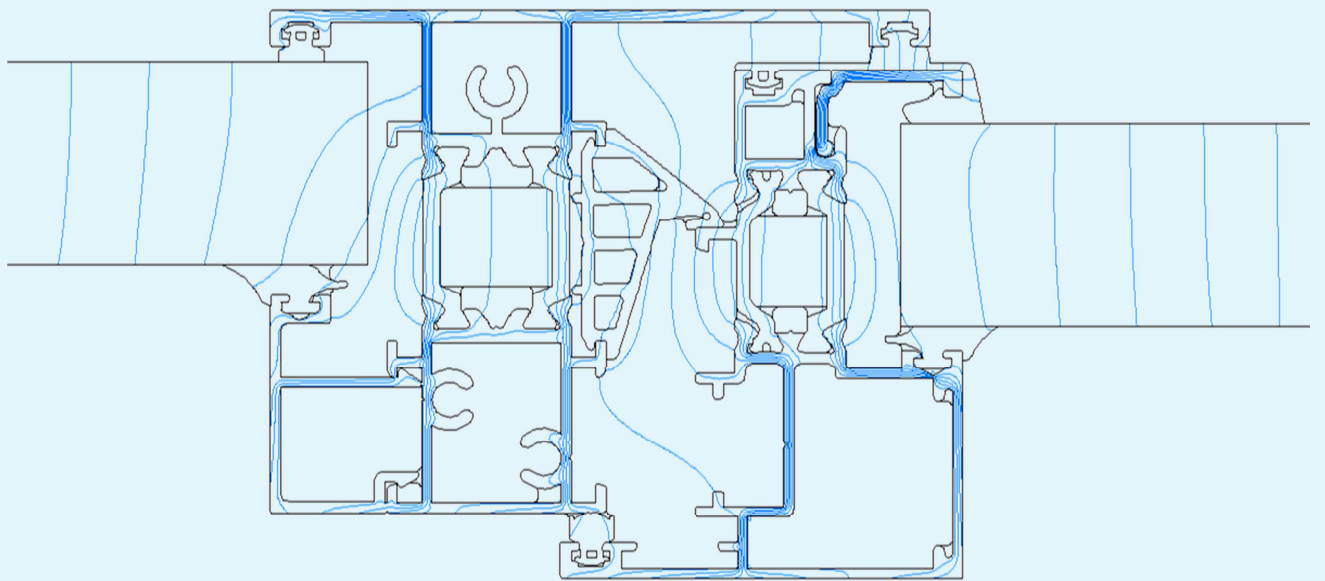**ISOTHERMS AND FLOW LINES FOR THE SECTIONS CONSIDERED**
SECTION 1

ISTITUTO GIORDANO
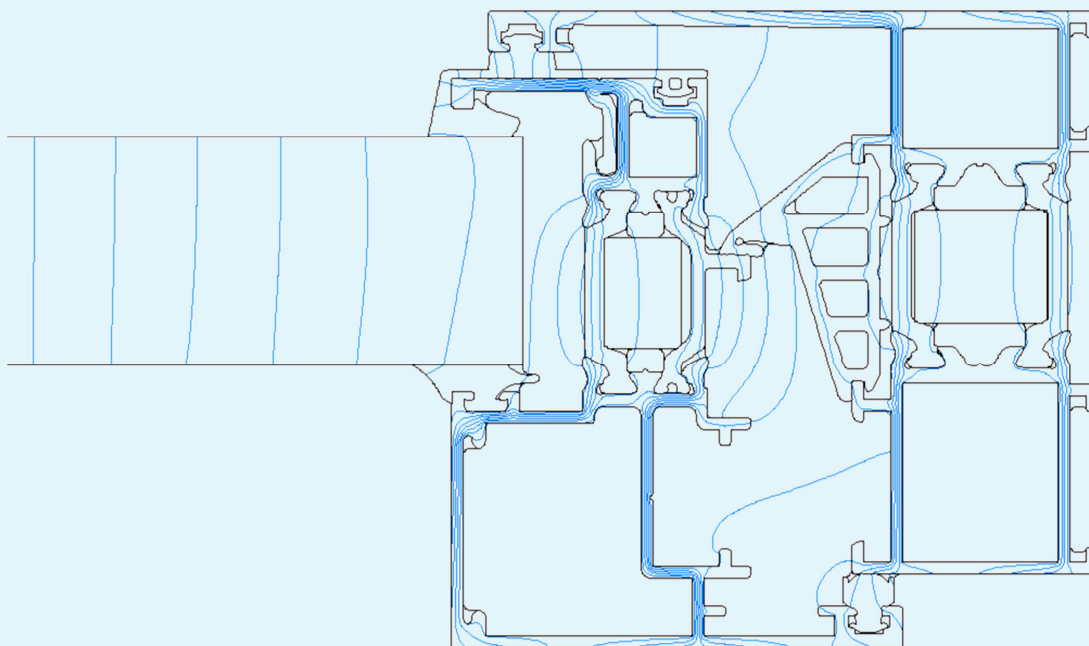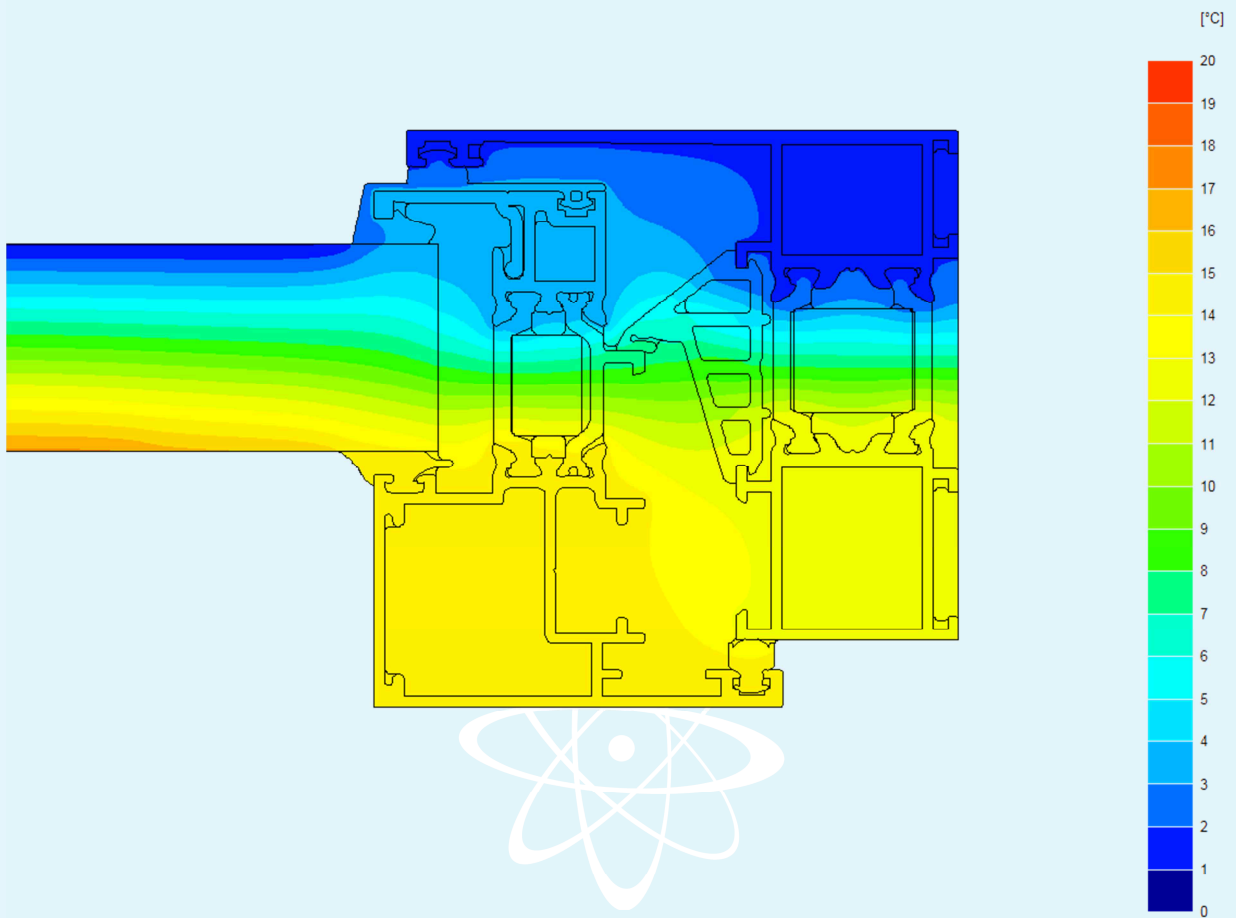
ISOTHERMS AND FLOW LINES FOR THE SECTIONS CONSIDERED
SECTION 2

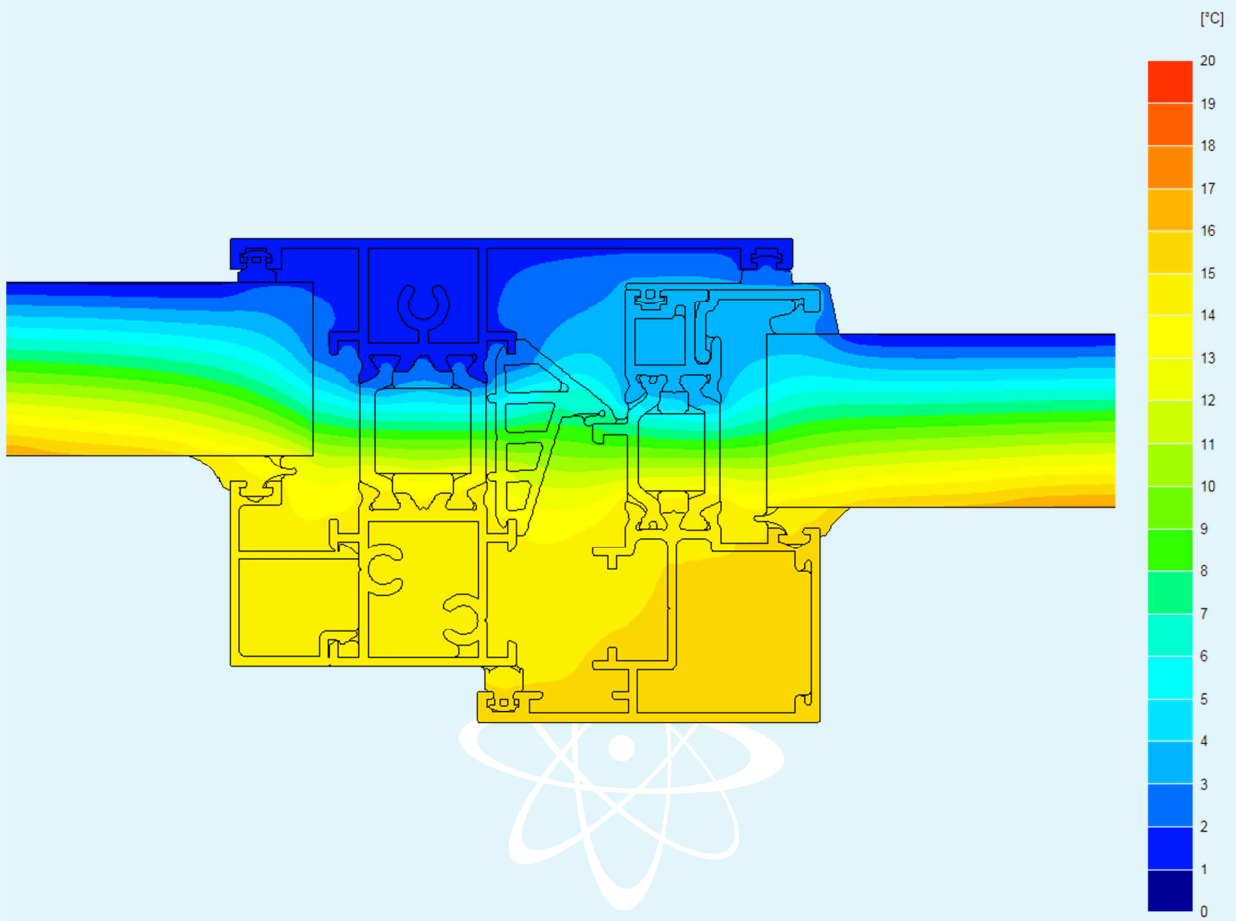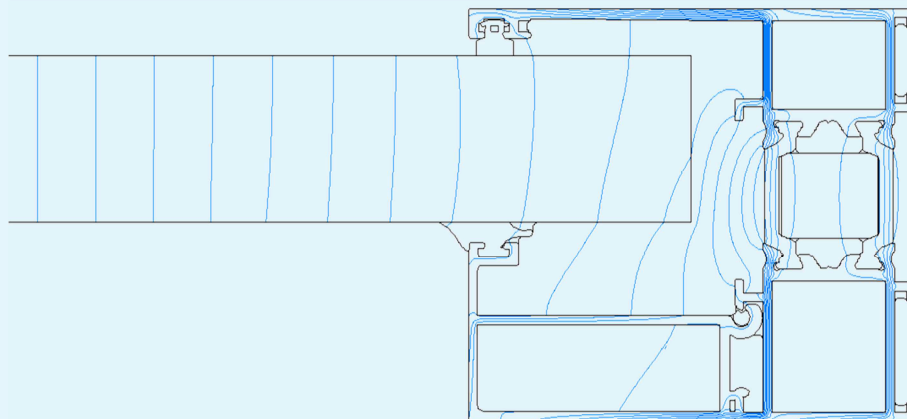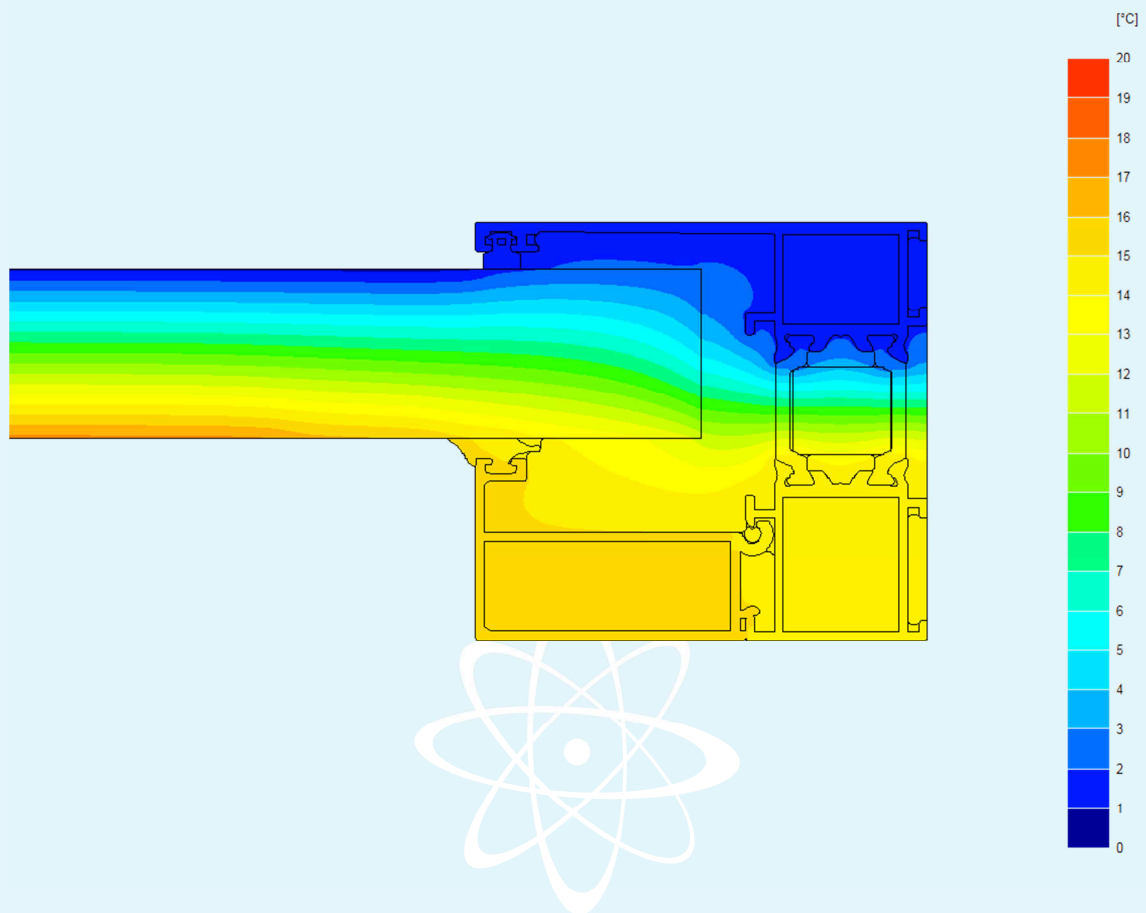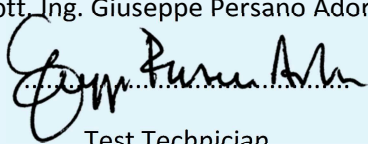**ISTITUTO GIORDANO**
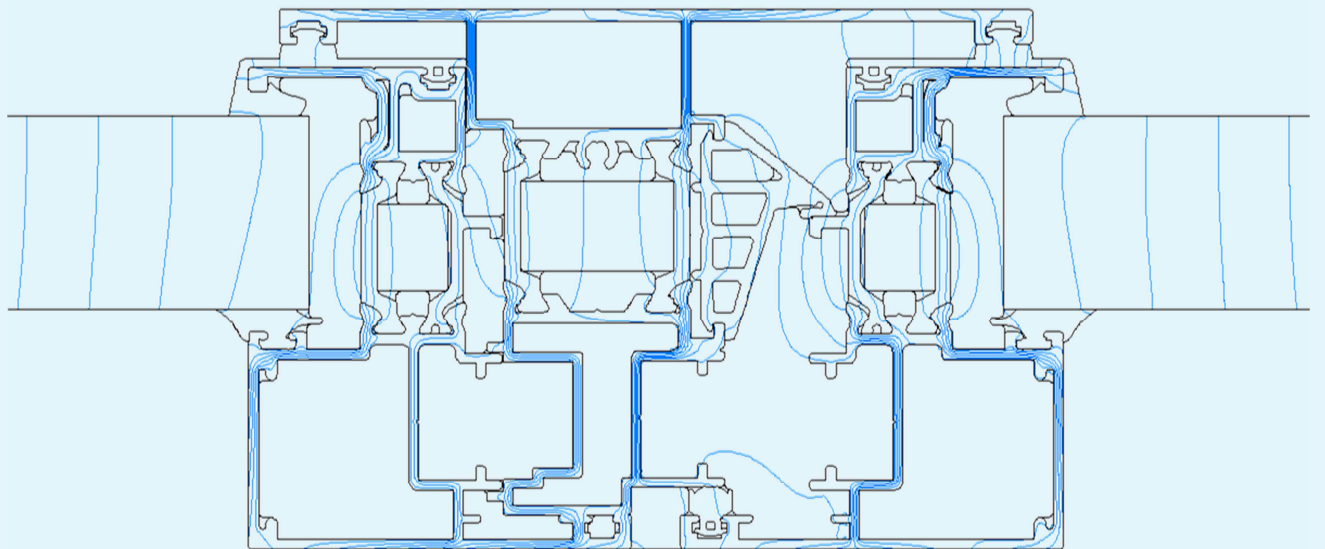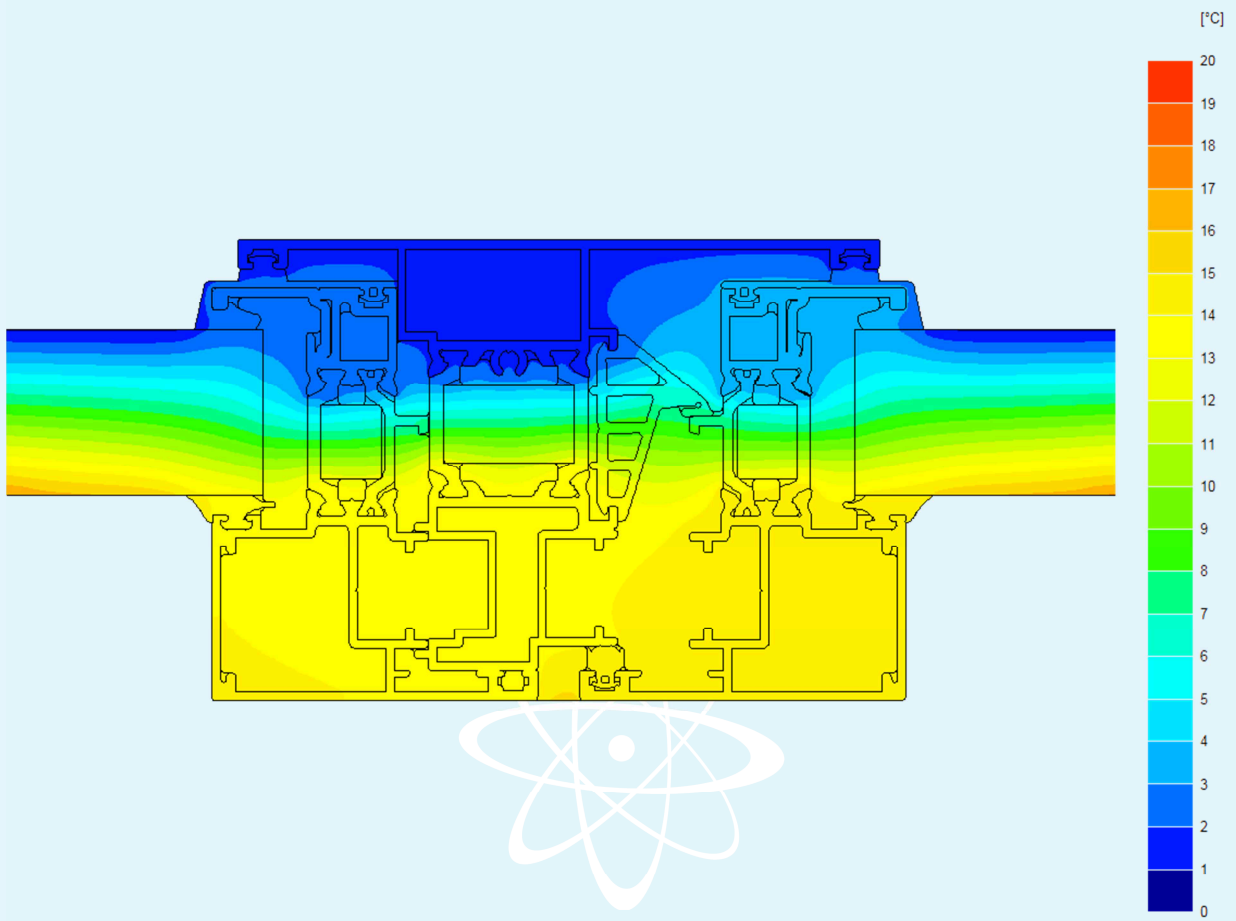
ISOTHERMS AND FLOW LINES FOR THE SECTIONS CONSIDERED
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ISOTHERMS AND FLOW LINES FOR THE SECTIONS CONSIDERED
SECTION 4

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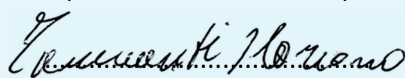**ISOTHERMS AND FLOW LINES FOR THE SECTIONS CONSIDERED**
SECTION 5

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