



THERMAL PERFORMANCE REPORT

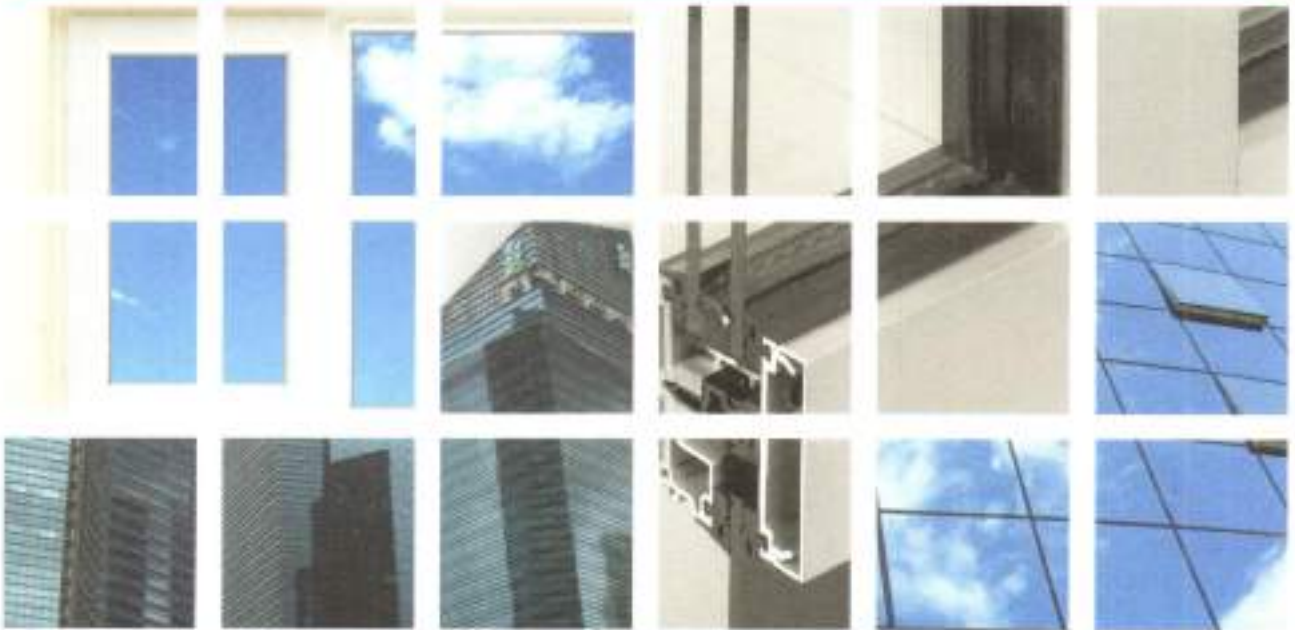
Selectron Elektrokimya Ltd. Şti.

TS EN ISO 10077-1:2006 Thermal Performance of Windows, Doors and Shutters -
Calculation of Thermal Transmittance - Part 1: General

TS EN ISO 10077-2:2012 Thermal Performance of Windows, Doors and Shutters -
Calculation of Thermal Transmittance - Part 2: Numerical Method for Frames

Report No: HY.02/03-1506-0

...yapı kalitesi için çalışır



THERMAL PERFORMANCE REPORT

TEST REQUESTED BY

Client No.: 836

Client Contract No.: 2

Date of Contract: 25.12.2015

Client: Selectron Elektrokimya Ltd. Şti.

Address: Dereboyu Cd. Şengül Sk. No: 6, 34303 Halkalı -
Küçükçekmece / İstanbul

Telephone: (212) 470 03 10 / (212) 471 28 89

DEFINITION AND DESCRIPTION OF PRODUCT

Manufacturer of Product: Selectron Elektrokimya Ltd. Şti. (Arbor Ahşap Pencere)

Address of Manufacturer of Product: Ali Paşa Köyü, Atatürk Blv. Köstemir Yolu Cd. No: 74, 34570 Silivri /
İstanbul; (212) 736 08 01

Type of Product: Frame Profiles and Windows/Doors With or Without
Glazing/Opaque Panels

Trade Name and Description of Product: Arbor-Fenex / 78t Balcony Door

Product Data Form Date / No.: 30.12.2015 / NBF.10077

Date of Calculation: 31.12.2015

Calculation Standard(s) Used: (1) Thermal Performance of Windows, Doors and Shutters -

Calculation of Thermal Transmittance - Part 1: General (TS EN ISO 10077-1:2006) and Part 2: Numerical Method for Frames (TS EN ISO 10077-2:2012); (2) Glass in Building-Determination of Thermal Transmittance (U-value)-Calculation Method (TS EN 673:2011)

Product Standard: TS EN 14351-1:2006+A1:2010 Windows and Doors-Product Standard, Performance Characteristics-Part 1:Windows and External Pedestrian Doorsets Without Resistance to Fire and/or Smoke Leakage Characteristics

Total Number of Pages of Report: 7 Pages (Except cover page) + Annexes



Prepared By

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Laboratory Chief

Approved By

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Standart Belgelendirme Denetim Deney Muayene ve Teknik Kontrol Ltd. Şti.

Mimar Sinan Mah. Üsküdar Cad. No: 1, Yedpa Ticaret Merkezi, F Katı, No: 11-12-14-15, 34779 Ataşehir-İstanbul/TR
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CONDITIONS OF ISSUE AND USE OF THE REPORT

1. This report is issued in accordance with the provisions of the Laboratory Contract approved. The reports are invalid if not signed and stamped properly.
2. The results contained herein apply only to the particular product evaluated and to the specific measurements, tests and calculations carried out, as detailed in this report.
3. The issuing of this report does not indicate any measure of approval, certification, supervision, technical control and surveillance by SBD of any product.
4. This report is not a 'Product Certificate' and may not be used as a 'Product Certificate'.
5. Any part of this report must not be copied or reproduced in any form without the written permission of the SBD laboratory. No extract, abridgement or abstraction from this report may be published or used to advertise a product without the written consent of the managing director, SBD. SBD reserves the absolute right to agree or reject all or any part of the details of any item or publicity for which consent may be sought.

SBD laboratory issues this report against the request of the client which is the manufacturer of the product (The request by the client is in the scope of the notified body). This report is published in accordance with the provisions of the Construction Products Regulation (305/2011) and the relevant legislations and standards. The notified body number of the SBD laboratory is "2271".

(SBD is the abbreviation of Standart Belgelendirme Denetim Deney Muayene ve Teknik Kontrol Ltd. Şti.)

INTRODUCTION

According to "TS EN 14351-1+A1 Windows and Doors-Product Standard, Performance Characteristics-Part-1: Windows and External Pedestrian Doorsets Without Resistance to Fire and/or Smoke Leakage" standard, the thermal transmittance calculation shall be carried out to determine the thermal performance of windows and doors. The thermal transmittance calculation shall consist of:

- a) TS EN ISO 10077-1 Thermal Performance of Windows, Doors and Shutters - Calculation of Thermal Transmittance - Part 1: General,
- b) TS EN ISO 10077-2 Thermal Performance of Windows, Doors and Shutters - Calculation of Thermal Transmittance - Part 2: Numerical Method for Frames and
- c) TS EN 673 Glass in Building-Determination of Thermal Transmittance (U-value)- Calculation Method Standards.

The SBD laboratory is to determine the thermal transmittance of the windows/doors defined in this report using the standards above.

Upon the request of the client, the Laboratory Contract was signed and approved on the specified date between the client and SBD. The calculation method was explained to the client and the client agreed on the method by approving the contract. The product of which technical specifications submitted by the client were detailed below were evaluated according to the applicable requirements of the relevant standard. The calculation results were shown on the following pages of this report.

Standart Belgelendirme Denetim Deney Muayene ve Teknik Kontrol Ltd. Şti.

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The report is related to the actual units that have been evaluated and does not provide information on the ongoing production. The manufacturer may use the calculation results for "CE" marking but it must also take the requirements of the relevant product standard into consideration for "CE" marking.

DEFINITION AND TECHNICAL SPECIFICATIONS OF PRODUCT

SBD has not taken any responsibility and has been involved neither in preparing the drawings of the window nor in specifying the technical specifications of the window and components used in the window. All information taking place in this report regarding the identity of the product are based on the information provided by the manufacturer.

The technical specifications of the product were identified and recorded under the laboratory project number given below. The product has the following properties as declared by the manufacturer.

Laboratory Project No:	HY.02/03-1506
Manufacturer of Product:	Selectron Elektrokimya Ltd. Şti. (Arbor Ahşap Pencere)
Address of Manufacturer of Product:	Ali Paşa Köyü, Atatürk Blv. Köstemir Yolu Cd. No: 74, 34570 Silyri / İstanbul; (212) 736 08 01
Type of Product:	Frame Profiles and Windows/Doors With or Without Glazing/Opaque Panels
Trade Name and Description of Product:	Arbor-Fenex / 78t Balcony Door
Product Data Form Date / No:	30.12.2015 / NBF.10077
Type of Opening:	Side hung
Direction of Opening:	Outward opening
Dimensions of Frame:	1500 mm (Outer width) x 1500 mm (Outer Height)
Dimensions of Casement:	1386 mm (Outer width) x 1408 mm (Outer Height)
Type of Frame Material:	Meranti and Pine Wood Frame (Specific weight = 450 kg/m ³ < 500 kg/m ³ - Softwood)
Thermal Break-Name of Manufacturer:	Sclegel
Thermal Break-Trade Name of Material:	Aquamac QLON Weather Seal 3120
Thermal Break-Type of Material:	Polyethylene (Liner) + PU (Foam) + Polypropylene (Hard foot)
Weather Stripping-Name of Manufacturer:	Uniform Sistemi Per Serramenti S. P. A.
Weather Stripping-Trade Name of Material:	DE 133

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Weather Stripping-Type of EPDM + EPDM Espensa 3 mm

Material:

Nominal Thickness of 24 mm

Glazing:

Outer Pane-Name of Trakya Cam

Manufacturer:

Outer Pane-Trade Name: TRC Ecotherm

Outer Pane-Type: Float Glass

Outer Pane-Thickness: 4 mm

Inner Pane-Name of Trakya Cam

Manufacturer:

Inner Pane-Trade Name: TRC Helio Clear

Inner Pane-Type: Float Glass

Inner Pane-Thickness: 4 mm

Cavity Type: ARGON (90%)

Cavity Thickness: 16 mm

Spacer: NEDEX Warm Edge Profiflex Isoprofil Spacer

Desiccant: Desiccant incorporated with spacer

Primary Sealant: Polyisobutylene

Secondary Sealant: Thiocol (Polysulfide)

DESCRIPTION OF CALCULATION METHOD

The findings presented in this report should be assessed together with and based on the standards mentioned already. The client delivered the requested technical specifications of the product and of the components/materials used in the manufacture of the product. The drawings with 'dxf' extension were also supplied by the client for the product as well as the section of the frames composing the product.

The thermal transmittance calculations were carried out using the DARTWIN Software (Frame Simulator 2 and Frame Composer 2) with the information supplied.

The thermal transmittance of a frame section (U_f) was determined with the glazing replaced by an insulating panel according to Annex C (TS EN 10077-2), with the external and internal surface resistances taken from Annex B. The linear thermal transmittance of the intersection of frame (ψ) and glazing were determined from calculations with the glazing in place and with the glazing replaced by an insulated panel.

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The thermal transmittance of glazing (U_g) was calculated based on TS EN 673 Standard using the specifications given for glazing. The calculation method, Excel Spreadsheet (HF.01.1) was employed for this purpose. The HF.01.1 Spreadsheet developed by the SBD Laboratory had been validated and accredited by the Turkish Accreditation Agency.

Unless otherwise specified, the design values for the thermal conductivities of the materials were obtained from TS EN 10077-2 Annex A and these values were also listed in the annexes of this report. Since some values were obtained from the tables of the relevant standards, the results given in this report should be regarded as 'indicative values' rather than the 'definitive values'.

Restrictions:

- 1) Calculations are valid for the technical specifications and conditions given in this report. The calculation results are highly dependent upon the internal and external conditions in use. Therefore, they are not the only criteria in assessing the performance of the product.
- 2) The report is valid for the dimensions of products as specified by TS EN 14531-1+A1 Annex E.1 for windows and E.2 for external pedestrian doorsets. The dimensions of the window/doorset of which the calculation was made are given in this report. The Annexes E.1 and E.2 specify the restrictions for the dimensions of windows/doorsets of which this report is valid. The restrictions are given below:
 - a) For windows of which the overall area is equal or less than $2,3 \text{ m}^2$ and sizes are $1,23(\pm 25\%) \text{ m} \times 1,48(-25\%) \text{ m}$ or
 - b) For windows of which the overall area is greater than $2,3 \text{ m}^2$ and sizes are $1,48(+25\%) \text{ m} \times 2,18(\pm 25\%) \text{ m}$ or
 - c) Provided that $U_g \leq 1,9 \text{ W}/(\text{m}^2 \cdot \text{K})$ [TS EN 673], "Overall area $\leq 2,3 \text{ m}^2$ " is replaced by "All sizes" for windows.
 - d) For doors of which the overall area is equal or less than $3,6 \text{ m}^2$ and sizes are $1,23(\pm 25\%) \text{ m} \times 2,18(\pm 25\%) \text{ m}$ or
 - e) For doors of which the overall area is greater than $3,6 \text{ m}^2$ and sizes are $2,00(\pm 25\%) \text{ m} \times 2,18(\pm 25\%) \text{ m}$.
- 3) The uncertainties in the calculations are found to be within the tolerances for the confidence level of 95%. The validity and uncertainty of the DARTWIN software had been performed by the supplier according to TS EN 10077-2 Annex D and found to be within the 5% precision limit for both the thermal transmittance and the linear thermal transmittance.

CALCULATIONS AND CALCULATION RESULTS

(1) Thermal Transmittance of the Frame - U_f (Based on TS EN 10077-2)

Please refer to the annex of this report for the calculations.

Standart Belgelendirme Denetim Deney Muayene ve Teknik Kontrol Ltd. Şti.

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Type of Frame Profile	Thermal transmittance of frame - U_f [W/(m ² .K)]
78t - Section A (1)	1,194
78t - Section B (1)	1,998
78t - Section C (1)	1,306
(2) Linear Thermal Transmittance of the Frame - ψ (Based on TS EN 10077-2)	
Please refer to the annex of this report for the calculations.	
Type of Frame Profile	Thermal transmittance of frame - U_f [W/(m.K)]
78t - Section A (1)	0,0230
78t - Section B (1)	0,0230
78t - Section C (1)	0,0240
(3) Center Thermal Transmittance of Glazing - U_g (Based on TS EN 673)	
Please refer to the annex of this report for the calculations.	
The detailed technical specifications of the glazing system were described in the "Definition and Technical Specifications of Product" part of this report.	
Type of Glazing	Thermal transmittance of glazing - U_g [W/(m ² .K)]
4 (Low-e) + 16 (90% Argon) + 4	1,1006
(4) Thermal Transmittance of Window - U_w (Based on TS EN 10077-1)	
Please refer to the annex of this report for the calculations.	
Type of Window	Thermal transmittance of window - U_w [W/(m ² .K)]
Arbor-Fenex / 78t Balcony Door	1,261

CONCLUSION

The thermal transmittance (U_w) of the product of which specifications were submitted by
Selectron Elektrokimya Ltd. Şti.
was found to be
1,2610

Standart Belgelendirme Denetim Deney Muayene ve Teknik Kontrol Ltd. Şti.

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THE REVISION NUMBER, REASON OF THE REVISION AND OTHER EXPLANATIONS

-

ANNEXES

- Annex-1:** Systematic sketch of the window
Annex-2: Technical specifications of the glazing
Annex-3: Calculation form for the thermal transmittance (U_g) of the glazing
Annex-4A: Computations of thermal transmittance (U_i) and linear thermal transmittance (ψ_i) and the thermal conductance ($L_{v,2D}$) of frame profile (Section A)
Annex-4B: Computations of thermal transmittance (U_i) and linear thermal transmittance (ψ_i) and the thermal conductance ($L_{v,2D}$) of frame profile (Section B)
Annex-4C: Computations of thermal transmittance (U_i) and linear thermal transmittance (ψ_i) and the thermal conductance ($L_{v,2D}$) of frame profile (Section C)
Annex-5: Calculation for the thermal transmittance (U_w) of the window / door
Annex-6A: Technical specifications of the frame profile (Section A)
Annex-6B: Technical specifications of the frame profile (Section B)
Annex-6C: Technical specifications of the frame profile (Section C)
Annex-7: Complaint and feedback form

Standart Belgelendirme Denetim Deney Muayene ve Teknik Kontrol Ltd. Şti.

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Annex-1: Systemetic Sketch of the Window / Door

Report No: HY.02/03-1506-0

Manufacturer: Selectron Elektrokimya Ltd. Şti. (Arbor Ahşap Pencere)

Type of Product: Frame Profiles and Windows/Doors With or Without Glazing/Opaque Panels

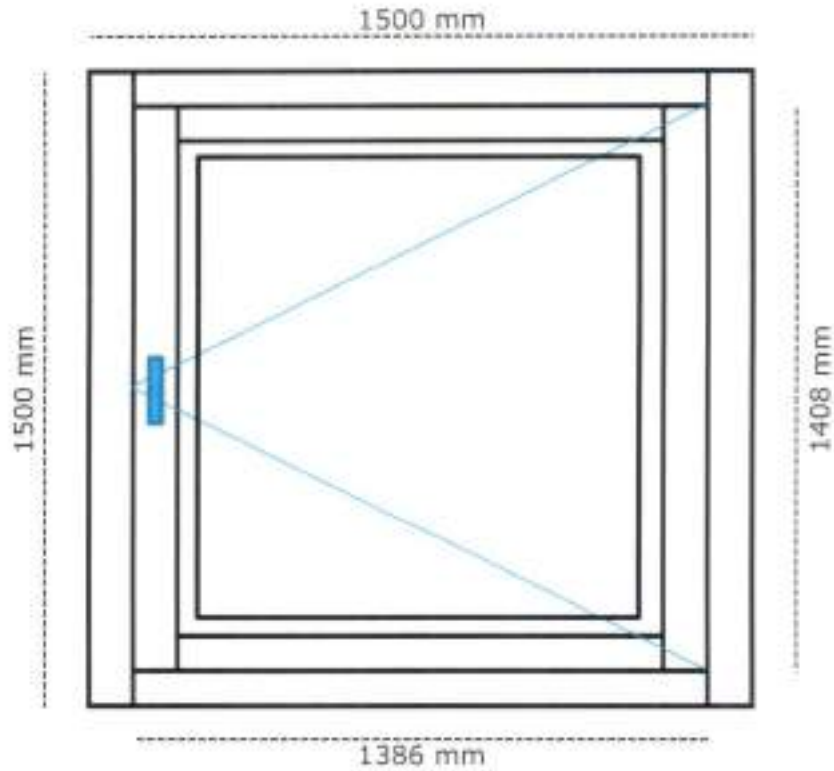
Trade Name: Arbor-Fenex / 78t Balcony Door

Width of Frame: 1500 mm

Height of Frame: 1500 mm

Width of Casement: 1386 mm

Height of Casement: 1408 mm



TS EN 673:2011'E GÖRE YAPILARDA KULLANILAN CAM ISI GEÇİRGENLİĞİNİN (U-DEĞERİ) HESAPLANMASI

VERİ GİRİŞ FORMU

KAYIT SAYISI: **HY.01 / 000**TARİH: **31 Aralık 2015**MÜŞTERİ ADI : **Selektron Elektrokimya Ltd. Şti.**MÜŞTERİ ADRESİ (MERKEZ): **Dereboyu Cd. Şengül Sk. No:6, Halkalı - Küçükçekmece / İstanbul**ÜRETİM YERİ (ŞUBE) ADRESİ: **Ali Paşa Köyü, Atatürk Blv. Köstemir Yolu Cd. No: 74, 34570 Silivri / İstanbul**ÜRÜN ADI VE ÖZELLİKLERİ: **Çift cam 4' + 16 (Argon, %90) + 4 ısı kontrol kaplamalı****ÜRÜN TÜRÜ:**[M] Cam bileşenlerin sayısı : **2**
[N] Ara boşlukların sayısı : **1**Pencerenin yatayla yaptığı açı (°) : **90**
Sıcaklıklar EN 673 Standardının gereğine göre mi (E)? : **1**Ara boşluktaki gaz (1): Hava ya da Argon
[s] Boşluk genişliği (mm)
Argonsa, karışım oranı
Boşluktaki gaz hava mı (E)?

ARA BOŞLUK	
1. Boşluk	2. Boşluk
ARGON	
16	
90%	
0	

Dış sıcaklık (°C)	2.5
İç sıcaklık (°C)	17.5
Sıcaklık farkı (°C)	15.0
Sıcaklık ortalaması (°C)	10
Arabulma için alt sıcaklık (°C)	GD
Arabulma için üst sıcaklık (°C)	GD

CAMIN YAPISI:

	1	2	3	4	5	6
Cam tedarikçisi:	Dış cam		Orta / İç cam		İç cam (Üçlü cam sistemi için)	
Camın markası / adı:	Trakya Cam		Trakya Cam		Trakya Cam	
Camın türü:	TRC Ecothem (Isı Kontrol Kaplamalı Cam)		TRC Heli Clear		TRC Heli Clear	
[d] Kalınlık (mm)	Düz Cam		Düz Cam		Düz Cam	
	4		4		4	

CAM TÜRÜ:

Cam, soda kireç silikat camı mı (E)?	1	1	
Diğer cam türü			
Müşterinin bildirdiği diğer tür camın ısıl öz direnci [r]			
Kullanılan camın ısıl öz direnci [r]	1,00	1,00	

KAPLAMA BİLGİLERİ:

Cam kaplamalıysa, kaplamanın olduğu yüzey (1)	2	0	
Yayınırılık katsayısı ve kaynağı (1)	1	1	
Müşterinin bildirdiği değer			
Normal yayınırılık (yayma gücü) katsayısı [EN 12898]	0,03	0,69	
Düzeltilmiş yayınırılık (yayma gücü) katsayısı	0,03622059	0,837365329	

Düzeltilmiş yayınırılık (yayma gücü) katsayısı EN 12898 Eşitlik 6'ya kullanılarak hesaplanmıştır.

İç camın İÇE bakan yüzeyi (4 ya da 6'ncı yüzeyi) kaplamalı ise, yüzeyin düzeltilmiş yayınırılık katsayısı: **0** Kaplama yoksa "0"dir.**ÜÇLÜ CAMLARDA ARDIŞIK YAKALŞTIRMADA (2 VE DAHA SONRAKİ YİNELEMELERDE) KULLANILACAK SICAKLIK DEĞERLERİ:**

DENEME	1. BOŞLUK		2. BOŞLUK		Orta sıcaklık
	ΔT	T_m	ΔT	T_m	
1					
2					
3					
4					
5					

KAPLAMA İÇİN AÇIKLAMALAR:

- 1) Tekli camlarda kaplama -fiziksel etkiler nedeniyle aşınıp yok olacağından- olmaz. Bu nedenle tekli camlarda kaplama için "1" ve "2"inci yüzeye "0" yazılır.
- 2) Çift camlarda kaplama -olacaksa- ya "2" ya da "3"üncü yüzeyde olur. Her iki yüzeyde de camın toplam U-değeri aynıdır. Kaplama "4"üncü yüzeyde olacaksa, kaplama zamanla aşınarak yok olur. Ancak gene de kaplama "4"üncü yüzeyde olursa, kaplanmış iç camın İÇ ISI AKTARIM KATSAYISI '7,7' yerine '3,8' olacağından toplam ısı geçirgenlik katsayısı (U-değeri) daha düşük olacaktır.
- 3) Üçlü camlarda kaplama -olacaksa- orta cam yerine ya dış camın "2"inci yüzeyi ya da iç camın "5"inci yüzeyi kaplanır. Çift camlardaki durum üçlü camlar için de geçerlidir.
- 4) İki cam yüzeyin birden kaplanması, ışık geçirgenliğini azaltıp, içeriğin daha karanlık olmasına yol açacağından, tercih edilmemektedir. Ancak özel bir durum nedeniyle uygulanacaksa, aşağıdaki "Açıklamalar" bölümüne bakılmalıdır.

AÇIKLAMALAR:

- ¹⁾ Ara boşluktaki gaz: Hava ya da Argon olabilir
- ²⁾ Evet için "1", Hayır için "0" dir.
- ³⁾ Cam kaplamalı: DEĞİLSE, '0' yazınız; KAPLAMALI ise, kaplamanın olduğu yüzey numarasını yazınız:
(0) Kaplamasız, (1) Dış camın dışa bakan yüzeyi, (2) Dış camın içe bakan yüzeyi
(0) Kaplamasız, (3) Orta/İç camın ara boşluğa bakan yüzeyi, (4) Orta/İç camın içe bakan yüzeyi
(0) Kaplamasız, (5) İç camın ikinci ara boşluğa bakan yüzeyi, (6) İç camın içe bakan yüzeyi
- ⁴⁾ Kullanılan camla ilgili yayımlık katsayısı verisi, hesaplama sayfasındaki kaynak verilerden alındıysa "1", cam tedarikçisinden alındıysa "0" yazınız.
- ⁵⁾ Yayımlık katsayı değeri (ve düzeltme katsayısı), tedarikçiden ya da bir başka kaynaktan alınıp ELLE girilebilir. 2 ve 3'üncü yüzeydeki kaplamaların ışınım ısı aktarımına etkisi aynıdır ve U-değerini aynı miktarda azaltırlar. 2 ve 3'üncü yüzeye konulan 'low-e' kaplamaların TOPLAM etkisi (K_{23}) $K_{23} = (k_2 \times k_3) / (k_2 + k_3)$ formülüyle hesaplanır. Çift camlarda ikinci bir yüzeye 'low-e' kaplama konulacaksa, 4'üncü yüzeye konulmalıdır. 4'üncü yüzeye konulan 'low-e' kaplama U-değerini %18 oranında azaltır.



TS EN 673:2011'E GÖRE YAPILARDA KULLANILAN CAM ISI GEÇİRGENLİĞİNİN (U DEĞERİ) HESAPLANMASI

HESAPLAMA FORMU

KAYIT SAYISI: HY.01 / 000

TARİH: 31 Aralık 2015

MÜŞTERİ ADI: Seletron Elektrokimya Ltd. Şti.

MÜŞTERİ ADRESİ (MERKEZ): Dereboyu Cd. Şengül Sk. No:6, Halkalı - Küçükçekirce / İstanbul

ÜRETİM YERİ (ŞUBE) ADRESİ: Ali Paşa Köyü, Atatürk Biv. Köstemir Yolu Cd. No: 74, 34570 Silivri / İstanbul

ÜRÜN ADI ve AÇIKLAMASI: Çift cam 4' + 16 (Argon, %80) + 4 lı kontrol kaplamalı

KAYNAK VERİLER:

Camların düzeltilmiş yayınlık (yayma gücü) katsayısının aşağıda verilen değere göre hesaplanması:

f_1	Normal yayınlık (yayma gücü) katsayısı	0,89	KAPLANMAMIŞ soda-kireç cam yüzeyleri, yayma gücü katsayısını ETKİLEMİYEN KAPLAMALI soda-kireç camları ve KAPLANMAMIŞ BORDOSİLİKAT cam yüzeyler ve cam-seramik için kullanılan normal ve düzeltilmiş yayınlık (yayma gücü) katsayısıdır.
f_2	Düzeltilmiş yayınlık (yayma gücü) katsayısı	0,837365329	

KAPLAMALI camın düzeltilmiş yayınlık (yayma gücü) katsayısının aşağıda verilen değere göre hesaplanması:

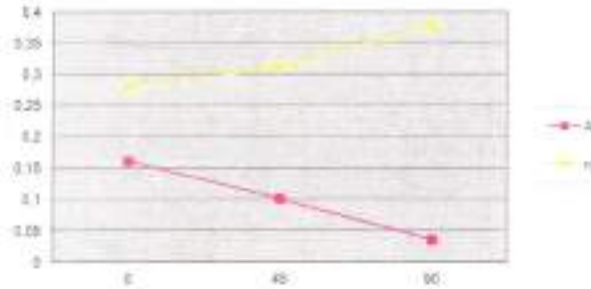
f_1	Normal yayınlık (yayma gücü) katsayısı	0,03	Bir yüzeyi KAPLANMIŞ soda-kireç cam yüzeyleri (EN 12888'e göre kaplamalı cam (Düşük e'li camlar) için kullanılan normal ve düzeltilmiş yayınlık (yayma gücü) katsayısıdır. Değerler, ayrıca Şişe Cam'ın www.trakyacam.com.tr adresi kullanılarak elde edilebilir.
f_2	Düzeltilmiş yayınlık (yayma gücü) katsayısı	0,03522059	

Özellikler	Hava				Argon				
	-10	0	10	20	-10	0	10	20	
ρ	Yoğunluk (kg/m ³)	1,3260	1,2770	1,2320	1,1890	1,8290	1,7520	1,6990	1,6400
μ	Dinamik viskozite (kg/(m.s))	1,661E-05	1,711E-05	1,761E-05	1,811E-05	2,038E-05	2,101E-05	2,164E-05	2,226E-05
λ	İletkenlik katsayısı (W/(m.K))	2,336E-02	2,416E-02	2,496E-02	2,576E-02	1,584E-02	1,634E-02	1,684E-02	1,734E-02
c	Özgü ısı kapasitesi (J/(kg.K))	1,009E+03				5,190E+02			
Pr	Prandtl sayısı	7,167E-01	7,136E-01	7,112E-01	7,087E-01	6,678E-01	6,673E-01	6,669E-01	6,669E-01

Özellikler	Ara boşluktaki gaz karışımına göre				Hesaplama istenen sıcaklığa göre ara boşluktaki gazın özellikleri:			
	-10	0	10	20	Alt değer	Ort değer	Hesaplanan sıcaklık	
					GD	GD	10,0	
ρ	Yoğunluk (kg/m ³)	1,7787	1,7135	1,6523	1,5948	GD	GD	1,6523E+00
μ	Dinamik viskozite (kg/(m.s))	2,000E-05	2,062E-05	2,124E-05	2,186E-05	GD	GD	2,1237E-05
λ	İletkenlik katsayısı (W/(m.K))	0,01859	0,01712	0,01565	0,01418	GD	GD	1,7952E-02
c	Özgü ısı kapasitesi (J/(kg.K))	5,879E+02				5,879E+02		
Pr	Prandtl sayısı	6,846E-01	6,839E-01	6,832E-01	6,829E-01	GD	GD	6,832E-01

ARA BOŞLUK VE CAM BİLEŞEN SAYILARI

M	Cam bileşenlerinin (Malzemelerin) sayısı	2
N	Gas / hava boşluklarının sayısı	1



SICAKLIKLAR

Hesap yapılan sıcaklıklar	°C	°K	
T_e	Dış sıcaklık	2,5	275,50
T_i	İç sıcaklık	17,5	290,50
ΔT	Sıcaklık farkı (Del T)	15,0	15,00
T_m	Ortalama sıcaklık	10,0	283
	Arabulma için alt sıcaklık	GD	GD
	Arabulma için üst sıcaklık	GD	GD

PENCERE / CAM YERLEŞİM AÇILARI

α_p	A	n
0	0,15	0,28
45	0,10	0,31
90	0,035	0,38
90	0,035	0,380

Gerekirse, yandaki grafiğe göre değişik açılar için hesaplanmalıdır.



MADDE 5.3 - ARA BOŞLUK GAZ(LARI) İÇİN İŞİNİM İLETİMİNİN (RADIATION CONDUCTANCE (h_r)) HESAPLANMASI:

h_r:

σ	Stefan-Boltzman sabiti	-	5,67E-08	
h _{r1}	İşinim iletimi (Radiation conductance)	W/(m ² .K)	ÇİFT CAM	Tek camlı sistemin İŞİNİM İLETİMİ
h _{r2}	İşinim iletimi (Radiation conductance)	W/(m ² .K)	0,17962	Çift cam/Üçlü cam sisteminde ilk boşluğun İŞİNİM İLETİMİ
h _{r3}	İşinim iletimi (Radiation conductance)	W/(m ² .K)	ÇİFT CAM	Üçlü camlı sisteminde KİNCİ BOŞLUK için İŞİNİM İLETİMİ

MADDE 5.4 - ARA BOŞLUK GAZ İLETİMİNİN (GAS CONDUCTANCE (h_g)) HESAPLANMASI:

h_g:

		Ara boşluktaki gaz karışımına göre					
		-10	0	10	20	Hesaplanan sıcaklık	
ρ	Yoğunluk	kg/m ³	1,7787E+00	1,7135E+00	1,6523E+00	1,5949E+00	1,6523
μ	Dinamik viskozite	kg/(m.s)	2,0003E-05	2,0620E-05	2,1237E-05	2,1863E-05	2,124E-05
λ	İletkenlik katsayısı	W/(m.K)	1,6592E-02	1,7122E-02	1,7652E-02	1,8182E-02	1,765E-02
c	Özgül ısı kapasitesi	J/(kg.K)	5,679E+02				5,679E+02
Pr	Prandtl sayısı		6,846E-01	6,839E-01	6,832E-01	6,825E-01	6,832E-01

		Dış cam	Ara boşluk	Orta / iç cam	Ara boşluk	İç cam (Üçlü)
		d ₁	s ₁	d ₂	s ₂	d ₃
s, d	Kalınlıklar (m)	m	0,004	0,016	0,004	0
r	Camın ısı öz direnci	m.K/W	1,00		1,00	0,00

Birinci ara boşluk (s ₁) için:		Ara boşluktaki gaz karışımına göre				
		-10	0	10	20	Hesaplanan sıcaklık
Gr	Grashof sayısı	16,840,26	14,707,02	12,892,15	11,333,95	12,892,15
Nu ₁	Nusselt sayısı (Hesaplanan)	1,223	1,162	1,104	1,051	1,104
Nu _{1c}	Nusselt sayısı (Kullanılan)	1,223	1,162	1,104	1,051	1,104
h _{g1}	Gaz iletimi (iki cam arasındaki gazın)	1,2688	1,2430	1,2184	1,1948	1,2184

İkinci ara boşluk (s ₂) için:		Ara boşluktaki gaz karışımına göre				
		-10	0	10	20	Hesaplanan sıcaklık
Gr	Grashof sayısı	ÇİFT CAM	ÇİFT CAM	ÇİFT CAM	ÇİFT CAM	ÇİFT CAM
Nu ₂	Nusselt sayısı (Hesaplanan)	ÇİFT CAM	ÇİFT CAM	ÇİFT CAM	ÇİFT CAM	ÇİFT CAM
Nu _{2c}	Nusselt sayısı (Kullanılan)	ÇİFT CAM	ÇİFT CAM	ÇİFT CAM	ÇİFT CAM	ÇİFT CAM
h _{g2}	Gaz iletimi (iki cam arasındaki gazın)	ÇİFT CAM	ÇİFT CAM	ÇİFT CAM	ÇİFT CAM	ÇİFT CAM

MADDE 5.2 - ARA BOŞLUK GAZ(LARI) İÇİN ISI AKTARIMININ (HEAT TRANSFER (h₁₂)) HESAPLANMASI:

h₁₂ = h_{g1} * h_{g2}

Birinci ara boşluk (s ₁) için:		Ara boşluktaki gaz karışımına göre				
		-10	0	10	20	Hesaplanan sıcaklık
h ₁₂	Her bir gaz boşluğunun ısı aktarımı (heat transfer)	W/(m ² .K)	1,44845	1,42280	1,39826	1,37464

İkinci ara boşluk (s ₂) için:		Ara boşluktaki gaz karışımına göre				
		-10	0	10	20	Hesaplanan sıcaklık
h ₁₂	Her bir gaz boşluğunun ısı aktarımı (heat transfer)	W/(m ² .K)	ÇİFT CAM	ÇİFT CAM	ÇİFT CAM	ÇİFT CAM

ÜÇLÜ CAM SİSTEMLERİ İÇİN ARDISIK YINELEMELER

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MADDE 5.2 - CAM SİSTEMİNİN TOPLAM ISI İLETİMİNİN (THERMAL CONDUCTANCE (h₀₃)) HESAPLANMASI:

Tek camlı sistemler için

h ₀₃	Cam sisteminin toplam ısı iletkenliği	W/(m ² .K)	ÇİFT CAM	ÇİFT CAM	ÇİFT CAM	ÇİFT CAM	ÇİFT CAM
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Çift camlı sistemler için

h ₀₃	Cam sisteminin toplam ısı iletkenliği	W/(m ² .K)	1,4319	1,4068	1,3825	1,3597	1,3328
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Üç camlı sistemler için

h ₀₃	Cam sisteminin toplam ısı iletkenliği	W/(m ² .K)	ÇİFT CAM	ÇİFT CAM	ÇİFT CAM	ÇİFT CAM	ÇİFT CAM
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Project name:	78t - Kesit A (1)		
Transmittance (Uf):	1.194 W/m ² K	Internal T:	20.000 °C
Conductance (Lf2D):	0.353 W/mK	External T:	0.000 °C
Frame width (Bf):	109.86 mm		

Frame
Simulator 2

Thermal transmittance (Uf) computation performed in accordance with EN ISO 10077-2:2012



Node details

Primitives used for finite element simulation:	15645
Frame width (Bf):	109.86 mm
Visible insulation panel width (Bp):	190.17 mm
Insulation panel thickness (Dp):	24.00 mm

External boundary conditions:

Temperature:	0.000 °C
Surface resistance:	0.04 m ² K/W

Internal boundary conditions:

Temperature:	20.000 °C
Surface resistance:	0.13 m ² K/W
Humidity:	60.00 %

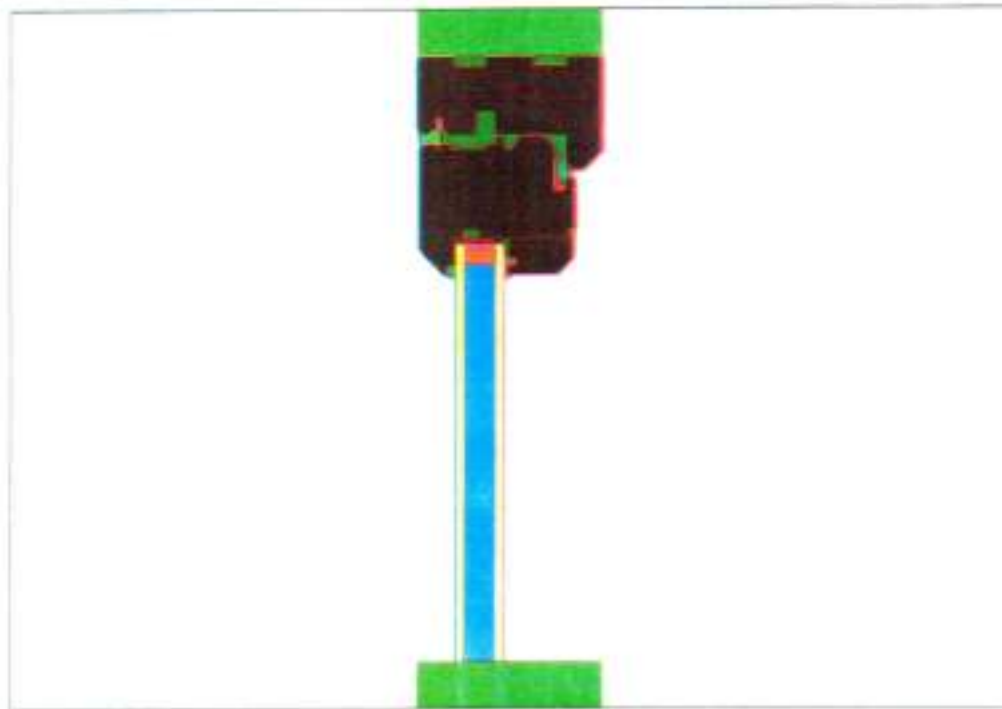
Results computed in accordance with EN ISO 10077-2:2012

Internal/external temperature difference:	20.000 °C
2D conductance (Lf2D):	0.353 W/mK
Transmittance (Uf):	1.194 W/m ² K

Materials list:



Name	Type	λ_x [W/mK]	λ_y [W/mK]	ϵ	Color
Polypropylene solid	Standard	0.2200	0.2200	0.900	Red
Polyethylene LD low density	Standard	0.3300	0.3300	0.900	Light Green
Nedex warm edge spacer - 16mm	Standard	0.0390	0.0390	0.900	Orange
Silicone outer sealant	Standard	0.3500	0.3500	0.900	Pink
Softwood	Standard	0.1300	0.1300	0.900	Dark Brown
PUR Polyurethane expanded closed cell	Standard	0.0300	0.0300	0.900	Teal
EPDM	Standard	0.2500	0.2500	0.900	Grey
Material	Adiabatic	0.0000	0.0000	0.900	Light Green
Silicone seal	Standard	0.2000	0.2000	0.900	Green
Soda lime glass	Standard	1.0000	1.0000	0.900	Yellow
Low-E Glass	Standard	1.0000	1.0000	0.041	Yellow
Argon	Gas	0.0223	1.1405	0.900	Blue



Boundary conditions list:

Name	Col.	R [m ² K/W]	H [%]
Internal	Red	0.1300	60.0
Internal increased resistance	Pink	0.2000	60.0
External	Blue	0.0400	60.0

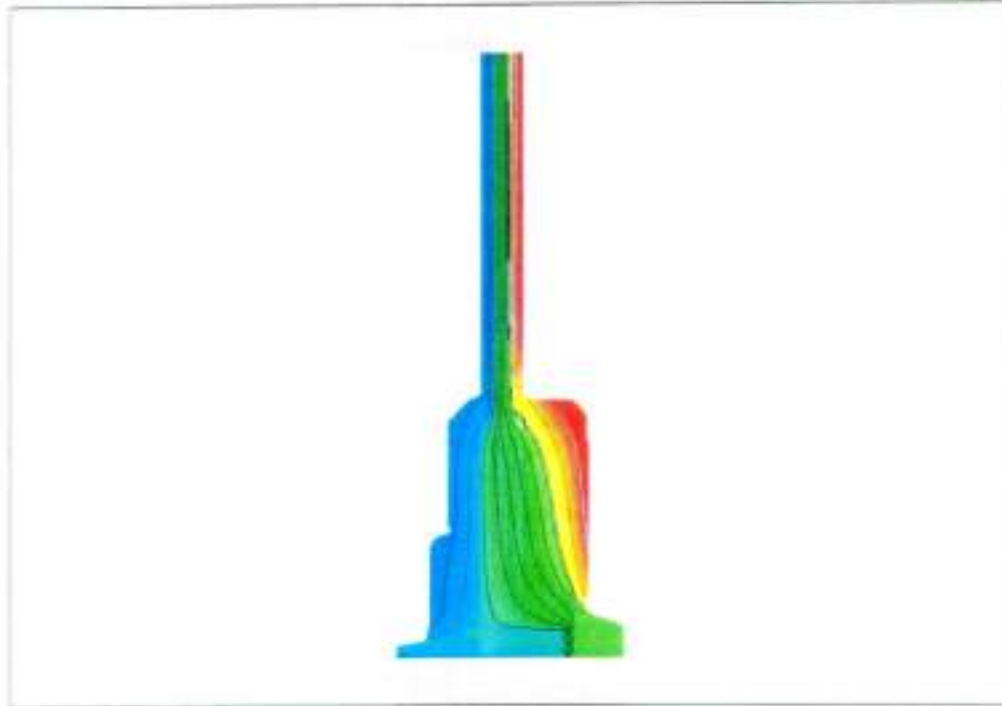
Boundary conditions analysis:

Name	Min T. [°C]	Max T. [°C]	Av. T. [°C]	Q [W/m]
Internal	15.58	18.23	17.14	6.1440
Internal increased resistance	14.14	17.85	15.99	1.2003
External	0.60	1.90	0.95	-7.3440
External increased resistance	-	-	0.00	0.0000

Project name:	78t - Kesit B (1)		
Transmittance (Uf):	1.998 W/m ² K	Internal T:	20.000 °C
Conductance (Lf2D):	0.504 W/mK	External T:	0.000 °C
Frame width (Bf):	141.15 mm		

Frame
Simulator: 2

Thermal transmittance (Uf) computation performed in accordance with EN ISO 10077-2:2012



Node details

Primitives used for finite element simulation:	15870
Frame width (Bf):	141.15 mm
Visible insulation panel width (Bp):	190.18 mm
Insulation panel thickness (Dp):	24.00 mm

External boundary conditions:

Temperature:	0.000 °C
Surface resistance:	0.04 m ² K/W

Internal boundary conditions:

Temperature:	20.000 °C
Surface resistance:	0.13 m ² K/W
Humidity:	60.00 %

Results computed in accordance with EN ISO 10077-2:2012

Internal/external temperature difference:	20.000 °C
2D conductance (Lf2D):	0.504 W/mK
Transmittance (Uf):	1.998 W/m ² K

Materials list:



Name	Type	λ_x [W/mK]	λ_y [W/mK]	ϵ	Color
Material	Adiabatic	0.0000	0.0000	0.900	Green
Polyethylene LD low density	Standard	0.3300	0.3300	0.900	Light Green
Softwood	Standard	0.1300	0.1300	0.900	Black
Nedex warm edge spacer - 16mm	Standard	0.0390	0.0390	0.900	Orange
Silicone outer sealant	Standard	0.3500	0.3500	0.900	Pink
PUR Polyurethane expanded closed cell	Standard	0.0300	0.0300	0.900	Teal
Polypropylene solid	Standard	0.2200	0.2200	0.900	Red
EPDM	Standard	0.2500	0.2500	0.900	Grey
Aluminium (anodized/coated)	Standard	160.0000	160.0000	0.900	Dark Grey
Polyamid (nylon)	Standard	0.2500	0.2500	0.900	Blue
Low-E Glass	Standard	1.0000	1.0000	0.041	Yellow
Soda lime glass	Standard	1.0000	1.0000	0.900	White
Silicone seal	Standard	0.2000	0.2000	0.900	Light Green
Argon	Gas	0.0223	1.1373	0.900	Cyan



Boundary conditions list

Name	Col.	R [m ² K/W]	H [%]
Internal	Red	0.1300	60.0
Internal increased resistance	Pink	0.2000	60.0
External	Blue	0.0400	60.0

Boundary conditions analysis:

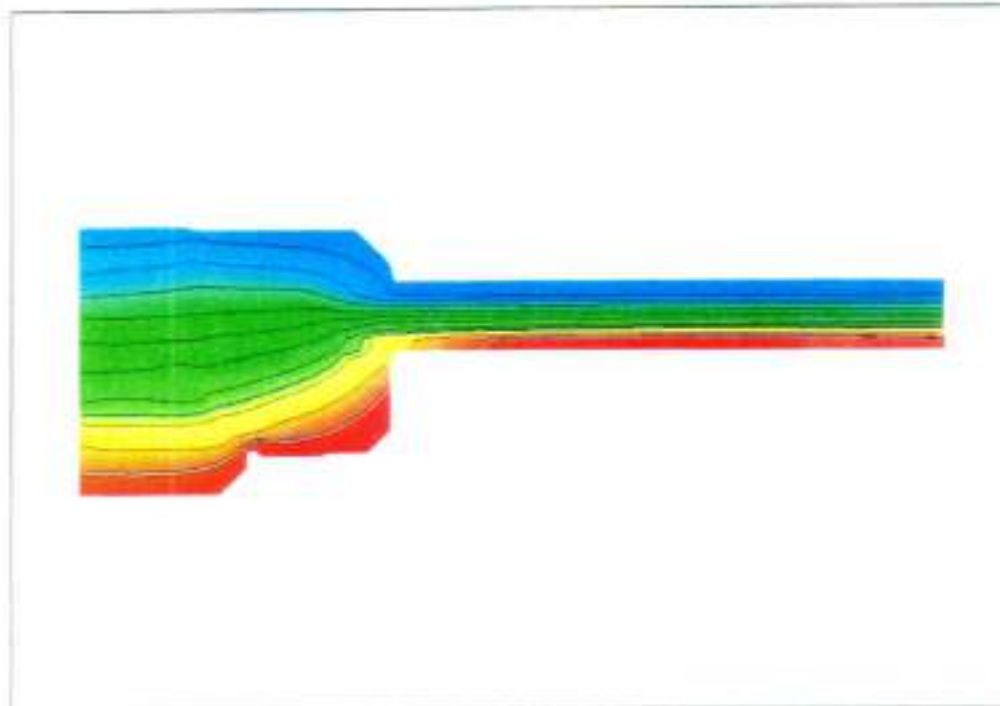
Name	Min T. [°C]	Max T. [°C]	Av. T. [°C]	Q [W/m]
Internal	10.99	17.22	16.19	6.9474
Internal increased resistance	10.96	17.54	15.18	3.4276
External	0.50	4.05	1.14	-10.3431
External increased resistance	-	-	0.00	0.0000



Project name:	78t - Kesit C (1)		
Transmittance (Uf):	1.306 W/m ² K	Internal T:	20.000 °C
Conductance (Lf2D):	0.361 W/mK	External T:	0.000 °C
Frame width (Bf):	106.03 mm		

Frame
Simulator 3

Thermal transmittance (Uf) computation performed in accordance with EN ISO 10077-2:2012



Node details

Primitives used for finite element simulation:	14273
Frame width (Bf):	106.03 mm
Visible insulation panel width (Bp):	190.09 mm
Insulation panel thickness (Dp):	24.00 mm

External boundary conditions:

Temperature	0.000 °C
Surface resistance	0.04 m ² K/W

Internal boundary conditions:

Temperature	20.000 °C
Surface resistance	0.13 m ² K/W
Humidity	60.00 %

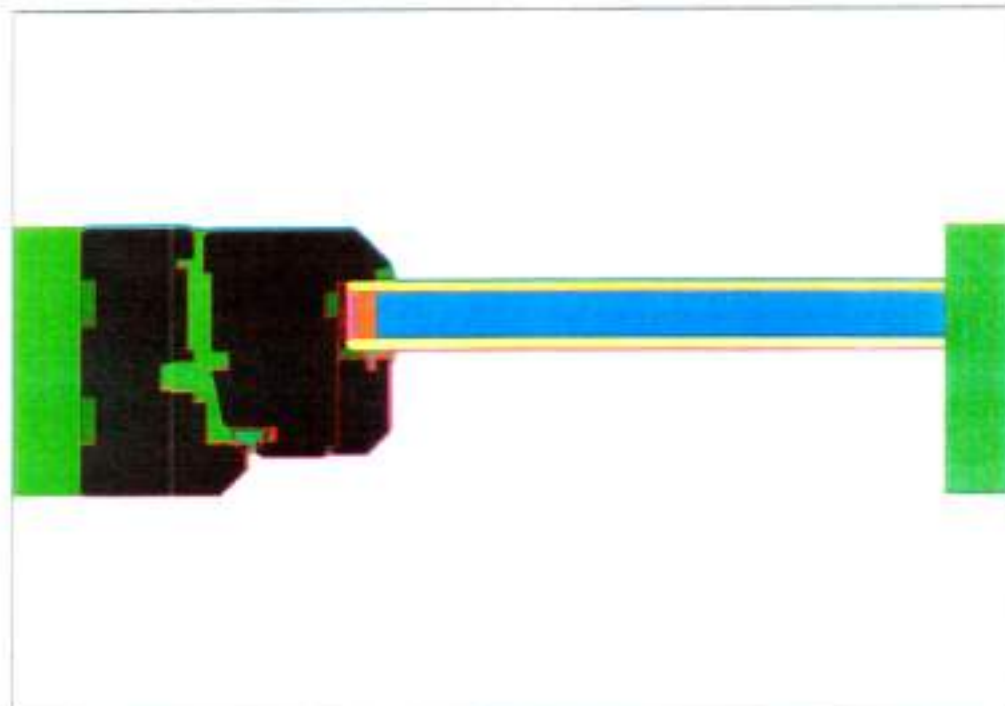
Results computed in accordance with EN ISO 10077-2:2012

Internal/external temperature difference	20.000 °C
2D conductance (Lf2D):	0.361 W/mK
Transmittance (Uf)	1.306 W/m ² K

Materials list:



Name	Type	λ_x [W/mK]	λ_y [W/mK]	ϵ	Color
Polypropylene solid	Standard	0.2200	0.2200	0.900	Red
EPDM	Standard	0.2500	0.2500	0.900	Grey
Polyethylene LD low density	Standard	0.3300	0.3300	0.900	Light Green
Nedex warm edge spacer - 16mm	Standard	0.0390	0.0390	0.900	Orange
Silicone outer sealant	Standard	0.3500	0.3500	0.900	Pink
Softwood	Standard	0.1300	0.1300	0.900	Black
PUR Polyurethane expanded closed cell	Standard	0.0300	0.0300	0.900	Teal
Material	Adiabatic	0.0000	0.0000	0.900	Light Green
Low-E Glass	Standard	1.0000	1.0000	0.041	Yellow
Argon	Gas	1.1355	0.0223	0.900	Blue
Soda lime glass	Standard	1.0000	1.0000	0.900	White
Silicone seal	Standard	0.2000	0.2000	0.900	Green



Boundary conditions list:

Name	Col.	R [m ² K/W]	H [%]
Internal	Red	0.1300	60.0
Internal increased resistance	Pink	0.2000	60.0
External	Blue	0.0400	60.0

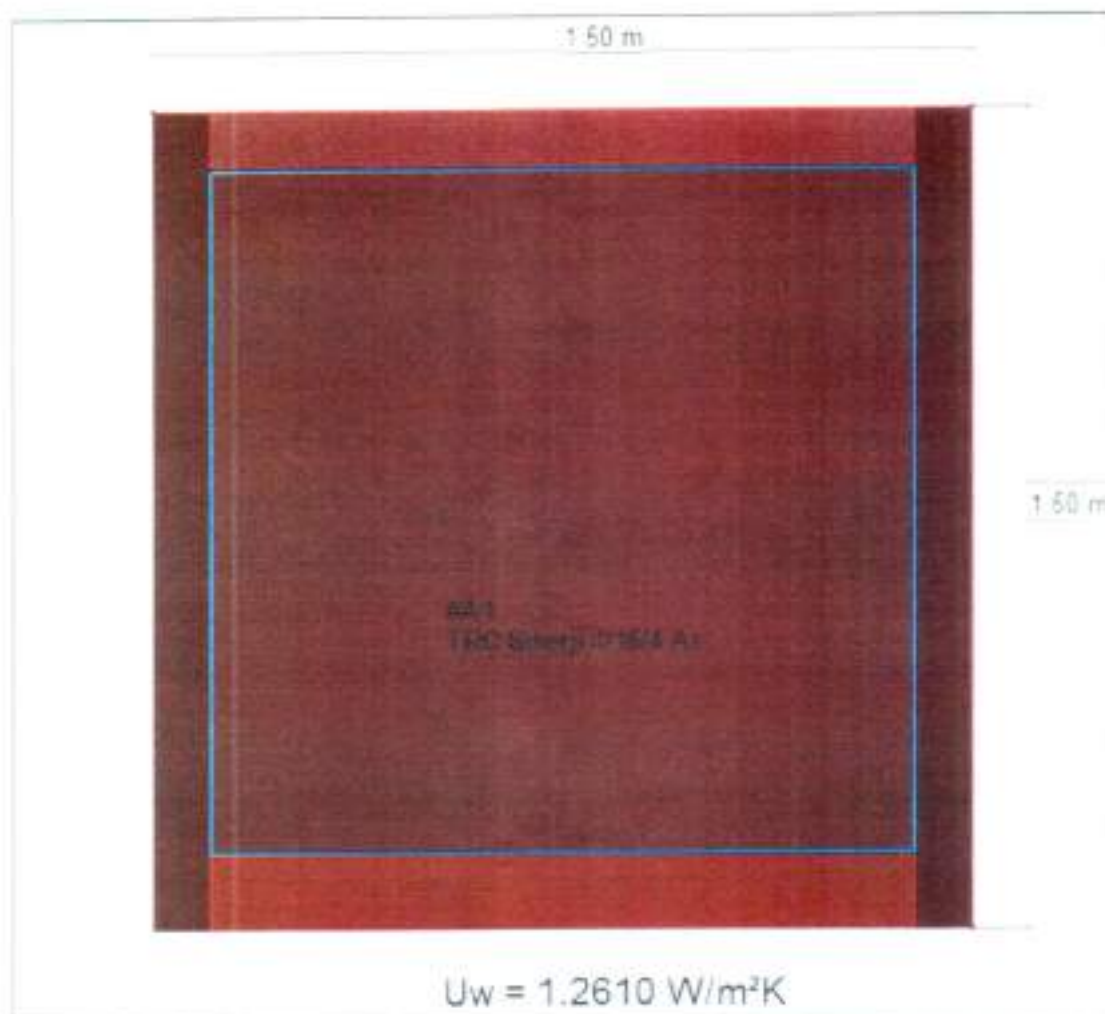
Boundary conditions analysis:

Name	Min T. [°C]	Max T. [°C]	Av. T. [°C]	Q [W/m]
Internal	15.54	17.73	16.90	5.4956
Internal increased resistance	14.08	17.49	16.24	1.9969
External	0.60	1.89	0.98	-7.4888
External increased resistance	-	-	0.00	0.0000

Name **Arbor - Fenex / 78t Balcony Door**
Transmittance (Uw) **1.2610 W/m²K**






Frame Color: 

Computations performed in accordance with EN ISO 10077-1:2007



**Arbor - Fenex / 78t
Balcony Door**

Width 1500.00 mm
Height 1500.00 mm
Transmittance (Uw) **1.2610 W/m²K**

Name	U [W/m²K]	Width [mm]	Height [mm]	A [m²]	Col.
#A1	1.1006	1287.93	1248.98	1.60860	
TRC Sinerji 4/16/4 Ar					
Kesit A	1.1940	1287.93	109.86	0.14150	
Kesit B	1.9980	1287.93	141.15	0.18180	
Kesit C	1.3060	106.03	1500.00	0.15905	
Kesit C	1.3060	106.03	1500.00	0.15905	



ψ material	ψ [W/mK]	Total length [mm]
Kesit A	0.0230	1287.93
Kesit B	0.0230	1287.93
Kesit C	0.0240	2497.97

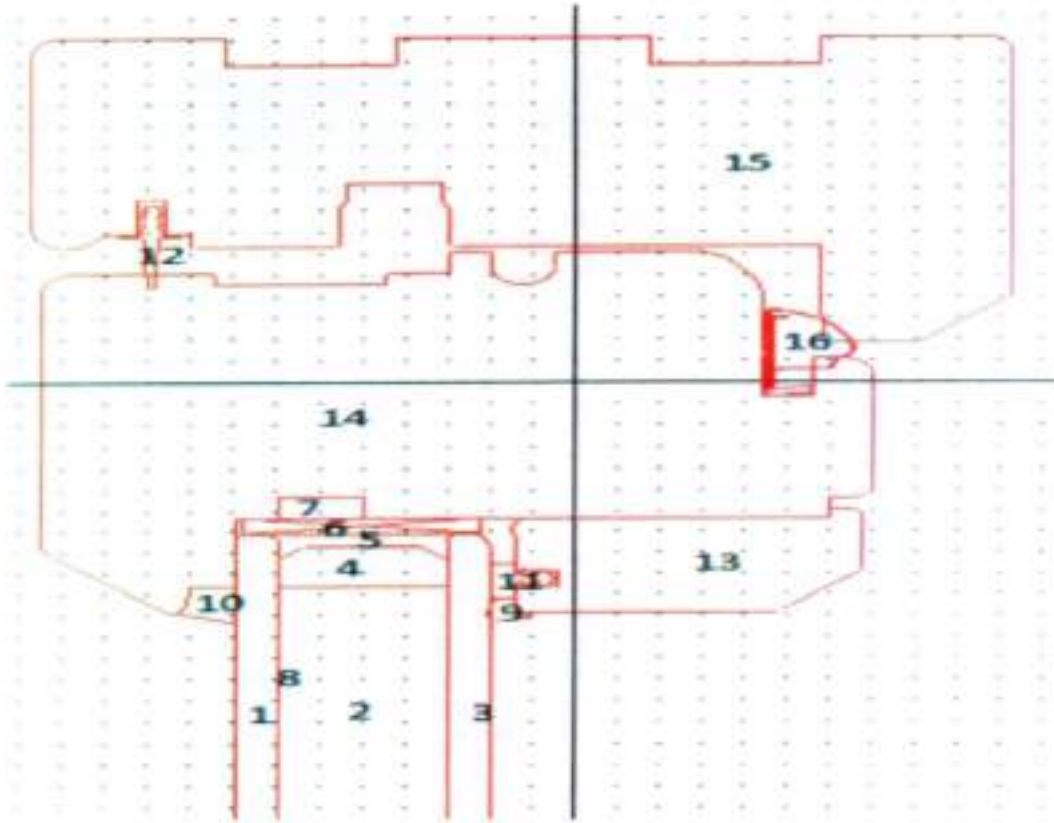
Col.



Annex-6: Information on Components Used

A: Arbor-Fenex / 78t Balcony Door / 78t - Section A (1)

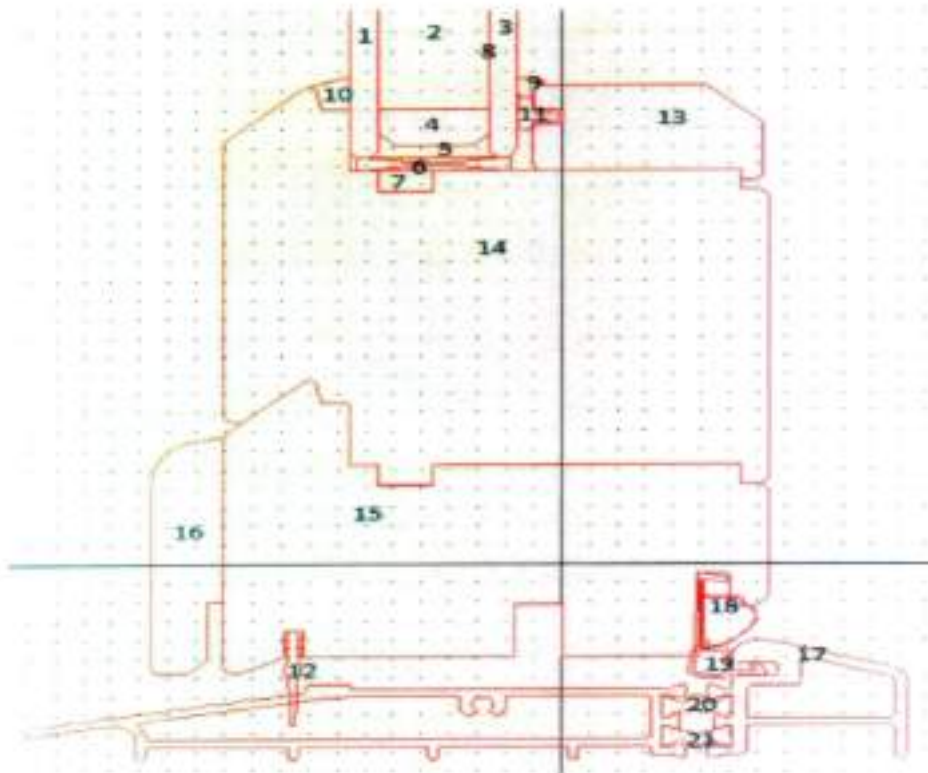
Purpose of Use / Place of Use	Type of Material	Ref
Outer Pane	Trakya Cam / TRC Ecotherm / Float Glass / 4 mm	1
Cavity	ARGON (90%)	2
Inner Pane	Trakya Cam / TRC Helio Clear / Float Glass / 4 mm	3
Spacer	NEDEX Warm Edge Profiflex Isoprofil Spacer	4
Secondary Sealant	Thiocol (Polysulfide)	5
Glazing Pane / Coating Type	TRC Ecotherm / Low-e	8
Glazing Wedge/Block	Meranti and Pine Wood Frame (Specific weight = 450 kg/m ³ < 500 kg/m ³ - Softwood)	6
Installation Gap (Between Glazing and Frame)	Air	7
Sealant For Installation of Glazing	Silicone	10
Material of Glazing Bead	Meranti and Pine Wood Frame (Specific weight = 450 kg/m ³ < 500 kg/m ³ - Softwood)	13
Casement Material	Meranti and Pine Wood Frame (Specific weight = 450 kg/m ³ < 500 kg/m ³ - Softwood)	14
Frame Material	Meranti and Pine Wood Frame (Specific weight = 450 kg/m ³ < 500 kg/m ³ - Softwood)	15
Thermal Break	Sciegel / Aquamac QLON Weather Seal 3120 / Polyethylene (Liner) + PU (Foam) + Polypropylene (Hard foot)	16
Weather Stripping	Uniform Sistemi Per Serramenti S. P. A. / DE 133 / EPDM + EPDM Espensa 3 mm	9; 11; 12



Annex-6: Information on Components Used

B: Arbor-Fenex / 78t Balcony Door / 78t - Section B (1)

Purpose of Use / Place of Use	Type of Material	Ref
Outer Pane	Trakya Cam / TRC Ecotherm / Float Glass / 4 mm	1
Cavity	ARGON (90%)	2
Inner Pane	Trakya Cam / TRC Hello Clear / Float Glass / 4 mm	3
Spacer	NEDEX Warm Edge Profiflex Isoprofil Spacer	4
Secondary Sealant	Thiocol (Polysulfide)	5
Glazing Pane / Coating Type	TRC Ecotherm / Low-e	8
Glazing Wedge/Block	Meranti and Pine Wood Frame (Specific weight = 450 kg/m ³ < 500 kg/m ³ - Softwood)	6
Installation Gap (Between Glazing and Frame)	Air	7
Sealant For Installation of Glazing	Silicone	10
Material of Glazing Bead	Meranti and Pine Wood Frame (Specific weight = 450 kg/m ³ < 500 kg/m ³ - Softwood)	13
Casement Material	Meranti and Pine Wood Frame (Specific weight = 450 kg/m ³ < 500 kg/m ³ - Softwood)	14
Frame Material	Meranti and Pine Wood Frame (Specific weight = 450 kg/m ³ < 500 kg/m ³ - Softwood)	15
Material of Bead for Bottom Frame	Meranti and Pine Wood Frame (Specific weight = 450 kg/m ³ < 500 kg/m ³ - Softwood)	16
Thermal Break	Sciegel / Aquamac QLON Weather Seal 3120 / Polyethylene (Liner) + PU (Foam) + Polypropylene (Hard foot)	18
Weather Stripping	Uniform Sistemi Per Serramenti S. P. A. / DE 133 / EPDM + EPDM Espensa 3 mm	9; 11; 12; 19
Door Sill	Aluminium Profile	17
Thermal Break Wedge/Block	Polyamide	20; 21



Annex-6: Information on Components Used

C: Arbor-Fenex / 78t Balcony Door / 78t - Section C (1)

Purpose of Use / Place of Use	Type of Material	Ref
Outer Pane	Trakya Cam / TRC Ecotherm / Float Glass / 4 mm	1
Cavity	ARGON (90%)	2
Inner Pane	Trakya Cam / TRC Helio Clear / Float Glass / 4 mm	3
Spacer	NEDEX Warm Edge Profiflex Isoprofil Spacer	4
Secondary Sealant	Thiocol (Polysulfide)	5
Glazing Pane / Coating Type	TRC Ecotherm / Low-e	8
Glazing Wedge/Block	Meranti and Pine Wood Frame (Specific weight = 450 kg/m ³ < 500 kg/m ³ - Softwood)	6
Installation Gap (Between Glazing and Frame)	Air	7
Sealant For Installation of Glazing	Silicone	10
Material of Glazing Bead	Meranti and Pine Wood Frame (Specific weight = 450 kg/m ³ < 500 kg/m ³ - Softwood)	13
Casement Material	Meranti and Pine Wood Frame (Specific weight = 450 kg/m ³ < 500 kg/m ³ - Softwood)	14
Frame Material	Meranti and Pine Wood Frame (Specific weight = 450 kg/m ³ < 500 kg/m ³ - Softwood)	15
Thermal Break	Sciegel / Aquamac QLON Weather Seal 3120 / Polyethylene (Liner) + PU (Foam) + Polypropylene (Hard foot)	16
Weather Stripping	Uniform Sistemi Per Serramenti S. P. A. / DE 133 / EPDM + EPDM Espensa 3 mm	9; 11; 12

