Nachweis

Berechnung des Wärmedurchgangskoeffizienten und Temperaturfaktors

Prüfbericht
Nr. 18-001612-PR01
(PB-E01-06-de-01)

Auftraggeber

ALUPROF S.A. Centrala, Zaklad Bielsko Biala
ul. Warszawska 153
43-300 Bielsko-Biala
Polen

Produkt

Rollladenkasten

Bezeichnung: SKB 260 / SKB 300

Leistungsrelevante Produktdetails: Material EPS, Grafit und Polyvinylchlorid (PVC-U), hart; Wärmeleitfähigkeit in W/(mK) 0,031 / 0,17; Ansichtsbreite in mm 260 / 305; Bautiefe in mm 264 / 311; Auslassschlitz des Rollladenkastens; Gesamtöffnungsmaß e_{tot} in mm 27 - 130; Lufthohlraum im Rollraum leicht und gut belüftet (siehe Anlage 2); Ersatzpaneel; Material Adiabat / Nutzholz (500 kg/m³); Dicke in mm 60 / 70; Rahmenlänge l_{fr} in mm 48 - 145;

Besonderheiten:

Ergebnisse

Berechnung des Wärmedurchgangskoeffizienten gem. EN ISO 10077-2:2017-07 (Radiosity-Verfahren)

U_{sb} = 0,40 W/(m²K) bis 0,55 W/(m²K)

Berechnung des Temperaturfaktors gem. EN ISO 13788:2012-12; (Radiosity-Verfahren) gem. EN ISO 10077-2:2017-07

f_{Rsi} = 0,74 bis 0,80

Die Berechnung des Temperaturfaktors f_{Rsi} wurde mit einer außenseitigen Temperatur von -5°C und einer raumseitigen Temperatur von 20°C durchgeführt.

ift Rosenheim
25.01.2019

Konrad Huber, Dipl.-Ing. (FH)
Prüfstellenleiter
Bauphysik

Till Stübben, Dipl.-Ing. (FH)
Prüfingenieur
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Grundlagen *)

EN ISO 10077-2:2017-07

EN ISO 10077-2:2012-02

SG 06-verpflichtend
NB-CPD/SG06/11/0832011-09

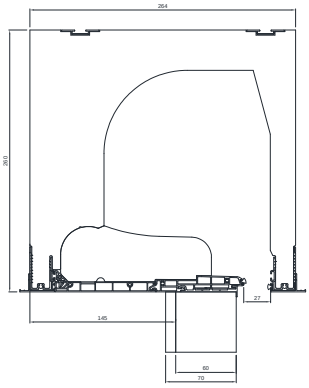
EN ISO 13788:2012-12*)

Entsprechende nationale Fassungen (z.B. DIN EN)

Prüfbericht 18-001612-PR01 (PB-E01-06-en-01) vom 30.08.2018

Darstellung

Querschnittdarstellung Probekörper -01



Weitere Darstellungen siehe Anlage.

Verwendungshinweise

Die ermittelten Ergebnisse können für den Nachweis entsprechend den oben angegebenen Grundlagen verwendet werden.

Gültigkeit

Die genannten Daten und Ergebnisse beziehen sich ausschließlich auf den geprüften und beschriebenen Probekörper. Diese Prüfung ermöglicht keine Aussage über weitere leistungs- und qualitätsbestimmende Eigenschaften der vorliegenden Konstruktion.

Veröffentlichungshinweise

Es gilt das **ift**-Merkblatt „Hinweise zur Benutzung von **ift**-Prüfberichten“. Das Dokument darf nur vollständig veröffentlicht werden.

Inhalt

Der Nachweis umfasst insgesamt 6 Seiten und Anlagen (45 Seiten).

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Prüfung und Kalibrierung – EN ISO/IEC 17025
Inspektion – EN ISO/IEC 17020
Zertifizierung Produkte – EN ISO/IEC 17065
Zertifizierung Managementsysteme – EN ISO/IEC 17021

Notified Body 0757
PÜZ-Stelle: BAY 18

ilac-MRA
DAkkS Deutsche Akkreditierungsstelle D-PL-11349-01-00

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.201930.08.2018
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala,
43-300 Bielsko-Biala (Polen)

1 Gegenstand

1.1 Probekörperbeschreibung

Zur Identifikation des Produkts ist der geprüfte Probekörper in der Anlage beschrieben / dargestellt. Materialangaben, Artikelnummern u.a. firmenspezifische Bezeichnungen sind Angaben des Auftraggebers und werden vom ift auf Plausibilität überprüft.

1.2 Probennahme

Dem **ift** liegen folgende Angaben zur Probennahme vor:

Probennehmer: ALUPROF S.A.
Centrala, Zaklad Bielsko Biala, 43-300 Bielsko-Biala (Polen)

Datum: 12.07.2018

Nachweis: Ein Probennahmebericht liegt dem ift nicht vor.

ift-Probekörper-Nr.: 18-001612-PK01

2 Durchführung

2.1 Grundlagendokumente *) der Verfahren

EN ISO 10077-2:2017-07
Thermal performance of windows, doors and shutters - Calculation of thermal transmittance - Part 2 - Numerical method for frames

EN ISO 10077-2:2012-02
Thermal performance of windows, doors and shutters - Calculation of thermal transmittance - Part 2 - Numerical method for frames

SG 06-verpflichtend NB-CPD/SG06/11/083 2011-09
EN 14351-1:2006 Treatment of unventilated rectangular cavities when calculating thermal properties to EN ISO 10077-2

EN ISO 13788:2012-12
Hygrothermal performance of building components and building elements - Internal surface temperature to avoid critical surface humidity and interstitial condensation - Calculation methods

*) und entsprechende nationale Fassungen (z.B. DIN EN)

2.2 Verfahrenskurzbeschreibung

Berechnung des Wärmedurchgangskoeffizienten U_{sb}
Der Profilquerschnitt wird in eine ausreichende Anzahl von Elemente geteilt, wobei eine kleinere Unterteilung zu keiner signifikanten Änderung des Gesamtwärmestroms führt. Die entsprechenden Materialien, bzw. Randbedingungen werden belegt, und der Gesamtwärmestrom ermittelt. Aus dem Wärmestrom wird der Wärmedurchgangskoeffizient ermittelt.

Berechnung des Temperaturfaktors f_{Rsi}
Der Profilquerschnitt wird in eine ausreichende Anzahl von Elemente geteilt, wobei eine kleinere Unterteilung zu keiner signifikanten Änderung des Gesamtwärmestroms führt. Die entsprechenden Materialien, bzw. Randbedingungen werden belegt, und der Gesamtwärmestrom ermittelt. Die geringste innere Oberflächentemperatur bzw. die innere Oberflächentemperatur an ausgewählten Punkten wird ermittelt und daraus der Temperaturfaktor errechnet.

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.201930.08.2018
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43-300 Bielsko-Biala (Polen)

3 Einzelergebnisse

Berechnung des Wärmedurchgangskoeffizienten und Temperaturfaktors

Projekt-Nr.	18-001612-PR01
Grundlagen der Prüfung	EN ISO 10077-2:2017-07 / EN ISO 10077-2:2012-02 Thermal performance of windows, doors and shutters - Calculation of thermal transmittance - Part 2 - Numerical method for frames SG 06-mandatory NB-CPD/SG06/11/083 2011-09 EN 14351-1:2006 Treatment of unventilated rectangular cavities when calculating thermal properties to EN ISO 10077-2
Verwendete Prüfmittel	Sim/029204 - flixo 8.0
Probekörper	Rollladenkasten
Probekörpernummer	18-001612-PK01
Prüfdatum	14.08.2018
Verantwortlicher Prüfer	Till Stübben
Prüfer	Till Stübben
Prüfdurchführung Abweichungen	Es gibt keine Abweichungen vom Prüfverfahren gemäß Norm/Grundlage.

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.201930.08.2018
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala,
43-300 Bielsko-Biala (Polen)

Ermittlung des Wärmedurchgangskoeffizienten U_{sb}

Der Wärmedurchgangskoeffizient eines Rollladenkastens berechnet sich aus:

$$U_{sb} = \frac{L_{sb}^{2D}}{b_{sb}}$$

mit

$$L_{sb}^{2D} = \frac{\Phi_{ges}}{\Delta T}$$

	Definitionen	Einheit
U_{sb}	Wärmedurchgangskoeffizient des Rollladenkastens	W/(m²K)
b_{sb}	Höhe des Rolladenkastens	m
L_{sb}^{2D}	zweidimensionaler thermischer Leitwert	W/(mK)
Φ_{ges}	längenbezogene Wärmestromdichte	W/m
ΔT	Temperaturdifferenz (Innen zu außen)	K

PK-Nr.	b_{sb}	Verfahren äqu. Wärmeleitf. (EN ISO 10077-2:2017-07)			Radiosity-Verfahren (EN ISO 10077-2:2017-07)		
		L_{sb}^{2D}	U_{sb} [1)]	U_{sb} [2)]	L_{sb}^{2D}	U_{sb} [1)]	U_{sb} [2)]
-01	0,260				0,134	0,514	**0,51**
-02	0,260				0,132	0,508	**0,51**
-03	0,260				0,105	0,405	**0,41**
-04	0,260				0,112	0,429	**0,43**
-05	0,260				0,103	0,398	**0,40**
-06	0,305				0,168	0,551	**0,55**
-07	0,305				0,168	0,552	**0,55**
-08	0,305				0,135	0,441	**0,44**
-09	0,305				0,143	0,469	**0,47**
-10	0,305				0,125	0,410	**0,41**

[1)] detailliertes Berechnungsergebnis

[2)] Berechnungsergebnis gerundet auf zwei Wertanzeigende Stellen, entsprechend Regelung der EN ISO 10007-2

PK-Nr.	b_{sb}	Verfahren äqu. Wärmeleitf. (EN ISO 10077-2:2012-02)		
		L_{sb}^{2D}	U_{sb} [1)]	U_{sb} [2)]
-01	0,260	0,129	0,496	**0,50**
-02	0,260	0,133	0,510	**0,51**
-03	0,260	0,107	0,413	**0,41**
-04	0,260	0,112	0,432	**0,43**
-05	0,260	0,104	0,400	**0,40**
-06	0,305	0,159	0,523	**0,52**
-07	0,305	0,169	0,553	**0,55**
-08	0,305	0,135	0,442	**0,44**
-09	0,305	0,144	0,470	**0,47**
-10	0,305	0,126	0,412	**0,41**

[1)] detailliertes Berechnungsergebnis

[2)] Berechnungsergebnis gerundet auf zwei Wertanzeigende Stellen, entsprechend Regelung der EN ISO 10007-2

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.201930.08.2018
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43-300 Bielsko-Biala (Polen)

ROSENHEIM

Ermittlung des Temperaturfaktors f_{Rsi}

Der Temperaturfaktor an der Innenoberfläche berechnet sich aus:

$$f_{Rsi} = \frac{\theta_{si} - \theta_e}{\theta_{int} - \theta_e}$$

Definitionen		Einheit
f_{Rsi}	Temperaturfaktor	-
θ_{si}	Temperatur der Innenoberfläche	°C
θ_{int}	Innenlufttemperatur	°C
θ_e	Außenlufttemperatur	°C

PK-Nr.	θ_{int}	θ_e	Verfahren äqu. Wärmeleitf. (EN ISO 10077-2:2017-07)		Radiosity-Verfahren (EN ISO 10077-2:2017-07)	
			θ_{si}	f_{Rsi}	θ_{si}	f_{Rsi}
-01	20	-5			13,6	**0,74**
-02	20	-5			13,5	**0,74**
-03	20	-5			14,0	**0,76**
-04	20	-5			13,9	**0,76**
-05	20	-5			15,0	**0,80**
-06	20	-5			13,5	**0,74**
-07	20	-5			13,4	**0,74**
-08	20	-5			13,5	**0,74**
-09	20	-5			13,4	**0,74**
-10	20	-5			13,8	**0,75**

PK-Nr.	θ_{int}	θ_e	Verfahren äqu. Wärmeleitf. (EN ISO 10077-2:2012-02)	
			θ_{si}	f_{Rsi}
-01	20	-5	13,6	**0,74**
-02	20	-5	13,5	**0,74**
-03	20	-5	13,9	**0,76**
-04	20	-5	13,8	**0,75**
-05	20	-5	14,9	**0,80**
-06	20	-5	13,5	**0,74**
-07	20	-5	13,3	**0,73**
-08	20	-5	13,5	**0,74**
-09	20	-5	13,3	**0,73**
-10	20	-5	13,8	**0,75**

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43-300 Bielsko-Biala (Polen)

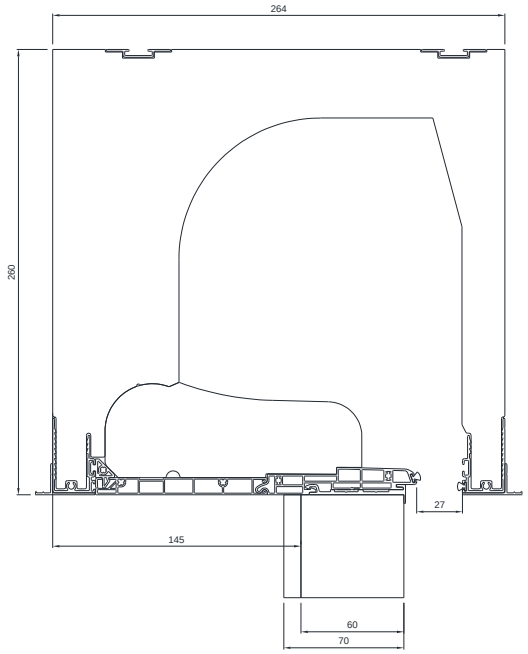

Bild 1: Querschnittdarstellung Probekörper -01, SKB 260 (l_{fr} = 145 mm / Auslassschlitz 27 mm)

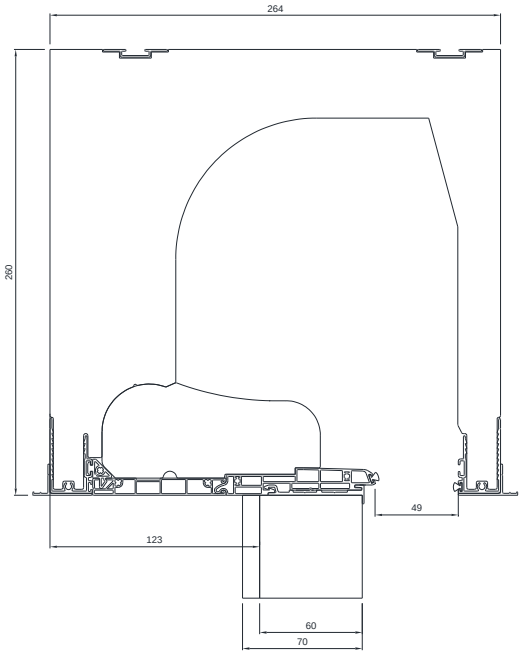

Bild 2: Querschnittdarstellung Probekörper -02, SKB 260 (l_{fr} = 123 mm / Auslassschlitz 49 mm)

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43-300 Bielsko-Biala (Polen)

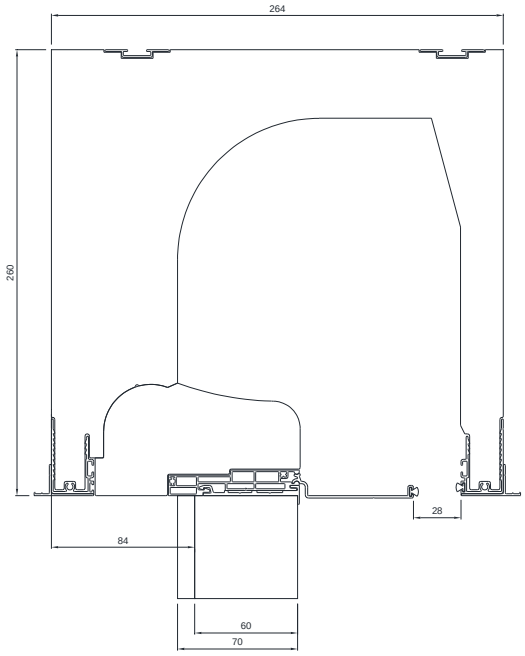

Bild 3: Querschnittdarstellung Probekörper -03, SKB 260 (l_{fr} = 84 mm / Auslassschlitz 28 mm)

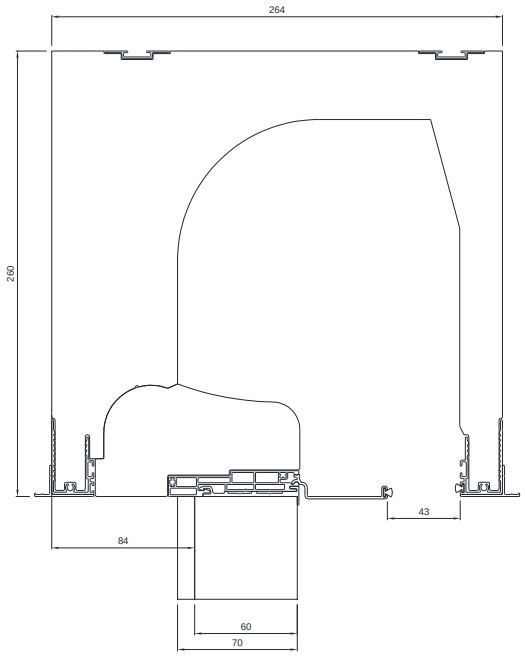

Bild 4: Querschnittdarstellung Probekörper -04, SKB 260 (l_{fr} = 84 mm / Auslassschlitz 43 mm)

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.2019
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala,
43-300 Bielsko-Biala (Polen)

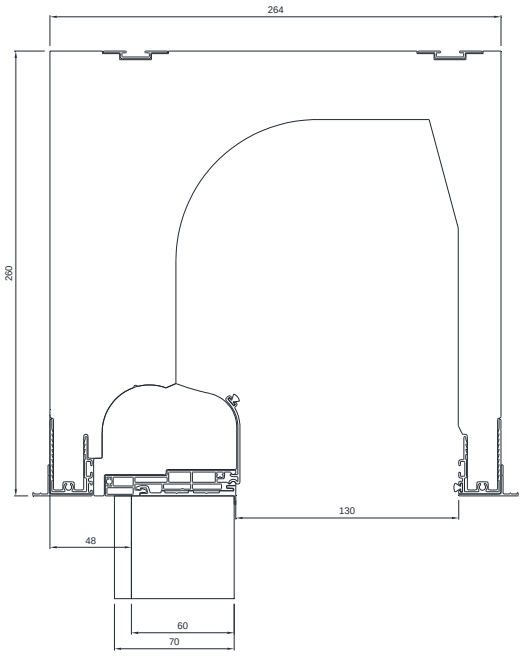

Bild 5: Querschnittdarstellung Probekörper -05, SKB 260 (l_{fr} = 48 mm / Auslassschlitz 130 mm)

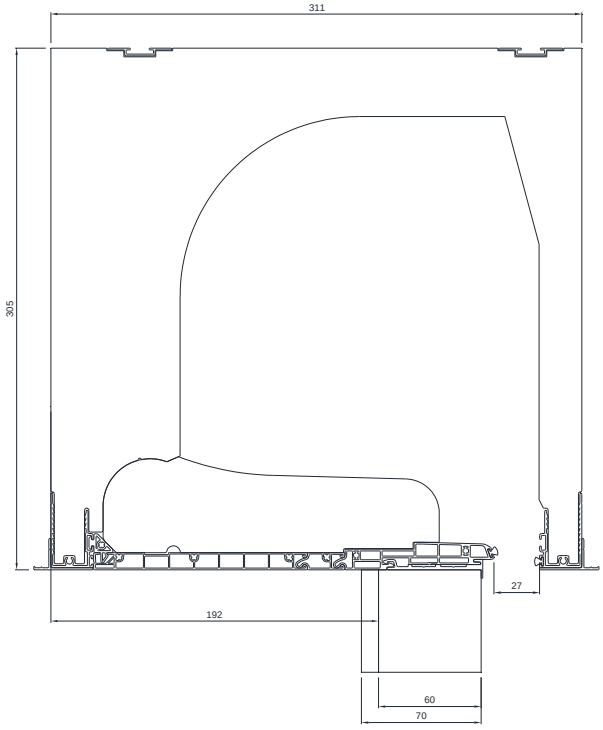

Bild 6: Querschnittdarstellung Probekörper -06, SKB 300 (l_{fr} = 192 mm / Auslassschlitz 27 mm)

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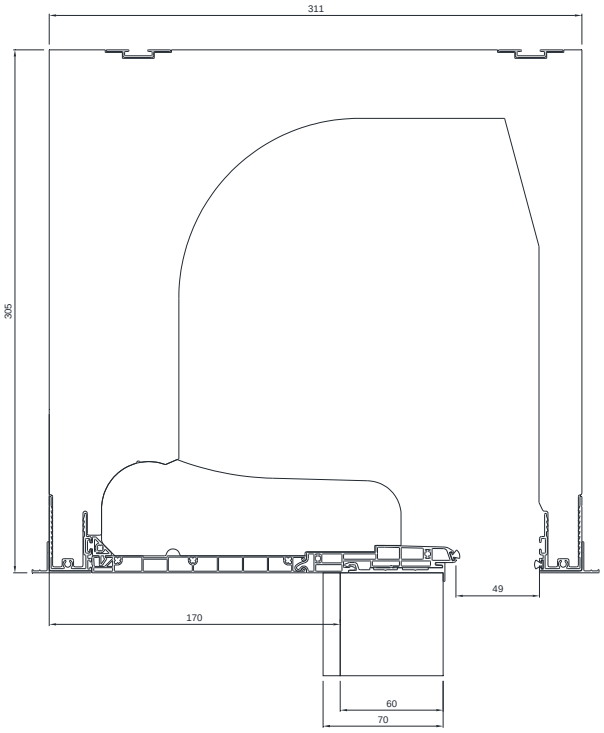

Bild 7: Querschnittdarstellung Probekörper -07, SKB 300 (l_{fr} = 170 mm / Auslassschlitz 49 mm)

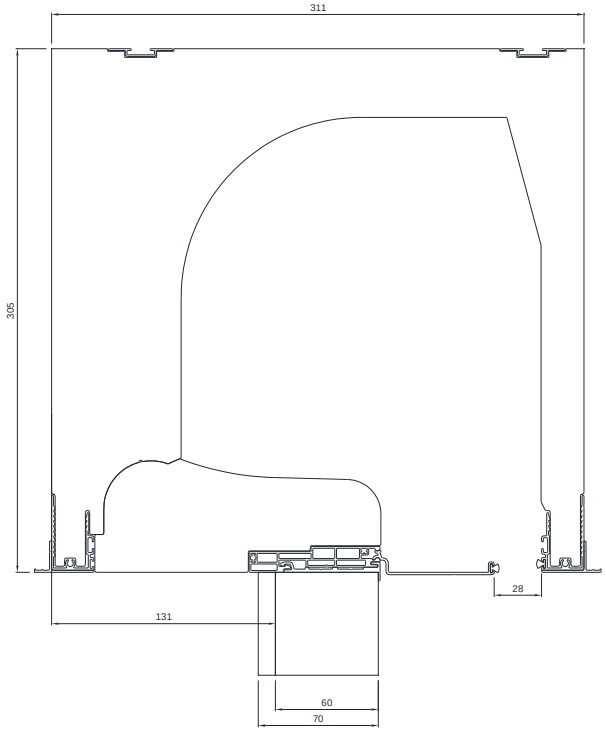

Bild 8: Querschnittdarstellung Probekörper -08, SKB 300 (l_{fr} = 131 mm / Auslassschlitz 28 mm)

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43-300 Bielsko-Biala (Polen)

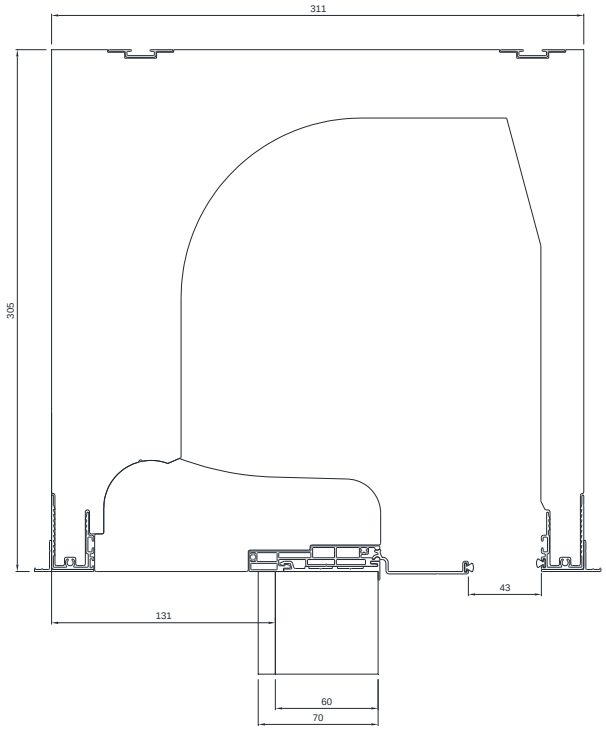

Bild 9: Querschnittdarstellung Probekörper -09, SKB 300 (l_{fr} = 131 mm / Auslassschlitz 43 mm)

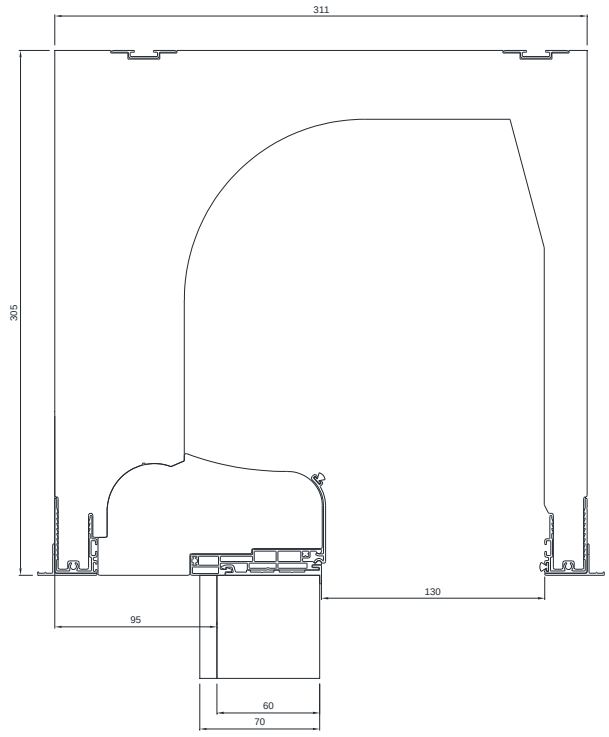

Bild 10: Querschnittdarstellung Probekörper -10, SKB 300 (l_{fr} = 95 mm / Auslassschlitz 130 mm)

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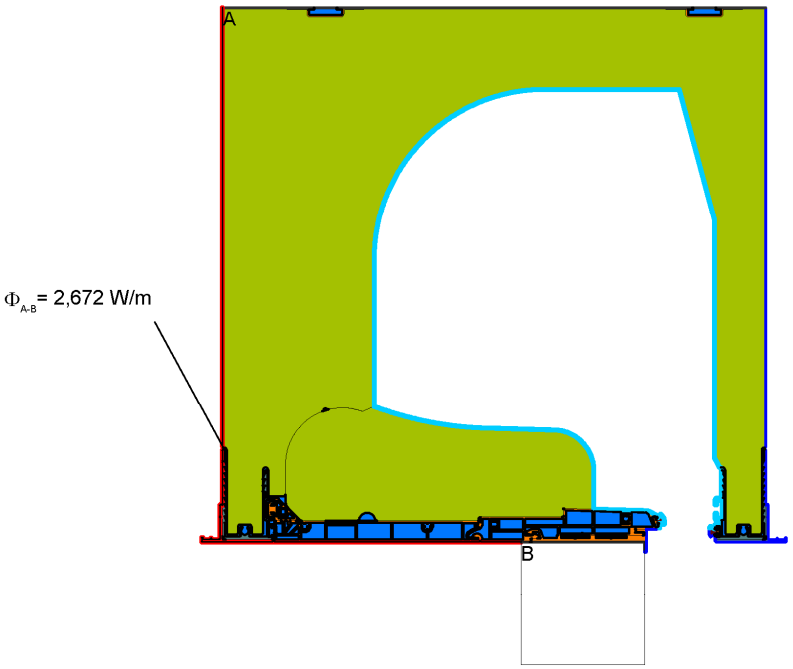
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala, 43-300 Bielsko-Biala (Polen)

Protocol: FEM-Calculation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0,0			
Epsilon 0,9				0,90
External		0,0	0,040	
Internal standard		20	0,13	
Window external 0,30		0,0	0,30	

Material	λ[W/(m·K)]	ε
Aluminium alloy - anodised - painted -powder coated	160	0,90
Aluminium alloy - anodised - painted -powder coated (1)	160	0,90
EPS, Grafit	0,031	0,90
EPS, Grafit (1)	0,031	0,90
PVC (polyvinylchloride), rigid	0,17	0,90
PVC (polyvinylchloride), rigid (1)	0,17	0,90
Polyester mohair (brush seal)	0,14	0,90
Unventilated air cavity **		

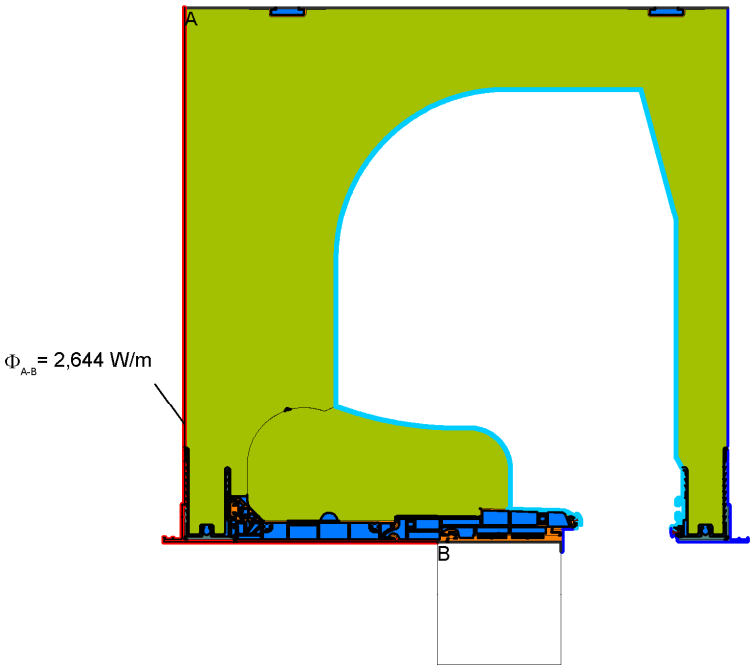
** EN ISO 10077-2:2017, 6.4.2

The data is based on EN ISO 10456 and EN ISO 10077-2.
The thermal conductivities and/or emissivities of the materials which are not based on that standards are deposited at ift-Rosenheim.
The documents have been evaluated. They are in accordance with the requirements of the current version of EN ISO 10077-2.
The emissivity of low emissive layers must be ensured by a factory production control.

Bild 1: Simulationsmodell Probekörper -01
U_{sb}-Berechnung (Radiosity-Verfahren gemäß EN ISO 10077-2:2017-07)

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.2019
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala, 43-300 Bielsko-Biala (Polen)

Protocol: FEM-Calculation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0,0			
Epsilon 0,9				0,90
External		0,0	0,040	
Internal standard		20	0,13	
Window external (1)		0,0	0,13	

Material	λ[W/(m·K)]	ε
Aluminium alloy - anodised - painted -powder coated	160	0,90
Aluminium alloy - anodised - painted -powder coated (1)	160	0,90
EPS, Grafit	0,031	0,90
EPS, Grafit (1)	0,031	0,90
PVC (polyvinylchloride), rigid	0,17	0,90
PVC (polyvinylchloride), rigid (1)	0,17	0,90
Polyester mohair (brush seal)	0,14	0,90
Unventilated air cavity **		

** EN ISO 10077-2:2017, 6.4.2

The data is based on EN ISO 10456 and EN ISO 10077-2.
The thermal conductivities and/or emissivities of the materials which are not based on that standards are deposited at ift-Rosenheim.
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The emissivity of low emissive layers must be ensured by a factory production control.

Bild 2: Simulationsmodell Probekörper -02
U_{sb}-Berechnung (Radiosity-Verfahren gemäß EN ISO 10077-2:2017-07)

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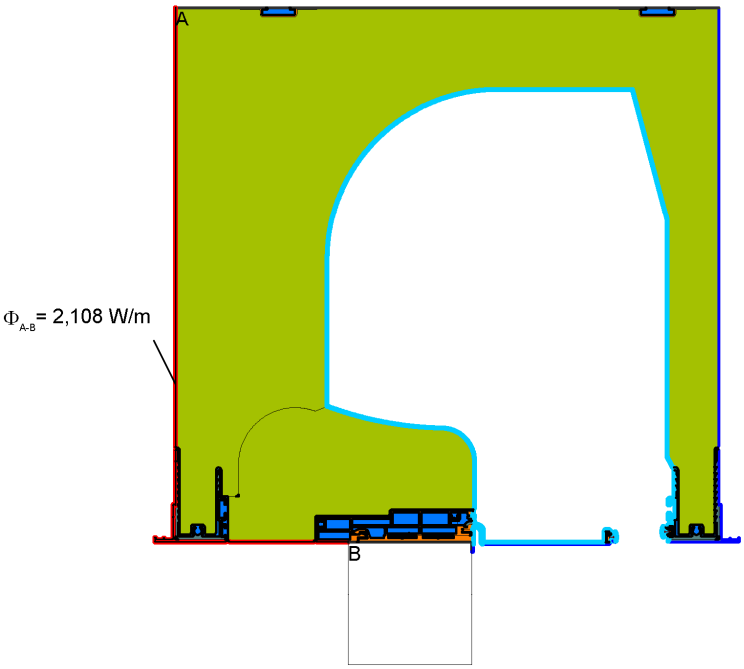
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala, 43-300 Bielsko-Biala (Polen)

Protocol: FEM-Calculation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0,0			
Epsilon 0,9				0,90
External		0,0	0,040	
Internal standard		20	0,13	
Window external 0,30		0,0	0,30	

Material	λ[W/(m·K)]	ε
Aluminium alloy - anodised - painted -powder coated	160	0,90
Aluminium alloy - anodised - painted -powder coated (1)	160	0,90
EPS, Grafit	0,031	0,90
EPS, Grafit (1)	0,031	0,90
PVC (polyvinylchloride), rigid	0,17	0,90
PVC (polyvinylchloride), rigid (1)	0,17	0,90
Polyester mohair (brush seal)	0,14	0,90
Unventilated air cavity **		

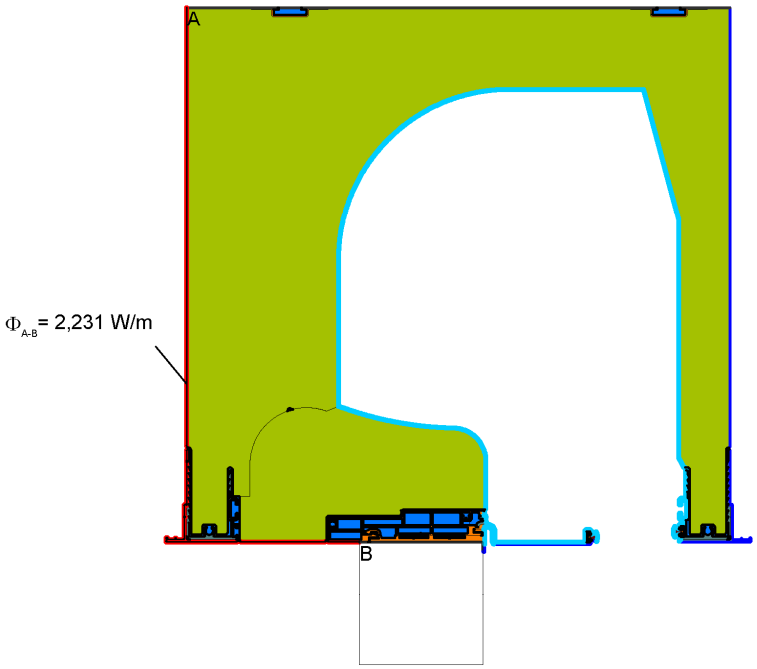
** EN ISO 10077-2:2017, 6.4.2

The data is based on EN ISO 10456 and EN ISO 10077-2.
The thermal conductivities and/or emissivities of the materials which are not based on that standards are deposited at ift-Rosenheim.
The documents have been evaluated. They are in accordance with the requirements of the current version of EN ISO 10077-2.
The emissivity of low emissive layers must be ensured by a factory production control.

Bild 3: Simulationsmodell Probekörper -03
U_{sb}-Berechnung (Radiosity-Verfahren gemäß EN ISO 10077-2:2017-07)

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.2019
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala, 43-300 Bielsko-Biala (Polen)

Protocol: FEM-Calculation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0,0			
Epsilon 0,9				0,90
External		0,0	0,040	
Internal standard		20	0,13	
Window external (1)		0,0	0,13	
Window external 0,30		0,0	0,30	

Material	λ[W/(m·K)]	ε
Aluminium alloy - anodised - painted -powder coated	160	0,90
Aluminium alloy - anodised - painted -powder coated (1)	160	0,90
EPS, Grafit	0,031	0,90
EPS, Grafit (1)	0,031	0,90
PVC (polyvinylchloride), rigid	0,17	0,90
PVC (polyvinylchloride), rigid (1)	0,17	0,90
Polyester mohair (brush seal)	0,14	0,90
Unventilated air cavity **		

** EN ISO 10077-2:2017, 6.4.2

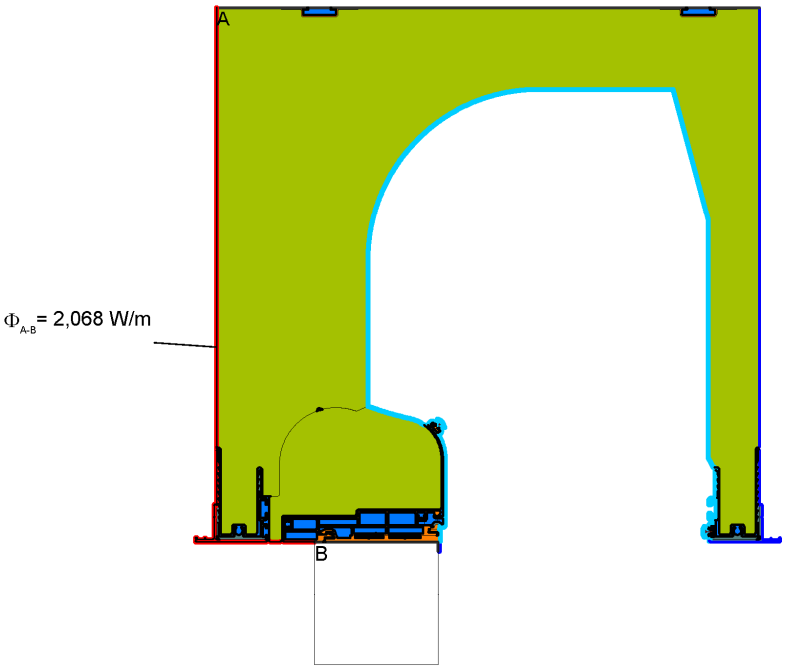
The data is based on EN ISO 10456 and EN ISO 10077-2.
The thermal conductivities and/or emissivities of the materials which are not based on that standards are deposited at ift-Rosenheim.
The documents have been evaluated. They are in accordance with the requirements of the current version of EN ISO 10077-2.
The emissivity of low emissive layers must be ensured by a factory production control.

Prüfer / Bearbeiter: Till Stübben
Speicherdatum: 06.08.2018
Programmversion (letzte Speicherung): flixo pro 8.0.923.1
Dokumentenvorlage (Template): 2018_03_ift_Template_v3.flt
Anzahl finiter Elemente: 63264
Rel. Wärmestromfehler: 2,7e-009

Bild 4: Simulationsmodell Probekörper -04
U_{sb}-Berechnung (Radiosity-Verfahren gemäß EN ISO 10077-2:2017-07)

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.2019
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala, 43-300 Bielsko-Biala (Polen)

Protocol: FEM-Calculation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0,0			
Epsilon 0,9				0,90
External		0,0	0,040	
Internal standard		20	0,13	
Window external (1)		0,0	0,13	

Material	λ[W/(m·K)]	ε
Aluminium alloy - anodised - painted -powder coated	160	0,90
Aluminium alloy - anodised - painted -powder coated (1)	160	0,90
EPS, Grafit	0,031	0,90
EPS, Grafit (1)	0,031	0,90
PVC (polyvinylchloride), rigid	0,17	0,90
PVC (polyvinylchloride), rigid (1)	0,17	0,90
Polyester mohair (brush seal)	0,14	0,90
Unventilated air cavity **		

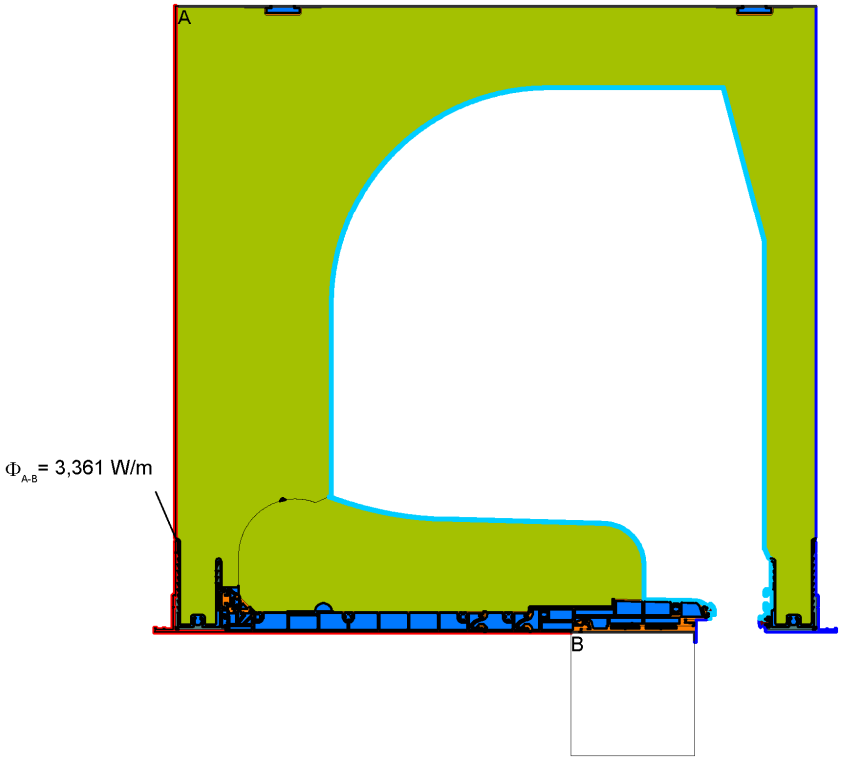
** EN ISO 10077-2:2017, 6.4.2

The data is based on EN ISO 10456 and EN ISO 10077-2.
The thermal conductivities and/or emissivities of the materials which are not based on that standards are deposited at ift-Rosenheim.
The documents have been evaluated. They are in accordance with the requirements of the current version of EN ISO 10077-2.
The emissivity of low emissive layers must be ensured by a factory production control.

Bild 5: Simulationsmodell Probekörper -05
U_{sb}-Berechnung (Radiosity-Verfahren gemäß EN ISO 10077-2:2017-07)

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.2019
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala, 43-300 Bielsko-Biala (Polen)

Protocol: FEM-Calculation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0,0			
Epsilon 0,9				0,90
External		0,0	0,040	
Internal standard		20	0,13	
Window external 0,30		0,0	0,30	

Material	λ[W/(m·K)]	ε
Aluminium alloy - anodised - painted -powder coated	160	0,90
Aluminium alloy - anodised - painted -powder coated (1)	160	0,90
EPS, Grafit	0,031	0,90
EPS, Grafit (1)	0,031	0,90
PVC (polyvinylchloride), rigid	0,17	0,90
PVC (polyvinylchloride), rigid (1)	0,17	0,90
Polyester mohair (brush seal)	0,14	0,90
Unventilated air cavity **		

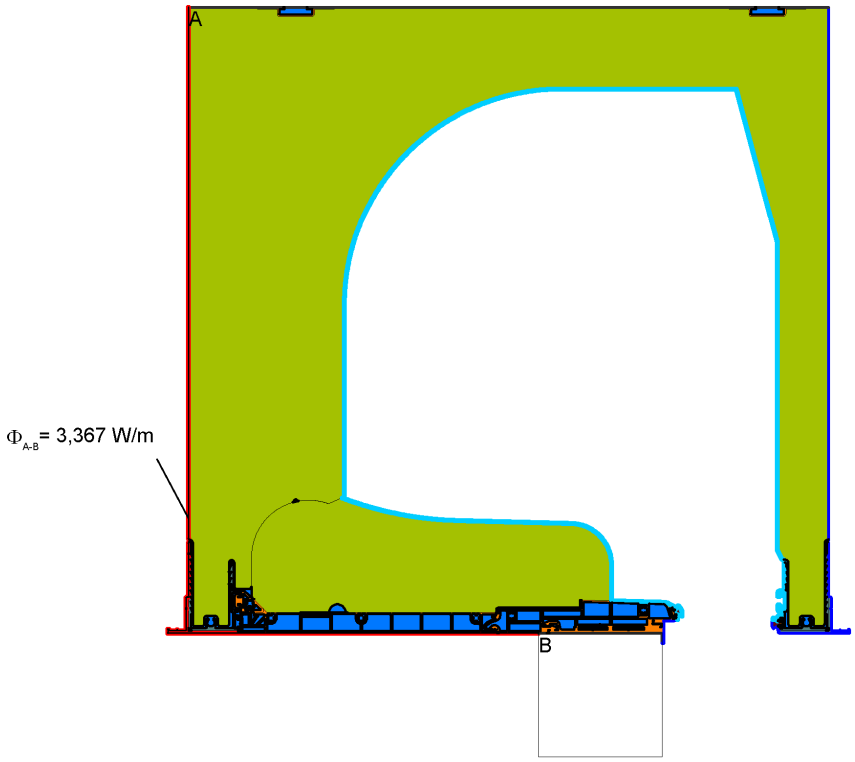
** EN ISO 10077-2:2017, 6.4.2

The data is based on EN ISO 10456 and EN ISO 10077-2.
The thermal conductivities and/or emissivities of the materials which are not based on that standards are deposited at ift-Rosenheim.
The documents have been evaluated. They are in accordance with the requirements of the current version of EN ISO 10077-2.
The emissivity of low emissive layers must be ensured by a factory production control.

Bild 6: Simulationsmodell Probekörper -06
U_{sb}-Berechnung (Radiosity-Verfahren gemäß EN ISO 10077-2:2017-07)

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.2019
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala,
43-300 Bielsko-Biala (Polen)

Protocol: FEM-Calculation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0,0			
Epsilon 0,9				0,90
External		0,0	0,040	
Internal standard		20	0,13	
Window external (1)		0,0	0,13	

Material	λ[W/(m·K)]	ε
Aluminium alloy - anodised - painted -powder coated	160	0,90
Aluminium alloy - anodised - painted -powder coated (1)	160	0,90
EPS, Grafit	0,031	0,90
EPS, Grafit (1)	0,031	0,90
PVC (polyvinylchloride), rigid	0,17	0,90
PVC (polyvinylchloride), rigid (1)	0,17	0,90
Polyester mohair (brush seal)	0,14	0,90
Unventilated air cavity **		

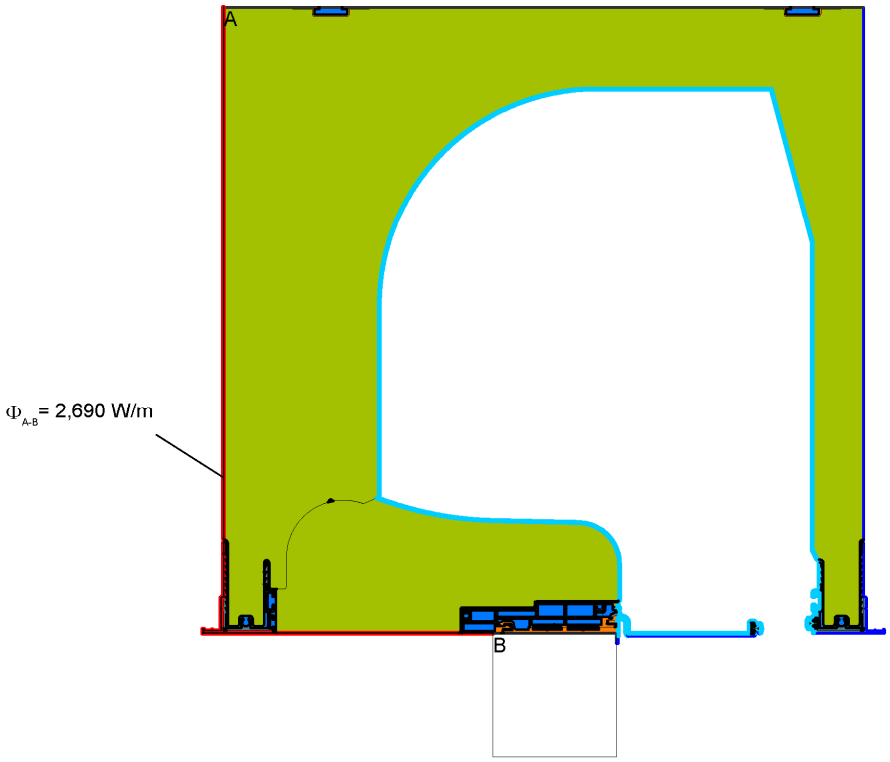
** EN ISO 10077-2:2017, 6.4.2

The data is based on EN ISO 10456 and EN ISO 10077-2.
The thermal conductivities and/or emissivities of the materials which are not based on that standards are deposited at ift-Rosenheim.
The documents have been evaluated. They are in accordance with the requirements of the current version of EN ISO 10077-2.
The emissivity of low emissive layers must be ensured by a factory production control.

Bild 7: Simulationsmodell Probekörper -07
U_{sb}-Berechnung (Radiosity-Verfahren gemäß EN ISO 10077-2:2017-07)

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.2019
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala, 43-300 Bielsko-Biala (Polen)

Protocol: FEM-Calculation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0,0			
Epsilon 0,9				0,90
External		0,0	0,040	
Internal standard		20	0,13	
Window external 0,30		0,0	0,30	

Material	λ[W/(m·K)]	ε
Aluminium alloy - anodised - painted -powder coated	160	0,90
Aluminium alloy - anodised - painted -powder coated (1)	160	0,90
EPS, Grafit	0,031	0,90
EPS, Grafit (1)	0,031	0,90
PVC (polyvinylchloride), rigid	0,17	0,90
PVC (polyvinylchloride), rigid (1)	0,17	0,90
Polyester mohair (brush seal)	0,14	0,90
Unventilated air cavity **		

** EN ISO 10077-2:2017, 6.4.2

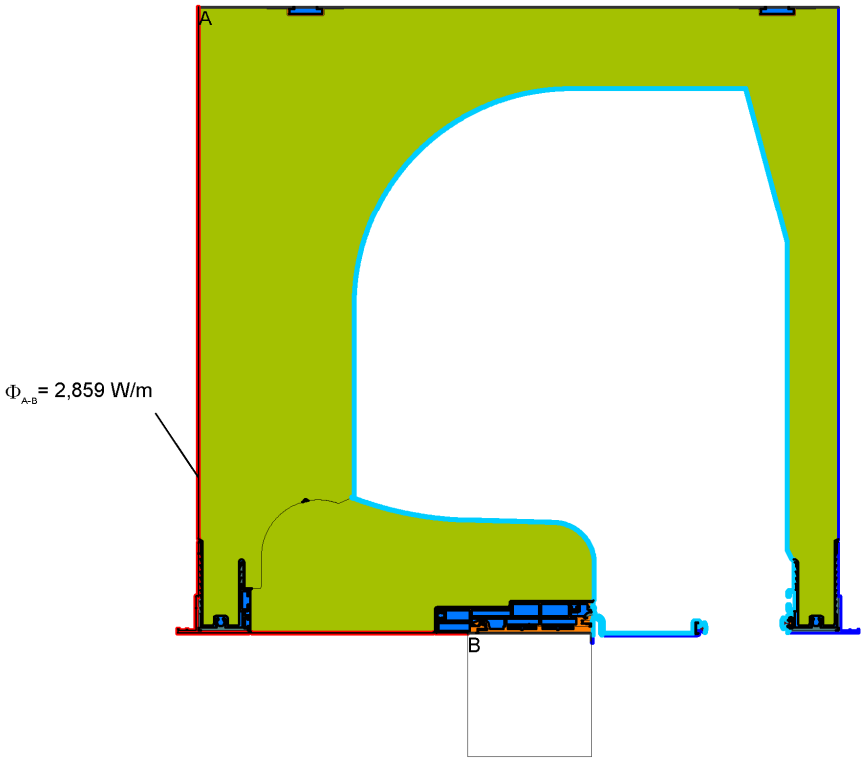
The data is based on EN ISO 10456 and EN ISO 10077-2.
The thermal conductivities and/or emissivities of the materials which are not based on that standards are deposited at ift-Rosenheim.
The documents have been evaluated. They are in accordance with the requirements of the current version of EN ISO 10077-2.
The emissivity of low emissive layers must be ensured by a factory production control.

Prüfer / Bearbeiter: Till Stübben
Speicherdatum: 06.08.2018
Programmversion (letzte Speicherung): flixo pro 8.0.923.1
Dokumentenvorlage (Template): 2018_03_ift_Template_v3.flt
Anzahl finiter Elemente: 63264
Rel. Wärmestromfehler: 2,7e-009

Bild 8: Simulationsmodell Probekörper -08
U_{sb}-Berechnung (Radiosity-Verfahren gemäß EN ISO 10077-2:2017-07)

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.2019
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala, 43-300 Bielsko-Biala (Polen)

Protocol: FEM-Calculation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0,0			
Epsilon 0,9				0,90
External		0,0	0,040	
Internal standard		20	0,13	
Window external (1)		0,0	0,13	
Window external 0,30		0,0	0,30	

Material	λ[W/(m·K)]	ε
Aluminium alloy - anodised - painted -powder coated	160	0,90
Aluminium alloy - anodised - painted -powder coated (1)	160	0,90
EPS, Grafit	0,031	0,90
EPS, Grafit (1)	0,031	0,90
PVC (polyvinylchloride), rigid	0,17	0,90
PVC (polyvinylchloride), rigid (1)	0,17	0,90
Polyester mohair (brush seal)	0,14	0,90
Unventilated air cavity **		

** EN ISO 10077-2:2017, 6.4.2

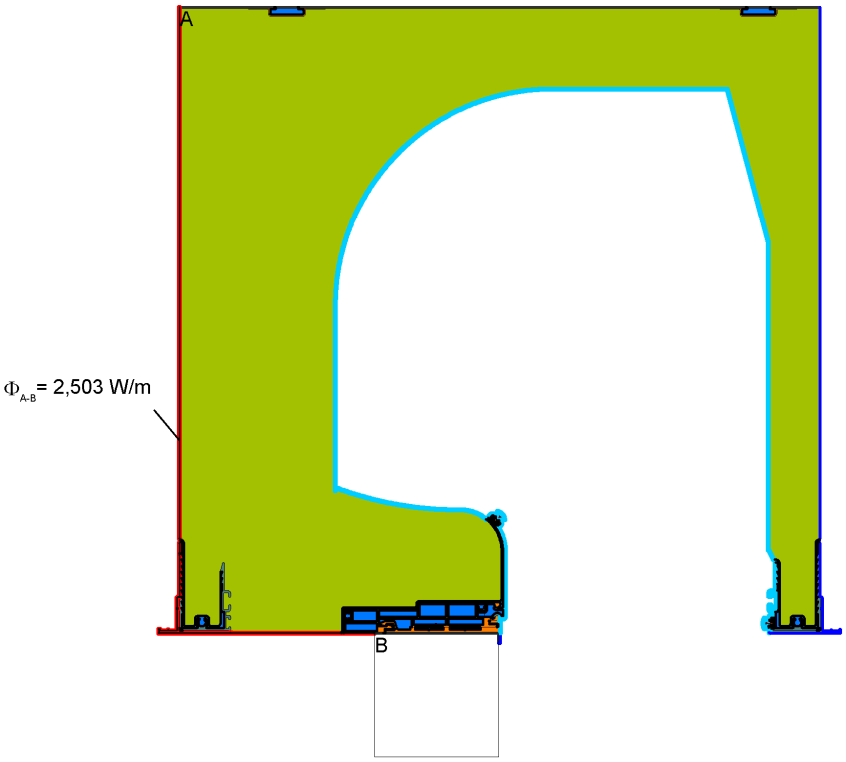
The data is based on EN ISO 10456 and EN ISO 10077-2.
The thermal conductivities and/or emissivities of the materials which are not based on that standards are deposited at ift-Rosenheim.
The documents have been evaluated. They are in accordance with the requirements of the current version of EN ISO 10077-2.
The emissivity of low emissive layers must be ensured by a factory production control.

Prüfer / Bearbeiter: Till Stübben
Speicherdatum: 06.08.2018
Programmversion (letzte Speicherung): flixo pro 8.0.923.1
Dokumentenvorlage (Template): 2018_03_ift_Template_v3.flt
Anzahl finiter Elemente: 63264
Rel. Wärmestromfehler: 2,7e-009

Bild 9: Simulationsmodell Probekörper -09
U_{sb}-Berechnung (Radiosity-Verfahren gemäß EN ISO 10077-2:2017-07)

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.2019
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala, 43-300 Bielsko-Biala (Polen)

Protocol: FEM-Calculation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0,0			
Epsilon 0,9				0,90
External		0,0	0,040	
Internal standard		20	0,13	
Window external (1)		0,0	0,13	

Material	λ[W/(m·K)]	ε
Aluminium alloy - anodised - painted -powder coated	160	0,90
Aluminium alloy - anodised - painted -powder coated (1)	160	0,90
EPS, Grafit	0,031	0,90
PVC (polyvinylchloride), rigid	0,17	0,90
PVC (polyvinylchloride), rigid (1)	0,17	0,90
Polyester mohair (brush seal)	0,14	0,90
Unventilated air cavity **		

** EN ISO 10077-2:2017, 6.4.2

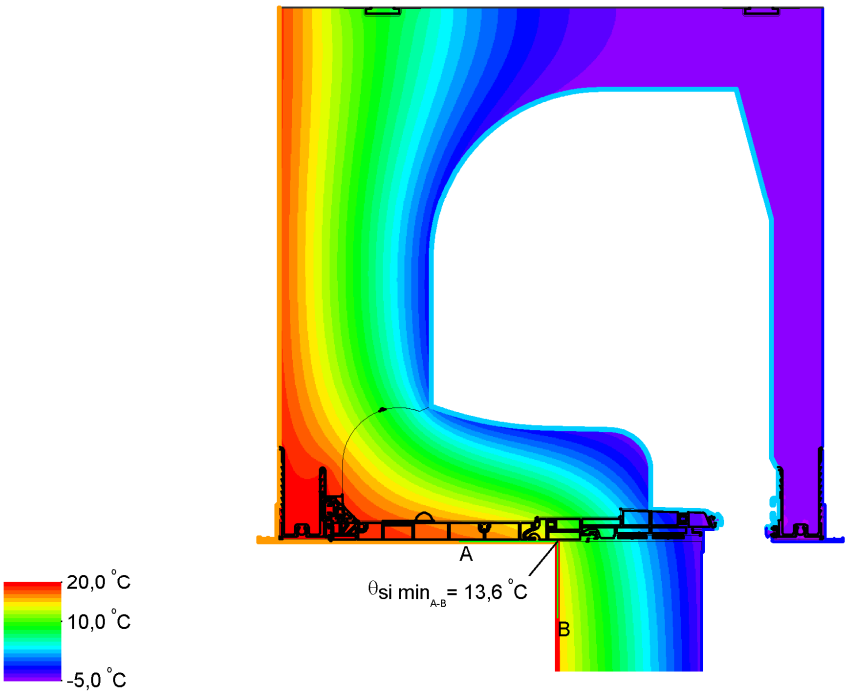
The data is based on EN ISO 10456 and EN ISO 10077-2.
The thermal conductivities and/or emissivities of the materials which are not based on that standards are deposited at ift-Rosenheim.
The documents have been evaluated. They are in accordance with the requirements of the current version of EN ISO 10077-2.
The emissivity of low emissive layers must be ensured by a factory production control.

Prüfer / Bearbeiter: Till Stübben
Speicherdatum: 06.08.2018
Programmversion (letzte Speicherung): flixo pro 8.0.923.1
Dokumentenvorlage (Template): 2018_03_ift_Template_v3.flt
Anzahl finiter Elemente: 63264
Rel. Wärmestromfehler: 2,7e-009

Bild 10: Simulationsmodell Probekörper -10
U_{sb}-Berechnung (Radiosity-Verfahren gemäß EN ISO 10077-2:2017-07)

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.2019
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala, 43-300 Bielsko-Biala (Polen)

Protocol: FEM-Calculation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0,0			
Epsilon 0,9				0,90
External		-5,0	0,040	
Internal 0,25		20	0,25	
Internal standard		20	0,13	
Window external 0,30		-5,0	0,30	

Material	λ[W/(m·K)]	ε
Aluminium alloy - anodised - painted -powder coated	160	0,90
Aluminium alloy - anodised - painted -powder coated (1)	160	0,90
EPS, Grafit	0,031	0,90
EPS, Grafit (1)	0,031	0,90
PVC (polyvinylchloride), rigid	0,17	0,90
PVC (polyvinylchloride), rigid (1)	0,17	0,90
Polyester mohair (brush seal)	0,14	0,90
Timber 500 kg/m³	0,13	0,90
Unventilated air cavity **		

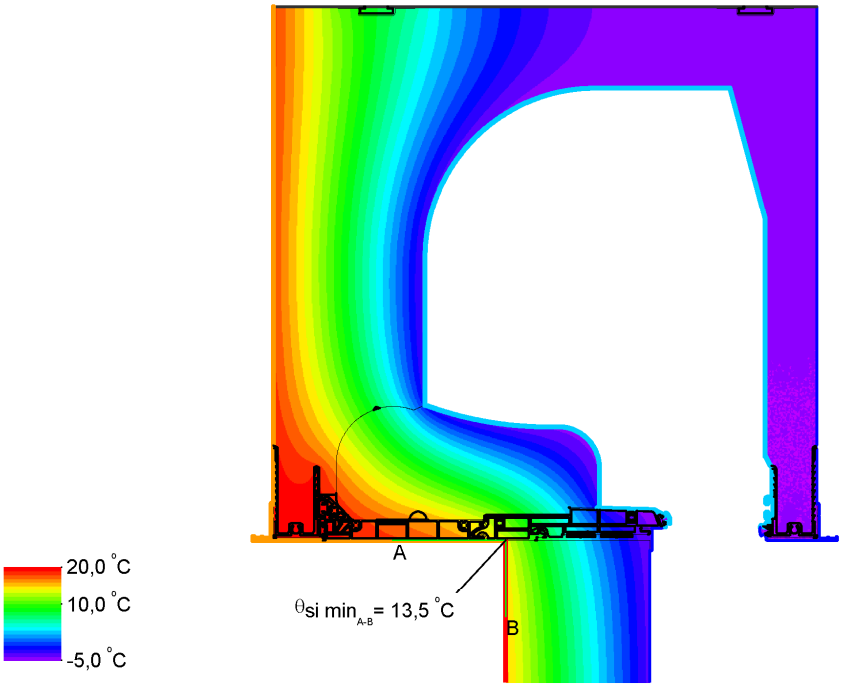
** EN ISO 10077-2:2017, 6.4.2

The data is based on EN ISO 10456 and EN ISO 10077-2.
The thermal conductivities and/or emissivities of the materials which are not based on that standards are deposited at ift-Rosenheim.
The documents have been evaluated. They are in accordance with the requirements of the current version of EN ISO 10077-2.
The emissivity of low emissive layers must be ensured by a factory production control.

Bild 11: Simulationsmodell Probekörper -01
fRsi-Berechnung (Radiosity-Verfahren gemäß EN ISO 10077-2:2017-07)

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.2019
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala, 43-300 Bielsko-Biala (Polen)

Protocol: FEM-Calculation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0,0			
Epsilon 0,9				0,90
External		-5,0	0,040	
Internal 0,25		20	0,25	
Internal standard		20	0,13	
Window external (1)		-5,0	0,13	

Material	λ[W/(m·K)]	ε
Aluminium alloy - anodised - painted -powder coated	160	0,90
Aluminium alloy - anodised - painted -powder coated (1)	160	0,90
EPS, Grafit	0,031	0,90
EPS, Grafit (1)	0,031	0,90
PVC (polyvinylchloride), rigid	0,17	0,90
PVC (polyvinylchloride), rigid (1)	0,17	0,90
Polyester mohair (brush seal)	0,14	0,90
Timber 500 kg/m³	0,13	0,90
Unventilated air cavity **		

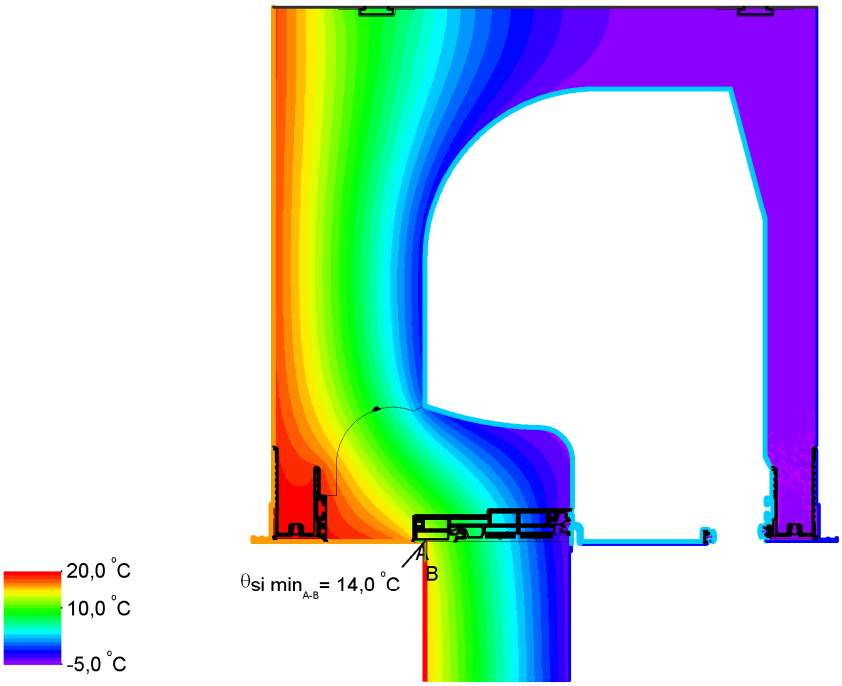
** EN ISO 10077-2:2017, 6.4.2

The data is based on EN ISO 10456 and EN ISO 10077-2.
The thermal conductivities and/or emissivities of the materials which are not based on that standards are deposited at ift-Rosenheim.
The documents have been evaluated. They are in accordance with the requirements of the current version of EN ISO 10077-2.
The emissivity of low emissive layers must be ensured by a factory production control.

Bild 12: Simulationsmodell Probekörper -02
fRsi-Berechnung (Radiosity-Verfahren gemäß EN ISO 10077-2:2017-07)

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.2019
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala, 43-300 Bielsko-Biala (Polen)

Protocol: FEM-Calculation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0,0			
Epsilon 0,9				0,90
External		-5,0	0,040	
Internal 0,25		20	0,25	
Internal standard		20	0,13	
Window external 0,30		-5,0	0,30	

Material	λ[W/(m·K)]	ε
Aluminium alloy - anodised - painted -powder coated	160	0,90
Aluminium alloy - anodised - painted -powder coated (1)	160	0,90
EPS, Grafit	0,031	0,90
EPS, Grafit (1)	0,031	0,90
PVC (polyvinylchloride), rigid	0,17	0,90
PVC (polyvinylchloride), rigid (1)	0,17	0,90
Polyester mohair (brush seal)	0,14	0,90
Timber 500 kg/m³	0,13	0,90
Unventilated air cavity **		

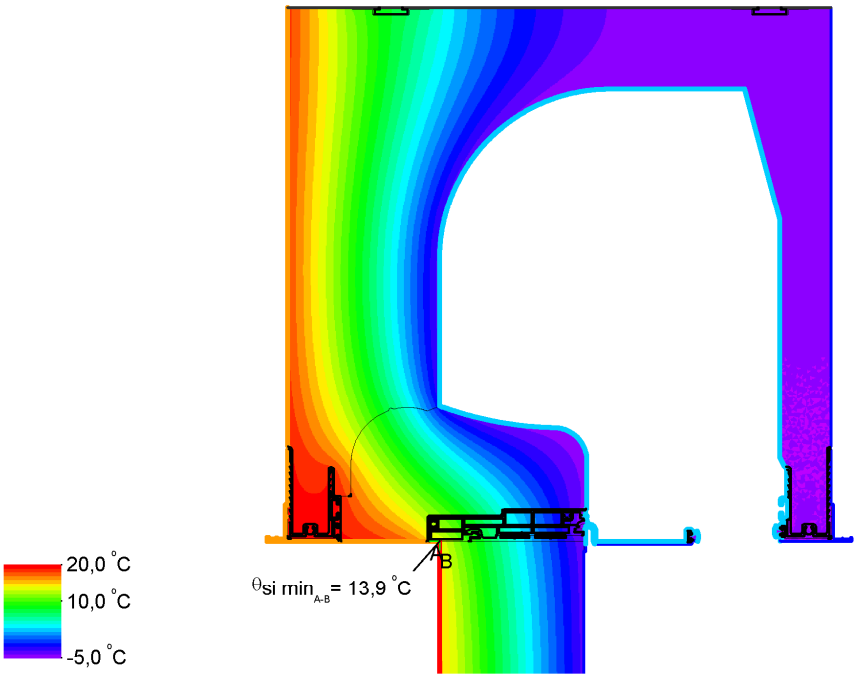
** EN ISO 10077-2:2017, 6.4.2

The data is based on EN ISO 10456 and EN ISO 10077-2.
The thermal conductivities and/or emissivities of the materials which are not based on that standards are deposited at ift-Rosenheim.
The documents have been evaluated. They are in accordance with the requirements of the current version of EN ISO 10077-2.
The emissivity of low emissive layers must be ensured by a factory production control.

Bild 13: Simulationsmodell Probekörper -03
f_{Rsi}-Berechnung (Radiosity-Verfahren gemäß EN ISO 10077-2:2017-07)

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.2019
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala, 43-300 Bielsko-Biala (Polen)

Protocol: FEM-Calculation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0,0			
Epsilon 0,9				0,90
External		-5,0	0,040	
Internal 0,25		20	0,25	
Internal standard		20	0,13	
Window external (1)		-5,0	0,13	
Window external 0,30		-5,0	0,30	

Material	λ[W/(m·K)]	ε
Aluminium alloy - anodised - painted -powder coated	160	0,90
Aluminium alloy - anodised - painted -powder coated (1)	160	0,90
EPS, Grafit	0,031	0,90
EPS, Grafit (1)	0,031	0,90
PVC (polyvinylchloride), rigid	0,17	0,90
PVC (polyvinylchloride), rigid (1)	0,17	0,90
Polyester mohair (brush seal)	0,14	0,90
Timber 500 kg/m³	0,13	0,90
Unventilated air cavity **		

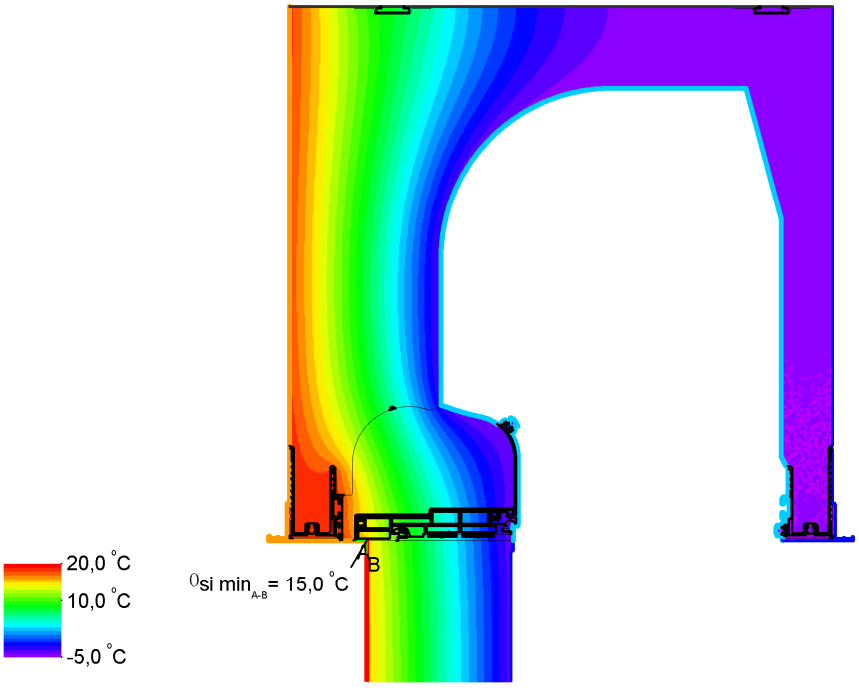
** EN ISO 10077-2:2017, 6.4.2

The data is based on EN ISO 10456 and EN ISO 10077-2.
The thermal conductivities and/or emissivities of the materials which are not based on that standards are deposited at ift-Rosenheim.
The documents have been evaluated. They are in accordance with the requirements of the current version of EN ISO 10077-2.
The emissivity of low emissive layers must be ensured by a factory production control.

Bild 14: Simulationsmodell Probekörper -04
f_{Rsi}-Berechnung (Radiosity-Verfahren gemäß EN ISO 10077-2:2017-07)

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.2019
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala, 43-300 Bielsko-Biala (Polen)

Protocol: FEM-Calculation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0,0			
Epsilon 0,9				0,90
External		-5,0	0,040	
Internal 0,25		20	0,25	
Internal standard		20	0,13	
Window external (1)		-5,0	0,13	

Material	λ[W/(m·K)]	ε
Aluminium alloy - anodised - painted -powder coated	160	0,90
Aluminium alloy - anodised - painted -powder coated (1)	160	0,90
EPS, Grafit	0,031	0,90
EPS, Grafit (1)	0,031	0,90
PVC (polyvinylchloride), rigid	0,17	0,90
PVC (polyvinylchloride), rigid (1)	0,17	0,90
Polyester mohair (brush seal)	0,14	0,90
Timber 500 kg/m³	0,13	0,90
Unventilated air cavity **		

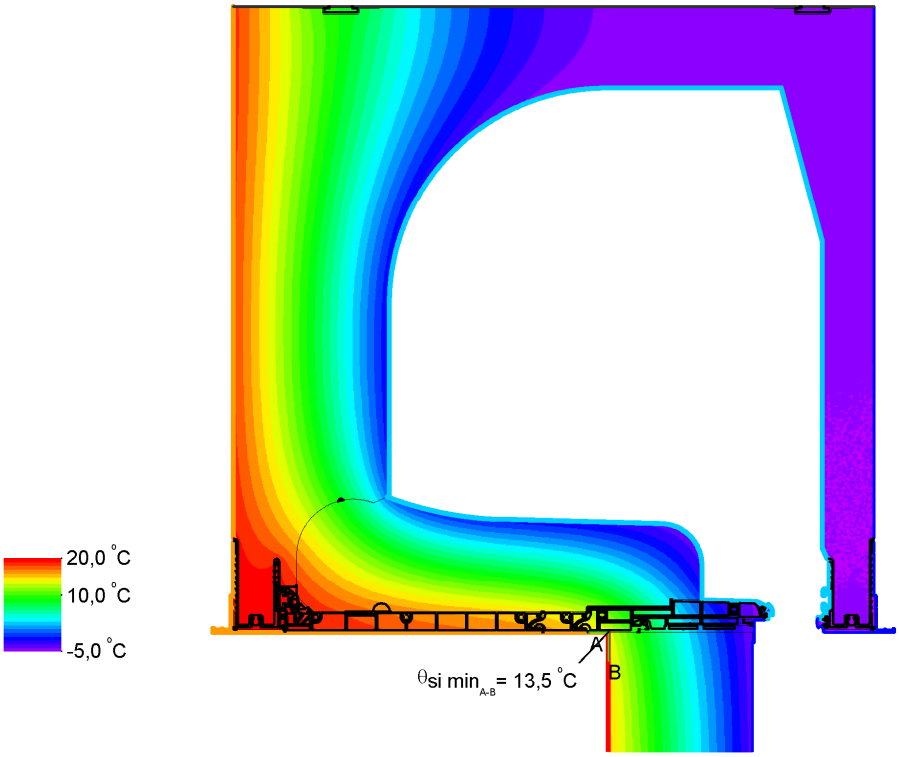
** EN ISO 10077-2:2017, 6.4.2

The data is based on EN ISO 10456 and EN ISO 10077-2.
The thermal conductivities and/or emissivities of the materials which are not based on that standards are deposited at ift-Rosenheim.
The documents have been evaluated. They are in accordance with the requirements of the current version of EN ISO 10077-2.
The emissivity of low emissive layers must be ensured by a factory production control.

Bild 15: Simulationsmodell Probekörper -05
f_{Rsi}-Berechnung (Radiosity-Verfahren gemäß EN ISO 10077-2:2017-07)

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.2019
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala, 43-300 Bielsko-Biala (Polen)

Protocol: FEM-Calculation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0,0			
Epsilon 0,9				0,90
External		-5,0	0,040	
Internal 0,25		20	0,25	
Internal standard		20	0,13	
Window external 0,30		-5,0	0,30	

Material	λ[W/(m·K)]	ε
Aluminium alloy - anodised - painted -powder coated	160	0,90
Aluminium alloy - anodised - painted -powder coated (1)	160	0,90
EPS, Grafit	0,031	0,90
EPS, Grafit (1)	0,031	0,90
PVC (polyvinylchloride), rigid	0,17	0,90
PVC (polyvinylchloride), rigid (1)	0,17	0,90
Polyester mohair (brush seal)	0,14	0,90
Timber 500 kg/m³	0,13	0,90
Unventilated air cavity **		

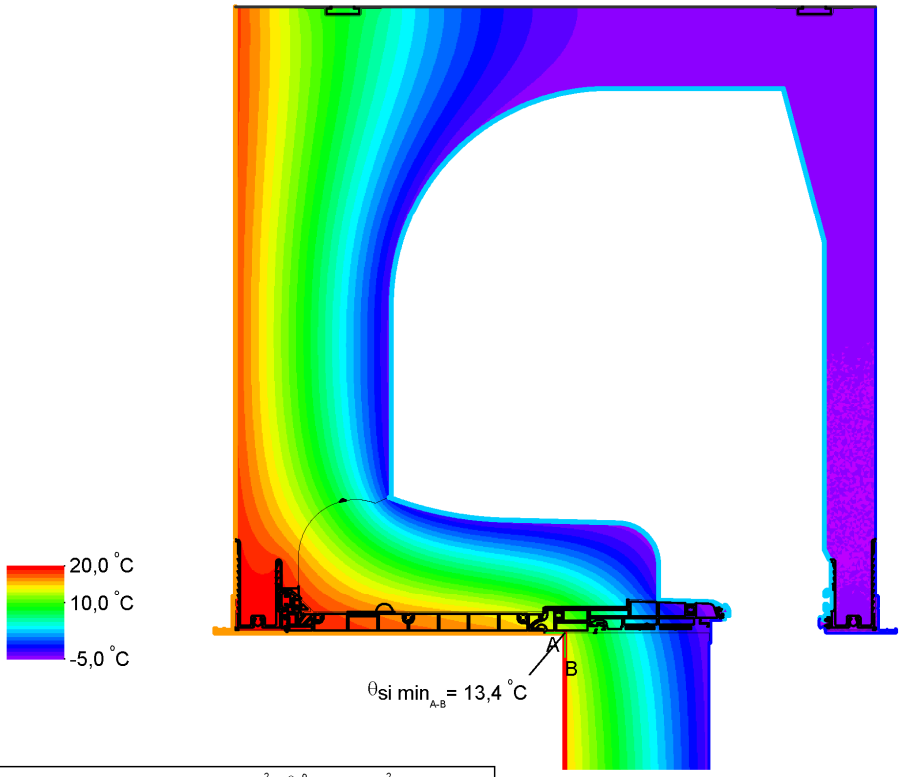
** EN ISO 10077-2:2017, 6.4.2

The data is based on EN ISO 10456 and EN ISO 10077-2.
The thermal conductivities and/or emissivities of the materials which are not based on that standards are deposited at ift-Rosenheim.
The documents have been evaluated. They are in accordance with the requirements of the current version of EN ISO 10077-2.
The emissivity of low emissive layers must be ensured by a factory production control.

Bild 16: Simulationsmodell Probekörper -06
f_{Rsi}-Berechnung (Radiosity-Verfahren gemäß EN ISO 10077-2:2017-07)

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.2019
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala, 43-300 Bielsko-Biala (Polen)

Protocol: FEM-Calculation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0,0			
Epsilon 0,9				0,90
External		-5,0	0,040	
Internal 0,25		20	0,25	
Internal standard		20	0,13	
Window external (1)		-5,0	0,13	

Material	λ[W/(m·K)]	ε
Aluminium alloy - anodised - painted -powder coated	160	0,90
Aluminium alloy - anodised - painted -powder coated (1)	160	0,90
EPS, Grafit	0,031	0,90
EPS, Grafit (1)	0,031	0,90
PVC (polyvinylchloride), rigid	0,17	0,90
PVC (polyvinylchloride), rigid (1)	0,17	0,90
Polyester mohair (brush seal)	0,14	0,90
Timber 500 kg/m³	0,13	0,90
Unventilated air cavity **		

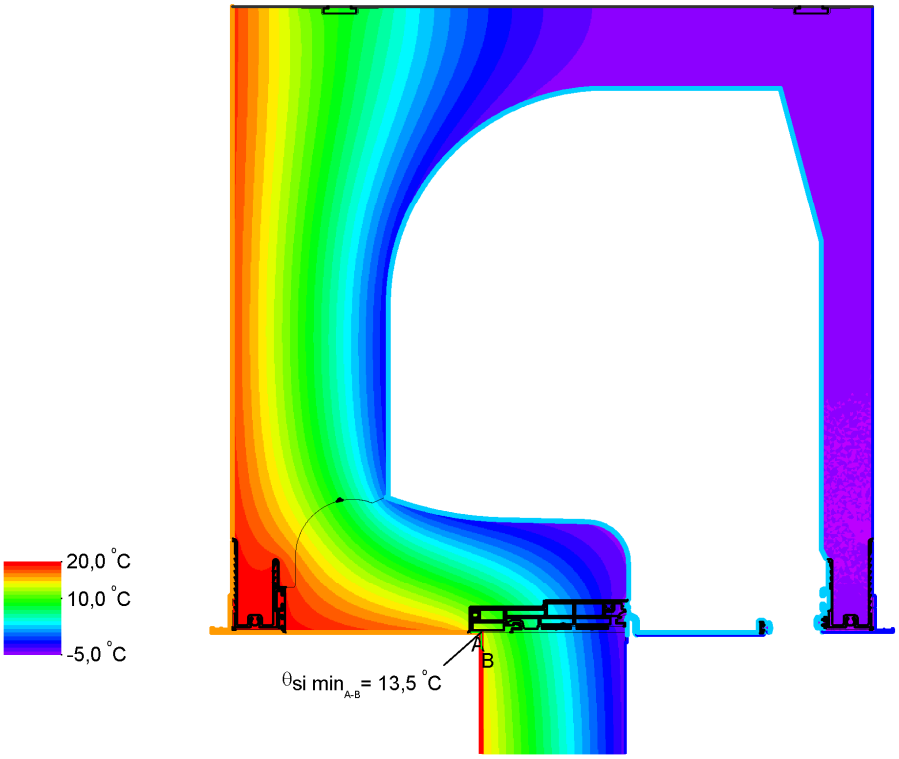
** EN ISO 10077-2:2017, 6.4.2

The data is based on EN ISO 10456 and EN ISO 10077-2.
The thermal conductivities and/or emissivities of the materials which are not based on that standards are deposited at ift-Rosenheim.
The documents have been evaluated. They are in accordance with the requirements of the current version of EN ISO 10077-2.
The emissivity of low emissive layers must be ensured by a factory production control.

Bild 17: Simulationsmodell Probekörper -07
f_{Rsi}-Berechnung (Radiosity-Verfahren gemäß EN ISO 10077-2:2017-07)

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.2019
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala, 43-300 Bielsko-Biala (Polen)

Protocol: FEM-Calculation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0,0			
Epsilon 0,9				0,90
External		-5,0	0,040	
Internal 0,25		20	0,25	
Internal standard		20	0,13	
Window external 0,30		-5,0	0,30	

Material	λ[W/(m·K)]	ε
Aluminium alloy - anodised - painted -powder coated	160	0,90
Aluminium alloy - anodised - painted -powder coated (1)	160	0,90
EPS, Grafit	0,031	0,90
EPS, Grafit (1)	0,031	0,90
PVC (polyvinylchloride), rigid	0,17	0,90
PVC (polyvinylchloride), rigid (1)	0,17	0,90
Polyester mohair (brush seal)	0,14	0,90
Timber 500 kg/m³	0,13	0,90
Unventilated air cavity **		

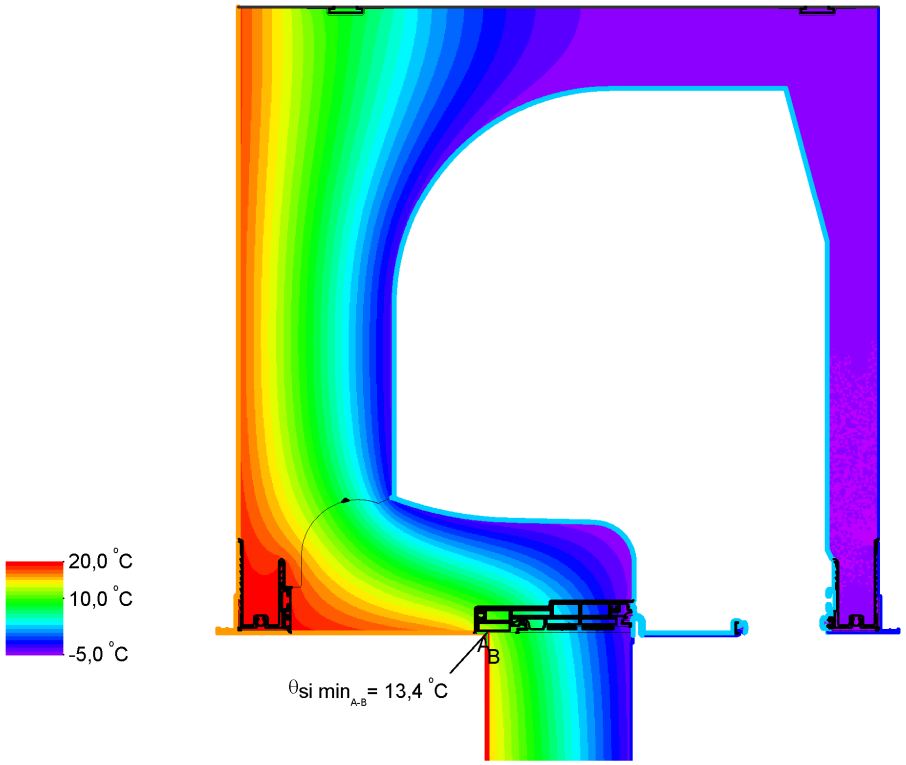
** EN ISO 10077-2:2017, 6.4.2

The data is based on EN ISO 10456 and EN ISO 10077-2.
The thermal conductivities and/or emissivities of the materials which are not based on that standards are deposited at ift-Rosenheim.
The documents have been evaluated. They are in accordance with the requirements of the current version of EN ISO 10077-2.
The emissivity of low emissive layers must be ensured by a factory production control.

Bild 18: Simulationsmodell Probekörper -08
f_{Rsi}-Berechnung (Radiosity-Verfahren gemäß EN ISO 10077-2:2017-07)

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.2019
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala, 43-300 Bielsko-Biala (Polen)

Protocol: FEM-Calculation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0,0			
Epsilon 0,9				0,90
External		-5,0	0,040	
Internal 0,25		20	0,25	
Internal standard		20	0,13	
Window external (1)		-5,0	0,13	
Window external 0,30		-5,0	0,30	

Material	λ[W/(m·K)]	ε
Aluminium alloy - anodised - painted -powder coated	160	0,90
Aluminium alloy - anodised - painted -powder coated (1)	160	0,90
EPS, Grafit	0,031	0,90
EPS, Grafit (1)	0,031	0,90
PVC (polyvinylchloride), rigid	0,17	0,90
PVC (polyvinylchloride), rigid (1)	0,17	0,90
Polyester mohair (brush seal)	0,14	0,90
Timber 500 kg/m³	0,13	0,90
Unventilated air cavity **		

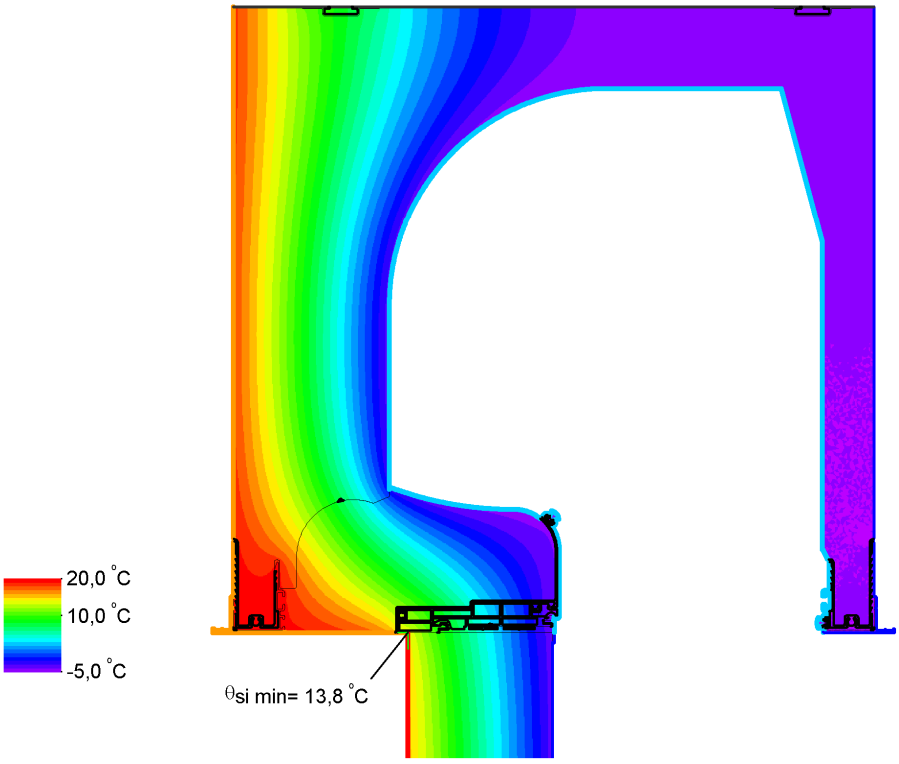
** EN ISO 10077-2:2017, 6.4.2

The data is based on EN ISO 10456 and EN ISO 10077-2.
The thermal conductivities and/or emissivities of the materials which are not based on that standards are deposited at ift-Rosenheim.
The documents have been evaluated. They are in accordance with the requirements of the current version of EN ISO 10077-2.
The emissivity of low emissive layers must be ensured by a factory production control.

Bild 19: Simulationsmodell Probekörper -09
f_{Rsi}-Berechnung (Radiosity-Verfahren gemäß EN ISO 10077-2:2017-07)

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.2019
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala, 43-300 Bielsko-Biala (Polen)

Protocol: FEM-Calculation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0,0			
Epsilon 0,9				0,90
External		-5,0	0,040	
Internal 0,25		20	0,25	
Internal standard		20	0,13	
Window external (1)		-5,0	0,13	

Material	λ[W/(m·K)]	ε
Aluminium alloy - anodised - painted -powder coated	160	0,90
Aluminium alloy - anodised - painted -powder coated (1)	160	0,90
EPS, Grafit	0,031	0,90
EPS, Grafit (1)	0,031	0,90
PVC (polyvinylchloride), rigid	0,17	0,90
PVC (polyvinylchloride), rigid (1)	0,17	0,90
Polyester mohair (brush seal)	0,14	0,90
Timber 500 kg/m³	0,13	0,90
Unventilated air cavity **		

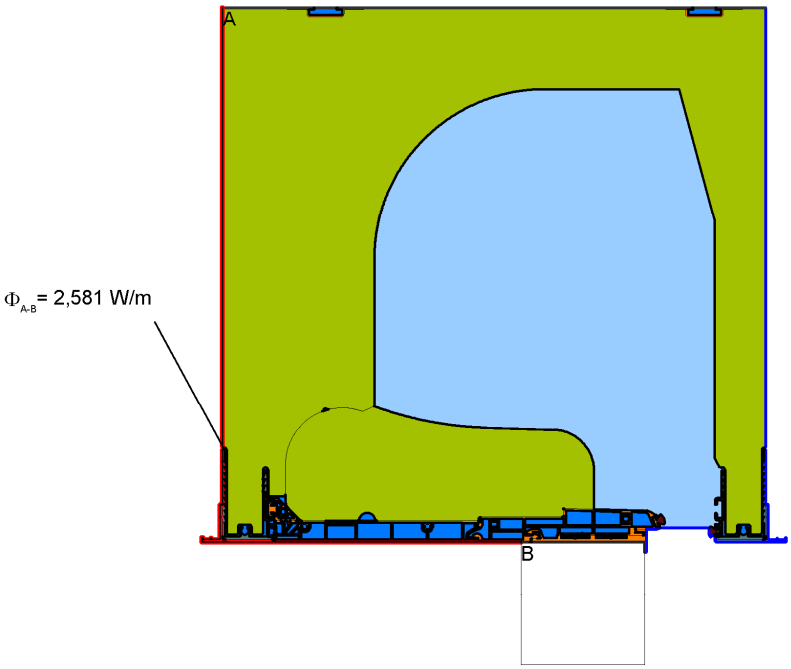
** EN ISO 10077-2:2017, 6.4.2

The data is based on EN ISO 10456 and EN ISO 10077-2.
The thermal conductivities and/or emissivities of the materials which are not based on that standards are deposited at ift-Rosenheim.
The documents have been evaluated. They are in accordance with the requirements of the current version of EN ISO 10077-2.
The emissivity of low emissive layers must be ensured by a factory production control.

Bild 20: Simulationsmodell Probekörper -10
f_{Rsi}-Berechnung (Radiosity-Verfahren gemäß EN ISO 10077-2:2017-07)

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.2019
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala, 43-300 Bielsko-Biala (Polen)

Protocol: FEM-Calculation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0,0			
Epsilon 0,9				0,90
External		0,0	0,040	
Internal standard		20	0,13	

Material	λ[W/(m·K)]	ε
Aluminium alloy - anodised - painted -powder coated	160	0,90
Aluminium alloy - anodised - painted -powder coated (1)	160	0,90
EPS, Grafit	0,031	0,90
EPS, Grafit (1)	0,031	0,90
PVC (polyvinylchloride), rigid	0,17	0,90
PVC (polyvinylchloride), rigid (1)	0,17	0,90
Polyester mohair (brush seal)	0,14	0,90
Slightly ventilated air cavity **		
Unventilated air cavity **		

** EN ISO 10077-2:2017, 6.4.3/anisotrop

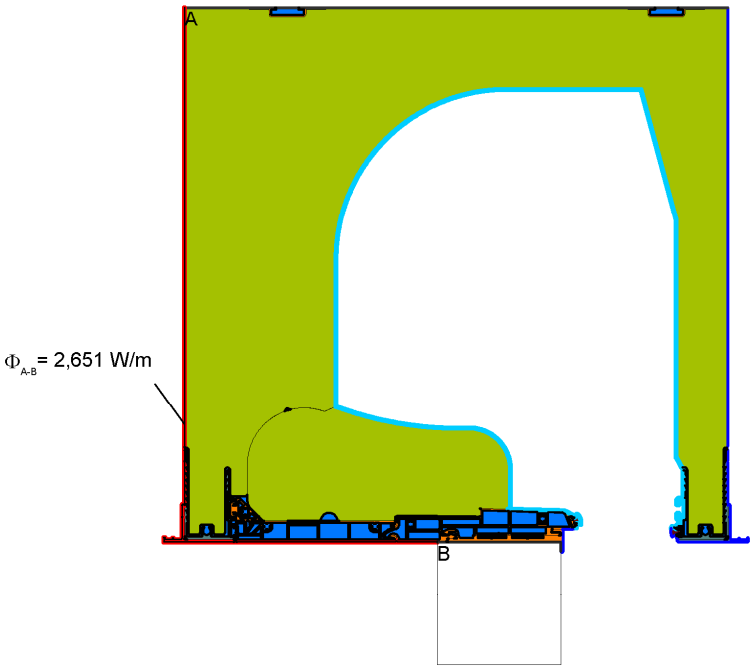
The data is based on EN ISO 10456 and EN ISO 10077-2.
The thermal conductivities and/or emissivities of the materials which are not based on that standards are deposited at ift-Rosenheim.
The documents have been evaluated. They are in accordance with the requirements of the current version of EN ISO 10077-2.
The emissivity of low emissive layers must be ensured by a factory production control.

Prüfer / Bearbeiter: Till Stübben
Speicherdatum: 06.08.2018
Programmversion (letzte Speicherung): flixo pro 8.0.923.1
Dokumentenvorlage (Template): 2018_03_ift_Template_v3.flt
Anzahl finiter Elemente: 84397
Rel. Wärmestromfehler: 7,5e-010

Bild 21: Simulationsmodell Probekörper -01
U_{sb}-Berechnung (Verfahren mit äquivalenter Wärmeleitfähigkeit gemäß EN ISO 10077-2:2012-02)

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.2019
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala, 43-300 Bielsko-Biala (Polen)

Protocol: FEM-Calculation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0,0			
Epsilon 0,9				0,90
External		0,0	0,040	
Internal standard		20	0,13	
Window external (1)		0,0	0,13	

Material	λ[W/(m·K)]	ε
Aluminium alloy - anodised - painted -powder coated	160	0,90
Aluminium alloy - anodised - painted -powder coated (1)	160	0,90
EPS, Grafit	0,031	0,90
EPS, Grafit (1)	0,031	0,90
PVC (polyvinylchloride), rigid	0,17	0,90
PVC (polyvinylchloride), rigid (1)	0,17	0,90
Polyester mohair (brush seal)	0,14	0,90
Unventilated air cavity **		

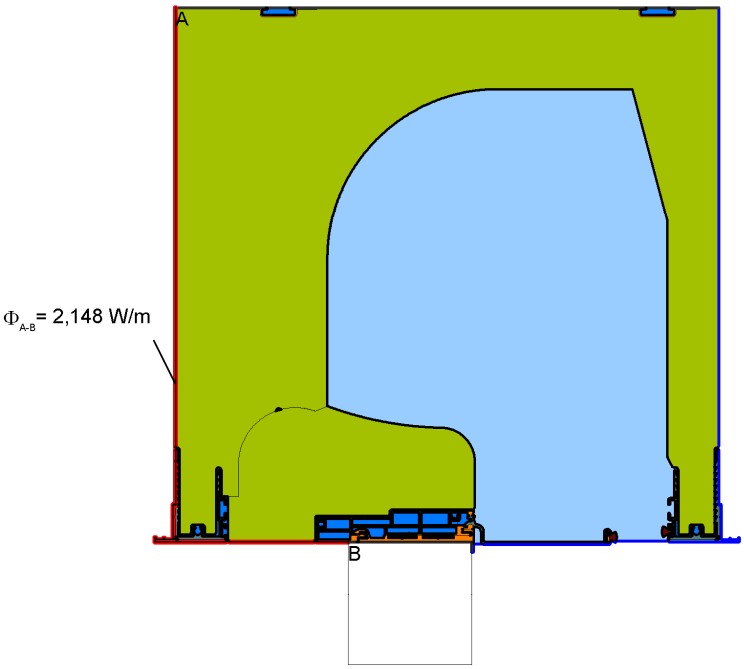
** EN ISO 10077-2:2017, 6.4.3/anisotrop

The data is based on EN ISO 10456 and EN ISO 10077-2.
The thermal conductivities and/or emissivities of the materials which are not based on that standards are deposited at ift-Rosenheim.
The documents have been evaluated. They are in accordance with the requirements of the current version of EN ISO 10077-2.
The emissivity of low emissive layers must be ensured by a factory production control.

Bild 22: Simulationsmodell Probekörper -02
U_{sb}-Berechnung (Verfahren mit äquivalenter Wärmeleitfähigkeit gemäß EN ISO 10077-2:2012-02)

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.2019
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala, 43-300 Bielsko-Biala (Polen)

Protocol: FEM-Calculation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0,0			
Epsilon 0,9				0,90
External		0,0	0,040	
Internal standard		20	0,13	

Material	λ[W/(m·K)]	ε
Aluminium alloy - anodised - painted -powder coated	160	0,90
Aluminium alloy - anodised - painted -powder coated (1)	160	0,90
EPS, Grafit	0,031	0,90
EPS, Grafit (1)	0,031	0,90
PVC (polyvinylchloride), rigid	0,17	0,90
PVC (polyvinylchloride), rigid (1)	0,17	0,90
Polyester mohair (brush seal)	0,14	0,90
Slightly ventilated air cavity **		
Unventilated air cavity **		

** EN ISO 10077-2:2017, 6.4.3/anisotrop

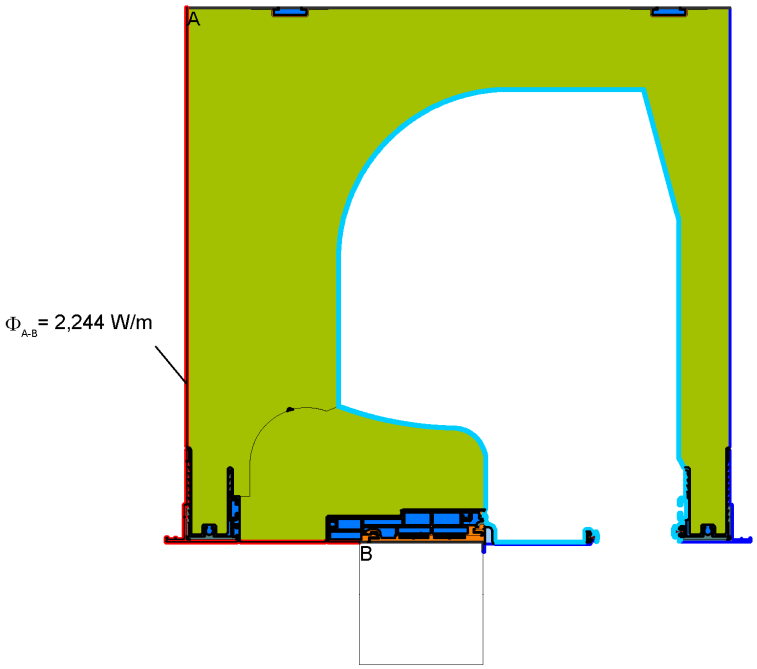
The data is based on EN ISO 10456 and EN ISO 10077-2.
The thermal conductivities and/or emissivities of the materials which are not based on that standards are deposited at ift-Rosenheim.
The documents have been evaluated. They are in accordance with the requirements of the current version of EN ISO 10077-2.
The emissivity of low emissive layers must be ensured by a factory production control.

Prüfer / Bearbeiter: Till Stübben
Speicherdatum: 06.08.2018
Programmversion (letzte Speicherung): flixo pro 8.0.923.1
Dokumentenvorlage (Template): 2018_03_ift_Template_v3.flt
Anzahl finiter Elemente: 84397
Rel. Wärmestromfehler: 7,5e-010

Bild 23: Simulationsmodell Probekörper -03
U_{sb}-Berechnung (Verfahren mit äquivalenter Wärmeleitfähigkeit gemäß EN ISO 10077-2:2012-02)

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.2019
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala, 43-300 Bielsko-Biala (Polen)

Protocol: FEM-Calculation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0,0			
Epsilon 0,9				0,90
External		0,0	0,040	
Internal standard		20	0,13	
Window external (1)		0,0	0,13	

Material	λ[W/(m·K)]	ε
Aluminium alloy - anodised - painted -powder coated	160	0,90
Aluminium alloy - anodised - painted -powder coated (1)	160	0,90
EPS, Grafit	0,031	0,90
EPS, Grafit (1)	0,031	0,90
PVC (polyvinylchloride), rigid	0,17	0,90
PVC (polyvinylchloride), rigid (1)	0,17	0,90
Polyester mohair (brush seal)	0,14	0,90
Slightly ventilated air cavity **		
Unventilated air cavity **		

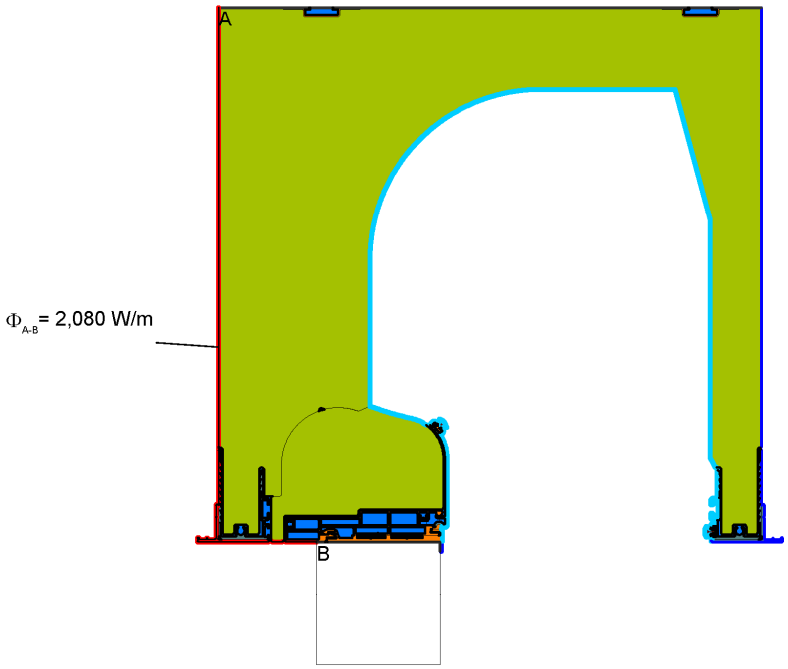
** EN ISO 10077-2:2017, 6.4.3/anisotrop

The data is based on EN ISO 10456 and EN ISO 10077-2.
The thermal conductivities and/or emissivities of the materials which are not based on that standards are deposited at ift-Rosenheim.
The documents have been evaluated. They are in accordance with the requirements of the current version of EN ISO 10077-2.
The emissivity of low emissive layers must be ensured by a factory production control.

Bild 24: Simulationsmodell Probekörper -04
U_{sb}-Berechnung (Verfahren mit äquivalenter Wärmeleitfähigkeit gemäß EN ISO 10077-2:2012-02)

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.2019
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala, 43-300 Bielsko-Biala (Polen)

Protocol: FEM-Calculation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0,0			
Epsilon 0,9				0,90
External		0,0	0,040	
Internal standard		20	0,13	
Window external (1)		0,0	0,13	

Material	λ[W/(m·K)]	ε
Aluminium alloy - anodised - painted -powder coated	160	0,90
Aluminium alloy - anodised - painted -powder coated (1)	160	0,90
EPS, Grafit	0,031	0,90
EPS, Grafit (1)	0,031	0,90
PVC (polyvinylchloride), rigid	0,17	0,90
PVC (polyvinylchloride), rigid (1)	0,17	0,90
Polyester mohair (brush seal)	0,14	0,90
Unventilated air cavity **		

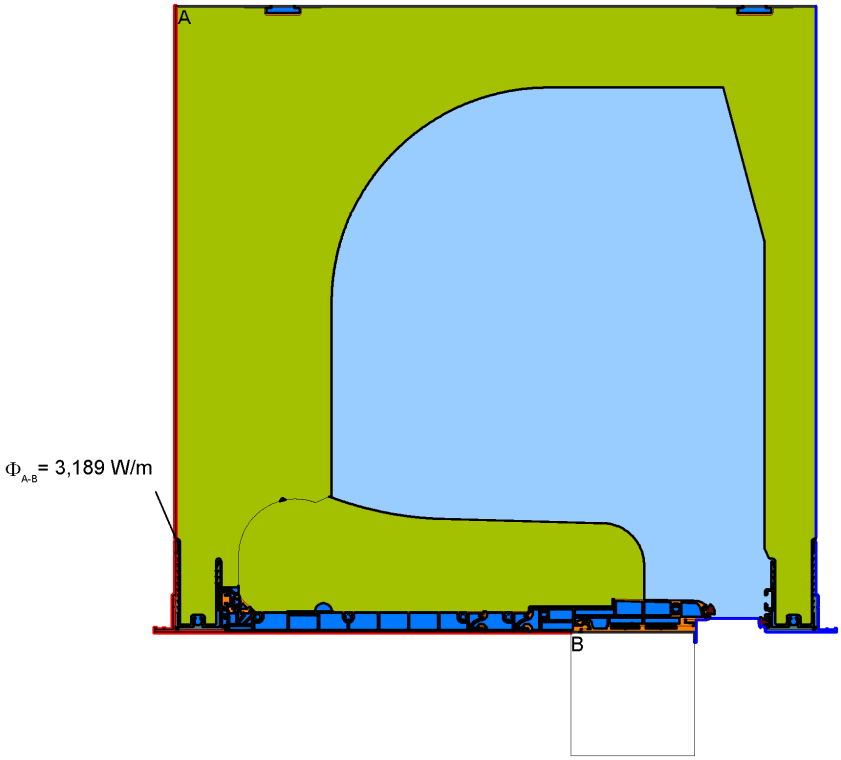
** EN ISO 10077-2:2017, 6.4.3/anisotrop

The data is based on EN ISO 10456 and EN ISO 10077-2.
The thermal conductivities and/or emissivities of the materials which are not based on that standards are deposited at ift-Rosenheim.
The documents have been evaluated. They are in accordance with the requirements of the current version of EN ISO 10077-2.
The emissivity of low emissive layers must be ensured by a factory production control.

Bild 25: Simulationsmodell Probekörper -05
U_{sb}-Berechnung (Verfahren mit äquivalenter Wärmeleitfähigkeit gemäß EN ISO 10077-2:2012-02)

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.2019
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala, 43-300 Bielsko-Biala (Polen)

Protocol: FEM-Calculation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0,0			
Epsilon 0,9				0,90
External		0,0	0,040	
Internal standard		20	0,13	

Material	λ[W/(m·K)]	ε
Aluminium alloy - anodised - painted -powder coated	160	0,90
Aluminium alloy - anodised - painted -powder coated (1)	160	0,90
EPS, Grafit	0,031	0,90
EPS, Grafit (1)	0,031	0,90
PVC (polyvinylchloride), rigid	0,17	0,90
PVC (polyvinylchloride), rigid (1)	0,17	0,90
Polyester mohair (brush seal)	0,14	0,90
Slightly ventilated air cavity **		
Unventilated air cavity **		

** EN ISO 10077-2:2017, 6.4.3/anisotrop

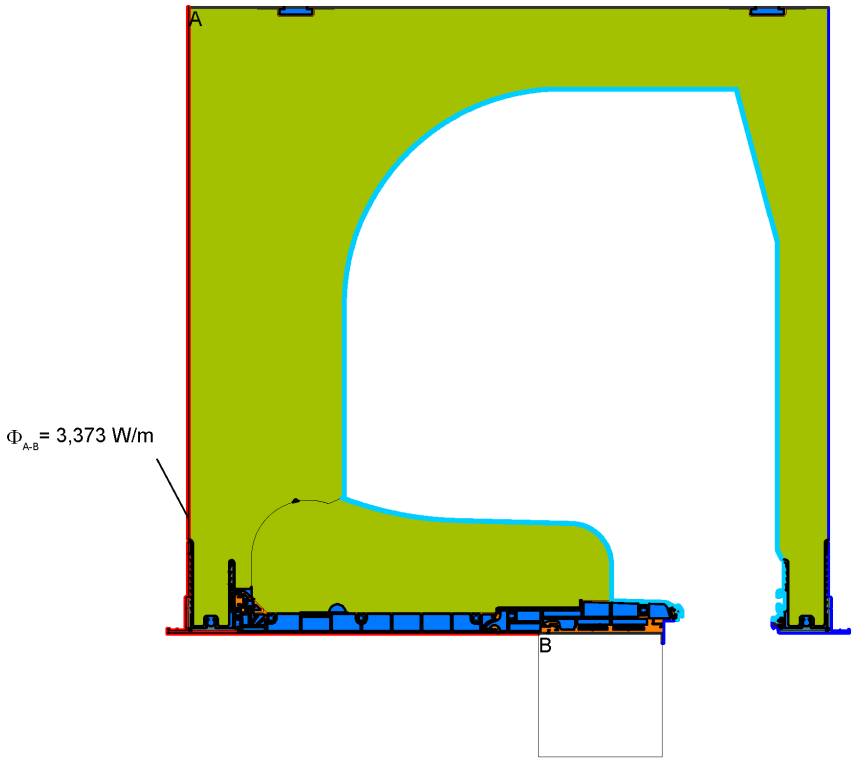
The data is based on EN ISO 10456 and EN ISO 10077-2.
The thermal conductivities and/or emissivities of the materials which are not based on that standards are deposited at ift-Rosenheim.
The documents have been evaluated. They are in accordance with the requirements of the current version of EN ISO 10077-2.
The emissivity of low emissive layers must be ensured by a factory production control.

Prüfer / Bearbeiter: Till Stübben
Speicherdatum: 06.08.2018
Programmversion (letzte Speicherung): flixo pro 8.0.923.1
Dokumentenvorlage (Template): 2018_03_ift_Template_v3.flt
Anzahl finiter Elemente: 84397
Rel. Wärmestromfehler: 7,5e-010

Bild 26: Simulationsmodell Probekörper -06
U_{sb}-Berechnung (Verfahren mit äquivalenter Wärmeleitfähigkeit gemäß EN ISO 10077-2:2012-02)

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.2019
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala, 43-300 Bielsko-Biala (Polen)

Protocol: FEM-Calculation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0,0			
Epsilon 0,9				0,90
External		0,0	0,040	
Internal standard		20	0,13	
Window external (1)		0,0	0,13	

Material	λ[W/(m·K)]	ε
Aluminium alloy - anodised - painted -powder coated	160	0,90
Aluminium alloy - anodised - painted -powder coated (1)	160	0,90
EPS, Grafit	0,031	0,90
EPS, Grafit (1)	0,031	0,90
PVC (polyvinylchloride), rigid	0,17	0,90
PVC (polyvinylchloride), rigid (1)	0,17	0,90
Polyester mohair (brush seal)	0,14	0,90
Unventilated air cavity **		

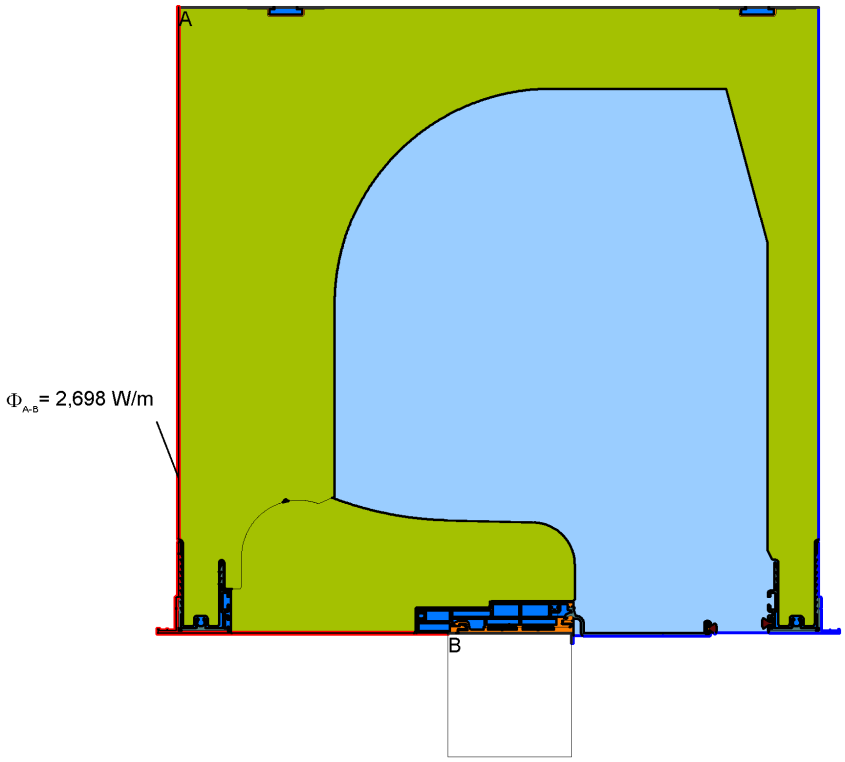
** EN ISO 10077-2:2017, 6.4.3/anisotrop

The data is based on EN ISO 10456 and EN ISO 10077-2.
The thermal conductivities and/or emissivities of the materials which are not based on that standards are deposited at ift-Rosenheim.
The documents have been evaluated. They are in accordance with the requirements of the current version of EN ISO 10077-2.
The emissivity of low emissive layers must be ensured by a factory production control.

Bild 27: Simulationsmodell Probekörper -07
U_{sb}-Berechnung (Verfahren mit äquivalenter Wärmeleitfähigkeit gemäß EN ISO 10077-2:2012-02)

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.2019
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala, 43-300 Bielsko-Biala (Polen)

Protocol: FEM-Calculation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0,0			
Epsilon 0,9				0,90
External		0,0	0,040	
Internal standard		20	0,13	

Material	λ[W/(m·K)]	ε
Aluminium alloy - anodised - painted -powder coated	160	0,90
Aluminium alloy - anodised - painted -powder coated (1)	160	0,90
EPS, Grafit	0,031	0,90
EPS, Grafit (1)	0,031	0,90
PVC (polyvinylchloride), rigid	0,17	0,90
PVC (polyvinylchloride), rigid (1)	0,17	0,90
Polyester mohair (brush seal)	0,14	0,90
Slightly ventilated air cavity **		
Unventilated air cavity **		

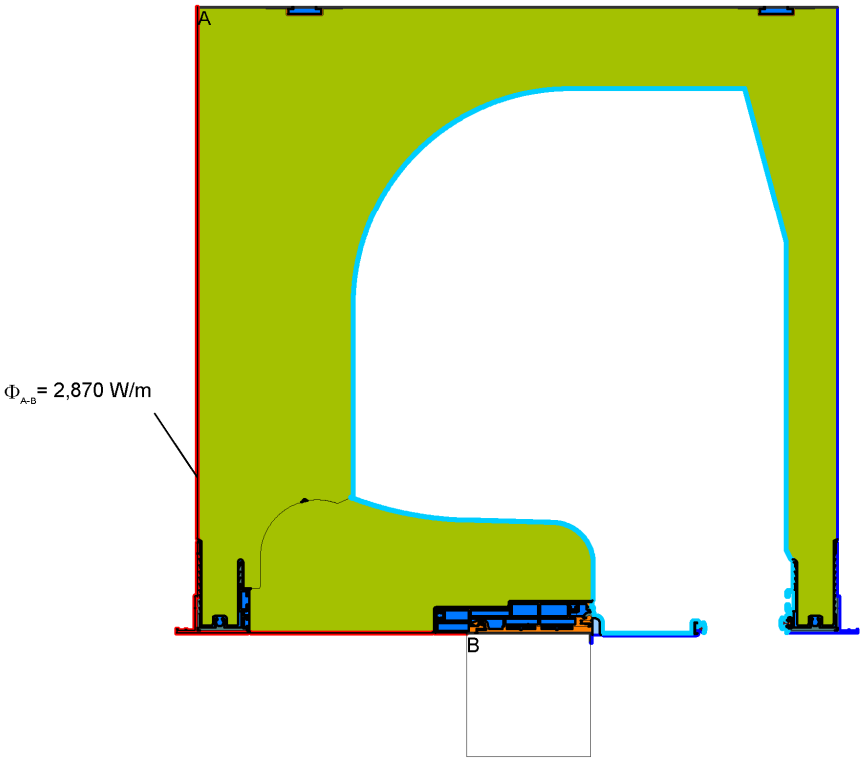
** EN ISO 10077-2:2017, 6.4.3/anisotrop

The data is based on EN ISO 10456 and EN ISO 10077-2.
The thermal conductivities and/or emissivities of the materials which are not based on that standards are deposited at ift-Rosenheim.
The documents have been evaluated. They are in accordance with the requirements of the current version of EN ISO 10077-2.
The emissivity of low emissive layers must be ensured by a factory production control.

Bild 28: Simulationsmodell Probekörper -08
U_{sb}-Berechnung (Verfahren mit äquivalenter Wärmeleitfähigkeit gemäß EN ISO 10077-2:2012-02)

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.2019
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala, 43-300 Bielsko-Biala (Polen)

Protocol: FEM-Calculation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0,0			
Epsilon 0,9				0,90
External		0,0	0,040	
Internal standard		20	0,13	
Window external (1)		0,0	0,13	

Material	λ[W/(m·K)]	ε
Aluminium alloy - anodised - painted -powder coated	160	0,90
Aluminium alloy - anodised - painted -powder coated (1)	160	0,90
EPS, Grafit	0,031	0,90
EPS, Grafit (1)	0,031	0,90
PVC (polyvinylchloride), rigid	0,17	0,90
PVC (polyvinylchloride), rigid (1)	0,17	0,90
Polyester mohair (brush seal)	0,14	0,90
Slightly ventilated air cavity **		
Unventilated air cavity **		

** EN ISO 10077-2:2017, 6.4.3/anisotrop

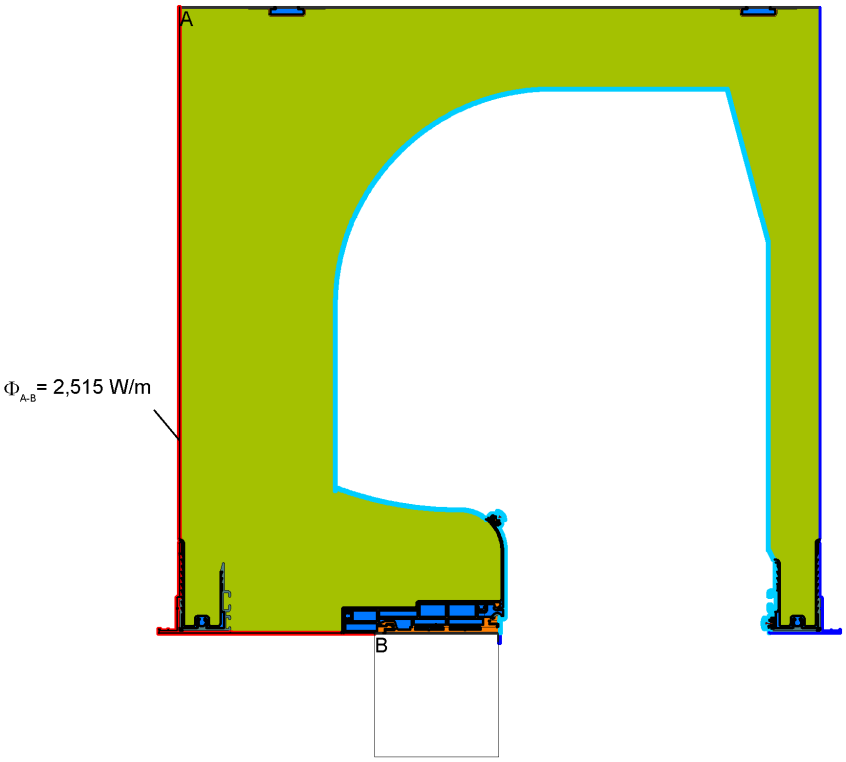
The data is based on EN ISO 10456 and EN ISO 10077-2.
The thermal conductivities and/or emissivities of the materials which are not based on that standards are deposited at ift-Rosenheim.
The documents have been evaluated. They are in accordance with the requirements of the current version of EN ISO 10077-2.
The emissivity of low emissive layers must be ensured by a factory production control.

Prüfer / Bearbeiter: Till Stübben
Speicherdatum: 06.08.2018
Programmversion (letzte Speicherung): flixo pro 8.0.923.1
Dokumentenvorlage (Template): 2018_03_ift_Template_v3.flt
Anzahl finiter Elemente: 84397
Rel. Wärmestromfehler: 7,5e-010

Bild 29: Simulationsmodell Probekörper -09
U_{sb}-Berechnung (Verfahren mit äquivalenter Wärmeleitfähigkeit gemäß EN ISO 10077-2:2012-02)

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.2019
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala, 43-300 Bielsko-Biala (Polen)

Protocol: FEM-Calculation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0,0			
Epsilon 0,9				0,90
External		0,0	0,040	
Internal standard		20	0,13	
Window external (1)		0,0	0,13	

Material	λ[W/(m·K)]	ε
Aluminium alloy - anodised - painted -powder coated	160	0,90
Aluminium alloy - anodised - painted -powder coated (1)	160	0,90
EPS, Grafit	0,031	0,90
PVC (polyvinylchloride), rigid	0,17	0,90
PVC (polyvinylchloride), rigid (1)	0,17	0,90
Polyester mohair (brush seal)	0,14	0,90
Unventilated air cavity **		

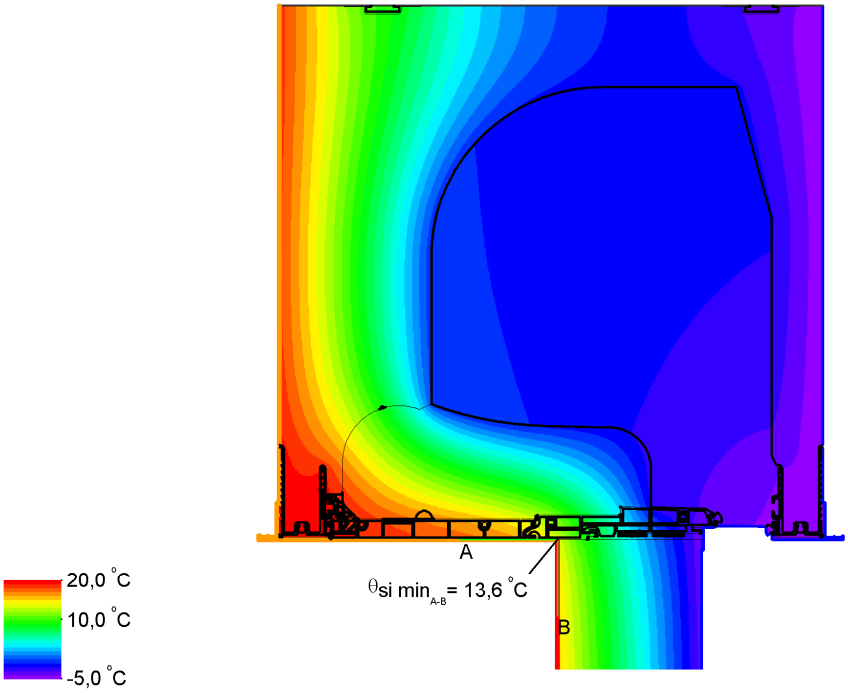
** EN ISO 10077-2:2017, 6.4.3/anisotrop

The data is based on EN ISO 10456 and EN ISO 10077-2.
The thermal conductivities and/or emissivities of the materials which are not based on that standards are deposited at ift-Rosenheim.
The documents have been evaluated. They are in accordance with the requirements of the current version of EN ISO 10077-2.
The emissivity of low emissive layers must be ensured by a factory production control.

Bild 30: Simulationsmodell Probekörper -10
U_{sb}-Berechnung (Verfahren mit äquivalenter Wärmeleitfähigkeit gemäß EN ISO 10077-2:2012-02)

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.2019
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala, 43-300 Bielsko-Biala (Polen)

Protocol: FEM-Calculation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0,0			
Epsilon 0,9				0,90
External		-5,0	0,040	
Internal 0,25		20	0,25	
Internal standard		20	0,13	

Material	λ[W/(m·K)]	ε
Aluminium alloy - anodised - painted -powder coated	160	0,90
Aluminium alloy - anodised - painted -powder coated (1)	160	0,90
EPS, Grafit	0,031	0,90
EPS, Grafit (1)	0,031	0,90
PVC (polyvinylchloride), rigid	0,17	0,90
PVC (polyvinylchloride), rigid (1)	0,17	0,90
Polyester mohair (brush seal)	0,14	0,90
Slightly ventilated air cavity **		
Timber 500 kg/m³	0,13	0,90
Unventilated air cavity **		

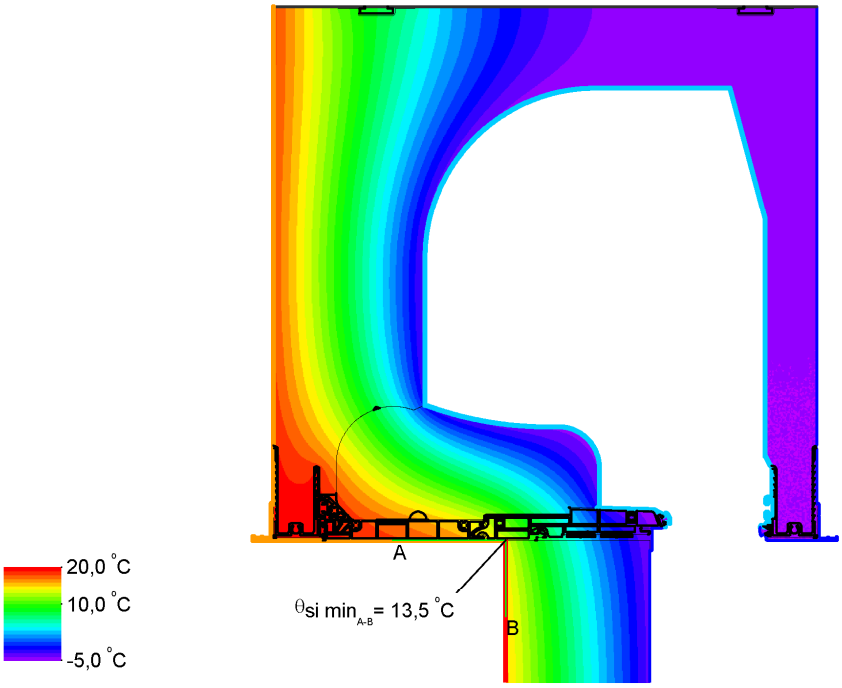
** EN ISO 10077-2:2017, 6.4.3/anisotrop

The data is based on EN ISO 10456 and EN ISO 10077-2.
The thermal conductivities and/or emissivities of the materials which are not based on that standards are deposited at ift-Rosenheim.
The documents have been evaluated. They are in accordance with the requirements of the current version of EN ISO 10077-2.
The emissivity of low emissive layers must be ensured by a factory production control.

Bild 31: Simulationsmodell Probekörper -01
f_{Rsi}-Berechnung (Verfahren mit äquivalenter Wärmeleitfähigkeit gemäß EN ISO 10077-2:2012-02)

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.2019
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala, 43-300 Bielsko-Biala (Polen)

Protocol: FEM-Calculation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0,0			
Epsilon 0,9				0,90
External		-5,0	0,040	
Internal 0,25		20	0,25	
Internal standard		20	0,13	
Window external (1)		-5,0	0,13	

Material	λ[W/(m·K)]	ε
Aluminium alloy - anodised - painted -powder coated	160	0,90
Aluminium alloy - anodised - painted -powder coated (1)	160	0,90
EPS, Grafit	0,031	0,90
EPS, Grafit (1)	0,031	0,90
PVC (polyvinylchloride), rigid	0,17	0,90
PVC (polyvinylchloride), rigid (1)	0,17	0,90
Polyester mohair (brush seal)	0,14	0,90
Timber 500 kg/m³	0,13	0,90
Unventilated air cavity **		

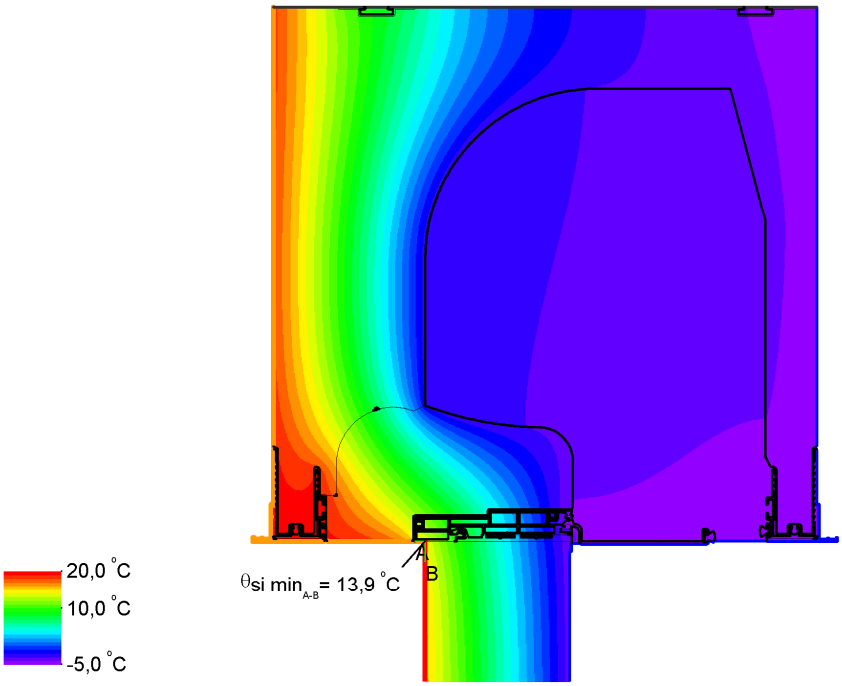
** EN ISO 10077-2:2017, 6.4.3/anisotrop

The data is based on EN ISO 10456 and EN ISO 10077-2.
The thermal conductivities and/or emissivities of the materials which are not based on that standards are deposited at ift-Rosenheim.
The documents have been evaluated. They are in accordance with the requirements of the current version of EN ISO 10077-2.
The emissivity of low emissive layers must be ensured by a factory production control.

Bild 32: Simulationsmodell Probekörper -02
f_{Rsi}-Berechnung (Verfahren mit äquivalenter Wärmeleitfähigkeit gemäß EN ISO 10077-2:2012-02)

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.2019
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala, 43-300 Bielsko-Biala (Polen)

Protocol: FEM-Calculation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0,0			
Epsilon 0,9				0,90
External		-5,0	0,040	
Internal 0,25		20	0,25	
Internal standard		20	0,13	

Material	λ[W/(m·K)]	ε
Aluminium alloy - anodised - painted -powder coated	160	0,90
Aluminium alloy - anodised - painted -powder coated (1)	160	0,90
EPS, Grafit	0,031	0,90
EPS, Grafit (1)	0,031	0,90
PVC (polyvinylchloride), rigid	0,17	0,90
PVC (polyvinylchloride), rigid (1)	0,17	0,90
Polyester mohair (brush seal)	0,14	0,90
Slightly ventilated air cavity **		
Timber 500 kg/m³	0,13	0,90
Unventilated air cavity **		

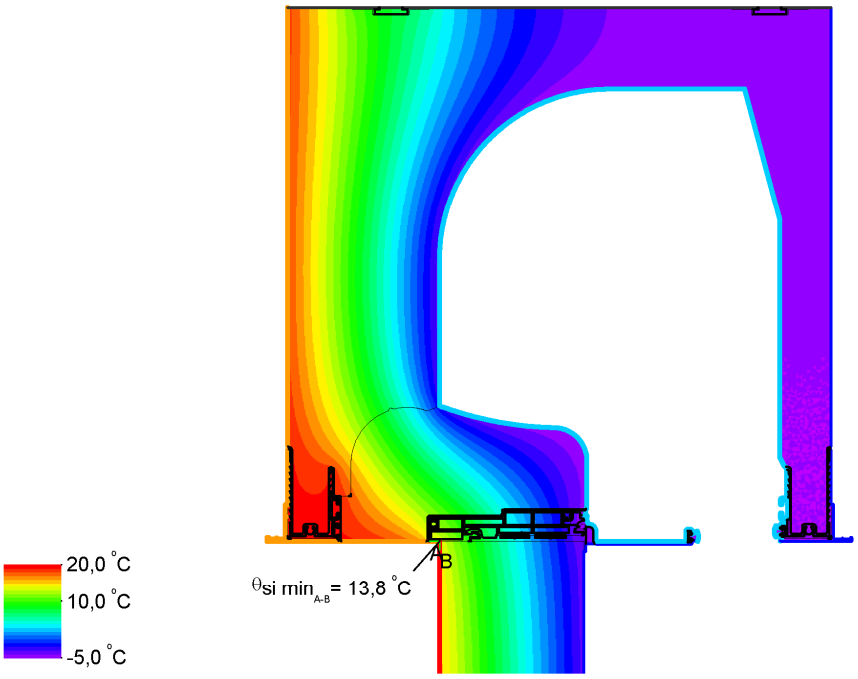
** EN ISO 10077-2:2017, 6.4.3/anisotrop

The data is based on EN ISO 10456 and EN ISO 10077-2.
The thermal conductivities and/or emissivities of the materials which are not based on that standards are deposited at ift-Rosenheim.
The documents have been evaluated. They are in accordance with the requirements of the current version of EN ISO 10077-2.
The emissivity of low emissive layers must be ensured by a factory production control.

Bild 33: Simulationsmodell Probekörper -03
f_{Rsi}-Berechnung (Verfahren mit äquivalenter Wärmeleitfähigkeit gemäß EN ISO 10077-2:2012-02)

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.2019
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala, 43-300 Bielsko-Biala (Polen)

Protocol: FEM-Calculation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0,0			
Epsilon 0,9				0,90
External		-5,0	0,040	
Internal 0,25		20	0,25	
Internal standard		20	0,13	
Window external (1)		-5,0	0,13	

Material	λ[W/(m·K)]	ε
Aluminium alloy - anodised - painted -powder coated	160	0,90
Aluminium alloy - anodised - painted -powder coated (1)	160	0,90
EPS, Grafit	0,031	0,90
EPS, Grafit (1)	0,031	0,90
PVC (polyvinylchloride), rigid	0,17	0,90
PVC (polyvinylchloride), rigid (1)	0,17	0,90
Polyester mohair (brush seal)	0,14	0,90
Slightly ventilated air cavity **		
Timber 500 kg/m³	0,13	0,90
Unventilated air cavity **		

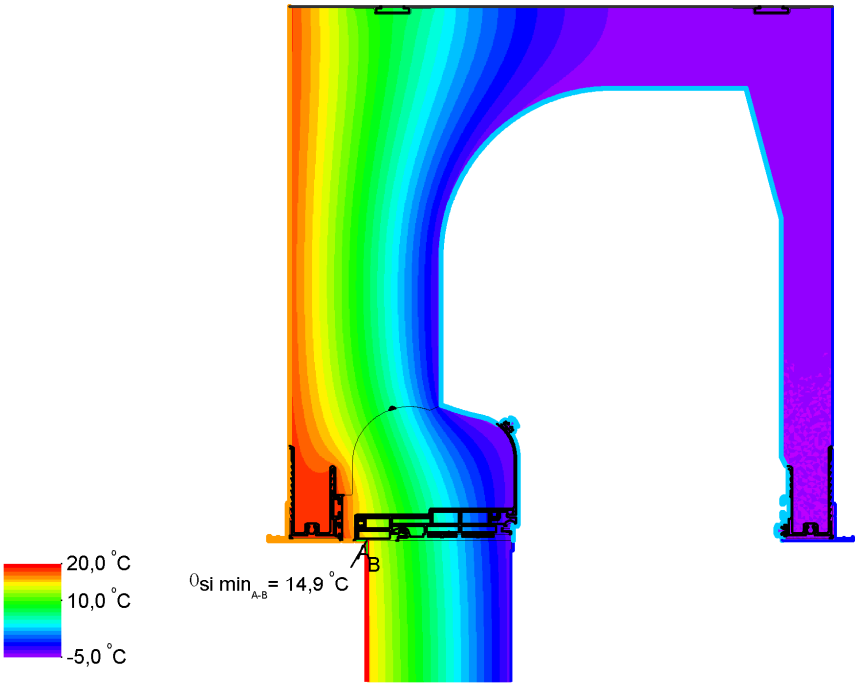
** EN ISO 10077-2:2017, 6.4.3/anisotrop

The data is based on EN ISO 10456 and EN ISO 10077-2.
The thermal conductivities and/or emissivities of the materials which are not based on that standards are deposited at ift-Rosenheim.
The documents have been evaluated. They are in accordance with the requirements of the current version of EN ISO 10077-2.
The emissivity of low emissive layers must be ensured by a factory production control.

Bild 34: Simulationsmodell Probekörper -04
f_{Rsi}-Berechnung (Verfahren mit äquivalenter Wärmeleitfähigkeit gemäß EN ISO 10077-2:2012-02)

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.2019
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala, 43-300 Bielsko-Biala (Polen)

Protocol: FEM-Calculation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0,0			
Epsilon 0,9				0,90
External		-5,0	0,040	
Internal 0,25		20	0,25	
Internal standard		20	0,13	
Window external (1)		-5,0	0,13	

Material	λ[W/(m·K)]	ε
Aluminium alloy - anodised - painted -powder coated	160	0,90
Aluminium alloy - anodised - painted -powder coated (1)	160	0,90
EPS, Grafit	0,031	0,90
EPS, Grafit (1)	0,031	0,90
PVC (polyvinylchloride), rigid	0,17	0,90
PVC (polyvinylchloride), rigid (1)	0,17	0,90
Polyester mohair (brush seal)	0,14	0,90
Timber 500 kg/m³	0,13	0,90
Unventilated air cavity **		

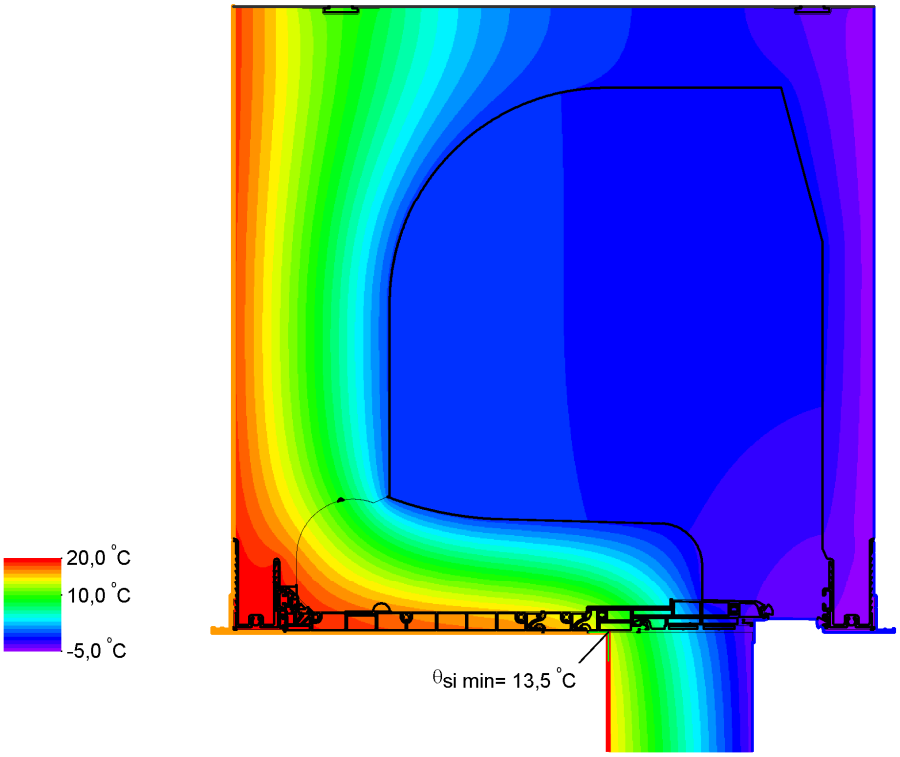
** EN ISO 10077-2:2017, 6.4.3/anisotrop

The data is based on EN ISO 10456 and EN ISO 10077-2.
The thermal conductivities and/or emissivities of the materials which are not based on that standards are deposited at ift-Rosenheim.
The documents have been evaluated. They are in accordance with the requirements of the current version of EN ISO 10077-2.
The emissivity of low emissive layers must be ensured by a factory production control.

Bild 35: Simulationsmodell Probekörper -05
f_{Rsi}-Berechnung (Verfahren mit äquivalenter Wärmeleitfähigkeit gemäß EN ISO 10077-2:2012-02)

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.2019
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala, 43-300 Bielsko-Biala (Polen)

Protocol: FEM-Calculation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0,0			
Epsilon 0,9				0,90
External		-5,0	0,040	
Internal 0,25		20	0,25	
Internal standard		20	0,13	

Material	λ[W/(m·K)]	ε
Aluminium alloy - anodised - painted -powder coated	160	0,90
Aluminium alloy - anodised - painted -powder coated (1)	160	0,90
EPS, Grafit	0,031	0,90
EPS, Grafit (1)	0,031	0,90
PVC (polyvinylchloride), rigid	0,17	0,90
PVC (polyvinylchloride), rigid (1)	0,17	0,90
Polyester mohair (brush seal)	0,14	0,90
Slightly ventilated air cavity **		
Timber 500 kg/m³	0,13	0,90
Unventilated air cavity **		

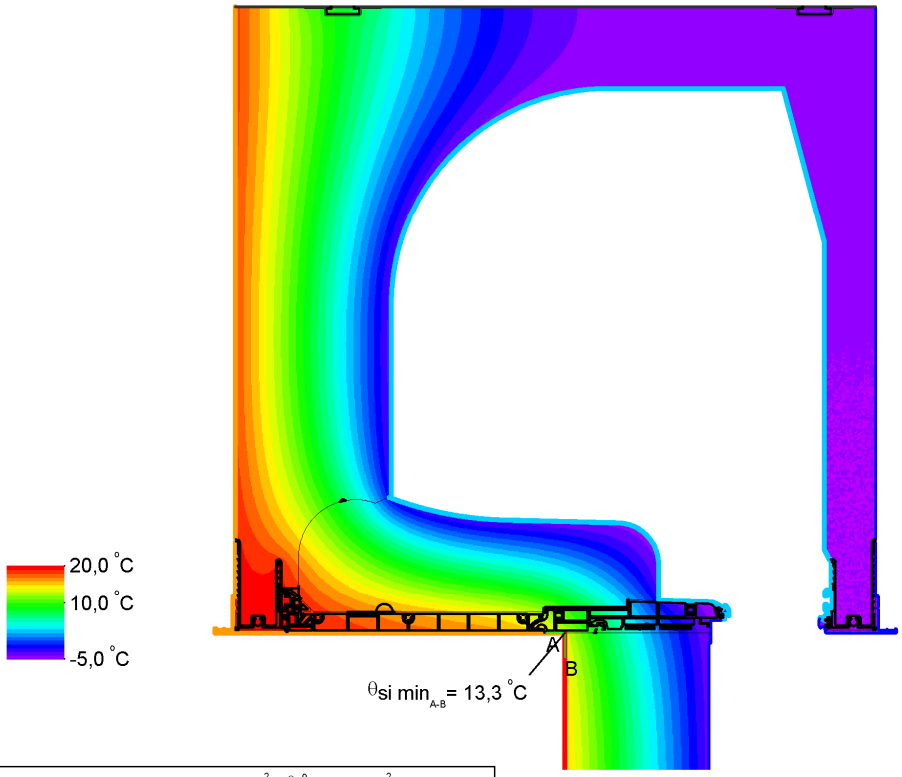
** EN ISO 10077-2:2017, 6.4.3/anisotrop

The data is based on EN ISO 10456 and EN ISO 10077-2.
The thermal conductivities and/or emissivities of the materials which are not based on that standards are deposited at ift-Rosenheim.
The documents have been evaluated. They are in accordance with the requirements of the current version of EN ISO 10077-2.
The emissivity of low emissive layers must be ensured by a factory production control.

Bild 36: Simulationsmodell Probekörper -06
f_{Rsi}-Berechnung (Verfahren mit äquivalenter Wärmeleitfähigkeit gemäß EN ISO 10077-2:2012-02)

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.2019
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala, 43-300 Bielsko-Biala (Polen)

Protocol: FEM-Calculation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0,0			
Epsilon 0,9				0,90
External		-5,0	0,040	
Internal 0,25		20	0,25	
Internal standard		20	0,13	
Window external (1)		-5,0	0,13	

Material	λ[W/(m·K)]	ε
Aluminium alloy - anodised - painted -powder coated	160	0,90
Aluminium alloy - anodised - painted -powder coated (1)	160	0,90
EPS, Grafit	0,031	0,90
EPS, Grafit (1)	0,031	0,90
PVC (polyvinylchloride), rigid	0,17	0,90
PVC (polyvinylchloride), rigid (1)	0,17	0,90
Polyester mohair (brush seal)	0,14	0,90
Timber 500 kg/m³	0,13	0,90
Unventilated air cavity **		

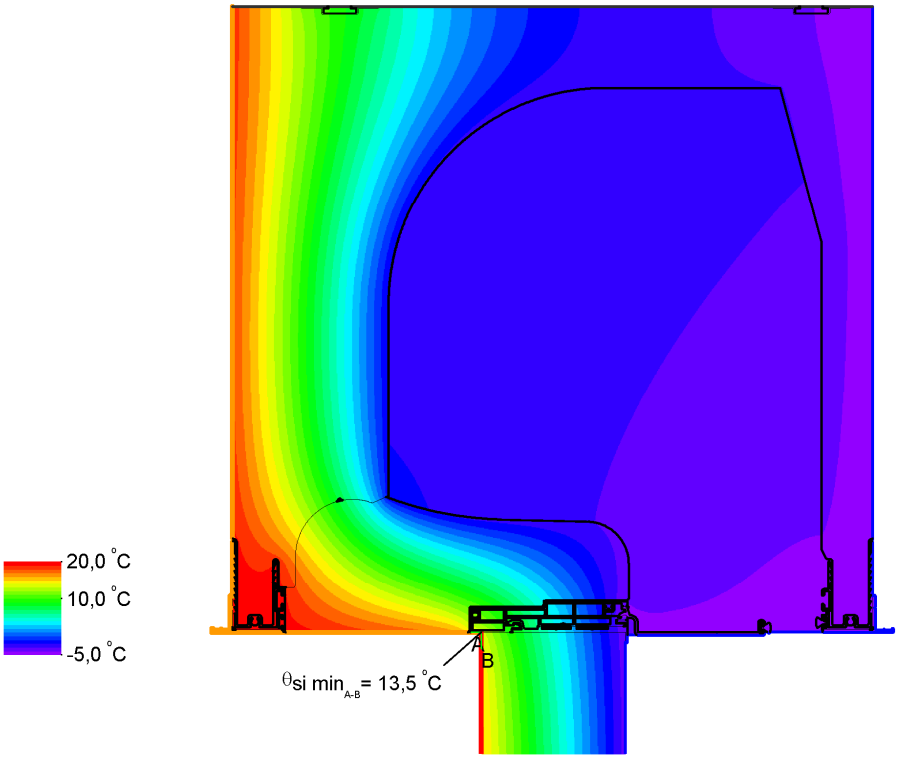
** EN ISO 10077-2:2017, 6.4.3/anisotrop

The data is based on EN ISO 10456 and EN ISO 10077-2.
The thermal conductivities and/or emissivities of the materials which are not based on that standards are deposited at ift-Rosenheim.
The documents have been evaluated. They are in accordance with the requirements of the current version of EN ISO 10077-2.
The emissivity of low emissive layers must be ensured by a factory production control.

Bild 37: Simulationsmodell Probekörper -07
f_{Rsi}-Berechnung (Verfahren mit äquivalenter Wärmeleitfähigkeit gemäß EN ISO 10077-2:2012-02)

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.2019
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala, 43-300 Bielsko-Biala (Polen)

Protocol: FEM-Calculation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0,0			
Epsilon 0,9				0,90
External		-5,0	0,040	
Internal 0,25		20	0,25	
Internal standard		20	0,13	

Material	λ[W/(m·K)]	ε
Aluminium alloy - anodised - painted -powder coated	160	0,90
Aluminium alloy - anodised - painted -powder coated (1)	160	0,90
EPS, Grafit	0,031	0,90
EPS, Grafit (1)	0,031	0,90
PVC (polyvinylchloride), rigid	0,17	0,90
PVC (polyvinylchloride), rigid (1)	0,17	0,90
Polyester mohair (brush seal)	0,14	0,90
Slightly ventilated air cavity **		
Timber 500 kg/m³	0,13	0,90
Unventilated air cavity **		

** EN ISO 10077-2:2017, 6.4.3/anisotrop

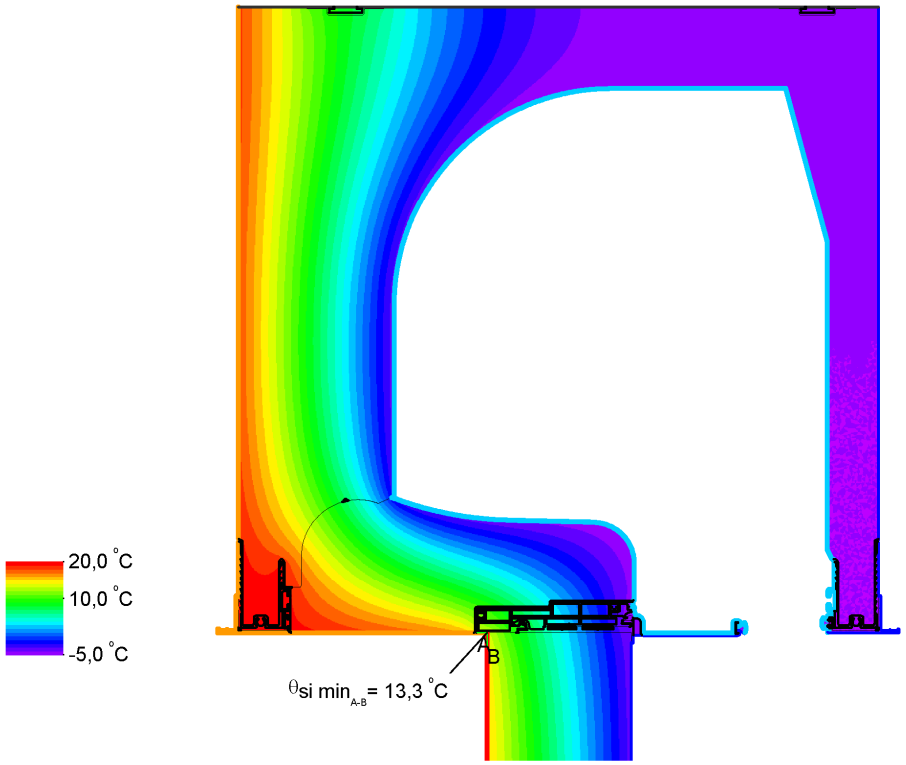
The data is based on EN ISO 10456 and EN ISO 10077-2.
The thermal conductivities and/or emissivities of the materials which are not based on that standards are deposited at ift-Rosenheim.
The documents have been evaluated. They are in accordance with the requirements of the current version of EN ISO 10077-2.
The emissivity of low emissive layers must be ensured by a factory production control.

Prüfer / Bearbeiter: Till Stübben
Speicherdatum: 06.08.2018
Programmversion (letzte Speicherung): flixo pro 8.0.923.1
Dokumentenvorlage (Template): 2018_03_ift_Template_v3.flt
Anzahl finiter Elemente: 54877
Rel. Wärmestromfehler: 8,5e-012

Bild 38: Simulationsmodell Probekörper -08
f_{Rsi}-Berechnung (Verfahren mit äquivalenter Wärmeleitfähigkeit gemäß EN ISO 10077-2:2012-02)

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.2019
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala, 43-300 Bielsko-Biala (Polen)

Protocol: FEM-Calculation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0,0			
Epsilon 0,9				0,90
External		-5,0	0,040	
Internal 0,25		20	0,25	
Internal standard		20	0,13	
Window external (1)		-5,0	0,13	

Material	λ[W/(m·K)]	ε
Aluminium alloy - anodised - painted -powder coated	160	0,90
Aluminium alloy - anodised - painted -powder coated (1)	160	0,90
EPS, Grafit	0,031	0,90
EPS, Grafit (1)	0,031	0,90
PVC (polyvinylchloride), rigid	0,17	0,90
PVC (polyvinylchloride), rigid (1)	0,17	0,90
Polyester mohair (brush seal)	0,14	0,90
Slightly ventilated air cavity **		
Timber 500 kg/m³	0,13	0,90
Unventilated air cavity **		

** EN ISO 10077-2:2017, 6.4.3/anisotrop

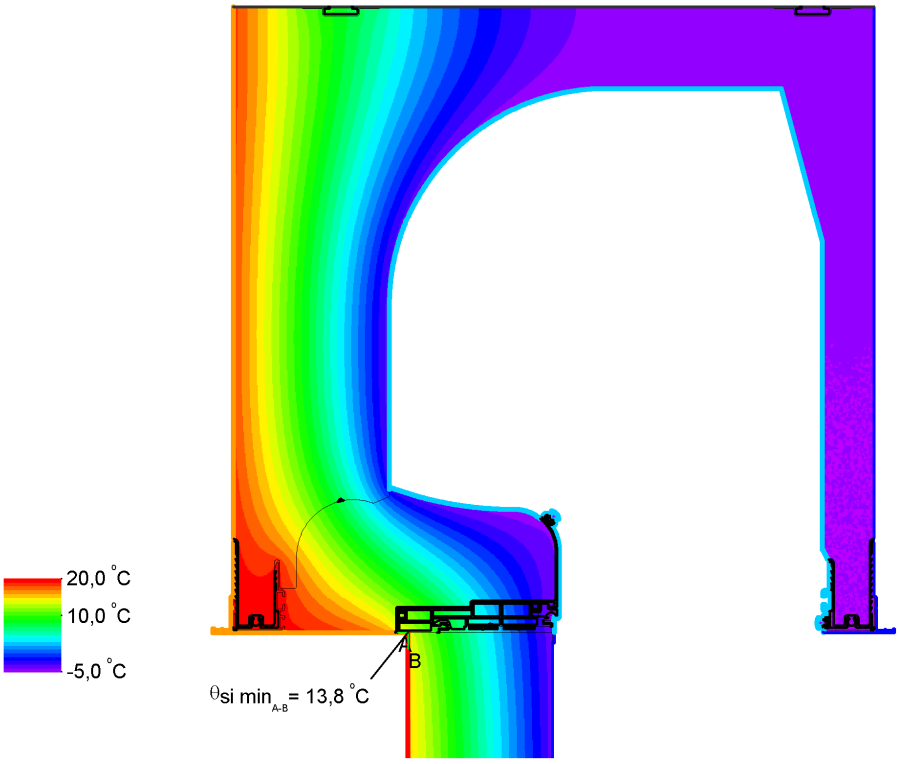
The data is based on EN ISO 10456 and EN ISO 10077-2.
The thermal conductivities and/or emissivities of the materials which are not based on that standards are deposited at ift-Rosenheim.
The documents have been evaluated. They are in accordance with the requirements of the current version of EN ISO 10077-2.
The emissivity of low emissive layers must be ensured by a factory production control.

Prüfer / Bearbeiter: Till Stübben
Speicherdatum: 06.08.2018
Programmversion (letzte Speicherung): flixo pro 8.0.923.1
Dokumentenvorlage (Template): 2018_03_ift_Template_v3.flt
Anzahl finiter Elemente: 54877
Rel. Wärmestromfehler: 8,5e-012

Bild 39: Simulationsmodell Probekörper -09
f_{Rsi}-Berechnung (Verfahren mit äquivalenter Wärmeleitfähigkeit gemäß EN ISO 10077-2:2012-02)

Prüfbericht 18-001612-PR01 (PB-E01-06-de-01) vom 25.01.2019
Auftraggeber: ALUPROF S.A. Centrala, Zaklad Bielsko Biala, 43-300 Bielsko-Biala (Polen)

Protocol: FEM-Calculation



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0,0			
Epsilon 0,9				0,90
External		-5,0	0,040	
Internal 0,25		20	0,25	
Internal standard		20	0,13	
Window external (1)		-5,0	0,13	

Material	λ[W/(m·K)]	ε
Aluminium alloy - anodised - painted -powder coated	160	0,90
Aluminium alloy - anodised - painted -powder coated (1)	160	0,90
EPS, Grafit	0,031	0,90
EPS, Grafit (1)	0,031	0,90
PVC (polyvinylchloride), rigid	0,17	0,90
PVC (polyvinylchloride), rigid (1)	0,17	0,90
Polyester mohair (brush seal)	0,14	0,90
Timber 500 kg/m³	0,13	0,90
Unventilated air cavity **		

** EN ISO 10077-2:2017, 6.4.3/anisotrop

The data is based on EN ISO 10456 and EN ISO 10077-2.
The thermal conductivities and/or emissivities of the materials which are not based on that standards are deposited at ift-Rosenheim.
The documents have been evaluated. They are in accordance with the requirements of the current version of EN ISO 10077-2.
The emissivity of low emissive layers must be ensured by a factory production control.

Bild 40: Simulationsmodell Probekörper -10
f_{Rsi}-Berechnung (Verfahren mit äquivalenter Wärmeleitfähigkeit gemäß EN ISO 10077-2:2012-02)