

Evidence of Performance

Thermal transmittance

Test Report

Nr. 17-003510-PR02
(PB-H01-06-en-01)



Client **RAMA-GLAS d.o.o.**
Vlakovo 366
71210 Ilidza
Bosnia-Herzegovina

Basis

EN 673 : 2011-02
Glass in building – Determination of thermal transmittance (U value) – Calculation method

Product	Insulating glass units
System designation	RAMATERM(+); RAMA3(+); RAMA QUADRO (+)
Construction	see result list
Gas filling	see result list
Type of coating	IR reflective coatings; details see result list

Instructions for use

This test report may be used to classify the thermal transmittance U_g .

Thermal transmittance



$$U_g = 0.3 - 2.5 \text{ W}/(\text{m}^2 \cdot \text{K})^*$$

* the exact value depends on the type of the Insulating glass unit; see result list

Validity

The data and results given relate solely to the described, tested object.

Testing the thermal transmittance does not allow any statement to be made on further characteristics of the present structure, which could define performance and quality.

ift Rosenheim
23.05.2018

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Notes on publication

The ift Guideline "Conditions and Guideline on the Use of ift Test Reports" applies.

The cover sheet can be used as an abstract.

Contents

The report contains 10 pages

- 1 Object
- 2 Procedure
- 3 Detailed results

1 Object

1.1 Description of test specimen (all dimensions in mm)

Product	insulating glass unit
Type	RAMATERM(+); RAMA3(+); RAMA QUADRO (+)
Construction	see result list
Coating	IR reflective coatings
Type / Manufacturer	unknown
Coating on surface	see result list
normal emissivity ϵ_n	see result list
Source	according to client
Gas filling in cavity	according to client
Gas type	see result list
Fill rate in %	see result list

The description is based on the documentation of **ift**. Numbers and names of material are given by the initial client.

1.2 Representation of insulating glass construction

The illustration was produced by the **ift** as a schematic representation of the cross section.

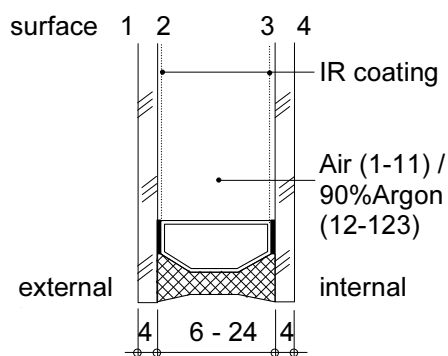


Figure 1 Representation of the system
 RAMATERM / RAMATERM+
 (No. 1 – 123)
 (No. 1-51 coating on pos. 2 or 3)

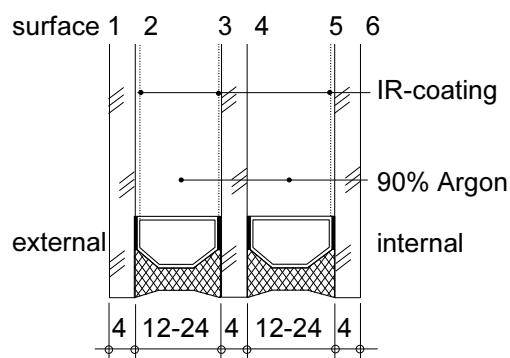


Figure 2 Representation of the system
 RAMA 3 / RAMA 3+
 (No. 124 – 209)
 (No.124-131 and 204-209 coating on
 pos 3 and 5 / No. 132-203 coating on
 pos. 2 and 5)

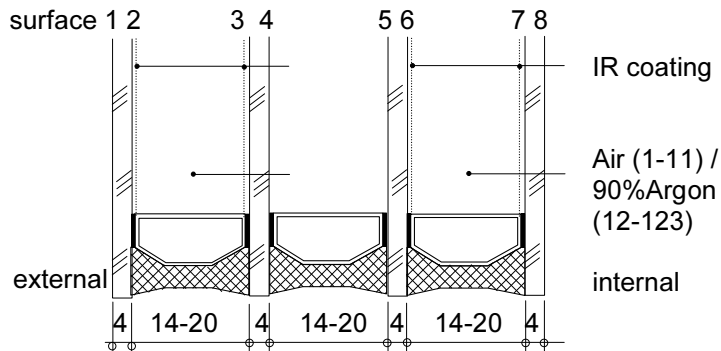


Figure 3 Representation of the system
RAMA QUADRO / RAMA QUADRO+
(No. 210 – 233)
(No. 210-229 coating on pos. 2; 5 and 7 /
230-233 coating on pos. 2; 3; 5 and 7)

2 Procedure

2.1 Calculation of the thermal transmittance

Technical basis

EN 673 : 2011-02

Glass in building - Determination of thermal transmittance (U value) –

Calculation method

Boundary conditions

as required in the standard

Inclination of glazing

vertical

$$\varepsilon_n = 0.89$$

normal emissivity of the room sided surface

$$\varepsilon = 0.837$$

corrected emissivity of the room sided surface

$$h_i = 7.7 \text{ W}/(\text{m}^2 \cdot \text{K})$$

external heat transfer coefficient

$$h_e = 25 \text{ W}/(\text{m}^2 \cdot \text{K})$$

internal heat transfer coefficient

Deviations

There are no deviations from the test procedure or test conditions.

2.2 Testing

Date/Period

15 May 2018

Testing personnel

Virginia Miguel Saez. Dipl.-Phys.

Carolin Lamprecht. B.Sc.

3 Detailed results

Glass list with calculated thermal transmittance U_g of an insulating glass unit

No.	Type	Structure in mm	Gas type / Gas ratio	E**	ϵ^*	$U_g^{(n)}$ calculated U_g -value according to EN 673 $\Delta T = 15 \text{ K}$ in $\text{W}/(\text{m}^2 \cdot \text{K})$
1	RAMATERM RAMATERM+	4/6/4	Air	3 or 2	0.03	2.5
2		4/9/4				1.9
3		4/10/4				1.8
4		4/12/4				1.6
5		4/14/4				1.5
6		4/15/4				1.4
7		4/16/4				1.4
8		4/18/4				1.4
9		4/20/4				1.4
10		4/22/4				1.4
11		4/24/4				1.4
12	RAMATERM RAMATERM+	4/6/4	Argon 90%	3 or 2	0.03	2.0
13		4/8/4				1.7
14		4/9/4				1.6
15		4/10/4				1.4
16		4/11/4				1.4
17		4/12/4				1.3
18		4/12.5/4				1.2
19		4/14/4				1.2
20		4/15/4				1.1
21		4/16/4				1.1
22		4/17/4				1.1
23		4/18/4				1.1
24		4/19/4				1.1
25		4/20/4				1.1
26		4/22/4				1.2
27		4/24/4				1.2

No.	Type	Structure in mm	Gas type / Gas ratio	E**	ϵ^*	U _g ⁽¹⁾ calculated Ug-value according to EN 673 $\Delta T = 15 \text{ K}$ in W/(m ² ·K)
28	RAMATERM RAMATERM+	4/6/4	Argon 90%	3 or 2	0.01	2.0
29		4/8/4				1.6
30		4/9/4				1.5
31		4/10/4				1.4
32		4/11/4				1.3
33		4/12/4				1.2
34		4/12.5/4				1.2
35		4/14/4				1.1
36		4/15/4				1.0
37		4/16/4				1.0
38		4/17/4				1.1
39		4/18/4				1.1
40		4/19/4				1.1
41		4/20/4				1.1
42		4/22/4				1.1
43	4/24/4	1.1				
44	RAMATERM RAMATERM+	4/12/4	Argon 90%	3 or 2	0.04	1.3
45		4/14/4				1.2
46		4/15/4				1.2
47		4/16/4				1.2
48		4/18/4				1.2
49		4/20/4				1.2
50		4/22/4				1.2
51		4/24/4				1.2
52	RAMATERM RAMATERM+	4/12/4	Argon 90%	2 3	0.14 0.03	1.3
53		4/14/4				1.1
54		4/15/4				1.1
55		4/16/4				1.1
56		4/18/4				1.1
57		4/20/4				1.1
58		4/22/4				1.1
59		4/24/4				1.2
60	RAMATERM RAMATERM+	4/12/4	Argon 90%	2 3	0.28 0.03	1.3
61		4/14/4				1.1
62		4/15/4				1.1
63		4/16/4				1.1
64		4/18/4				1.1
65		4/20/4				1.1
66		4/22/4				1.2
67		4/24/4				1.2

No.	Type	Structure in mm	Gas type / Gas ratio	E**	ϵ^*	U _g ⁽¹⁾ calculated Ug-value according to EN 673 $\Delta T = 15 K$ in W/(m ² ·K)
68	RAMATERM RAMATERM+	4/12/4	Argon 90%	2 3	0.41 0.03	1.3
69		4/14/4				1.1
70		4/15/4				1.1
71		4/16/4				1.1
72		4/18/4				1.1
73		4/20/4				1.1
74		4/22/4				1.2
75		4/24/4				1.2
76	RAMATERM RAMATERM+	4/12/4	Argon 90%	2 3	0.42 0.03	1.3
77		4/14/4				1.1
78		4/15/4				1.1
79		4/16/4				1.1
80		4/18/4				1.1
81		4/20/4				1.1
82		4/22/4				1.2
83		4/24/4				1.2
84	RAMATERM RAMATERM+	4/12/4	Argon 90%	2 3	0.43 0.03	1.3
85		4/14/4				1.1
86		4/15/4				1.1
87		4/16/4				1.1
88		4/18/4				1.1
89		4/20/4				1.1
90		4/22/4				1.2
91		4/24/4				1.2
92	RAMATERM- RAMATERM+	4/12/4	Argon 90%	2 3	0.53 0.03	1.3
93		4/14/4				1.1
94		4/15/4				1.1
95		4/16/4				1.1
96		4/18/4				1.1
97		4/20/4				1.1
98		4/22/4				1.2
99		4/24/4				1.2
100	RAMATERM RAMATERM+	4/12/4	Argon 90%	2 3	0.71 0.03	1.3
101		4/14/4				1.2
102		4/15/4				1.1
103		4/16/4				1.1
104		4/18/4				1.1
105		4/20/4				1.1
106		4/22/4				1.2
107		4/24/4				1.2

No.	Type	Structure in mm	Gas type / Gas ratio	E**	ϵ^*	U _g ⁽¹⁾ calculated Ug-value according to EN 673 $\Delta T = 15 \text{ K}$ in W/(m ² ·K)
108	RAMATERM RAMATERM+	4/12/4	Argon 90%	2 3	0.83 0.03	1.3
109		4/14/4				1.2
110		4/15/4				1.1
111		4/16/4				1.1
112		4/18/4				1.1
113		4/20/4				1.1
114		4/22/4				1.2
115		4/24/4				1.2
116	RAMATERM RAMATERM+	4/12/4	Argon 90%	1 or 2 3	0.89 0.03	1.3
117		4/14/4				1.2
118		4/15/4				1.1
119		4/16/4				1.1
120		4/18/4				1.1
121		4/20/4				1.1
122		4/22/4				1.2
123	4/24/4	1.2				
124	RAMA3 RAMA3+	4/12/4/12/4	Argon 90%	3 5	0.03 0.03	0.7
125		4/14/4/14/4				0.6
126		4/15/4/15/4				0.6
127		4/16/4/16/4				0.6
128		4/18/4/18/4				0.5
129		4/20/4/20/4				0.5
130		4/22/4/22/4				0.5
131		4/24/4/24/4				0.5
132	RAMA3 RAMA3+	4/12/4/12/4	Argon 90%	2 5	0.03 0.03	0.7
133		4/14/4/14/4				0.6
134		4/15/4/15/4				0.6
135		4/16/4/16/4				0.6
136		4/18/4/18/4				0.5
137		4/20/4/20/4				0.5
138		4/22/4/22/4				0.5
139		4/24/4/24/4				0.5
140	RAMA3 RAMA3+	4/12/4/12/4	Argon 90%	2 5	0.01 0.03	0.7
141		4/14/4/14/4				0.6
142		4/15/4/15/4				0.6
143		4/16/4/16/4				0.6
144		4/18/4/18/4				0.5
145		4/20/4/20/4				0.5
146		4/22/4/22/4				0.5
147		4/24/4/24/4				0.5

No.	Type	Structure in mm	Gas type / Gas ratio	E**	ε*	U _g ⁽¹⁾ calculated Ug-value according to EN 673 ΔT = 15 K in W/(m ² ·K)
148	RAMA3 RAMA3+	4/12/4/12/4	Argon 90%	2 5	0.01 0.01	0.7
149		4/14/4/14/4				0.6
150		4/15/4/15/4				0.6
151		4/16/4/16/4				0.5
152		4/18/4/18/4				0.5
153		4/20/4/20/4				0.5
154		4/22/4/22/4				0.5
155		4/24/4/24/4				0.5
156	RAMA3 / RAMA3+	4/12/4/12/4	Argon 90%	2 5	0.04 0.03	0.7
157		4/14/4/14/4				0.7
158		4/16/4/16/4				0.6
159		4/18/4/18/4				0.5
160		4/20/4/20/4				0.5
161		4/22/4/22/4				0.5
162	RAMA3 RAMA3+	4/12/4/12/4	Argon 90%	2 5	0.14 0.03	0.8
163		4/14/4/14/4				0.7
164		4/16/4/16/4				0.7
165		4/18/4/18/4				0.6
166		4/20/4/20/4				0.6
167		4/22/4/22/4				0.6
168	RAMA3 RAMA3+	4/12/4/12/4	Argon 90%	2 5	0.28 0.03	0.9
169		4/14/4/14/4				0.8
170		4/16/4/16/4				0.7
171		4/18/4/18/4				0.7
172		4/20/4/20/4				0.7
173		4/22/4/22/4				0.7
174	RAMA3 RAMA3+	4/12/4/12/4	Argon 90%	2 5	0.41 0.03	0.9
175		4/14/4/14/4				0.8
176		4/16/4/16/4				0.8
177		4/18/4/18/4				0.8
178		4/20/4/20/4				0.8
179		4/22/4/22/4				0.8

No.	Type	Structure in mm	Gas type / Gas ratio	E**	ε*	U _g ⁽¹⁾ calculated Ug-value according to EN 673 ΔT = 15 K in W/(m ² ·K)
180	RAMA3 RAMA3+	4/12/4/12/4	Argon 90%	2 5	0.42 0.03	0.9
181		4/14/4/14/4				0.9
182		4/16/4/16/4				0.8
183		4/18/4/18/4				0.8
184		4/20/4/20/4				0.8
185		4/22/4/22/4				0.8
186	RAMA3 RAMA3+	4/12/4/12/4	Argon 90%	2 5	0.43 0.03	0.9
187		4/14/4/14/4				0.9
188		4/16/4/16/4				0.8
189		4/18/4/18/4				0.8
190		4/20/4/20/4				0.8
191		4/22/4/22/4				0.8
192	RAMA3 RAMA3+	4/12/4/12/4	Argon 90%	2 5	0.53 0.03	1.0
193		4/14/4/14/4				0.9
194		4/16/4/16/4				0.8
195		4/18/4/18/4				0.8
196		4/20/4/20/4				0.8
197		4/22/4/22/4				0.8
198	RAMA3 RAMA3+	4/12/4/12/4	Argon 90%	2 5	0.83 0.03	1.0
199		4/14/4/14/4				0.9
200		4/16/4/16/4				0.9
201		4/18/4/18/4				0.9
202		4/20/4/20/4				0.9
203		4/22/4/22/4				0.9
204	RAMA3 RAMA3+	4/12/4/12/4	Argon 90%	1(2) 3 5	0.89 0.03 0.03	0.7
205		4/14/4/14/4				0.6
206		4/16/4/16/4				0.6
207		4/18/4/18/4				0.5
208		4/20/4/20/4				0.5
209		4/22/4/22/4				0.5

No.	Type	Structure in mm	Gas type / Gas ratio	E**	ϵ^*	U _g ⁽¹⁾ calculated Ug-value according to EN 673 $\Delta T = 15 \text{ K}$ in $\text{W}/(\text{m}^2 \cdot \text{K})$
210	RAMA QUADRO RAMA QUADRO+	4/14/4/14/4/14/4	Argon 90%	2 5 7	0.04 0.03 0.03	0.4
211		4/16/4/16/4/16/4				0.4
212		4/18/4/18/4/18/4				0.4
213		4/20/4/20/4/20/4	Argon 90%	2 5 7	0.14 0.03 0.03	0.3
214		4/14/4/14/4/14/4				0.4
215		4/16/4/16/4/16/4				0.4
216		4/18/4/18/4/18/4				0.4
217		4/20/4/20/4/20/4	Argon 90%	2 5 7	0.28 0.03 0.03	0.4
218		4/14/4/14/4/14/4				0.5
219		4/16/4/16/4/16/4				0.5
220		4/18/4/18/4/18/4	Argon 90%	2 5 7	0.41 0.03 0.03	0.4
221		4/20/4/20/4/20/4				0.4
222		4/14/4/14/4/14/4				0.5
223		4/16/4/16/4/16/4				0.5
224		4/18/4/18/4/18/4	Argon 90%	2 5 7	0.42 0.03 0.03	0.4
225		4/20/4/20/4/20/4				0.4
226		4/14/4/14/4/14/4				0.5
227		4/16/4/16/4/16/4	Argon 90%	1(2) 3 5 7	0.89 0.03 0.03 0.03	0.5
228		4/18/4/18/4/18/4				0.4
229		4/20/4/20/4/20/4				0.4
230		4/14/4/14/4/14/4				0.4
231		4/16/4/16/4/16/4	Argon 90%	5 7	0.03 0.03	0.4
232		4/18/4/18/4/18/4				0.4
233	4/20/4/20/4/20/4	0.3				

ϵ_n^* normal emissivity; source: declaration by client

E** coated surface

(1) The calculation was carried out on the construction with the smallest glass thicknesses. Using thicker glass may slightly improve the value