


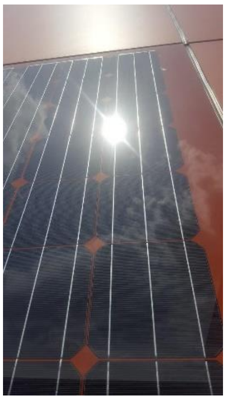

Q-Air – detailed physical properties

- Centre of glass heat transmission (U_g)
- Temperature dependency of the centre of glass U_g value
- Angular dependency of solar heat gain (g – value)
- Linear heat transmittance value (ψ - values)
- Light transmission (LT), solar heat gain (g) datasheets
- Sound insulation

REFLEX

Q-Air

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Centre of glass heat transmission (U_g)

Calculation standard:

- EN673:2011

Boundary conditions:

T_i (internal)	20°C
T_e (external)	0°C
h_i	7.7 W/m²K
h_e	25 W/m²K

Model data synopsis:

												Inside	
	Glass	**Gap**	**Glass**	**Gap**	**Glass**	**Gap**	**Glass**	**Gap**	**Glass**	**Gap**	**Glass**	**Gap**	**Glass**
Q-AIR3L							6 mm	18 mm	3 mm	18 mm	3 mm	18 mm	3 mm
Q-AIR3E							8 mm	18 mm	3 mm	18 mm	3 mm	18 mm	55.2
Q-AIR3							8 mm	24 mm	3 mm	24 mm	3 mm	48 mm	55.2
Q-AIR4K					8 mm	14 mm	3 mm	14 mm	3 mm	14 mm	3 mm	14 mm	55.2
Q-AIR4G					10 mm	18 mm	4 mm	18 mm	4 mm	18 mm	4 mm	18 mm	55.2
Q-AIR5			8 mm	18 mm	3 mm	18 mm	3 mm	18 mm	3 mm	18 mm	4 mm	16 mm	55.2
Q-AIR5S			8 mm	18 mm	3 mm	18 mm	3 mm	18 mm	3 mm	20 mm	4 mm	20 mm	6 mm
Q-AIR5G			10 mm	18 mm	4 mm	18 mm	4 mm	18 mm	4 mm	18 mm	5 mm	18 mm	55.2
Q-AIR6	8 mm	18 mm	2.1 mm	18 mm	2.1 mm	18 mm	2.1 mm	18 mm	4 mm	18 mm	6 mm	**16** mm	55.2
Q-AIR6K	8 mm	16 mm	3 mm	16 mm	3 mm	16 mm	3 mm	16 mm	4 mm	20 mm	6 mm	**16** mm	55.2

Krypton 95% *
Argon 90% *
Air *
Air

* Low-E coated glass on at least one side.

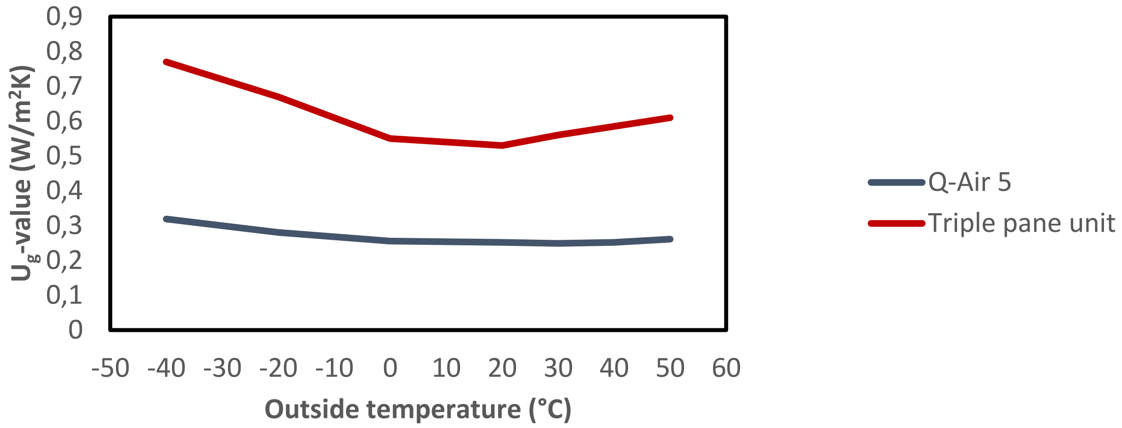
Centre of glass thermal transmittance (U_g):

Q-AIR3L	0.36 W/m²K
Q-AIR3E	0.49 W/m²K
Q-AIR3	0.49 W/m²K
Q-AIR4G	0.35 W/m²K
Q-AIR4K	0.28 W/m²K
Q-AIR5	0.27 W/m²K
Q-AIR5S	0.24 W/m²K
Q-AIR5G	0.27 W/m²K
Q-AIR6	0.22 W/m²K
Q-AIR6K	0.16 W/m²K

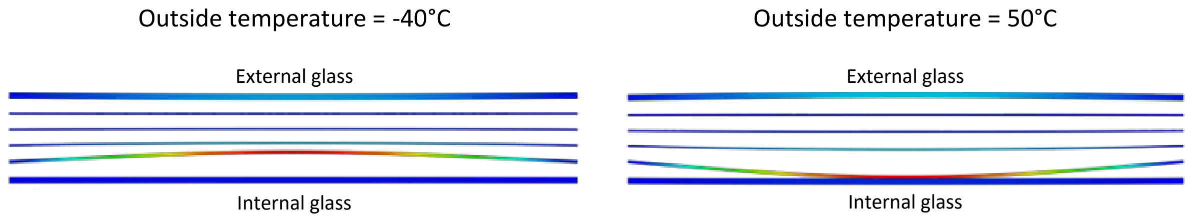
Temperature dependency of the centre of glass U_g value

Heat transfer through the glazed unit consists of heat radiation exchange among the glass panes and gas-gap related heat transfer combining conduction and convection. Q-Air reduces heat transfer using low thermal conductivity gas, which in most applications is argon and through the application of Low-E coatings, which mitigate heat radiation. Sealed glass units' centre of glass U value (U_g) change with exterior conditions.

A simulated (EN 673) glass deflection's dependent U_g for the Q-Air 5 and triple pane unit:



Below is FEM analysis (Q-Air 5) layout of the glass panes at most extreme points from diagram above:



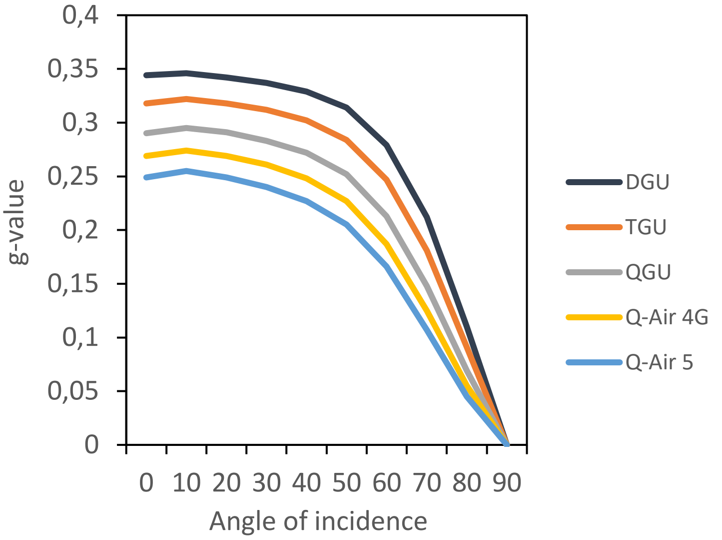
U_g-values were calculated with Berkeley Lab Window 7.4. according to EN673:2011

$T_{outdoor}$ (°C)	Solar irradiation (W)	U_g (W/m²K) (Temperature depended)	U_g (W/m²K) (Temperature & deflection depended)
- 40	0	0.311	0.319
-20	0	0.271	0.280
0	0	0.254	0.256
20	383	0.261	0.252
30	683	0.264	0.249
40	783	0.268	0.252
50	783	0.271	0.261

Modelled panel size: 750 x 1500 mm;
Boundary conditions for center of glass thermal transmittance calculation: Internal temperature T_i = 22 °C; external temperature T_e = from -40°C to 50°C; internal heat transfer coefficient h_i = 7.0 W/m²K; external heat transfer coefficient h_e = 15.0 W/mK;
External glass: Arcon Sunbelt A70;
Q-Air 5 characteristic: g-value = 0.30; T_{vis} = 0.46; T_{sol} = 0.20; R_{fvis} = 0.20; R_{fsol} = 0.43;

Seasonal dependency of the solar gain (g)

Since real solar gain is angle of incidence dependent, it makes sense to check how this property influences the overall seasonal g value as one could naturally expect that due to the different effective solar incidence angles between summer and winter there would be difference in effective g values as incidence angle of the solar radiation changes through the year.

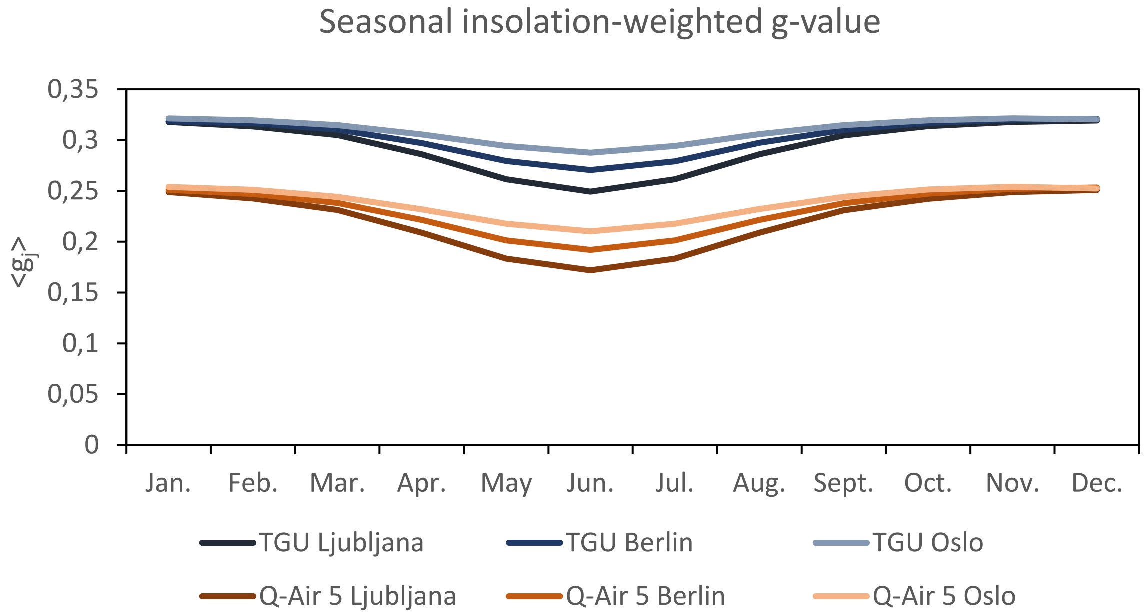


The change in solar gain (g) originates in direct solar light being sent through many layers of glass where mutual Fresnel reflections diminish transmitted light at high angles of incidence.

On the left image, DGU stands for double-pane glass, TGU for triple-pane glass, and QGU for quad pane glass. Q-Air 4G has five panes and Q-Air 5 has six panes.

On a monthly basis we use hourly solar irradiation weighted effective $<g_j>$ value, which represents clear sky effective g value for that month.

Image below shows calculated $<g_j>$ value for south, triple and six pane glazing units equipped with exterior selective solar control pane with visible light transmittance 0.68, and solar energy transmittance of 0.32.



Calculations were made for three characteristic geographical latitudes: Ljubljana (46°15`), Berlin (52°31'), and Oslo (60°11`). The greater the number of panes the greater the difference. It is convenient that a multipane glass unit provides for some seasonal selectivity of the $<g_j>$ value where it decreases in summer. **For Berlin, in summer $<g_j>$ value of TGU decreases for 15%, while for Q-Air 5, decreases 23%.**

Linear heat transmittance value (ψ - values)

Calculation standard:

- SIST EN ISO 10211:2008

Linear thermal transmittance (ψ):

Q-AIR3L	0.027 W/mK	Estimated value. Interpolated between triple-pane value with the same spacer type (0.038 W/mK – 18 mm spacers) and Q-AIR5
Q-AIR3E	0.027 W/mK	Estimated value. The same configuration as Q-AIR3L
Q-AIR3	0.015 W/mK	Report on the initial type calculation of the linear thermal transmittance of the horizontal and vertical joints of the system and of the panel QATT3 according to the standard SIST EN ISO 10211:2008 (No. P 0073/15-520-5)
Q-AIR4G	0.020 W/mK	Estimated value. Interpolated from Q-Air 5 (standard 18 mm spacers)
Q-AIR4K	0.025 W/mK	Estimated value. Interpolated from Q-Air 5 (narrow 14 mm spacers)
Q-AIR5	0.016 W/mK	Report on the initial type calculation of the linear thermal transmittance of the horizontal and vertical joints of the system and of the panel QATT5 according to the standard SIST EN ISO 10211:2008 (No. P 0073/15-520-6)
Q-AIR5S	0.016 W/mK	The same configuration as Q-AIR5
Q-AIR5G	0.016 W/mK	Estimated value. The same configuration as Q-AIR5, only thicker intermediate glass panes

Light transmission (LT), solar heat gain (g) datasheets

Selected basic glass combinations are disclosed below.

Q-Air 3, Q-Air 3E

Twin silver selective coated outer glass

ID	g	LT
7127	0.12	0.20
11672	0.20	0.32
11682	0.23	0.40
11692	0.29	0.49
11707	0.32	0.55

Triple silver super selective coated outer glass

ID	g	LT
64211	0.20	0.40
64213	0.25	0.47

Q-Air 4G

Twin silver selective coated outer glass

ID	g	LT
7127	0.11	0.18
11672	0.18	0.29
11682	0.21	0.37
11692	0.26	0.45
11707	0.29	0.50

Triple silver super selective coated outer glass

ID	g	LT
64211	0.19	0.36
64213	0.23	0.43

Q-Air 5, Q-Air 5G, Q-Air 5S

Twin silver selective coated outer glass

ID	g	LT
7127	0.11	0.17
11672	0.17	0.27
11682	0.20	0.34
11692	0.25	0.41
11707	0.28	0.46

Triple silver super selective coated outer glass

ID	g	LT
64211	0.17	0.33
64213	0.22	0.39

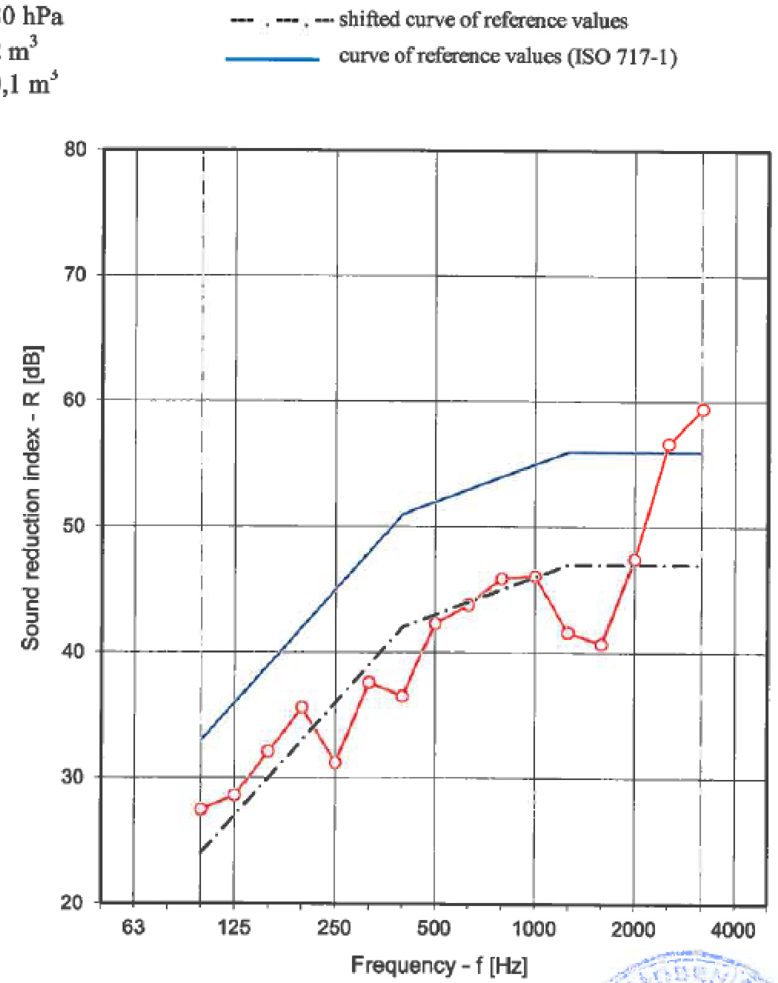
Sound insulation

By default, thick Q-Airs, Q-Air 3, Q-Air 4G, Q-Air 5, Q-Air 5S, Q-Air 5G and Q-Air 6 offer sound insulation, Rw, of 43 dB, where with improvements 55 dB is achievable. Thinner Q-Airs, Q-Air 3L, Q-Air 3E and Q-Air 4K offer sound insulation performance, Rw, 35 dB or better.

A-Air 3 test result example:

Surface area of the test specimen:	1,87 m^2
Air temperature:	18^0C
Relative air humidity:	50 %
Static pressure:	980 hPa
Source room volume:	52 m^3
Receiving room volume:	50,1 m^3

Frequency f Hz	*R* (third oct.) dB
50	
63	
80	
100	27,5
125	28,6
160	32,1
200	35,6
250	31,2
315	37,6
400	36,5
500	42,3
630	43,8
800	45,9
1000	46,1
1250	41,6
1600	40,7
2000	47,5
2500	56,7
3150	59,5
4000	
5000	



Rating according to SIST EN ISO 717-1 (2013) :
R_w (C;C_{tr}) = 43 (-1;-3) dB
Evaluation based on laboratory measurement results, using sound intensity.