



Technical Data Sheet – iplus/Energy

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1 INTRODUCTION

This Technical Datasheet gives information about the range of magnetron coated glass iplus and Energy: iplus 1.1, iplus 1.1T, iplus 1.0, iplus 1.0NT, iplus 1.0T, iplus LS, iplus Top 1.0, Energy 72/38, Energy 72/38T, Energy 70/37, Energy 65/42S, Energy 65/41.

These information's are related to stock sizes.

2 NORMATIVE REFERENCES

iplus products conform to:

- EN 1096-1 – Glass in building – Coated glass – Part 1: Definitions and classification
- EN 1096-3 – Glass in building – Coated glass – Part 3: Requirements and test methods for class C and D coatings
- EN 1096-4 – Glass in building – Coated glass – Part 4: Evaluation of conformity/Product standard

iplus and Energy products are CE-marked following EN 1096-4 ; CE-Marking declarations are available from <https://www.agc-yourglass.com/configurator/app/login>

iplus are produced in factories being ISO 9001 certified.

3 COMPOSITION AND PROPERTIES OF THE GLASS

The basic glass used for coated glass is float glass conform to EN 572-1 & 2. The properties of the float glass are listed hereunder.

3.1 CHEMICAL COMPOSITION

The EN 572-1 defines the magnitude of the proportions by mass of the principal constituents of float glass is as follows.

Constituents	Proportion by mass of element
Silicon (Si)	32 % - 35 %
Calcium (Ca)	3,5 % - 10,1 %
Sodium (Na)	7,4 % - 11,9 %
Magnesium (Mg)	0 % - 3,7 %
Aluminium (Al)	0 % - 1,6 %
Others ^a	< 5 %
^a properties other than photometric characteristics shall not be significantly altered by these other components	

3.2 MECHANICAL PROPERTIES FOR SODA LIME SILICATE GLASS

- Density (at 18°C): $\rho = 2\,500 \text{ kg/m}^3$
- Hardness (Knoop): $\text{HK}_{0,1/20} 6 \text{ GPa}^a$
- Young's Modulus (modulus of Elasticity): $E = 70\,000 \text{ N/mm}^2 (7 \times 10^{10} \text{ Pa})$
- Poisson Ratio: $\mu = 0,2$
- Shear Modulus: $G = E / [2 (1+\nu)] \approx 29\,166 \text{ N/mm}^2$
- Hardness (Mohs): 5-6
- Characteristic bending strength: $f_{g,kk} 45 \text{ N/mm}^2$
Resistance against temperature differential and sudden temperature change 40K^b

^a Knoop Hardness in accordance with ISO 9385

^b Generally accepted value that is influenced by edge quality and glass type

3.3 THERMAL PROPERTIES

- Softening temperature $T_{so}: \approx 725 \text{ }^\circ\text{C}$
- Working temperature $T_w: \approx 1030 \text{ }^\circ\text{C}$
- Fusion temperature $T_f \approx 1300 \text{ }^\circ\text{C}$ to $1600 \text{ }^\circ\text{C}$
- Linear expansion coefficient: $\alpha = 9 \cdot 10^{-6} / \text{K}$ (between 20° and 300°)
- Specific heat capacity: $C_p = 720 \text{ J/(kg.K)}$
- Emissivity of glass without coating:
 - Normal emissivity $\varepsilon_n = 0,89$
 - Corrected emissivity $\varepsilon = 0,837$

3.4 OPTICAL PROPERTIES

- Refractive index N to visible radiation (380 to 780 nm):
 - air/glass: 0,67
 - glass/air: 1,50 at 589,3 nm

3.5 ELECTRICAL PROPERTIES

- Specific resistance: $5 \cdot 10^7 \text{ } \Omega \cdot \text{m}$ at 1 000 Hz and 25°C
- Dielectric constant: 7,6 at 1 000 Hz and 25°C

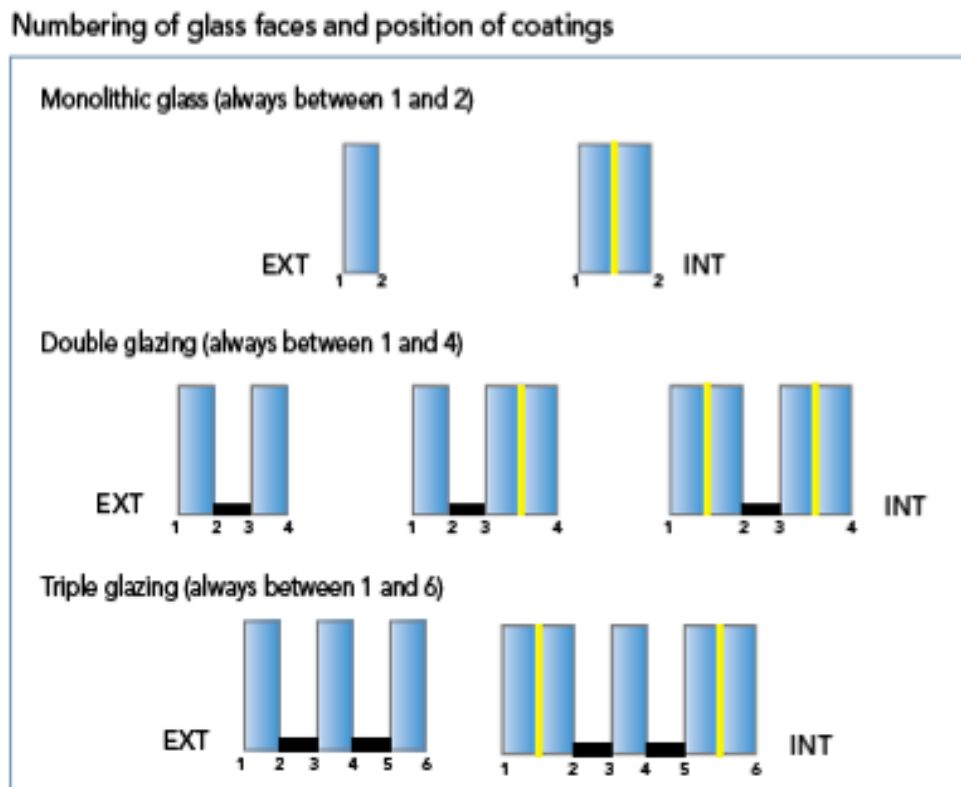
4 DURABILITY OF COATINGS

Coatings are class C following EN 1096-1. They succeed an UV resistance test following EN 1096-3.

5 LIGHT, SOLAR AND THERMAL PROPERTIES

5.1 CONVENTION FOR COATING POSITION

The following conventions are used for the numbering of the glass faces and the position of the coating.



5.2 TOLERANCES ON LIGHT AND SOLAR PROPERTIES

The light and solar properties are calculated using spectral measurement that conforms with standards EN 410 and WIS/WINDAT. The following properties are given:

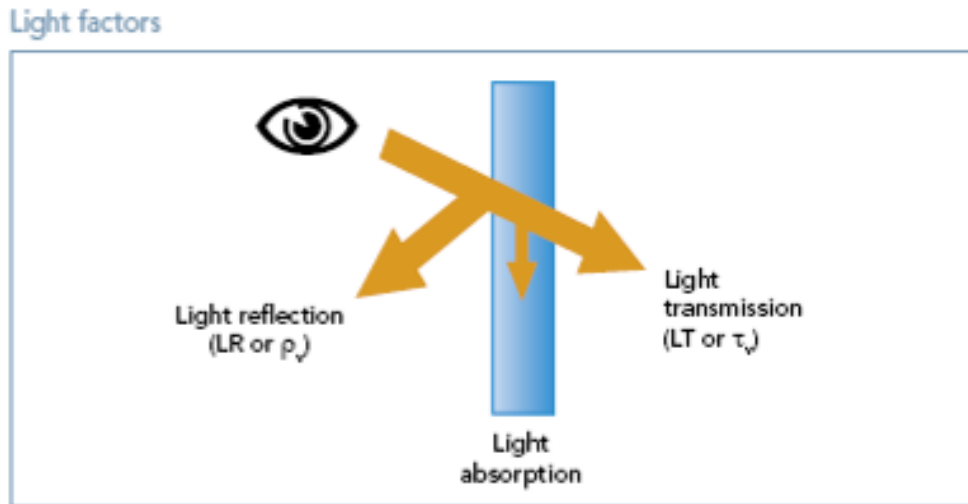
- LT (τ_v): Light transmission
- LR (ρ_v): Light reflection on coating side
- LR' (ρ'_v): Light reflection on glass side
- DET (τ_e): Direct energy transmission
- ER (ρ_e): Energy reflection on coating side
- ER' (ρ'_e): Energy reflection on glass side
- EA (α_e): Energy absorption

- SF (g): Solar factor
- SC: Shading coefficient

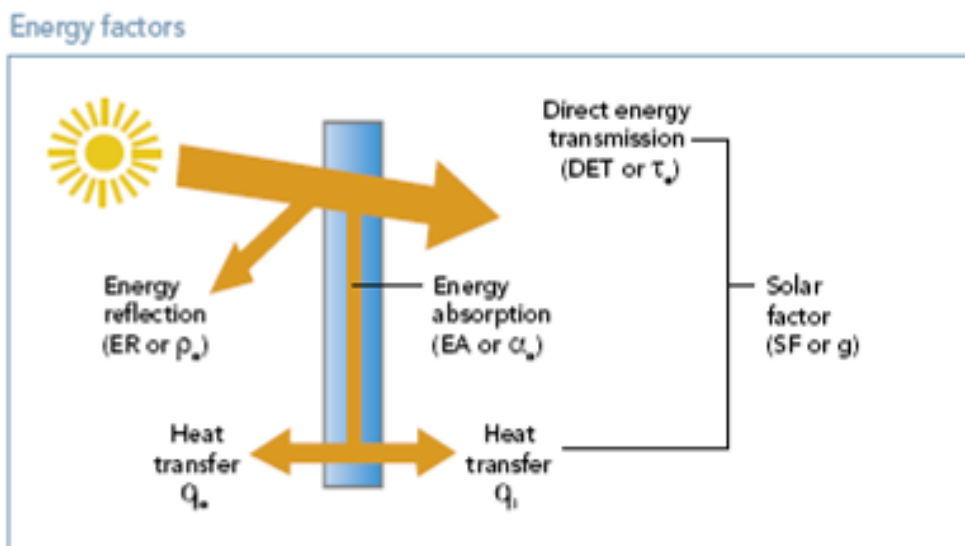
The tolerances on the values LT, LR, LR', DET, ER, ER' are +/- 3 %.

Notes: they are no direct tolerances on SF, SC and EA as these values are calculated from the previous ones.

Light Properties



Energy Properties



5.3 TOLERANCES ON THERMAL PROPERTIES

The thermal transmittance U_g (W/m²K) is calculated according EN 673. The emissivity measurement complies with EN 673 and EN 12898.

The tolerance on the values of normal emissivity ϵ_n is + 0,01 absolutely.

5.4 PERFORMANCES OF IPLUS AND ENERGY PRODUCTS

The table lists the light, solar and thermal properties of the iplus and Energy products of 4 mm thickness. For other thicknesses, see www.agc-yourglass.com.

	LT	LR	LR'	DET	ER	ϵ_n
4 mm iplus 1.1	90	5	6	64	27	0,03
4 mm iplus 1.1T*	90	5	5	67	25	0,03
4 mm iplus 1.0	84	9	11	54	36	0,01
4 mm iplus 1.0NT*	84	9	10	57	35	0,01
4 mm iplus 1.0T*	89	6	7	63	30	0,01
4 mm iplus Top-1.0	77	15	17	47	42	0,01
4 mm iplus LS	90	6	6	73	18	0,08
4 mm Energy 72/38	80	8	8	41	43	0,01
4 mm Energy 72/38T *	80	8	8	41	43	0,01
4 mm Energy 70/37	77	8	8	39	45	0,01
4 mm Energy 65/42S	71	20	22	45	44	0,01
4 mm Energy 65/41	72	19	22	44	43	0,01
* Temperable products. Their values are those obtained after the tempering process.						

6 ACOUSTIC PROPERTIES

The table lists the acoustic properties.

	Rw (C;Ctr)	Rw+C	Rw+Ctr
4	30 (-2;-4)	28	26
5	30 (-1;-2)	29	28
6	31 (-2;-3)	29	28
8	32 (-1;-2)	31	30
10	34 (-2;-3)	32	31

7 TOLERANCES ON DIMENSIONS

The same tolerances than for the float used as the basic glass for coatings apply. These information's are related to stock sizes.

7.1 THICKNESS

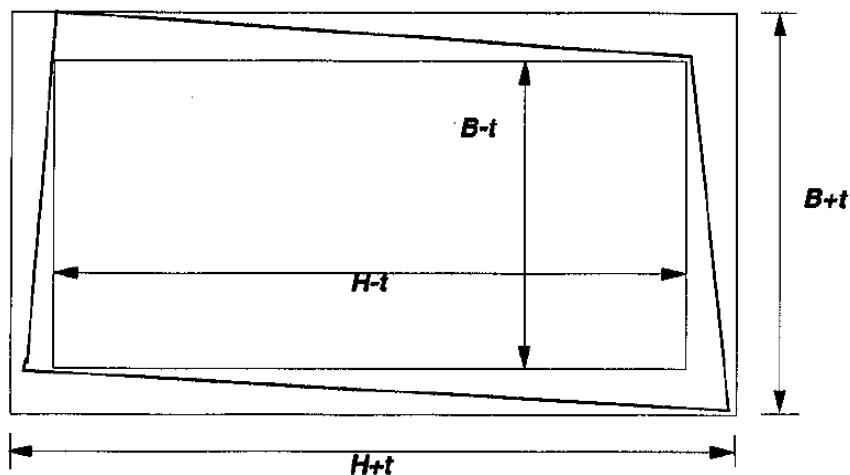
The actual thickness shall be the average of for measurements, taken to the nearest 0,01 mm, one taken at the center of each side.

The actual thickness rounded to the nearest 0,1mm shall not vary from the nominal thickness by more than the tolerances shown in the table.

	Minimum (mm)	Maximum (mm)
3,15	3,0	3,2
4	3,8	4,2
5	4,8	5,2
6	5,8	6,2
8	7,7	8,3
10	9,7	10,3
12	11,7	12,3

7.2 LENGTH AND WIDTH

The tolerances on nominal dimensions length H and width B are respectively ± 3 mm and ± 2 mm.



The limit of squareness is described by the difference between diagonals. The difference is maximum 5 mm.

8 QUALITY REQUIREMENTS

8.1 INTRODUCTION

The defect affecting appearances are:

- Specific from the float glass: see the Technical Datasheet "Planibel."
- Specific to the coating: see hereunder.

If a defect specific to the glass substrate is more visible because of the coating, it will be treated as a coating defect.

8.2 DEFINITIONS OF DEFECTS

The following definitions apply:

- **Uniformity defect:** Slight visible variation in color, in transmission or reflection, within a coated glass pane or from pane to pane
- **Stain:** Defect in the coating larger than punctual defect, often irregularly shaped, partially of mottled structure.
- **Punctual defect:** Punctual disturbance of the visual transparency looking through the glass and of the visual reflectance looking at the glass
Note: Spot, pinhole and scratch are types of punctual defect.
- **Spot:** Defect that commonly looks dark against the surrounding coating, when viewed in transmission
- **Pinhole:** Punctual void in the coating with partial or total absence of coating and normally contrasts clear relative to the coating, when viewed in transmission
- **Scratch:** Variety of linear mark, whose visibility depends on their length, depth, width, position and arrangement
- **Cluster:** Accumulation of very small defects giving the impression of stain.

8.3 DETECTION OF DEFECTS

8.3.1 GENERAL

The defects are detected visually by an observation of the coated glass in transmission and/or reflection. An artificial sky or daylight may be used as the source of illumination.

8.3.2 ARTIFICIAL SKY

The artificial sky is a plane emitting diffuse light with a uniform brightness and a general coloring index Ra higher than 70.

It is obtained by using a light source whose correlated color temperature is in the range between 4000 K and 6000 K. In front of the arrangement of light sources is a light scattering

panel, without spectral selectivity. The illuminance level, on the glass surface shall be between 400 lx and 20000 lx.

8.3.3 DAYLIGHT ILLUMINATION

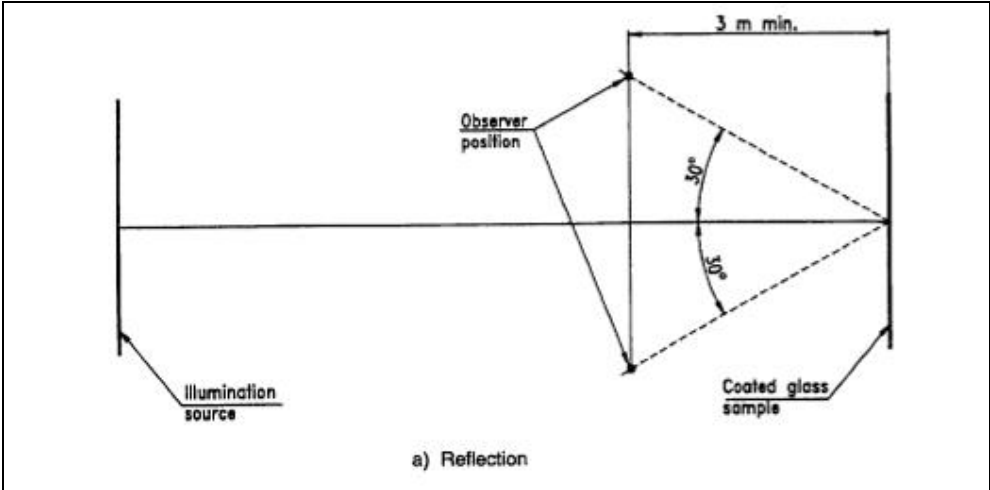
Daylight illumination is a uniform overcast sky, without direct sunlight.

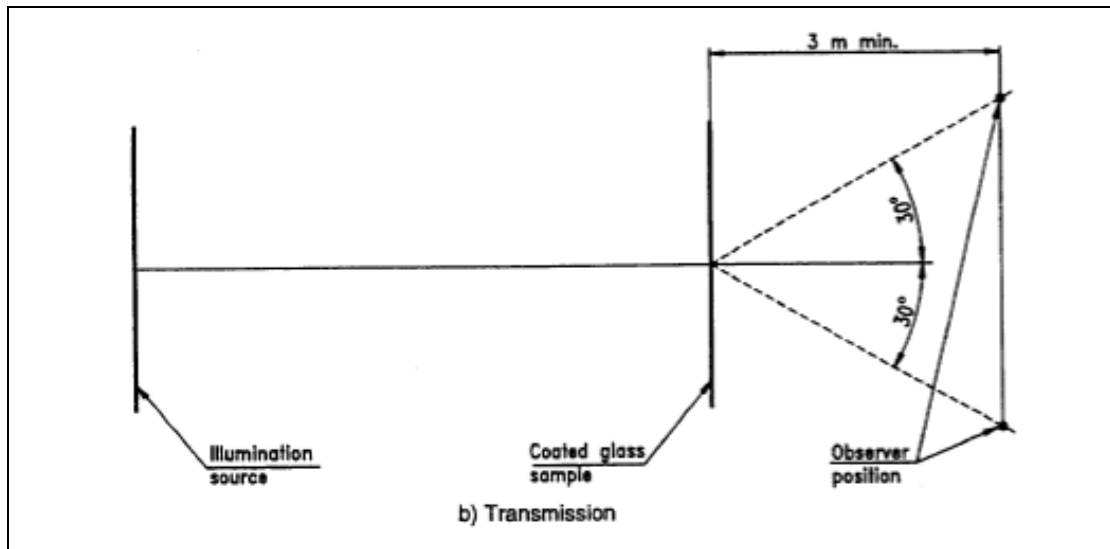
8.4 CONDITION OF OBSERVATION OF DEFECTS

8.4.1 GENERAL

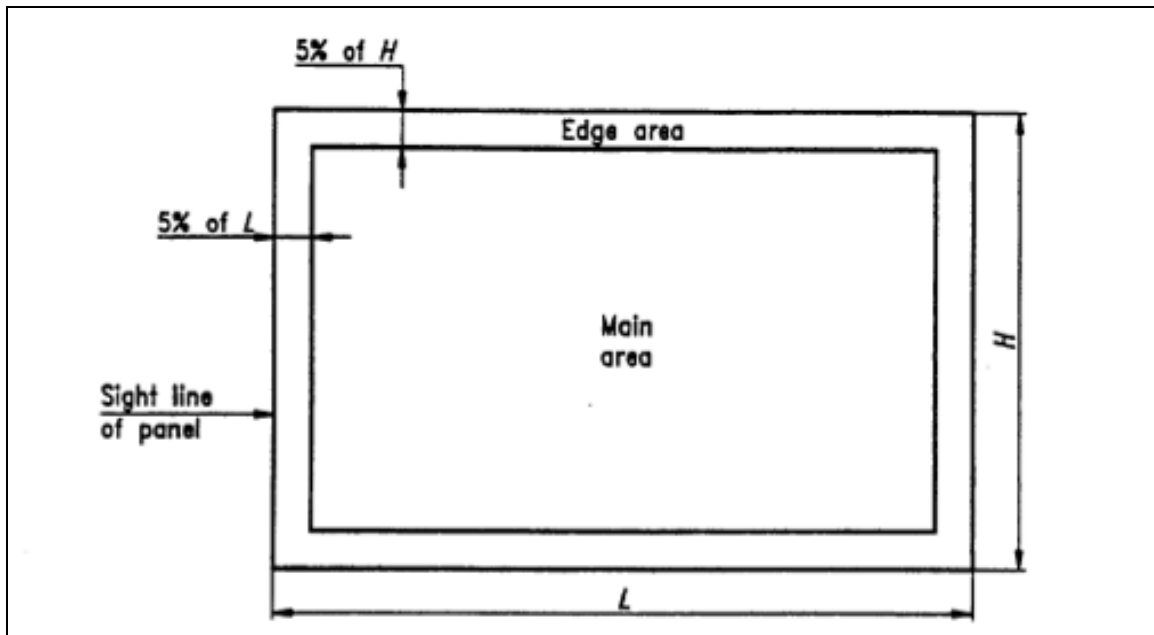
Coated glass may be examined in stock size or in finished sizes ready for installation. The examination may be undertaken in the factory or on site when glazed.

The pane of coated glass being examined is viewed from a minimum distance of 3 m. The actual distance will be dependent on the defect being considered and which illumination source is being used. The examination of the coated glass in reflection is performed by the observer looking at the side which will be the outside of the glazing. During the examination the angle between the normal to the surface of the coated glass and the light beam proceeding to the eyes of the observer after reflection or transmission by the coated glass shall not exceed 30° (see figure).





For panes of coated glass in finished sizes ready to be installed, both main area and edge area of the pane shall be examined (see figure).



Each examination will take no more than 20 s.

8.4.2 UNIFORMITY DEFECTS AND STAINS

Under the condition of examination given in 8.4.1, note any coating variations either within on pane or between neighboring panes which are visually disturbing.

8.4.3 PUNCTUAL DEFECTS

Under the conditions of examination given in 8.4.1, note any spots, pinholes and/or scratches that are visually disturbing.

For spots/pinholes, measure the size and note the number relative to the size of the pane. If there are any clusters found, their position relative to the through vision area shall be determined.

For scratches, determine whether or not they are in the main or edge area. Measure the length of any scratches noted. For scratches > 75 mm long, determine the distance between adjacent scratches. For scratches ≤ 75 mm long, note any area where their density produces visual disturbances.

8.5 ACCEPTANCE CRITERIA OF COATINGS GLASS DEFECTS

The acceptance criteria for the defects of coating glass are given in the table.

Defects types	Acceptance criteria		
	Pane/Pane	Individual pane	
UNIFORMITY/STAIN	Allowed as long not visually disturbing	Allowed as long not visually disturbing	
PUNCTUAL Spot/pinholes > 3 mm > 2 mm and ≤ 3 mm	Not applicable	Main area	Edge Area
		Not allowed	Not allowed
		Max 1 by m ²	Max 1 by m ²
Clusters	Not applicable	Not allowed	Allowed as long as not in area of through vision
Scratches > 75 mm ≤ 75 mm	Not applicable	Not allowed	Allowed as long as they are separated by > 50mm
		Allowed as long as local density is not visually disturbing	Allowed as long as local density is not visually disturbing

8.6 COLOR DIFFERENCE IN FAÇADES

8.6.1 METHOD AND CONDITION OF OBSERVATION

When coated glasses are installed on façades, some variations of color can appear between the panes. The document of Glass for Europe "Code of practice for in-situ measurement and evaluation of the color of coated glass used in façades" (available at [Measurement-and-Evaluation-of-the-Colour-of-Coated-Glass.pdf \(glassforeurope.com\)](#)) describes the way to measure and evaluate these differences of color.

8.6.2 REQUIREMENTS

The values of ΔL^* , Δa^* and Δb^* determined in accordance with 8.6.1 shall meet the following requirement.

ΔL^*	$\leq 4,0$
Δa^*	$\leq 3,0$
Δb^*	$\leq 3,0$

9 OTHER RELATED DOCUMENTS

Following documents are also available from www.agc-yourglass.com:

- Processing Guide <https://www.agc-yourglass.com/en-BE/document-library>
- Cleaning and Maintenance Guide for Façade glazing <https://www.agc-yourglass.com/en-BE/document-library>
- Glazing Instruction <https://www.agc-yourglass.com/en-BE/document-library>
- CE-Marking and Declaration of Performance at <https://www.agc-yourglass.com/configurator/app/login>