



GLASS UNLIMITED

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## **Technical Data Sheet - iplus**

**10/2014**

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# 1 INTRODUCTION

This Technical Datasheet gives information about the range of magnetron coated glass iplus : iplus Advanced 1.0, Energy N, Energy NT, I-Top, Light, LS, LST, Top 1.0, Top 1.1, Top 1.1T.

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 products are CE-marked following EN 1096-4 ; CE-Marking declarations are available from [www.yourglass.com/CE](http://www.yourglass.com/CE).

iplus are produced in factories being ISO 9001 certified.

## 3 COMPOSITION AND PROPERTIES OF THE GLASS

The basis glass used for low-e production 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 following.

SiO <sub>2</sub>	69 to 74 %
Na <sub>2</sub> O	10 to 16 %
CaO	5 to 14 %
MgO	0 to 6 %
Al <sub>2</sub> O <sub>3</sub>	0 to 3 %
Others	0 to 5 %

### **3.2 MECHANICAL PROPERTIES**

- Weight (at 18°C):  $\rho = 2\,500 \text{ kg/m}^3$
- Density: 2,5
- Young's Modulus (modulus of Elasticity):  $E = 70\,000 \text{ N/mm}^2$
- Poisson Ratio:  $\mu = 0,2$
- Shear Modulus:  $G = E / [2 (1+\nu)] \approx 29\,166 \text{ N/mm}^2$
- Knoop Hardnes: 6 GPa
- Mohs Hardness: 6
- Characteristic bending strength:  $45 \text{ N/mm}^2$

### **3.3 THERMAL PROPERTIES**

- Softening point:  $\approx 600 \text{ }^\circ\text{C}$
- Fusion temperature:  $\approx 1500 \text{ }^\circ\text{C}$
- Linear expansion coefficient:  $\alpha = 9 \cdot 10^{-6} / \text{K}$  (between  $20^\circ$  and  $300^\circ$ )
- Specific heat capacity:  $C = 720 \text{ J/(kg.K)}$

### **3.4 OPTICAL PROPERTIES**

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

### **3.5 ELECTRICAL PROPERTIES**

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

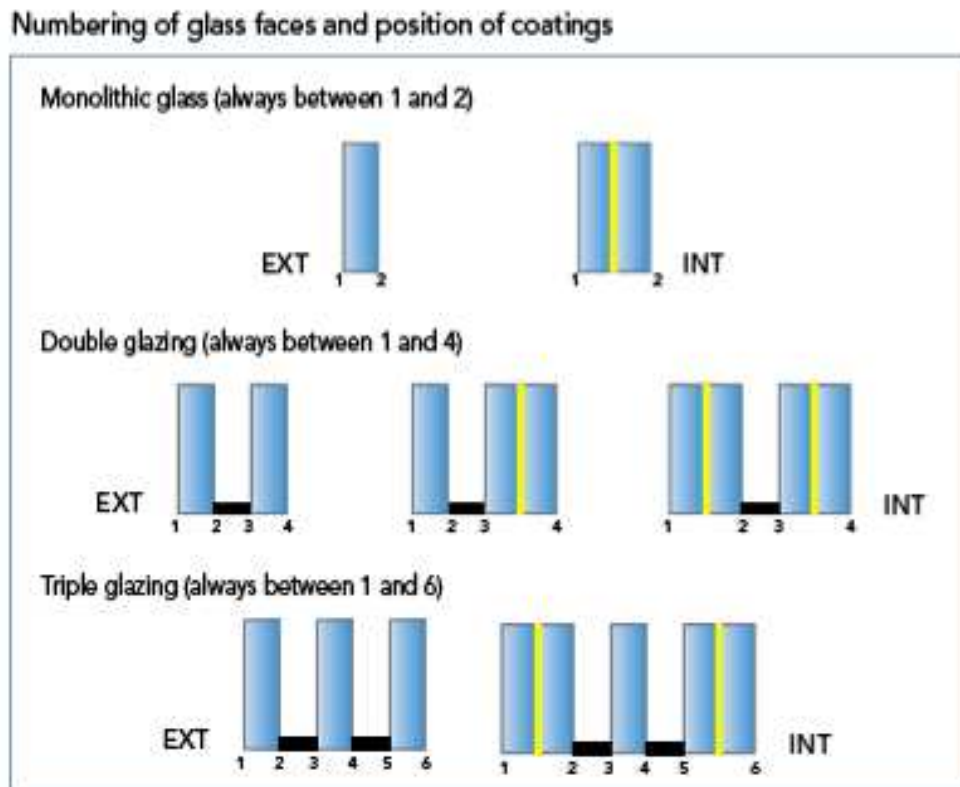
## **4 DURABILITY OF COATINGS**

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

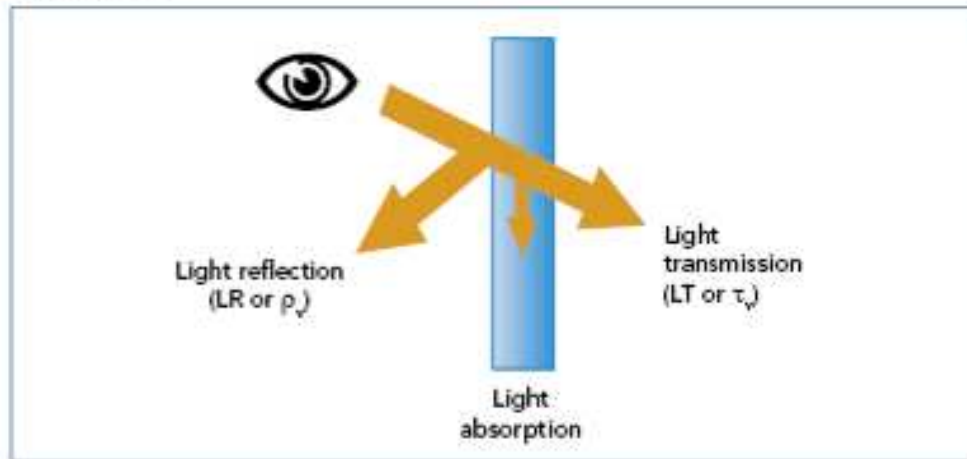
The light and solar properties are calculated using spectral measurement that conforms with standards EN 410 and WIS/WINDAT. The following properties are given:

- LT ( $\tau_v$ ): Light transmission
- LR ( $\rho_v$ ): Light reflection on coating side
- LR' ( $\rho'_v$ ): Light reflection on glass side
- DET ( $\tau_e$ ): Direct energy transmission
- ER ( $\rho_e$ ): Energy reflection on coating side
- ER' ( $\rho'_e$ ): Energy reflection on glass side
- EA ( $\alpha_e$ ): Energy absorption
- SF (g): Solar factor
- SC: Shading coefficient

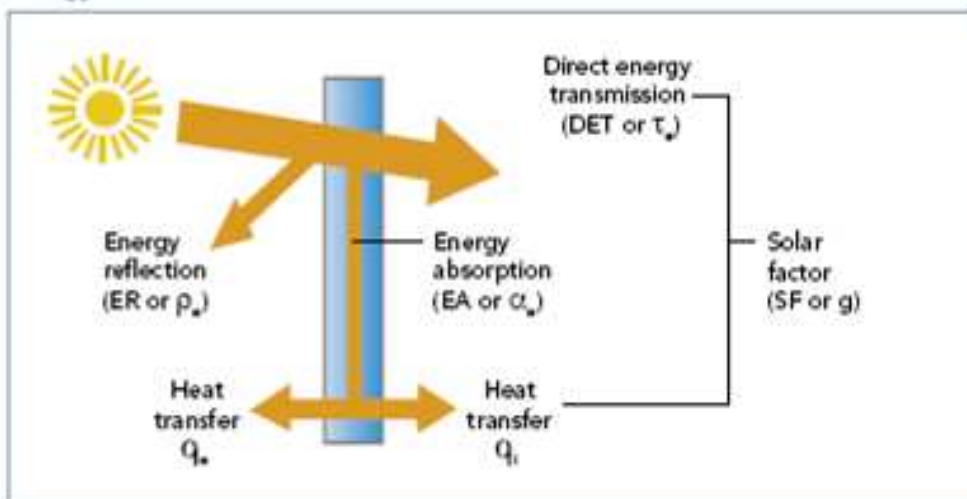
The tolerances on the values LT, LR, LR', DET, ER, ER' are +/- 3 %.

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

Light factors



Energy factors



### 5.3 TOLERANCES ON THERMAL PROPERTIES

The thermal transmittance  $U_g$  ( $W/m^2K$ ) is calculated according EN 673. The emissivity measurement complies with EN 673 and EN 12898.

The tolerance on the values of normal emissivity  $\epsilon_n$  is + 0,01.

## 5.4 PERFORMANCES OF IPLUS PRODUCTS

The table lists the light, solar and thermal properties of the iplus products of 4 mm thickness. For other thicknesses, see [www.YourGlass.com](http://www.YourGlass.com).

	<b>LT</b>	<b>LR</b>	<b>LR'</b>	<b>DET</b>	<b>ER</b>	<b>ER'</b>	<b><math>\epsilon_n</math></b>
4 mm iplus Advanced 1.0	84	8	10	54	36	29	0,01
4 mm iplus Advanced 1.0 on Clearvision	86	8	10	57	36	35	0,01
4 mm iplus Energy N	81	7	7	43	41	32	0,01
4 mm iplus Energy N on Clearvision	82	7	7	44	41	42	0,01
4 mm iplus Energy NT *	80	7	7	43	40	29	0,01
4 mm iplus Energy NT on Clearvision*	82	8	7	46	40	39	0,01
4 mm iplus I-Top	87	6	7	58	29	22	0,03
4 mm iplus I-Top on Clearvision	89	6	7	63	29	29	0,03
4 mm iplus Light	71	19	21	42	43	34	0,01
4 mm iplus Light on Clearvision	73	19	22	45	43	44	0,01
4 mm iplus LS	90	6	6	74	18	16	0,08
4 mm iplus LST	90	6	6	74	18	16	0,08
4 mm iplus Top 1.0	77	15	17	47	42	38	0,01
4 mm iplus Top 1.0 on Clearvision	78	15	18	49	42	42	0,01
4 mm iplus Top 1.1	89	5	6	63	27	21	0,03
4 mm iplus Top 1.1 on Clearvision	91	5	6	67	27	26	0,03
4 mm iplus Top 1.1T *	90	5	5	65	25	20	0,03
4 mm iplus Top 1.1T on Clearvision *	92	5	5	70	25	24	0,03
* Temperable products. Their values are those obtained after the tempering process.							

## 6 ACOUSTIC PROPERTIES

The table lists the acoustic properties.

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

# 7 TOLERANCES ON DIMENSIONS

The same tolerances than for the float used as support of the coating apply. These information's are related to stock sizes.

## 7.1 THICKNESS

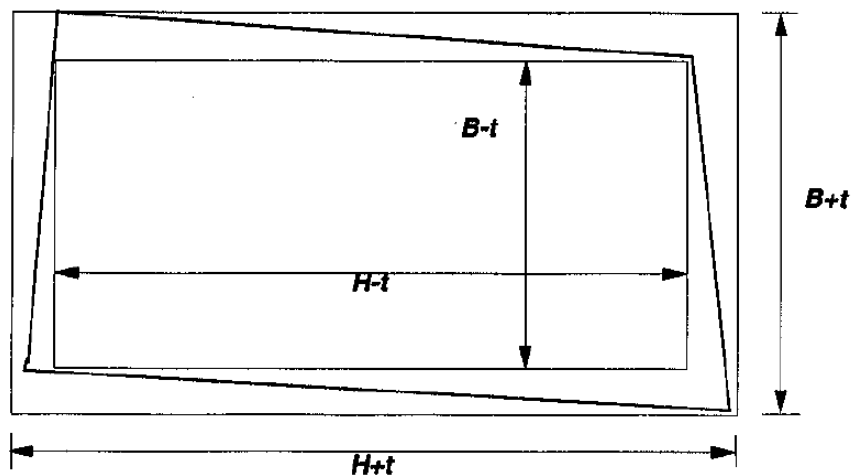
The actual thickness shall be the average of for measurements, taken to the nearest 0,01 mm, one taken at the center of each side.

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)
<b>3,15</b>	3,0	3,2
<b>4</b>	3,8	4,2
<b>5</b>	4,8	5,2
<b>6</b>	5,8	6,2
<b>8</b>	7,7	8,3
<b>10</b>	9,7	10,3
<b>12</b>	11,7	12,3

## 7.2 LENGTH AND WIDTH

The tolerances on nominal dimensions length H and width B are respectively  $\pm 3$  mm and  $\pm 2$  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 transparence 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

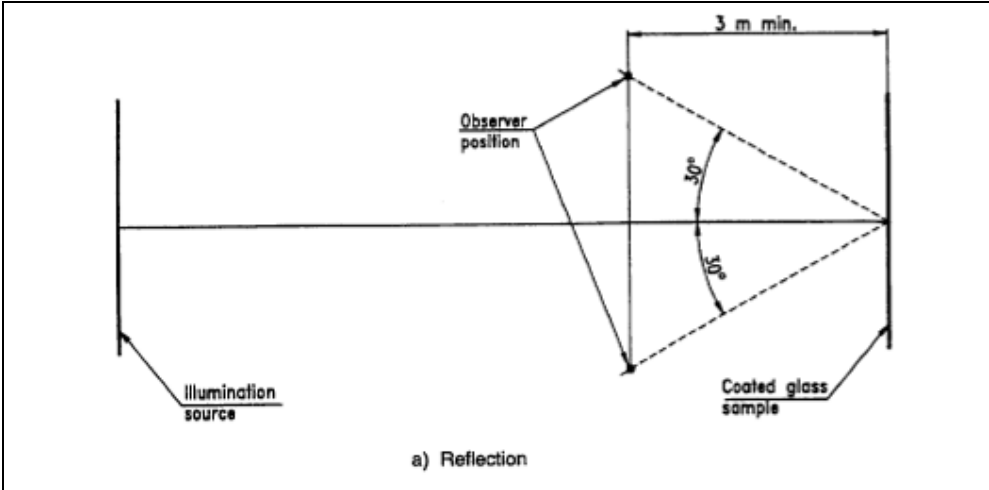
Daylight illumination is a uniform overcast sky, without direct sunlight.

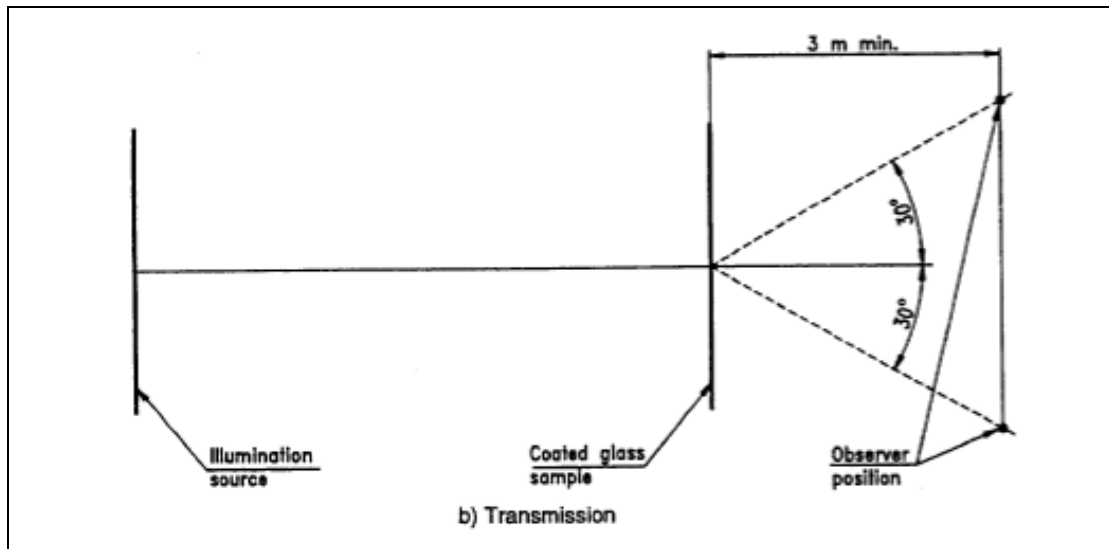
## 8.4 CONDITION OF OBSERVATION OF DEFECTS

### 8.4.1 GENERAL

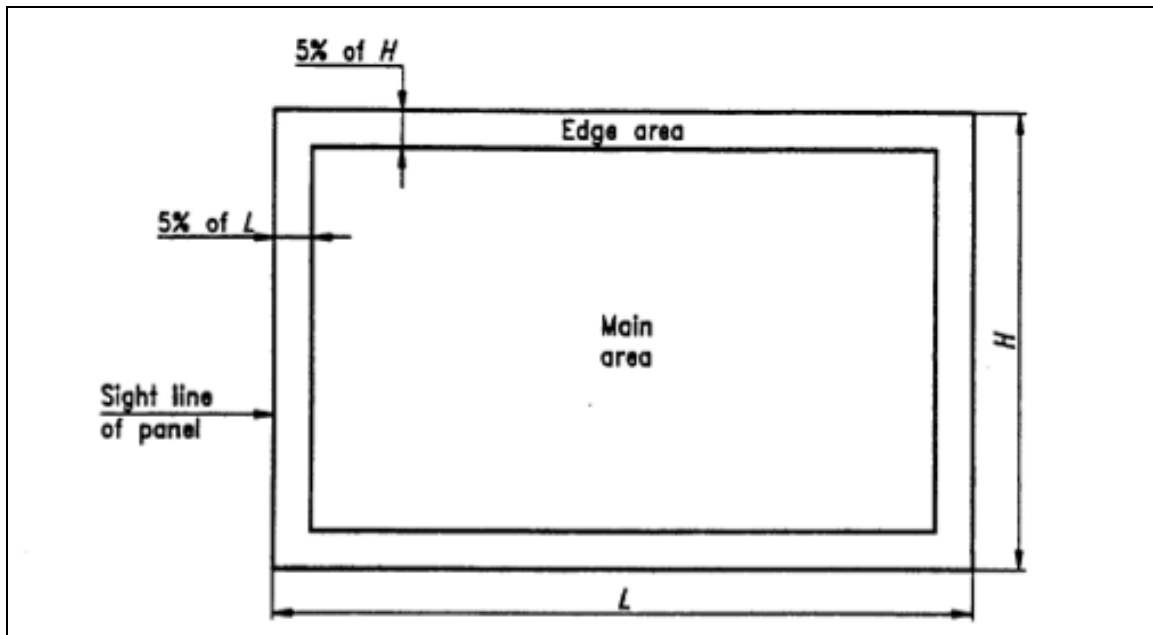
Coated glass may be examined in stock size or in finished sizes ready for installation .The examination may be undertaken in the factory or on site when glazed.

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 neighbouring 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	
<b>UNIFORMITY/STAIN</b>	Allowed as long not visually disturbing	Allowed as long not visually disturbing	
<b>PUNCTUAL</b> Spot/pinholes > 3 mm  > 2 mm and ≤ 3 mm	Not applicable	<b>Main area</b>	<b>Edge Area</b>
		Not allowed	Not allowed
		Max 1 by m <sup>2</sup>	Max 1 by m <sup>2</sup>
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 > 50 mm
		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 [www.glassforeurope.com/images/cont/91\\_19807\\_file.pdf](http://www.glassforeurope.com/images/cont/91_19807_file.pdf)) describes the way to measure and evaluate these differences of color.

### 8.6.2 REQUIREMENTS

The values of  $\Delta L^*$ ,  $\Delta a^*$  and  $\Delta b^*$  determined in accordance with 8.6.1 shall meet the following requirement.

$\Delta L^*$	$\leq 4,0$
$\Delta a^*$	$\leq 3,0$
$\Delta b^*$	$\leq 3,0$

## 9 OTHER RELATED DOCUMENTS

Following documents are also available from [www.YourGlass.com](http://www.YourGlass.com):

- Processing Guide
- Cleaning and Maintenance Guide for Façade glazing
- Glazing Instruction
- CE-Marking declarations