



GLASS UNLIMITED

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**Technical Data Sheet  
Mirox (SAFE+)**

**06/2018**

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# 1 INTRODUCTION

This Technical Datasheet provides information on the Mirox range of mirror glass, both with and without a SAFE+ safety film. The Mirox substrate is a float glass as per standard EN 572-2.

## 2 STANDARDS

Mirox products comply with:

- EN 1036-1 – Glass in building – Mirrors from silver-coated float glass for internal use – Part 1: Definitions, requirements and test methods
- EN 1036-2 - Glass in building – Mirrors from silver-coated float glass for internal use – Part 2: Evaluation of conformity/Product standard

All Mirox products are CE-marked as per EN 1036-2. CE marking declarations are available from [www.agc-yourglass.com/CE](http://www.agc-yourglass.com/CE).

All Mirox products are produced in ISO 9001-certified plants.

## 3 COMPOSITION AND PROPERTIES

The base glass used for Mirox is float glass that complies with EN 572-1 & 2. The properties of the float glass are listed below.

### 3.1 CHEMICAL COMPOSITION

Standard EN 572-1 defines the magnitude of the proportions by mass of the principal constituents of float glass as follows:

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's ratio:  $\mu = 0.2$
- Shear modulus:  $G = E / [2 (1+\nu)] \approx 29,166 \text{ N/mm}^2$
- Knoop hardness: 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:  $\approx 1,500 \text{ }^\circ\text{C}$
- Linear expansion coefficient:  $\alpha = 9.10^{-6}/\text{K}$  (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:  $5.10^7 \text{ } \Omega.\text{m}$  at 1,000 Hz and  $25 \text{ }^\circ\text{C}$
- Dielectric constant: 7.6 at 1,000 Hz and  $25 \text{ }^\circ\text{C}$

## 4 DURABILITY OF MIROX

Mirox products are tested using the durability method described in EN 1036-1.

Mirox products outperform the requirements set out in EN 1036-1.

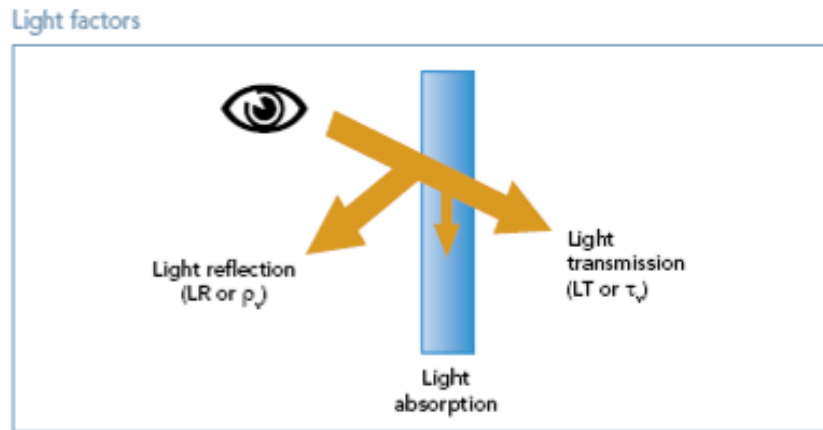
	EN 1036-1 criteria	Performance of Mirox MNGE and Mirox 4Green
Neutral salt spray test: - Maximum corrosion around the edge	1.0 mm	0.05mm
Copper accelerated acetic acid salt spray test: - Maximum corrosion around the edge - Maximum number of spots (diameter between 0.2 and 3 mm)	1.5 mm  2 (accepted provided $\leq 0.2$ mm)	0.25 mm  $\leq 1$ (accepted provided $\leq 0.2$ mm)
Condensation water test - Maximum corrosion around the edge - Maximum number of spots (diameter $\leq 0.3$ mm)	0.2 mm  1	0.05 mm  0

# 5 LIGHT PROPERTIES

Light properties are calculated using spectral measurement in compliance with standard EN 410.

Light reflection (LR - $\rho_v$ ), measured in accordance with EN 410, must be at least:

- 86% for mirrors made from clear float with a thickness between 2 mm and 6 mm
- 83% for mirrors made from clear float with a thickness between 8 mm and 10 mm.



Mirox 4Green is opaque thanks to its paint. Its opacity is measured with a lux meter (HD 2102-2 – Probe 471) and a spotlight. Only 0.0002% of light (lux) passes through Mirox 4Green. In a standard mirror, 0.1% of light passes through.

# 6 DIMENSIONAL TOLERANCES

We apply the same tolerances as those that apply to the float glass used as a substrate for mirrors.

This information pertains to jumbo sizes (PLF and DLF).

## 6.1 THICKNESS

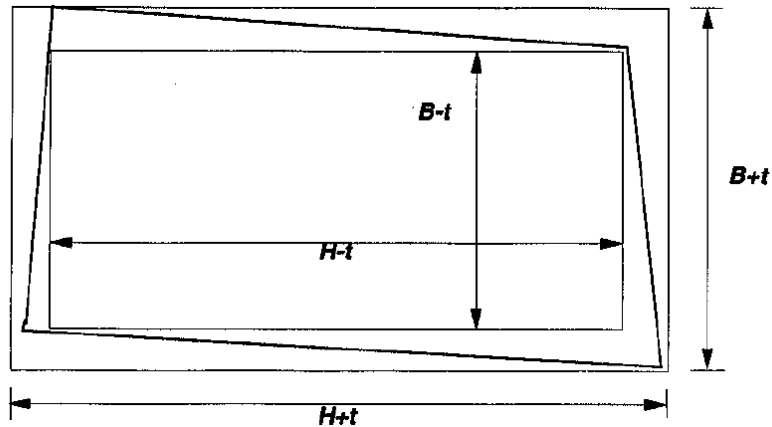
The actual thickness will be the average of four measurements, rounded to the nearest 0.01 mm, taken at the centre of each side.

The actual thickness, rounded to the nearest 0.1 mm, must not vary from the nominal thickness by more than the tolerances given in the table.

	Minimum (mm)	Maximum (mm)
<b>1.9</b>	1.8	2.0
<b>3</b>	2.8	3.0
<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

## 6.2 LENGTH AND WIDTH

The tolerances for length  $H$  and width  $B$  are  $\pm 3$  mm and  $\pm 2$  mm respectively.



The limit of squareness is described as the difference between diagonals. The difference may not exceed 5 mm.

# 7 QUALITY REQUIREMENTS

## 7.1 INTRODUCTION

Mirror quality can be affected by faults that distort the appearance of the image of reflected objects. Such alteration of the image can result from optical faults, faults in the glass and faults in the reflective coating.

## 7.2 DEFINITIONS OF FAULTS

The following definitions apply:

- Optical faults: faults directly associated with the distortion of the reflected image.
- Glass appearance faults: faults which alter the visual quality of the mirror on silver-coated float glass. They can be spot and/or linear and/or enlarged area faults.
- Spot faults: solid or gaseous inclusions, deposits, crush marks etc. In some cases, spot faults are accompanied by a type of distortion called 'halo'. The nucleus of the spot fault is measurable.
- Linear faults: scratches, extended spot faults, etc.
- Brush marks: very fine, barely visible circular scratches that are associated with glass cleaning techniques.
- Scratches: any kind of scratches that are not brush marks.

- Reflective silver coating faults: faults in the reflective silver layer that alter the appearance of the silvered glass. They consist of scratches, stain, colour spots and edge deterioration.
- Stain: alteration of the reflective coating characterised by a more or less brownish, yellowish or greyish coloration of zones which can sometimes cover the entire reflective surface.
- Colour spots: alteration of the reflective coating taking the form of small, generally coloured spots.
- Edge deterioration: discoloration of the reflective silver at the edge of the silvered glass.
- Protective coating(s) faults: faults where the metallic layer is exposed. These can be scratches or loss of adhesion of the protective coating(s).
- Edge faults: faults that affect the as-cut edge of the silvered glass. These can include entrant/emergent faults, shelling, corners on/off and vents.

## **7.3 GLASS FAULTS**

### **7.3.1 INSPECTION METHOD**

The silvered mirror must be observed in a vertical position, with the naked eye and under normal diffused lighting conditions (natural daylight or simulated daylight, between 300 lux and 600 lux at the silvered mirror), at a distance of at least 1 metre. The direction of observation is normal, i.e. at right angles, to the silvered mirror. The use of an additional lighting source, e.g. spotlight, is not allowed.

The dimension and number of brush marks, scratches and spot faults which distort vision must be noted.



## 7.3.2 ACCEPTANCE LEVELS

The tables below show the acceptance levels for glass faults for standard sizes.

### Acceptance level for linear faults in standard sizes

	Mirrors with clear and tinted glass substrate	
	Jumbo size (defects/ sheets of 6 m x 3.21 m)	Other sizes (defects/m <sup>2</sup> )
Brush marks ( $\leq 50$ mm)	8	0.375
Scratches ( $\leq 50$ mm)	3	0.139

### Acceptance level for spot faults<sup>a</sup> in standard sizes

	Mirrors with <b>clear</b> glass substrate			
	Jumbo size (defects/ sheets of 6 m x 3.21 m)		Other sizes (defects/m <sup>2</sup> )	
	Max/sheet	Average/sheet	Max/sheet	Average/sheet <sup>b</sup>
$\leq 0.2$ mm	Accepted <sup>c</sup>	Accepted <sup>c</sup>	Accepted <sup>c</sup>	Accepted <sup>c</sup>
$> 0.2$ mm and $\leq 0.5$ mm	26	18	1.35	0.93
$> 0.5$ mm	3	2	0.16	0.11
	Mirrors with <b>tinted</b> glass substrate			
	Jumbo size (defects/ sheets of 6 m x 3.21 m)		Other sizes (defects/m <sup>2</sup> )	
	Max/sheet	Average/sheet	Max/sheet	Average/sheet <sup>b</sup>
$\leq 0.2$ mm	Accepted <sup>c</sup>	Accepted <sup>c</sup>	Accepted <sup>c</sup>	Accepted <sup>c</sup>
$> 0.2$ mm and $\leq 0.5$ mm	30	29	1.55	1.50
$> 0.5$ mm	4	3	0.21	0.16
<sup>a</sup> The dimensions stated are without the halo effect and relate to the largest of the fault dimensions.				
<sup>b</sup> The average must be calculated taking into account the total individual pack area (m <sup>2</sup> ).				
<sup>c</sup> Accepted, providing they do not form a cluster.				

## 7.4 REFLECTIVE SILVER COATING FAULTS

### 7.4.1 INSPECTION METHOD

Same as section 7.3.1.

### 7.4.2 ACCEPTANCE LEVELS

The reflective silver coating faults are not allowed if they are visible under the condition set out in section 7.3.1.

## **7.5 PROTECTIVE COATING FAULTS**

### **7.5.1 INSPECTION METHOD**

Same as section 7.3.1.

### **7.5.2 ACCEPTANCE LEVELS**

Using the method described in section 7.3.1, the presence of pinholes, burst bubbles, flaking of the protective coating along the edges or other faults in the protective coating(s) must not be allowed.

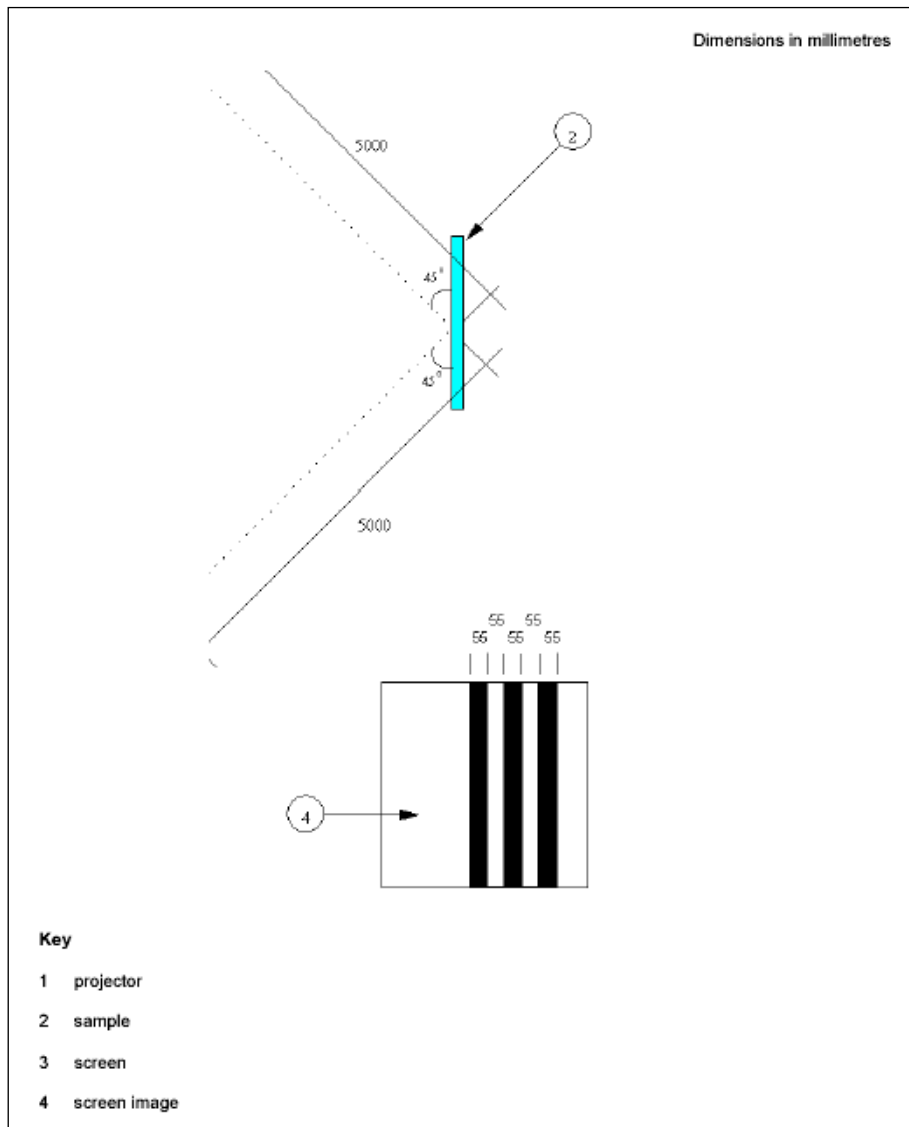
## **7.6 OPTICAL QUALITY**

### **7.6.1 QUALITATIVE VISUAL INSPECTION METHOD**

A silvered mirror must be examined in 500 mm × 500 mm areas at a time. The observer must be located at a distance of 2 m in front of and perpendicular to the area being examined. There must be an irregular background behind the observer. The reflected image must not be optically distorted, e.g. by another reflective surface or window. The observed distortions can be quantified using the method described in section 7.6.2.

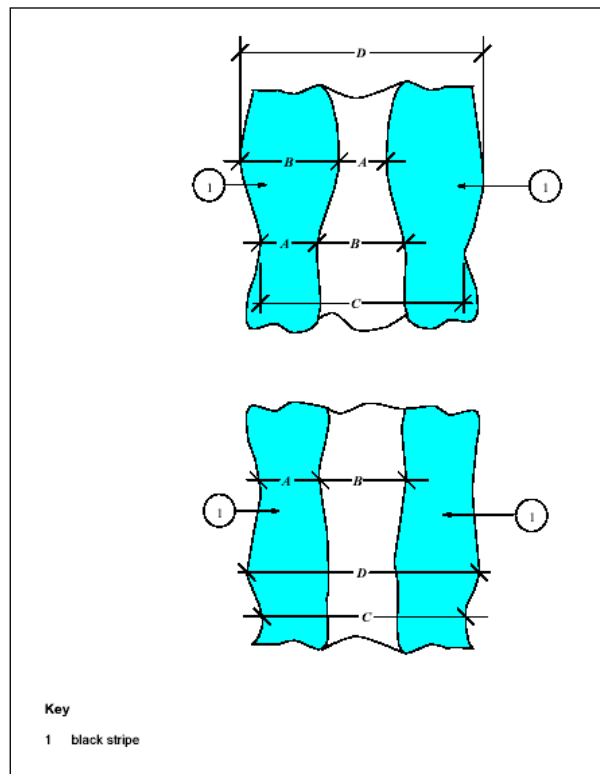
### **7.6.2 OPTIONAL QUANTITATIVE TEST METHOD**

A projector with a focal length between 80 mm and 100 mm and an aperture of 8 mm must be positioned at a distance of 5 m from the specimen being examined, at a 45° angle to the specimen, which is positioned vertically. A screen must be located 5,000 mm from the centre of the mirror at right angles to the reflected beam.



A grid pattern slide, when projected onto the screen must give dark and clear stripes measuring 55 mm wide. Stripe width is calibrated using a non-distorted front surfaced mirror in place of the specimen.

The difference in width of each projected stripe, or of three neighbouring stripes must be measured.



### 7.6.3 ACCEPTANCE LEVELS

The mirror meets the requirements if it does not exhibit any distorting optical variation of the image following the visual inspection described in section 7.6.1.

In case of doubt, the method described in section 7.6.2 can be used. The measured deviations must remain within the following limits (see figure above):

- $A = 55 \text{ mm} - a$
- $B = 55 \text{ mm} + a$
- $C = 165 \text{ mm} - b$
- $D = 165 \text{ mm} + b$

where  $a = 10 \text{ mm}$  and  $b = 15 \text{ mm}$ .

If the pane includes an original edge of the basic glass production width  $B$ , the following values for  $a$  and  $b$  apply in the corresponding 165 mm wide border band:

- Nominal glass thickness  $< 4 \text{ mm}$ :
  - $a = 30 \text{ mm}$
  - $b = 40 \text{ mm}$
- Nominal glass thickness  $\geq 4 \text{ mm}$ :
  - $a = 20 \text{ mm}$
  - $b = 30 \text{ mm}$

## 7.7 APPEARANCE OF THE SAFE+ VERSION

Mirox can be delivered with the SAFE+ safety backing film on the painted side. The appearance of this film is not perfect and some bubbles can appear. Visual imperfections in the SAFE+ safety backing film do not have a negative impact on soft body impact resistance as per EN 12600.

## 7.8 EDGE FAULTS

### 7.8.1 INSPECTION METHOD

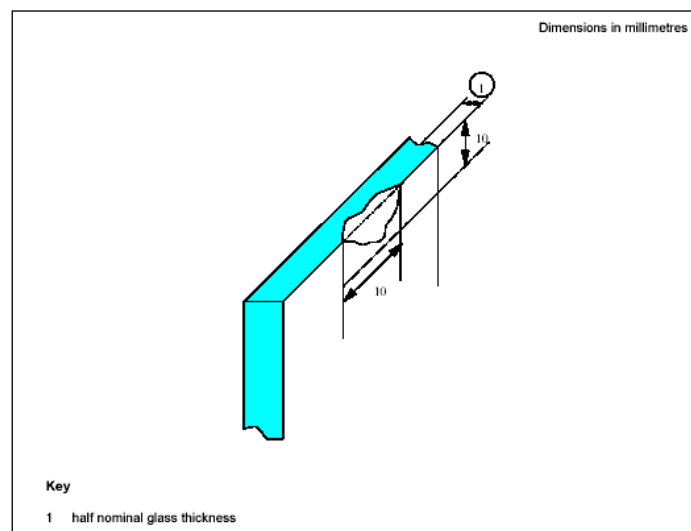
Same as section 7.3.1.

### 7.8.2 ACCEPTANCE LEVELS

The edge quality of stock size mirrors can be affected by the presence of entrant/emergent faults and shelling. Using the method described in section 7.3.1, the edges of the mirrors must be checked for the presence of shells, corners on/off and edge vents.

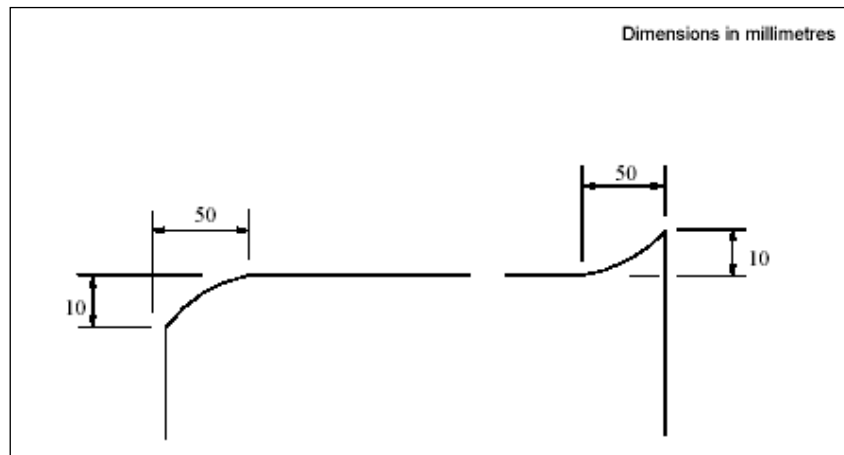
#### 7.8.2.1 CHIPS OR SHELLS

For stock sizes, entrant or emergent chips or shells must be accepted provided they do not exceed a maximum length and depth of 10 mm and half the nominal glass thickness.



#### 7.8.2.2 CORNERS ON/OFF

For stock sizes occasional corners on/off are allowed. No more than 5% of the sheets on a delivery may be affected.



### 7.8.2.3 VENTED (CRACKED) EDGES

Vented (cracked) edges are not allowed for stock sizes.

## 8 ENVIRONMENTAL CONSIDERATIONS

Mirox has been developed to be environmentally friendly.

The current Mirox MNGE production line has, among other things, made it possible to:

- eliminate the copper layer
- reduce lead content to < 0.3% (<3000 ppm) for Mirox MNGE
- reduce ammonia waste by 90%

Mirox 4Green goes one step further:

- lead content in paints reduced to < 0.004% (< 40 ppm\*)

\* No lead intentionally added, only limited lead contamination from other natural materials used for the manufacture of the paint.

None of the substances identified as substances of very high concern (SVHC) in the REACH Candidate List\* is present above 0.1% in Mirox products, including SAFE+ versions (REACH Regulation 1907/2006/EC concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals).

\* <http://echa.europa.eu/web/guest/candidate-list-table>

For specific product details, go to [www.agc-yourglass.com](http://www.agc-yourglass.com) and visit the “Mirox MNGE or Mirox 4Green product section, or look in the Tools section under Regulatory Documents.

# 9 SAFETY

## 9.1 SAFETY IN USE - PENDULUM BODY IMPACT RESISTANCE

Shatter properties (safe breakability) and pendulum body impact resistance are determined and classified in accordance with EN 12600.

Mirox mirrors show a mode of breakage typical of annealed glass (EN 12600, type A).

Mirox SAFE+ includes a polymer film applied to the back of the glass. This safety backing film ensures safety in case of soft body impact.

Mirox SAFE+ shows a mode of breakage typical of laminated glass (EN 12600, type B). Numerous cracks appear under soft body impact, but the fragments hold together and do not separate.

For specific product details, register an account for access to the restricted area on [www.agc-yourglass.com](http://www.agc-yourglass.com), then log in and go to Certificates in the Mirox MNGE or Mirox 4Green product section.

## 9.2 SAFETY IN CASE OF FIRE - REACTION TO FIRE

Reaction to fire is determined and classified in accordance with EN 13501-1.

Mirrors, manufactured from silvered float glass, are products/materials that are not required to be tested for reaction to fire (e.g. products/materials belonging to Classes A as per Commission Decision 96/603/EC, as amended by 2000/605/EC).

*\* Contribution to fire growth ranges from class A1 (best, not contributing to fire growth or to the fully developed fire) to class E (worst, quickly leading to a flashover situation). In addition to the main classification for contribution to fire growth, additional classification parameters are assigned to a product for smoke production, and flaming droplets and particles.*

Mirox (SAFE+) shows a reaction to fire behaviour ranging from class A1 to class B, depending on whether or not the safety backing is present and on the type of installation.

For specific product details, register an account for access to the restricted area on [www.agc-yourglass.com](http://www.agc-yourglass.com), then log in and go to Certificates in the Mirox MNGE or Mirox 4Green product section.

CE Marking declarations are available from [www.agc-yourglass.com/CE](http://www.agc-yourglass.com/CE).

# 10 HEALTH AND HYGIENE CONSIDERATIONS

AGC puts great effort into developing products that preserve our indoor air quality. Mirox products show very little indoor emissions of volatile organic compounds (VOCs), including very low levels of formaldehyde.

Following the publication of French Decree No. 2011-321 of March 23, 2011, as supplemented by the French Decree of 19 April 2011 on the labelling of their emissions of volatile pollutants of construction products, or wall cladding, or floor and paintings and varnish, the Mirox product range (including SAFE+ versions) has achieved A+ level\*.

*\* Information on the emission levels of volatile substances in indoor air, presenting a risk of toxicity by inhalation, on a scale from A+ (very weak emissions) to C (high emissions).*

# 11 RELATED DOCUMENTS

The following documents are also available from [www.agc-yourglass.com](http://www.agc-yourglass.com):

- Installation Guide
- Processing Guide
- Cleaning and Maintenance Guide for Decorative Glazing
- Glazing Instructions – Traditional Setting
- CE Marking declarations