



GLASS UNLIMITED

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**Technical Data Sheet  
Stratobel & Stratophone**

**11/2014**

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# 1 INTRODUCTION

This Technical Data Sheet gives general information about the AGC ranges of laminated glass Stratobel and Stratophone in stock sizes.

## 2 NORMATIVE REFERENCES

Stratobel and Stratophone products conform to:

- EN ISO 12543-1: Glass in building – Laminated glass and laminated safety glass – Part 1: Definition and description of component parts
- EN ISO 12543-2: Glass in building – Laminated glass and laminated safety glass – Part 2: Laminated safety glass
- EN ISO 12543-4: Glass in building – Laminated glass and laminated safety glass – Part 4: Test methods for durability
- EN ISO 12543-5: Glass in building – Laminated glass and laminated safety glass – Part 5: Dimensions and edge finishing
- EN ISO 12543-6: Glass in building – Laminated glass and laminated safety glass – Part 6: appearance
- EN 14449: Glass in building – Laminated glass and laminated safety glass – Evaluation of conformity/Product standard.

All Stratobel and Stratophone products are CE-marked following EN 14449; CE-Marking declarations are available from [www.yourglass.com/CE](http://www.yourglass.com/CE).

All Stratobel and Stratophone are produced in factories being ISO 9001 certified.

## 3 COMPOSITION AND PROPERTIES OF THE GLASS

The basis glass used for Stratobel and Stratophone production is float glass and patterned glass conform to EN 572-1, 2 & 5. 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 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° and 300°)
- 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°C
- Dielectric constant: 7.6 at 1 000 Hz and 25°C

# 4 DURABILITY OF STRATOBEL AND STRATOPHONE

Stratobel and Stratophone are laminated safety glass following EN 12543-2.

They succeed the durability test following EN 12543-4:

- High temperature test (16 hours at 100°C)
- Humidity test (2 weeks at 50°C and 100 % of relative humidity)
- Radiation test (2000 hours of UV radiation).

# 5 LIGHT, SOLAR AND THERMAL PROPERTIES

## 5.1 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

## 5.2 THERMAL PROPERTIES

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

## 5.3 PERFORMANCES OF STRATOBEL AND STRATOPHONE

All light, solar and thermal performances of Stratobel and Stratophone products are available on [www.yourglass.com](http://www.yourglass.com) and in the YourGlass Pocket.

## 6 SAFETY AND SECURITY PROPERTIES

Stratobel and Stratophone are safety products classified following EN 12600. The table gives the related performances.

<b>Composition</b>		<b>Class</b>
Stratobel	22.1	2B2
Stratobel	33.1	2B2
Stratobel	44.1	2B2
Stratobel	55.1	1B1
Stratobel	22.2	1B1
Stratobel	33.2	1B1
Stratobel	44.2	1B1
All thicker compositions		1B1
Stratophone	22.1 st	1B1
Stratophone	33.1 st	1B1
Stratophone	44.1 st	1B1
Stratophone	55.1 st	1B1
Stratophone	33.2 st	1B1
Stratophone	44.2 st	1B1
Stratophone	44.4 st	1B1
All thicker compositions		1B1

Stratobel and Stratophone are security products classified following EN 356. The table gives the related performances for basic glass composition; for other structures, see [www.yourglass.com](http://www.yourglass.com).

<b>Class</b>	<b>Product</b>	<b>Composition</b>	<b>Thickness (mm)</b>	<b>Weight (kg/m<sup>2</sup>)</b>
P1A	Stratobel 22.2	22.2	5	11
P2A	Stratobel 22.2	22.2	5	11
P2A	Stratobel 33.2	33.2	7	16
P2A	Stratobel 44.2	44.2	9	21
P3A	Stratobel 33.4	33.4	8	17
P4A	Stratobel 33.4	33.4	8	17
P4A	Stratobel 44.4	44.4	10	22
P5A	Stratobel 44.6	44.6	10	22
P5A	Stratobel 66.6	66.6	14	32
P6B	Stratobel 502-2	-	15	33
P6B	Stratobel 502-1	-	15	33
P6B	Stratobel 802-2	-	18	43
P7B	Stratobel 603-9	-	26	57
P8B	Stratobel 204-9	-	32	68
P8B	Stratobel 504-4	-	35	81

## 7 ACOUSTIC PROPERTIES

The table lists the acoustic performances of Stratobel and Stratophone following EN ISO 717-1.

<b>Composition</b>	<b>Rw</b>	<b>C</b>	<b>Ctr</b>	<b>Rw + C</b>	<b>Rw + Ctr</b>
Stratobel 33.1	32	-1	-3	31	29
Stratobel 33.2	33	-1	-4	32	29
Stratobel 44.1	34	-1	-2	33	28
Stratobel 44.2	35	-1	-3	34	32
Stratobel 44.6	35	-1	-3	34	32
Stratobel 55.1	35	-1	-3	34	32
Stratobel 55.4	36	-1	-4	35	32
Stratobel 66.2	36	-1	-3	35	33
Stratobel 66.4	37	-1	-4	36	33
Stratobel 88.2	39	-1	-3	38	36
Stratobel 12 12.4	42	0	-3	42	39
Stratobel 15 15.4	44	-1	-5	43	39
Stratophone 22.1 st	33	-2	-5	32	28
Stratophone 22.2 st	33	-1	-4	32	29
Stratophone 33.1 st	35	-1	-3	34	32
Stratophone 33.2 st	36	0	-3	36	33
Stratophone 44.1 st	37	0	-2	37	35
Stratophone 44.2 st	37	0	-2	37	35
Stratophone 44.4 st	37	0	-3	37	34
Stratophone 44.6 st	38	-1	-3	37	35
Stratophone 55.1 st	38	-1	-3	37	35
Stratophone 55.2 st	39	-1	-3	38	36
Stratophone 66.1 st	40	-1	-3	39	37
Stratophone 66.2 st	40	-1	-3	39	37
Stratophone 88.2 st	41	-1	-2	40	39
Stratophone 12 12.2 st	43	-1	-4	42	39

# 8 TOLERANCES ON DIMENSIONS

## 8.1 THICKNESS

### 8.1.1 NOMINAL THICKNESS

The nominal thickness of laminated glass shall be the sum of the nominal thicknesses of the constituent panes of glass, plastics glazing sheet material and the interlayers.

### 8.1.2 MEASUREMENT OF THICKNESS

The thickness of the pane shall be calculated as the mean of measurements taken at the centers of the four sides. The measurements shall be taken to an accuracy of 0.01 mm and the mean is then rounded to the nearest 0.1 mm shall also be within the limit deviations.

For laminated glass incorporating patterned glass the measurement shall be made by means of an instrument of the plate gauge type with a diameter of  $55 \text{ mm} \pm 5 \text{ mm}$ .

### 8.1.3 LIMIT DEVIATION ON THICKNESS

The limit deviations on thickness of laminated glass shall not exceed the sum of the limit deviations of the constituent glass panes specified in EN 572.

If the total interlayer thickness is less than 2 mm an additional limit deviation of  $\pm 0.1 \text{ mm}$  applies. If the total interlayer thickness is greater than 2 mm, an additional limit deviation of  $\pm 0.2 \text{ mm}$  shall be applied.

The thickness limit deviation for plastics glazing sheet material shall be the same as a float glass of the same nominal thickness in accordance with EN 572-2.

NOTE: If the plastics glazing sheet material is covered by a European Technical agreement, then the actual limit deviations on thickness can be used.

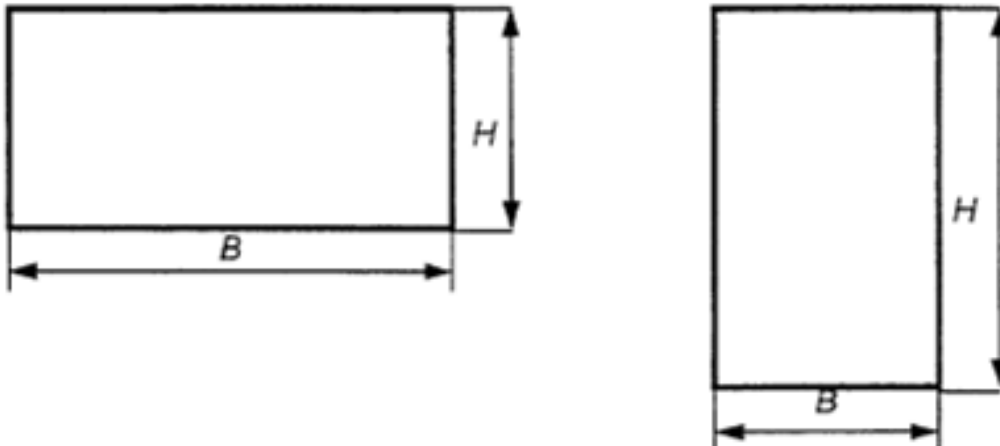
EXAMPLE: A laminated glass made from two sheets of float glass of 3 mm nominal thickness and a folio interlayer of 0.5 mm. From EN 572-2, the limit deviation of 3 mm float glass is  $\pm 0.2 \text{ mm}$  and the limit deviation of the folio interlayer is  $\pm 0.1 \text{ mm}$ . Therefore, the nominal thickness is 6.5 mm and the limit deviation is  $\pm 0.5 \text{ mm}$ .



## 8.2 LENGTH AND WIDTH

### 8.2.1 GENERAL

When laminated glass sizes are quoted for rectangular panes the first dimension shall be the width  $B$  and the second dimension the length  $H$ , as shown in figure.



Dimensions shall be given in millimeters. Each dimension shall be within the specified limit deviations.

### 8.2.2 METHODS OF MEASURING DIMENSIONS AND SQUARENESS

The pane of glass shall not be larger than the nominal dimensions, either increased by the upper limit deviation  $t_+$  or smaller than the nominal dimension reduced by the lower deviation limit  $t_-$  given in §8.2.3.

Note: The squareness of rectangular glass panes is expressed by the difference between the diagonals.

The difference between the two diagonal lengths of the pane of glass shall not be larger than the deviation limit  $v$  given in §8.2.3.

### 8.2.3 LIMIT DEVIATION ON WIDTH B AND LENGTH H

Limit deviations  $t_+$  and  $t_-$  on width  $B$  and length  $H$  shall be in accordance with the next table for finished sizes and stock sizes.

If one component of the laminated glass is a toughened or heat strengthened glass an additional tolerance of  $\pm 3$  mm shall be taken into account.

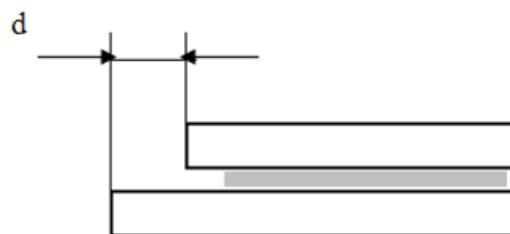
<b>Limit deviation <math>t_+</math> and <math>t_-</math> on width <math>B</math> and length <math>H</math> (mm)</b>			
Nominal dimension $B$ or $H$	Total nominal thickness $\leq 8$ mm	Total nominal thickness $> 8$ mm	
		Each glass pane $< 10$ mm nominal thickness	At least one glass pane $\geq$ 10 mm nominal thickness
$\leq 2000$ mm	+ 3,0 -2,0	+3,5 -2,0	+5,0 -3,5
$\leq 3000$ mm	+4,5 -2,5	+5,0 -3,0	+6,0 -4,0
$> 3000$ mm	+5,0 -3,0	+6,0 -4,0	+7,0 -5,0

The limit deviations for the difference  $v$  between the diagonals shall be in accordance with following table.

<b>Limit deviation <math>v</math> on the difference between diagonals (mm)</b>			
Nominal dimension $B$ or $H$	Total nominal thickness $\leq 8$ mm	Total nominal thickness $> 8$ mm	
		Each glass pane $< 10$ mm nominal thickness	At least one glass pane $\geq$ 10 mm nominal thickness
$\leq 2000$ mm	6	7	9
$\leq 3000$ mm	8	9	11
$> 3000$ mm	10	11	13

### 8.3 DISPLACEMENT

The maximum displacement  $d$  shall be as specified in the next table. Width  $B$  and length  $H$  shall be considered separately.

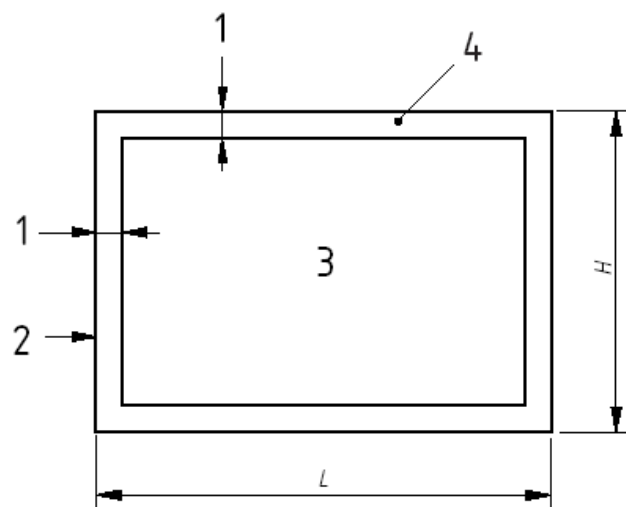


Nominal dimension $B$ or $H$ (mm)	Maximum displacement $d$ (mm)
$2000 < B, H \leq 4000$	3,0
$B, H > 4000$	5,0

# 9 QUALITY REQUIREMENTS

## 9.1 DEFINITIONS

- **Spot defects:** type of defect that includes opaque spots, bubbles and foreign bodies
- **Linear defects:** type of defect that includes foreign bodies and scratches or grazes
- **Other defects:** glass defects such as vents, and interlayer defects such as creases, shrinkage and streaks
- **Opaque spots:** visible defects in the laminated glass (for example, tin marks and inclusions in the glass or interlayer)
- **Bubbles:** usually air, in the glass or the interlayer
- **Foreign bodies:** unwanted item introduced into the laminated glass during manufacture
- **Scratches or grazes:** linear damage to the outside surface of the laminated glass
- **Vents:** sharp tipped fissures or cracks running into the glass from an edge
- **Creases:** distortions introduced into the interlayer by folds visible after manufacture
- **Streaks due to interlayer inhomogeneity:** distortions in the interlayer, caused by manufacturing defects in the interlayer, that are visible after manufacture
- **Edge area:** area of edge of pane  
NOTE: For pane sizes that are less than 5 m<sup>2</sup>, the width of the edge area as given in next figure 1 is 15 mm. The width of the edge area is increased to 20 mm for pane sizes that are greater than 5 m<sup>2</sup>
- **Vision area:** main area of the glass that excludes the edge area



## **9.2 METHOD OF OBSERVATION**

The laminated glass is put in a vertical position, in front of and parallel to a matt grey screen, and is lit by diffuse daylight or equivalent.

The laminated glass is visually inspected perpendicularly at a distance of two meters from the glass, with the matt screen on the other side of the glass.

Any visible defects are marked.

## **9.3 ACCEPTANCE LEVELS FOR DEFECTS**

### **9.3.1 DEFECTS IN THE EDGE AREA FOR FRAMED EDGES**

The edge area shall be inspected in accordance with §9.2, and shall not contain any defects that exceed 5 mm in diameter or 5 % of the edge area.

For glass pane sizes that are less than or equal to five square meters, the width of the edge area shall be at least 15 mm.

For glass pane sizes that are greater than five square meters, the width of the edge area shall be at least 20 mm.

### **9.3.2 VENTS**

Vents are not permitted.

### **9.3.3 CREASES AND STREAKS**

They are not allowed in the vision area.

### **9.3.4 DEFECTS IN THE VISION AREA**

#### **9.3.4.1 SPOT DEFECTS**

When inspected in accordance with §9.2, the following aspects of spot defects shall be determined:

- size of the defect (d)
- frequency of the defect

- size of the pane (A)
- number of panes as components of a laminated glass.

The number of permissible defects in a pane shall be in accordance with following table.

Defects less than 0,5 mm shall not be considered.

Defects greater than 3 mm shall not be permitted.

Size of defect d (mm)		0,5 < d ≤ 1,0	1,0 < d ≤ 3,0			
Size of pane A (m <sup>2</sup> )		All sizes	A ≤ 1	1 < A ≤ 2	2 < A ≤ 8	A > 8
<b>Number of permissible defects</b>	2 panes	no limitation, however no accumulation of defects	1/sheet	2/sheet	1/m <sup>2</sup>	1,2/m <sup>2</sup>
	3 panes		2/sheet	3/sheet	1,5/m <sup>2</sup>	1,8/m <sup>2</sup>
	4 panes		3/sheet	4/sheet	2/m <sup>2</sup>	2,4/m <sup>2</sup>
	≥ 5 panes		4/sheet	5/sheet	2,5/m <sup>2</sup>	3/m

NOTE: An accumulation of defects occurs if four or more defects are at a distance of < 200 mm from each other. This distance is reduced to 180 mm laminated glass consisting of three panes, to 150 mm laminated glass consisting of 4 panes and to 100 mm laminated glass consisting of five or more panes.

The number of permissible defects given in the table shall be increased by 1 for each individual interlayer which is thicker than 2 mm.

#### 9.3.4.2 LINEAR DEFECTS IN THE VISION AREA

When inspected in accordance with §9.2, linear defects are allowed as given in next table

Area of pane A (m <sup>2</sup> )	Number of permissible defects > 30 mm in length
A ≤ 5	not allowed
5 < A ≤ 8	1
A > 8	2

Linear defects less than 30 mm in length shall be allowed.

#### 9.3.5 DEFECTS IN THE EDGE AREA FOR UNFRAMED EDGES

Laminated glass is usually installed in frames; when it is unframed, its edges may be in accordance with EN ISO 12543-5):

- Ground edges
- Polished edges
- Beveled edges.

When inspected according to the test method given in § 9.2, shells, bubbles are permissible if they do not become obvious. Interlayer defects, i. e. extrusions and retractions are permissible.

## 10 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
- Cleaning and Maintenance Guide for Decorative glazing
- Glazing Instructions – Traditional Setting
- CE-Marking declarations