

ROBAX® Glass Ceramic Panels

Technical Delivery Specification TL 1 00 05 51 - 02

SCHOTT
ROBAX®

Glass Ceramic Panels

SCHOTT AG

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1. Description, Range of Application and Validity

1.1 Description

ROBAX® glass ceramic panels consist of a transparent glass ceramic material. Because of its material characteristics the product is designed for the use as thermal window in fireplaces.

1.2 Range of Application

This technical delivery specification applies to ROBAX® glass ceramic panels (delivery form: flat stock-size sheets, cut-to-size-panels and bent panels with or without decoration) for applications which require a low thermal expansion and transparency:

- electric, oil or gas stoves
- conventionally heated fireplaces and room heaters (wood, coal, pellets ...)

1.3 Range of Validity

This technical delivery specification applies to the commercial relationship between SCHOTT AG, Business Unit Home Tech and its customers.

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2. Technical Features

2.1 General Remarks

All data stated in this technical delivery specification are to be seen as guideline values. Those values, for which no generally valid measuring method exist or which are not generally defined (e.g. by a technical standard), are specified and explained.

2.2 Appearance

- Transparent, slightly coloured due to the material composition and production process
- Surface appearance: plane, slightly textured due to the production process

2.3 Mechanical Characteristics

2.3.1 Density

ρ approx. 2.6 g / cm³

2.3.2 Modulus of Elasticity (ASTM C-1259)

E approx. 93 × 10³ MPa

2.3.3 Poisson's Ratio (ASTM C-1259)

μ approx. 0.25

2.3.4 Bending Strength (DIN EN 1288 part 5, R45)

$\bar{\sigma}_{bB}$ approx. 35 MPa

2.3.5 Impact Resistance

The impact resistance of ROBAX® depends on the kind of installation, the size and thickness of the panel, the kind of impact, the geometry of the panel and especially here on the drilled holes and their position on the ROBAX® panel.

Therefore information regarding the impact resistance can only be given with knowledge of the respective application (especially in combination with the technical standards regarding impact resistance that have to be met for single applications). Corresponding guideline values on request.

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2.4 Thermal Characteristics

2.4.1 Coefficient of Mean Linear Expansion (DIN ISO 51045-1, DIN ISO 7991)

$$\alpha_{(20-700^{\circ}\text{C})} \quad (0 \pm 0.5) \times 10^{-6} / \text{K}$$

2.4.2 Mean Specific Thermal Capacity

$$c_p (20-100^{\circ}\text{C}) \quad \text{approx. } 0.8 \times 10^3 \text{ J / (kg} \cdot \text{K)}$$

2.4.3 Thermal Conductivity (DIN 51936, ASTM E 1461-01)

$$\lambda_{(90^{\circ}\text{C})} \quad \text{approx. } 1.6 \text{ W / (m} \cdot \text{K)}$$

2.4.4 Resistance to Temperature Differences (RTD)

Resistance of the panel to temperature differences between heated zone and cold panel edge (room temperature).

No cracking due to thermal stress at $T_{\text{es, max}}^{1)} \leq 700^{\circ}\text{C}$

2.4.5 Thermal Shock Resistance

Resistance of the panel to thermal shock when the hot panel is quenched with cold water (room temperature).

No cracking due to thermal stress at $T_{\text{es, max}}^{1)} \leq 700^{\circ}\text{C}$

2.4.6 Temperature / Time Load Capacity (under consideration of items 2.4.4 and 2.4.5)

The temperature / time load capacity specifies the maximum permissible temperature for given load times for the fireplace panels, below which no cracking due to thermal stress occurs.

The value pairs specified in the following [table 2.1](#) are relevant to the practical use of the glass ceramic material as fireplace panel. The temperature values refer to the hottest point on the exterior side of the panel ($T_{\text{es, max}}$) because this temperature can be measured more easily and more reliably.

¹⁾ $T_{\text{es, max}}$: Maximum temperature on the exterior side of the panel, that means the reverse side of the heat source, at the hottest point

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Load temperature $T_{es, max}^{1)}$	Load time
560°C (1040°F)	5000 hr.
610°C (1130°F)	1000 hr.
660°C (1220°F)	100 hr.
710°C (1310°F)	10 hr.
760°C (1400°F)	5 hr.

Table 2.1: Temperature / time load capacity for ROBAX® fireplace panels

Note:

For ROBAX® fireplace panels the temperature / time load capacity specified in [table 2.1](#) must be maintained. It must be ensured that this temperature / time load capacity is not exceeded during use, to prevent cracking due to thermal stress.

The temperature / time load data for even temperature distributions within an entire glass ceramic panel (e.g. homogeneous heating conditions in a testing furnace) are given in [table 2.2](#). This data is to be seen purely as characteristic data for the glass ceramic material itself. It is not typical for use of the ROBAX® glass ceramic material as fireplace panels, which have a temperature distribution totally different from evenness. The temperatures refer to the homogeneous heating of the ROBAX® panel (T_{hom}).

Load temperature $T_{hom}^{2)}$	Load time
700°C (1292°F)	6000 hr.
750°C (1382°F)	750 hr.
775°C (1427°F)	275 hr.
800°C (1472°F)	100 hr.
825°C (1517°F)	35 hr.

Table 2.2: Temperature / time load capacity for uniformly heated ROBAX® panels

- 1) $T_{es, max}$: Maximum temperature on the exterior side of the panel, that means the reverse side of the heat source, at the hottest point
- 2) T_{hom} : Homogenous temperature, i.e. material temperature under homogeneous heating conditions

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2.5 Chemical Characteristics of Base Material

2.5.1 Acid Resistance (DIN 12116)

S at least class S2

2.5.2 Alkaline Resistance (ISO 695)

A at least class A1

2.5.3 Hydrolytic Class (DIN ISO 719)

HGB class HGB 1

2.5.4 Change of Surface due to Use

ROBAX® has a good resistance against chemical surface attack. In isolated cases and under special critical conditions, e.g. aggressive exhaust gases (acidification at high temperatures) changes of the surface may occur. For such applications practice tests have to be carried out before being used.

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3. General Dimensional Tolerances and Material Characteristics

The following describes characteristics which are valid for all four product groups (stock-size sheets, cut-to-size panels, round bent and angular bent panels). With regard to stock-size sheets all of the following characteristics (with exception of flatness, see item 4.1) refer to the net-size as agreed on with the customer.

3.1 Dimensional Tolerances

Characteristics / Areas / Location	Tolerance
Thickness t $t = 3.0 / 4.0 / 5.0 \text{ mm}$	$\pm 0.2 \text{ mm}$

Table 3.1: Dimensional tolerances

3.2 Material Characteristics

Visual inspection in the normal installation position without visual aids and illumination of approx. 800 Lux when viewed from a minimum distance of 1 m.

The inspection shall be executed with a background in the colour of fireclay bricks:
Light ivory RAL-1015.

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3.2.1 Bubbles

Bubbles are gaseous inclusions within the glass ceramic material. Closed bubbles can appear as low-spots on the surface depending on their size and position within the glass. Open bubbles are open towards the panel surface and are not permissible if bigger than 1 mm. The production of material totally free of bubbles is not possible due to the production process. [Table 3.2](#) contains the permissible number of closed bubbles in dependence of their length and the panel size.

Characteristic's Length L [mm]	Panel Size A				
	$A \leq 20\text{dm}^2$	$20 < A \leq 40\text{dm}^2$	$40 < A \leq 80\text{dm}^2$	$80 < A \leq 150\text{dm}^2$	$150 < A \leq 250\text{dm}^2$
$L \leq 1.0$	uncons.	uncons.	uncons.	uncons.	unconsidered
$1.0 < L \leq 2.0$	1 ¹⁾	4 ¹⁾	8 ¹⁾	12 ¹⁾	15
$2.0 < L \leq 4.0$	0	1 ¹⁾	2 ¹⁾	4 ¹⁾	6
$4.0 < L$	0	0	0	0	0

¹⁾ The distance between two adjacent characteristics must be minimum 200 mm.

[Table 3.2:](#) Permissible number of closed bubbles per panel

3.2.2 Solid Inclusions and Stains

Solid inclusions are inhomogeneities within the glass ceramic material. Stains are deviations of the surface which are easily visible under normal inspection conditions. Both characteristics cannot be completely avoided due to the production process. [Table 3.3](#) contains the permissible number of solid inclusions and stains in dependence of their length and the panel size.

Characteristic's Length L [mm]	Panel Size A				
	$A \leq 20\text{dm}^2$	$20 < A \leq 40\text{dm}^2$	$40 < A \leq 80\text{dm}^2$	$80 < A \leq 150\text{dm}^2$	$150 < A \leq 250\text{dm}^2$
$L \leq 0.5$	uncons.	uncons.	uncons.	uncons.	unconsidered
$0.5 < L \leq 2.0$	0	1 ¹⁾	2 ¹⁾	6 ¹⁾	8
$2.0 < L \leq 4.0$	0	0	1 ¹⁾	2 ¹⁾	3
$4.0 < L$	0	0	0	0	0

¹⁾ The distance between two adjacent characteristics must be minimum 200 mm.

[Table 3.3:](#) Permissible number of solid inclusions and stains per panel

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3.2.3 Scratches

The delivery of ROBAX® panels totally free of scratches is not possible due to technical reasons. It has to be distinguished between slight scratches (scratches not detectable with finger nail) and strong scratches (scratches detectable with finger nail). [Table 3.4](#) contains the permissible number of scratches in dependence of their length and the panel size.

Characteristic's Length L [mm]	Panel Size A				
	$A \leq 20\text{dm}^2$	$20 < A \leq 40\text{dm}^2$	$40 < A \leq 80\text{dm}^2$	$80 < A \leq 150\text{dm}^2$	$150 < A \leq 250\text{dm}^2$
Slight Scratches:					
$L \leq 10$	uncons.	uncons.	uncons.	uncons.	unconsidered
$10 < L$	0	2 ¹⁾	4 ¹⁾	5 ¹⁾	10
Strong Scratches:					
$L \leq 10$	0	0	0	5 ¹⁾	10
$10 < L$	0	0	0	0	0

¹⁾ The distance between two adjacent characteristics must be minimum 200 mm.

[Table 3.4:](#) Permissible number of scratches per panel

3.2.4 Pits

ROBAX® panels may show pits. These pits must not be recognizable during a visual inspection according to the conditions for visual inspections as described in item 3.2.

3.2.5 Other Characteristics

If the panel - when inspected according to the conditions for visual inspections as described in item 3.2 - shows a number of defects which impair the aesthetic appearance SCHOTT and the customer will agree on limit values for the respective characteristics and, if necessary, limit samples will be defined.

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4. Stock-Size Sheets

Stock-size sheets are large-size glass ceramic panels without any further processing, especially without edge processing. They serve as base material for cut-to-size panels. There has to be differentiated between stock-size sheets (GL) and the larger Jumbo-size sheets or Jumbo Formats (SGL).

4.1 Dimensional Tolerances

Characteristics / Areas / Location	Stock-Size Sheet GL	Jumbo Format SGL
Edge length Length: Width:	1580 mm ± 3,0 mm 890 mm ± 3,0 mm	1954 mm ± 3,0 mm 1100 mm ± 3,0 mm
Flatness	≤ 0.3 % × measuring length (Measuring length at least 500 mm)	

Table 4.1: Dimensional tolerances for stock-size sheets

4.2 Material Characteristics

The material characteristics comply with the specifications of item 3.2, incl. sub items.

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5. Cut-to-Size Panels

5.1 Dimensional Tolerances

Characteristics / Areas / Location	Tolerance
Edge length l $l \leq 500$ mm $l > 500$ mm Special designs (contour shapes)	± 1.0 mm ± 1.5 mm as per separate agreement
Corner radius r $r \leq 20$ mm $r > 20$ mm	± 1.5 mm ± 2.0 mm
Squareness of cut-to-size panels a (according to fig. 5.1) Edge length ≤ 500 mm Edge length > 500 mm	$a \leq 1.0$ mm $a \leq 1.5$ mm
Flatness of cut-to-size panels Flatness	$\leq 0.3\% \times D$ D : diagonal of cut-to-size panel
Drilled hole diameter d_H $4 \text{ mm} \leq d_H \leq 20 \text{ mm}$ $20 \text{ mm} < d_H \leq 60 \text{ mm}$ $60 \text{ mm} < d_H \leq 200 \text{ mm}$	± 0.2 mm ± 0.5 mm ± 1.0 mm
Position of drilled hole <ul style="list-style-type: none"> Deviation between drilled hole centre axis and panel centre axis Deviation between drilled hole centre axis of adjacent drilled holes (max. distance 500 mm) 	± 1.5 mm ± 1.0 mm

Table 5.1: Dimensional tolerances for cut-to-size panels

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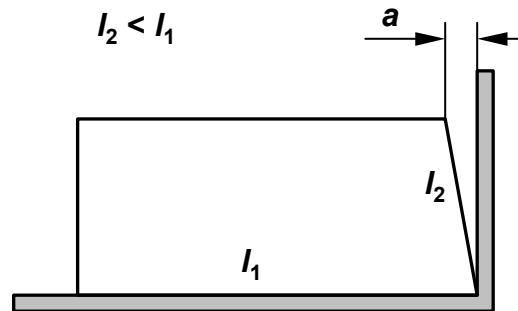


Fig. 5.1: Squareness measurement

5.2 Edge Finish

The edges of flat cut-to-size panels are processed according to DIN 1249, e.g. either arrised or round ground to size, by default as U-profile.

ROBAX® panels may show small chippings at the edges. The maximum permissible size of these chippings is 1.5 mm when measured from the outer edge of the panel.

ROBAX® panels with V-shaped edge defects are not permissible.

The above is also valid for round and angular bent panels.

5.3 Material Characteristics

The material characteristics comply with the specifications of item 3.2, incl. sub items.

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6. Round Bent Panels

6.1 Dimensional and Form Tolerances

Characteristics / Areas / Location	Tolerance
Panel height h $h \leq 500$ mm $500 \text{ mm} < h \leq 650$ mm $650 \text{ mm} < h$	± 1.0 mm ± 1.5 mm Determination according to initial sample
Arc length l_A $l_A \leq 500$ mm $l_A > 500$ mm	± 1.5 mm ± 2.0 mm
Corner radius r $r \leq 20$ mm $r > 20$ mm	± 1.5 mm ± 2.0 mm
Sagging at panel edge s_h $h \leq 500$ mm $500 \text{ mm} < h \leq 650$ mm $650 \text{ mm} < h$	$s_h \leq 1.5$ mm $s_h \leq 2.0$ mm Determination according to initial sample
Drilled hole diameter d_H $4 \text{ mm} \leq d_H \leq 20$ mm $20 \text{ mm} < d_H \leq 60$ mm $60 \text{ mm} < d_H \leq 200$ mm	± 0.2 mm ± 0.5 mm ± 1.0 mm
Position of drilled hole <ul style="list-style-type: none"> Deviation between drilled hole centre axis and panel centre axis Deviation between drilled hole center axis of adjacent drilled holes (max. distance 500 mm) 	± 1.5 mm ± 1.0 mm

Table 6.1: Dimensional and form tolerances for round bent panels (see also [fig. 6.1](#))

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Table 6.2 contains the permissible overall torsion values of round bent panels.

	Panel Size A		
	$A \leq 20 \text{ dm}^2$	$20 \text{ dm}^2 < A \leq 40 \text{ dm}^2$	$40 \text{ dm}^2 < A$
Permissible overall torsion s_T [mm]	2.5	4	5

Table 6.2: Permissible overall torsion of round bent panels (see also [fig. 6.1](#))

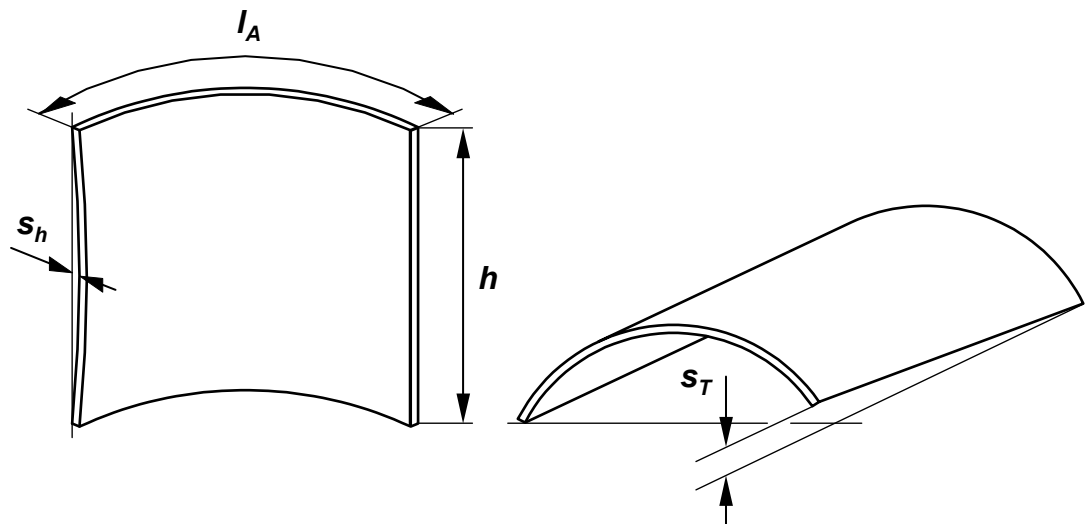


Fig. 6.1: Round bent ROBAX® panels

All geometric tolerances are specified by means of a two-dimensional enveloping contour. For testing the geometric tolerances a flat plastic gauge with a defined contour slot is used. The geometry of the contour slot is determined by the radius of curvature of the panel R_{soll} , by the arc length l_A and by the tolerance of the contour slot widths s_i , s_a (see [fig. 6.2](#)). If required the drawing of the contour slot gauge can be provided for the customer.

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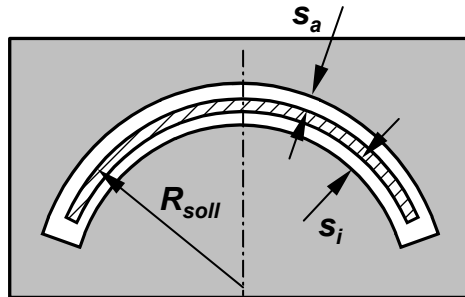


Fig. 6.2: Contour slot gauge geometry for round bent ROBAX® panels

The tolerances of the contour slot widths for round bent panels are given in [table 6.3](#).

Aperture angle α_B	Arc length I_A					
	$185 \text{ mm} < I_A \leq 400 \text{ mm}$		$400 \text{ mm} < I_A \leq 600 \text{ mm}$		$600 \text{ mm} < I_A \leq 1100 \text{ mm}$	
	s_i	s_a	s_i	s_a	s_i	s_a
$\alpha_B \leq 130^\circ$	1.0 mm	1.0 mm	1.25 mm	1.25 mm	1.25 mm	1.25 mm
$130^\circ < \alpha_B \leq 180^\circ$	1.25 mm	1.25 mm	1.5 mm	1.5 mm	1.5 mm	1.5 mm

Table 6.3: Tolerances of the contour slot widths s_i , s_a for round bent panels

The glass ceramic panel must easily fit into the contour slot gauge.

6.2 Material Characteristics

The material characteristics comply with the specifications of item 3.2, incl. sub items.

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7. Angular Bent Panels

7.1 Dimension and Form Tolerances

Characteristics / Areas / Location	Tolerance
Leg length l_1, l_3	± 2.0 mm
Middle section length l_2	± 1.0 mm
Panel height h $h \leq 500$ mm $500 \text{ mm} < h \leq 650$ mm $650 \text{ mm} < h$	± 1.0 mm ± 1.5 mm Determination according to initial sample
Corner radius r $r \leq 20$ mm $r > 20$ mm	± 1.5 mm ± 2.0 mm
Sagging at leg edge s_{l1}, s_{l3}	$s_{l1}, s_{l3} \leq 2.0$ mm
Sagging at middle section edge s_{l2}	$s_{l2} \leq 2.0$ mm
Sagging at panel edge s_h $h \leq 500$ mm $500 \text{ mm} < h \leq 650$ mm $650 \text{ mm} < h$	$s_h \leq 1.5$ mm $s_h \leq 2.0$ mm Determination according to initial sample
Drilled hole diameter d_H $4 \text{ mm} \leq d_H \leq 20$ mm $20 \text{ mm} < d_H \leq 60$ mm $60 \text{ mm} < d_H \leq 200$ mm	± 0.2 mm ± 0.5 mm ± 1.0 mm
Position of drilled hole <ul style="list-style-type: none"> Deviation between drilled hole centre axis and panel centre axis Deviation between drilled hole centre axis of adjacent drilled holes (max. distance 500 mm) 	± 1.5 mm ± 1.0 mm

Table 7.1: Dimension and form tolerances for angular bent panels (see also [fig. 7.1](#))

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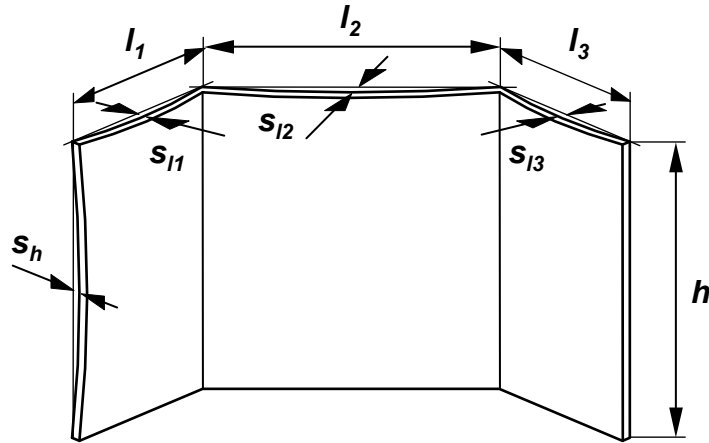


Fig. 7.1: Angular bent ROBAX® panels

Table 7.2 contains the permissible overall torsion values of angular bent panels.

	Panel Size A		
	$A \leq 20 \text{ dm}^2$	$20 \text{ dm}^2 < A \leq 40 \text{ dm}^2$	$40 \text{ dm}^2 < A$
Permissible overall torsion s_T [mm]	2.5	4	5

Table 7.2: Permissible overall torsion of angular bent panels (see also fig. 7.2)

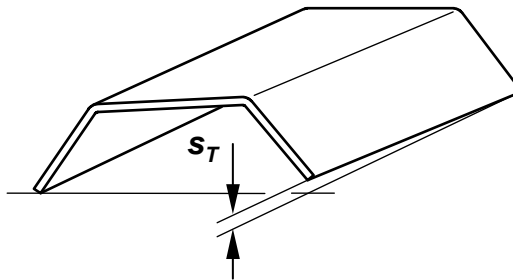


Fig. 7.2: Overall torsion of an angular bent ROBAX® panel

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All geometric tolerances are specified by means of a two-dimensional enveloping contour. For testing the geometric tolerances a flat plastic gauge with a defined contour slot is used. The geometry of the slot is determined by the edge lengths l_1 , l_2 , and l_3 , by the bending angle α_W and by the tolerances of the contour slot widths s_i , s_a (see [fig. 7.1](#), [7.2](#), [7.3](#) and [7.4](#)). If required the drawing of the contour slot gauge can be provided for the customer.

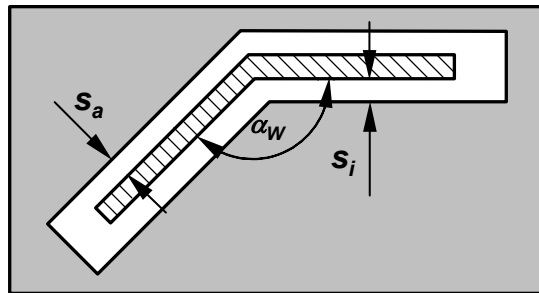


Fig. 7.3: Contour slot gauge geometry for single angular bent ROBAX® panels

The tolerances of the contour slot widths for single angular bent panels are given in [tables 7.3](#) and [7.4](#) (for panels with a 1x90° angle).

Bending angle α_W	Sum of leg lengths L					
	180 mm < L ≤ 440 mm		440 mm < L ≤ 900 mm		900 mm < L ≤ 1200 mm	
	s_i	s_a	s_i	s_a	s_i	s_a
90° ≤ α_W ≤ 160°	1.0 mm	1.0 mm	1.5 mm	1.5 mm	2.0 mm	2.0 mm

Table 7.3: Tolerances of the contour slot widths s_i , s_a for single angular bent panels (except panels with 1x 90° angle)

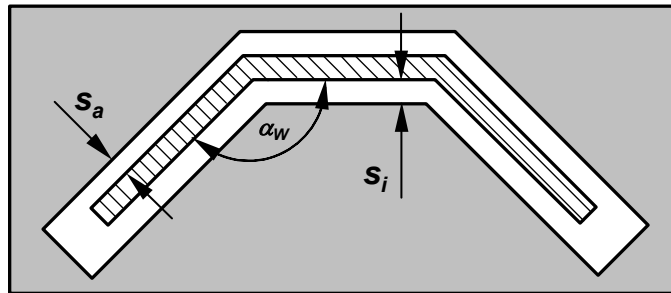
Bending angle α_W	Longest Leg Length l_{max}			
	$l_{max} \leq 300$ mm		300 mm < l_{max}	
	s_i	s_a	s_i	s_i
$\alpha_W = 90^\circ$	0.75 mm	0.75 mm	1.25 mm	1.25 mm

Table 7.4: Tolerances of the contour slot widths s_i , s_a for single angular bent panels with 1x 90° angle

The glass ceramic panel must easily fit into the slot gauge.

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The contour slot gauge geometry as shown in [fig. 7.4](#) is valid for double angular bent panels.



[Fig. 7.4:](#) Slot gauge geometry for double angular bent ROBAX® panels

The tolerances of the contour slot widths for double angular bent panels are given in [table 7.5](#):

Bending angle α_W	Longest leg length l_{max}					
	30 mm < $l \leq 100$ mm		100 mm < $l \leq 200$ mm		200 mm < $l \leq 340$ mm	
	S_i	S_a	S_i	S_a	S_i	S_a
$90^\circ \leq \alpha_W \leq 145^\circ$	1.0 mm	1.0 mm	1.25 mm	1.25 mm	1.5 mm	1.5 mm

[Table 7.5:](#) Tolerances of the contour slot widths s_i , s_a for double angular bent panels

The glass ceramic panel must easily fit into the slot gauge.

7.2 Material Characteristics

The material characteristics comply with the specifications of item 3.2, incl. sub items.

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8. Decoration

8.1 Technical Features of the Decoration

8.1.1 Adherence

Test with TESAFILM® (“Tesa test“ method) in the state of delivery in accordance with internal SCHOTT test specifications:

Apply a strip of TESAFILM® 4104 (approx. 12 × 45 mm) to the decorated surface at room temperature, rub down firmly and then pull off with a jerk. Evaluate colour residues sticking to the tape when the TESAFILM® 4104 is pulled off. Adhesion is insufficient when a number of colour dots with a diameter ≥ 0.8 mm stick to the strip of TESAFILM® 4104 and voids are visible in the decoration.

8.1.2 Thermal Shock Resistance

Resistance of the decoration against thermal shock situations when the hot panel is quenched with cold water (room temperature).

Heat the specimen up to $T_{\max} = 500^{\circ}\text{C}$ (retention time at T_{\max} : 15 min) and quench it by immersing it in cold water ($T_{\text{water}} = 25 \pm 5\text{K}$). This procedure is to be repeated 10 times.

After this test, the “Tesa test” procedure according to item 8.1.1 must be fulfilled.

8.1.3 Temperature Load Resistance

The temperature / time load capacity of the decoration is adjusted to the temperature load of the decorated area of the ROBAX® glass ceramic panel as it occurs in practical use as thermal window in fireplaces.

8.2 Decoration Characteristics

Visual inspection in the normal installation position without visual aids and illumination of approx. 800 Lux when viewed from a minimum distance of 1 m.

The inspection shall be executed with a dark, preferably a black background.

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8.2.1 Decoration Voids

Decorated ROBAX® glass ceramic panels find no objections if they show no noticeable voids when inspected according to the conditions for visual inspections as given above.

Decoration defects in the edge area of the panel (≤ 4.0 mm surrounding the panel edge), which are covered by the frame after installation, are permissible as long as no information about partly or totally frameless assembly of the panel is given.

Decoration defects, which are located at a distance of 2 mm from the edge of a drilled hole, remain unconsidered. The drilled hole chamfer is included in this special area of 2 mm.

Furthermore the limit values as given in [table 8.1](#) are valid for decoration defects.

Characteristic's Length L [mm]	Panel Size A			
	$A \leq 20\text{dm}^2$	$20 < A \leq 40\text{dm}^2$	$40 < A \leq 80\text{dm}^2$	$80 \text{ dm}^2 < A$
$L \leq 0.5$	unconsidered	unconsidered	unconsidered	unconsidered
$0.5 < L \leq 1.0$	1	2	3	4
$1.0 < L$	0	0	0	0

Table 8.1: Permissible decoration defects per panel

For completely decorated panels (i.e. $\geq 70\%$ of the panel size is decorated) the limits according to [table 8.2](#) are valid for decoration defects.

Characteristic's Length L [mm]	Panel Size A			
	$A \leq 20\text{dm}^2$	$20 < A \leq 40\text{dm}^2$	$40 < A \leq 80\text{dm}^2$	$80 \text{ dm}^2 < A$
$L \leq 1.0$	unconsidered	unconsidered	unconsidered	unconsidered
$1.0 < L \leq 2.0$	1	2	3	4
$2.0 < L$	0	0	0	0

Table 8.2: Permissible decoration defects per completely decorated panel

8.2.2 Other Decoration Characteristics

If the panel - when inspected according to the conditions for visual inspections as described in item 8.2 - shows a number of decoration defects which impair the aesthetic appearance SCHOTT and the customer will agree on limit values for the respective characteristics and, if necessary, limit samples will be defined.

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8.3 Decoration Tolerances

8.3.1 Decoration Tolerances for Printed Logos

If the decoration consists only of a printed logo the tolerances as given in [table 8.3](#) are valid (see also [fig. 8.1](#)). These tolerances are valid for cut-to-size, round bent and angular bent panels.

Characteristics / Areas / Location	Tolerance
Position of printed logo x-direction, x_L y-direction, y_L	± 3.0 mm ± 3.0 mm
Parallel deviation of printed logo from panel edge, p_L maximum permissible deviation p_L at longest edge of printed logo	± 1.0 mm

Table 8.3: Decoration tolerances for printed logos

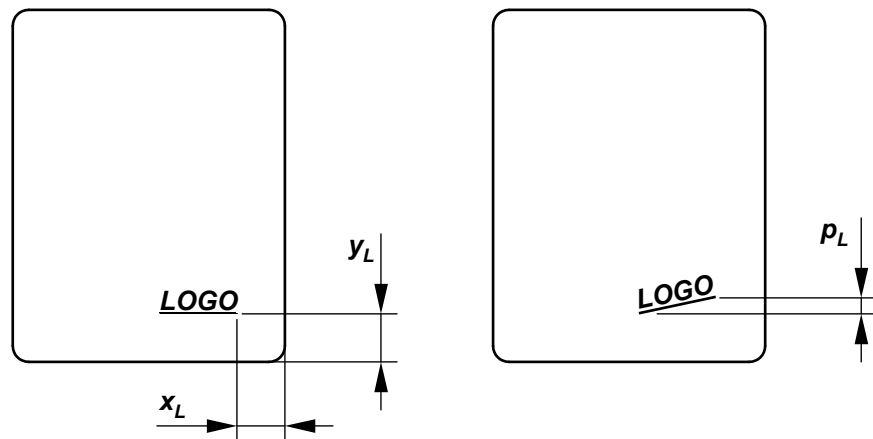


Fig. 8.1: Decoration tolerances for ROBAX® panels with printed logo

The logo is supposed to be applied always onto the interior side for round bent panels and for angular bent panels with a 90° angle and should be applied always onto the exterior side for angular bent panels with a non-90° angle.

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8.3.2 Decoration Tolerances for Printed Frames and Full-Surfaces

Decorated ROBAX® panels may show a circumferential undecorated edge area of the width a due to the production process (see fig. 8.2).

Characteristics / Areas / Location	Tolerance
Decoration position¹⁾ Position of decoration pattern	$\pm 1.5 \text{ mm}$
Width of undecorated edge area a <ul style="list-style-type: none"> Permissible width of undecorated edge area a (absolute): 	$a = 1.0 \pm 1.0 \text{ mm}$ An overprinting over the edge ($a < 0 \text{ mm}$) is thus not permissible.
Distance of decoration to drilled hole edge Maximum permissible distance of decoration to drilled hole edge $s_{c,max}$	$s_{c,max} \leq 2.0 \text{ mm}$

¹⁾ The decoration position is dictated by the centre axes of the decoration and the ROBAX® glass ceramic panel. All dimensions refer to the centre axes of the ROBAX® glass ceramic panel.

Table 8.4: Decoration tolerances for ROBAX® panels (see also fig. 8.2)

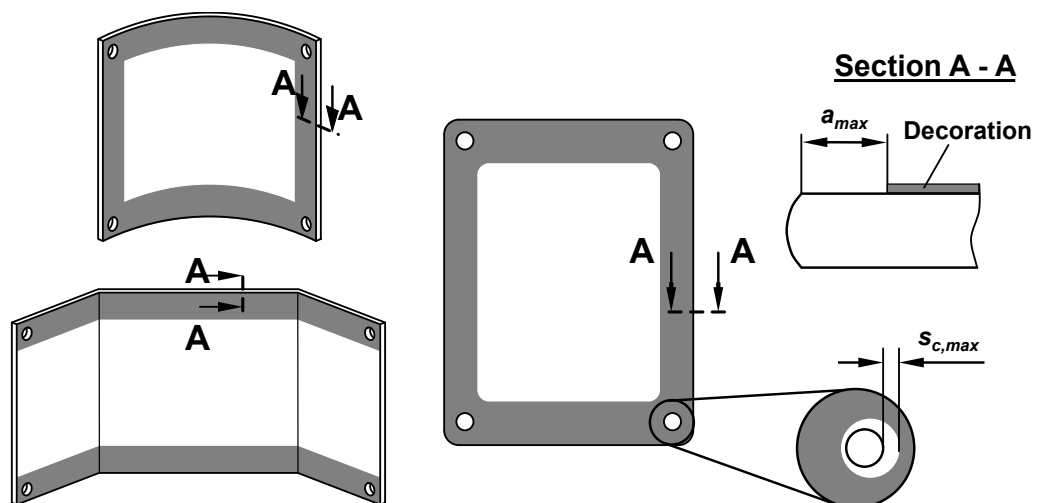


Fig. 8.2: Decoration tolerances for decorated ROBAX® panels

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9. Transport, Storage and Handling

To avoid damage, it is necessary for the panels to be handled properly as well as transported and stored only vertically secured, and protected against touching each other by suitable intermediate layers (paper, cardboard, cork or PE foam foils).

10. Installation Guidelines

The same conditions apply to the installation and the handling of ROBAX® panels as are generally valid for handling glass and glass ceramic parts.

- The **different thermal expansions** between the various frame materials and the ROBAX® panel has to be taken into account for the complete construction. Furthermore the possible production tolerances of frame and panel have to be considered.
- For installation it is necessary to use a sufficiently **low distortion frame construction**. As a minimal distortion of the frame construction cannot be excluded a **temperature stable, permanently resilient gasket** (e.g. fibre glass cloth or mineral fibre cloth) or a **suitable holding tolerance** is required in order to prevent any transfer of distortions from the frame construction onto the ROBAX® panel. A direct contact between the glass ceramic and a hard material may reduce the impact resistance of the glass ceramic in use. Also any direct contact between glass ceramics and metal has to be avoided.
- If for constructive reasons a pressing of the panel in the frame is required the **contact pressure must be applied uniformly (never at points only)** over the entire edge area of the panel.
- Any touch of the surfaces with hard objects during assembly should be avoided.
- By advice in the user manual of the fireplace the end user should be made aware that the fireplace panels **regarding mechanical behaviour** are more related to glass panels than to ceramic walls.
- The **cleaning of the fireplace panel** can be done with help of commercially available cleaning detergents for glass ceramic surfaces or with help of commercially available glass cleaners. Abrasive or chemically very aggressive cleaning detergents (e.g. cleaners for baking ovens) should not be used. Generally residues of cleaning detergents should be removed by wiping with clear water.

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11. Procedures if Deviations Occur

11.1 Basic Action

Deviations should be handled in the most cost-effective manner for both partners. Deviations are estimated according to the state of the products at time of delivery. Changes in the material which occur during further processing of ROBAX® glass ceramic panels exclude warranty claims of the recipient against SCHOTT.

11.2 Obligation of Recipient to Provide Information

SCHOTT requires the following data for reporting, testing and evaluating deviations:

- SCHOTT order number
- Pallet voucher with production order number
- Warehouse unit number
- Delivery quantity affected
- Complaint quantity with article number
- Reasons for complaint
- Results of random sample tests

11.3 Recipient's Storage Obligation

All parts with characteristic values deviating from the specifications and complained about by the recipient must be stored by the recipient until final clarification of the facts and made available to SCHOTT upon request. If such parts are scrapped by the recipient without written authorization from SCHOTT or if they are no longer available for other reasons, all warranty rights regarding such parts shall be null and void.

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