

# Technical Terms & Conditions of Delivery: BG-TE.

## Intention

Overview of the quality requirements and specifications for etched glass products of Berliner Glas Herbert Kubatz GmbH & Co. KG Syrgenstein.

Determination of the exact criteria for the definition, classification and evaluation of quality characteristics associated with etched glass products.

## Scope

The following technical terms and conditions of delivery apply to double-sided etched glass products of the brand BG-TE (transmission enhancing etching).

## Definition

### Surface Defects

Surface defects are local defects which change the visual quality of the glass. There are point and linear/elongated defects.

Surface defects are for example scratches, chips, chafe marks and punctiform etching defects.

The designation for the number and size of surface defects is specified according to ISO 10110-7.

### Etching Defects

Etching defects are areas with a modified etching structure unlike the actual etching.

Etching defects are for example bright stripes/stains and significantly different reflection colors. This does not include errors, which are caused by the production process (e. g. "barcodes" in rolled glasses).

### Glass Defects

Glass defects are defects that result from the manufacturing process of the float glass.

Glass defects are local defects such as bubbles, inclusions and tin spots as well as linear or elongated defects like drawmarks/-scratches and tin lines/-stains on the float side.

The conditions for evaluation of number and size of allowable glass defects are specified within DIN EN 572-2.

## Defect Sizes

The definition of defect sizes according to DIN ISO 10110-7 is: defect size [mm] = square root (defect length [mm] x defect width [mm]).

For example, defect size 1.0 mm corresponds to a square with an edge length of 1.0 mm or a circle with a diameter of 1.1 mm.

## Stock Sheets and Customized Sizes

Stock sheets are dimensions which are cut from (split) ribbon sizes for further processing at Berliner Glas.

Pre-cut sizes are dimensions that are cut from (split) ribbon sizes or already further processed products on customers request.

## Contract Processing

Contract processing terms the TE-etching on a glass substrate provided by the customer.

For the TE-etching on customer-provided materials Berliner Glas takes no responsibility for glass defects, scratches, edge damage, or similar errors that were already present by delivery.

## Geometry

### Maximum Length and Width

The maximum size for the etching of **BG-TE** is 2,130 x 1,250 mm.

### Tolerances for Length and Width Dimension

Glass product	Glass thickness [mm]	Edge length [mm]	Tolerance [mm]
Pre-cut	2.0–3.15	≤ 1.000	±0.5
Pre-cut	2.0–3.15	> 1.000	±1.0
Pre-cut	4.0–5.0	all	±1.0
Stock sheet	2.0–5.0	all	±5.0

Further length and width tolerance requirements have to be agreed on in each case.

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## Tolerances for Glass Thickness

Thickness [mm]	Tolerance [mm]	Thickness [mm]	Tolerance [mm]
2.0	+0.20/-0.30	3.0	+0.00/-0.30
2.25	+0.05/-0.15	3.15	+0.05/-0.15
2.35	+0.05/-0.15	4.0	+0.20/-0.30
2.5	+0.10/-0.20	5.0	+0.20/-0.30
2.6	+0.10/-0.20		

Further glass thicknesses on request.

## Measuring Equipment Geometry

Characteristic	Measuring device
Length/width $\leq$ 1,500 mm	Calliper
Length/width $>$ 1,500 mm	Tape measure
Thickness	Micrometer
Angle	Angulometer

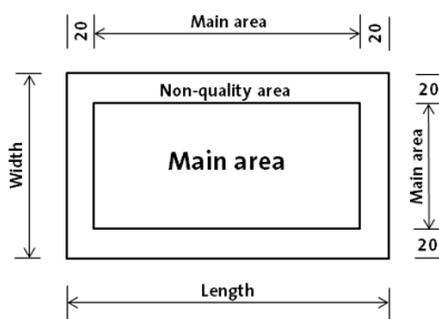
## Warranty Exclusion for Toll Manufacturing

Berliner Glas doesn't take any warranty regarding geometry for the TE-etching on customer-provided materials.

## Quality

### Edge Zone for Stock Sheets

For stock sheets, surface and glass defects (with exception of fracture causing edge defects) as well as deviations of optical properties within a circumferential edge zone of 20 mm (non-quality area) are unrestricted admissible.



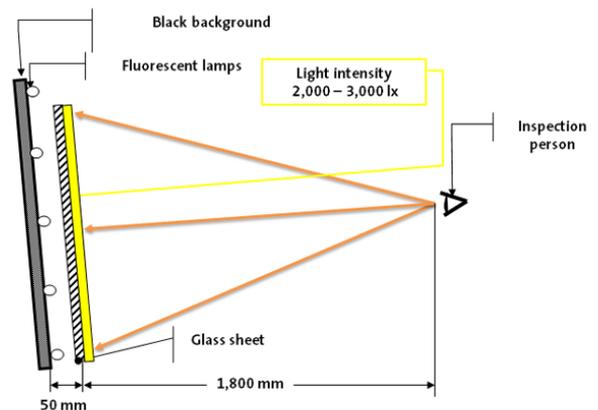
## Conditions of Evaluation

The inspection for surface and glass defects in transmission and reflection is performed under the following conditions:

### Conditions of Evaluation Transmission

	Description
Inspection equipment	Naked eye
Lighting	Rear illumination with five fluorescent lamps (light color "day-light") with a length of 1,200 mm, arranged one above the other at a distance of 300 mm in front of a black background at the washing machine outlet.
Light intensity	Intensity of illumination 2,000–3,000 lux
Incidence angle of light	85–90° to the evaluating area
Evaluation angle	40–90° to the evaluating surface
Evaluation time	The inspection time for the entire area is about ten seconds.
Evaluation distance	1,8 m from the glass surface

## Schematic Test Assembly

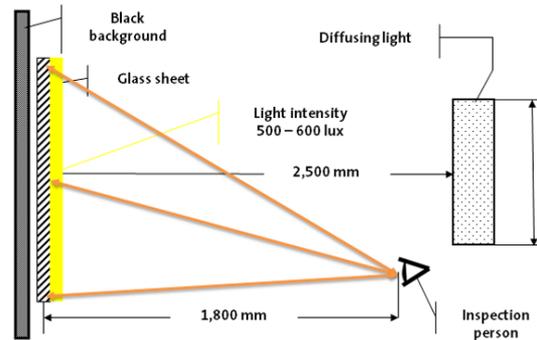


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## Conditions of Evaluation Reflection

	Description
Inspection equipment	Naked eye
Lighting	Six fluorescent lamps with a length of 1,200 mm, arranged behind a diffusing glass sheet (GW 0.5) at a distance of 2.5 m to the washing machine outlet.
Light intensity	Intensity of illumination 500–600 lux
Incidence angle of light	60–90° to the evaluating area
Evaluation angle	40–90° to the evaluating surface
Evaluation time	The inspection time for the entire area is about ten seconds.
Evaluation distance	1.8 m from the glass surface
Note	The inspection takes place while the glass sheet leaves the washing machine. The inspecting person does not move, but sweeps systematically the eye over the entire surface.

Top view



Basically the following applies: all errors and discrepancies which are not identified according to the given conditions and within the given time will be ignored.

## Surface Defects

The following numbers and sizes of surface defects are permitted in the main area of stock sheets and on the whole area for pre-cut sizes:

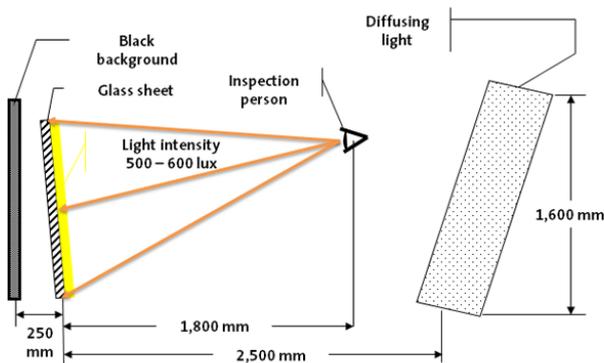
Area up to m <sup>2</sup>	Permissible point defects max. number x max. defect size [mm]	Permissible scratches max. number x max. scratch width [mm]/ cumulated length [mm]
0.04	1 x 1.6	2 x 0.15/5
0.16	2 x 1.6	3 x 0.15/20
0.36	4 x 1.6	4 x 0.15/40
0.64	6 x 2.0	6 x 0.15/60
1.00	8 x 2.0	8 x 0.15/100
>1.00	12 x 2.0	12 x 0.15/120

- Defect sizes ≤ 0.63 mm will not be regarded
- Scratches with a width < 0.10 mm are not regarded
- Point defects and scratches are cumulative, i. e. point defects and scratches are allowed together
- No accumulation of surface defects allowed, definition according to ISO 10110-7
- Removable residues (dust, paper marks etc.) will not be considered as a defect

Further demands on surface quality have to be agreed on in each case.

## Schematic Test Assembly

Side view



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## Edge Defects

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For pre-cut sizes, edge damages of a maximum length x width x depth of 2 mm x 1 mm x  $\frac{1}{3}$  glass thickness are permitted.

Fracture causing edge defects are not permitted.

## Properties

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### Reflection Measurement

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The process is monitored by measuring the wavelength-dependent reflectance at 400–1000 nm with a spectrometer. For the measurement a sensing head, that is connected to the spectrometer via an optical fibre, is placed directly on the glass surface.

The measurement is possible on blank or dull glass (but not on glass with a prismatic surface), whereat on the opposite side of the sensing head a black felt cloth is held against the glass.

### Specifications Reflection

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Parameter	Area/Tolerance
Wavelength range for reflection measurement	400–1,000 nm
Position of minimum of reflection $\lambda_{\min}$	500–900 nm
Tolerance for position of minimum reflection	$\pm 50$ nm
Max. reflection per side at minimum $R(\lambda_{\min})$	$\leq 1.0$ %

Further demands on gloss values and their tolerances have to be agreed on in each case.

### Further Characteristics

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The values for solar transmission  $T_{\text{sol}}$  and visual transmission  $T_{\text{vis}}$  can be calculated from reference curves.

On customer demand further optical parameters can be measured, e. g. the transmission (only for not tempered glass in the range from 400 nm to 900 nm) or the haze value in transmission.

## Warranty

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In terms of warranty, please pay attention to our delivery and payment conditions - point 11.

### Return of Rejected Goods

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For the assessment of complaints, Berliner Glas can request the entire disputed goods from the customer.

The redelivery costs go at the expense of Berliner Glas. The customer has to ensure proper packaging so that the goods may not be damaged on the backhaul. Unauthorized complaints will be returned to the customer and partial transportation and sorting costs will be invoiced.

### Storage Conditions

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The storage of refined glass products has to be done properly, as is common in the glass industry. This includes in particular the prevention of moisture and temperature changes. Berliner Glas is not liable for damages caused by improper storage.