

Clear fused quartz resized tubes

Product standard and inspection criteria

Application

This standard is applicable to resized tubes produced with Ilmasil™ feedstock material.

Dimensional characteristics

Outside diameter (OD)

Definition: outer tube diameter, to measure in all directions and on all positions rectangular to the tube axis

Limits: see attachment # 1

Inspection: measuring machine in minimum 3 sections (end/middle/end),
16 measuring point each section

Wall thickness (WT)

Definition: wall thickness in all sections over total length

Limits: attachment #1

Inspection: spot tests by measuring machine

Siding (SD)

Definition: difference between maximum and minimum wall thickness in percent based on specified nominal wall thickness (WT)

$$SD [\%] = \frac{\text{max. WT} - \text{min. WT}}{\text{WT}} * 100 \%$$

Limits: attachment #1

Inspection: spot tests by measuring machine

Ovality (OVA)

Definition: difference between maximum and minimum OD in percent, based a specified nominal OD

$$OVA [\%] = \frac{\text{max. OD} - \text{min. OD}}{\text{OD}} * 100 \%$$

Limits: attachment #1

Inspection: spot tests by measuring machine

Length (L)

Definition: total length between tube ends, saw cut

Limits: ± 2 mm

Inspection: by measuring tape

Parallelism between both ends (P)

Definition: max. deviation from being parallel between the planes of both ends

Limits: max. 0.5 mm

Inspection: by measuring machine, 16 measuring point each saw cut ends

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Flatness of cut ends (F)

Definition: max. deviation from all points on the surface are in one plane.
The tolerance specifies the max. distance formed by two parallel planes.

Limits: max. 0.5 mm

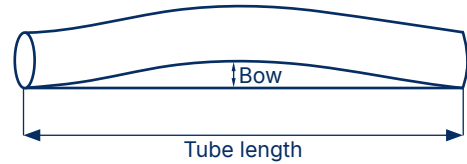
Inspection: spot tests

Bow (bow)

Definition: max. amount of deviation to a straight edge, usually a curve or bend

Limits: maximum bow [mm] = tube length [mm] : 1000

Inspection: measuring machine



Visual characteristics

The term "visual" is used for the inspection method where the tubing to be inspected at a distance of 0.3 – 0.6 m from the inspector, with a white/black background under general overhead inspection illumination.

Orange peel

Definition: transparent surface distortions along the outer surface looking like the outside texture of an orange skin

Limits: letterings in format arial bold font size 12 must be possible to read with unaided eye

Inspection: visual

Waves/Ripples

Definition: circumferential rings created by the resizing process.

Limits: all dimensional limits must be maintained

Inspection: visual

Surface adhesions

Definition: non-colored quartz particles fused into the surface causing a protrusion

Tolerance: none with any sharp edges allowed.
maximum dimension 0.4 mm; maximum 20 pcs per 100 cm² if fully smooth and glazed

Inspection: visual

Repairs

Definition: fire polished local machine mark, optical defect

Limits: no standard repair area larger than 500 mm². No variation of the OD or wall by more than 0.4 mm from the repaired area to the nearest unrepaired area.

Tube length	Maximum allowed # per tube
< 1830 mm	2
1830... 2135 mm	3
2135... 2440 mm	4
> 2440 mm	5

Inspection: visual/caliper

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Vapor

Definition: a broad area or band of white haze on the ID or OD surface visible to the unaided eye on a black background

Limits: not permitted

Inspection: visual

Cutting irregularities

Definition: junctions, chipping, protrusion

Limits: no chips > 2 mm or maximum 1/3 of the wall thickness, no cracks

Inspection: visual, caliper

Scratch

Definition: a fine line abrasion of surface visible visual (line wider as 0.1 mm) under general illumination with a black background

Limits: a) lines > 0.1 mm → maximum length 150 mm;
b) total length of all scratched: max. ½ tube length
c) no scratches permitted on inside surface

Inspection: visual, caliper, measuring tape

Scuff

Definition: a broad surface abrasion visible visual (groups of lines wider as 0.1 mm)

Limits: a) no individual OD scuff wider than 12.5 mm or longer than 150 mm
b) total area of all scuffs on the outer surface, added together, are to be no more than 2 % of tube outer surface area.
c) not permitted on inside diameter

Inspection: visual, caliper, measuring tape

Waterspots, fingerprints, cutter dust

Definition: removable surface deposits left by washing residue or finger touch

Tolerance: not permitted

Inspection: visual

Devitrification

Definition: surface spots, white in appearance (not an inclusion), visible to the unaided eye on an black background

Limits: ≤ 1 mm are not counted;
max. diameter 5 mm;
max. average number along tube length: 1 piece each 100 mm

Inspection: visual

Bubbles and inclusions

Open bubbles

Definition: a void, open to the outer or inner surface, which has sharp edges

Limits: not permitted above > 0.1 mm

Inspection: visual

Open bubbles, fire polished

Definition: a void, open to the outer or inner surface, which has no sharp edges

Limits: max. depth: 0.4 mm, wall thickness limits must be maintained

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Closed bubbles and inclusions

Definition: bubble: a spherical void, wholly within the tube wall

Inclusion: included particles (spots), visible by color difference

Limits: a) bubbles and inclusions < 0.1 mm are not counted
b) max.TBCS for bubbles ≤ 0.5 mm and inclusions ≤ 0.3 mm: 15 mm²/100 cm³

Bubbles size in mm	> 0.5 – 1.0	> 1.0 – 2.0	> 2.0 – 3.0	> 3.0
Max. number per 600 cm ²	3	1	0.1	0

Inclusions size in mm	> 0.3 – 1.0	>1.0 – 1.5	> 1.5 – 2.0	> 2.0 – 3.0	> 3.0
Max. number per 600 cm ²	15	5	1	1	0

Inspection: visual and/or microscope

OD (mm)	OD- Tolerance ± (mm)	Wall thickness range (mm)		Wallthickness tolerance ± % of nominal wallthickness	Max. siding (SD) %	Max. ovality (OVA) %
		Min.	Max.			
120	1.5	6	10	20	15	0.8
130	1.5	6	10	20	15	0.8
140	1.5	6	10	20	15	0.8
150	1.5	6	12	20	20	0.8
160	1.5	6	12	20	20	0.8
170	1.5	6	12	20	20	0.8
180	1.5	5	12	20	20	0.8
190	1.5	5	12	20	20	0.5
200	1.5	5	12	20	20	0.5
210	1.5	4	10	20	20	0.5
220	1.5	4	10	20	20	0.5
230	1.5	4	10	20	20	0.5
240	1.5	4	10	20	20	0.5
250	1.5	4	10	20	20	0.5
260	1.5	4	10	20	20	0.5
270	1.5	4	10	20	20	0.5
280	1.5	4	10	20	20	0.5
290	1.5	4	10	20	20	0.5
300	1.5	4	10	20	20	0.5
310	1.5	4	8	20	20	0.5
> 310 – 800	1.5	4	8	20	20	0.5
> 800		upon request				