		Product Standard – Inspection Criteria for ilmasil® Clear Fused Quartz Resized Tubes		
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**Application:** This standard is applicable to resized tubes produced with ilmasil® feedstock material.

## 1 Dimensional Characteristics

### 1.1 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

### 1.2 Wall Thickness (WT)

**Definition:** wall thickness in all sections over total length

**Limits:** attachment #1

**Inspection:** spot tests by measuring machine

### 1.3 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

### 1.4 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

### 1.4 Length (L)

**Definition:** total length between tube ends, saw cut

**Limits:** ± 2mm

**Inspection:** by measuring tape

### 1.5 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

### 1.6 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

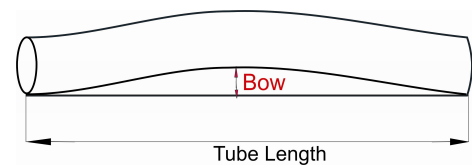
Inspection: spot tests

### 1.7 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



## 2 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.

### 2.1 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

### 2.2 Waves / Ripples

Definition: circumferential rings created by the resizing process.

Limits: All dimensional limits must be maintained

Inspections: visual



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### 2.3 Surface adhesions

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

Tolerance: None with any sharp edges allowed.  
Maximum dimension 0.4mm; maximum 20 pcs per 100 cm<sup>2</sup> if fully smooth and glazed

Inspection: visual

### 2.4 Repairs

Definition: fire polished local machine mark, optical defect

Limits: No standard repair area larger than 500mm<sup>2</sup>. 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
<1830mm	2
1830...2135mm	3
2135...2440mm	4
>2440mm	5

Inspection: visual / caliper

### 2.5 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

### 2.6 Cutting Irregularities

Definition: junctions, chipping, protrusion

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

Inspection: visual, caliper

### 2.7 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



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### 2.8 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

### 2.9 Waterspots, Fingerprints, Cutter dust

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

Tolerance: not permitted

Inspection: visual

### 2.10 Devitrification

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

Limits:  $\leq 1$  mm are not counted;  
Max. diameter 5 mm;  
Max. average number along tube length: 1 piece each 100 mm

Inspection: visual

## 2.11 Bubbles and Inclusions

### Open Bubbles

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

Limits: not permitted above >0.1mm

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

### 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  $\leq$  0,5 mm and inclusions  $\leq$  0,3 mm: 15 mm<sup>2</sup>/100cm<sup>3</sup>

Bubbles size in mm	> 0.5 – 1.0	> 1.0 – 2.0	> 2.0 – 3.0	> 3.0	
Max.number per 600 cm <sup>2</sup>	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 <sup>2</sup>	15	5	1	1	0

Inspection: visual and/or microscope

## 3 Further applicable documents

S-101-01 Specification of base materials

**Attachment 1**

OD (mm)	OD-Tolerance ± (mm)	Wall Thickness Range (mm)		Wallthickness Tolerance	Max. siding (SD)	Max. Ovality (OVA)
		Min.	Max.	±	%	%
				% of nominal wallthickness		
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				