

**1. General:**

This product specification applies to optical and geometric properties of DSC tubes of Raesch Quarz (Germany) GmbH. DSC tubes are direct drawn process tubes used in the semiconductor industry.

**2. Optical Characteristics:**

Defects are just specified if they are detected with the unaided eye in front of a black or white background. The optical measuring instruments are scale magnifiers and caliper gauges.

**2.1 Bubbles**

There are three different types of bubbles:

- a) Enclosed bubbles are cavities completely surrounded by the wall and not tactile.
- b) Tactile bubbles are a raised area on the tube wall located directly above an enclosed cavity. Bubbles are tactile if they can be felt with a glove.

Limits for enclosed and tactile bubbles:

width [mm]	max length	max amount per 300mm tube length
≤ 0.25	15	3
> 0.25 - ≤ 0.50	8	3
> 0.50 - ≤ 0.75	4	1
> 0.75 - ≤ 1.00	2	1
> 1.00	Not permitted	

table 1

- c) Open bubbles are cavities which are open on the inner or outer surface of the tube and have sharp edges. Such a defect is not permitted.

**2.2 Contaminations**

Contaminations are substances adhering to the tube surface which can be removed with suitable cleaning agents. This kind of contaminations is permitted.

**2.3 Scratches**

Scratches are fine surface defects caused by material removal. No inner surface scratches are permitted. On the outer surface they are only allowed, if they are not palpable with a glove. The defected area should not exceed 2% of the tube surface.

**2.4 Cracks**

Cracks are clearly visible defects in the glass wall. Crack formations at Furnace Cut tubes (FC) are permitted unless the effective length is not affected. No cracks are permitted in Trim Cut tubes (TC).

**2.5 Vapor**

Vapor are SiO<sub>2</sub> deposits on the surface that are visible to the unaided eye. Only white deposits are permitted.

### 2.6 Discolorations

Discolorations are visible color differences of the tube caused by the production process. These are permitted if the glass properties are not negatively affected.

### 2.7 Stripes

Stripes are classified into drawing lines and striations.

Drawing lines are visible, not tactile inhomogeneities in the glass. A slight stripe forming is accepted.

Striations are tactile peaks or pits on the tube surface. These are allowed as their height or depth does not exceed 0.05mm.

### 2.8 Inclusions

Inclusions are foreign particles partially or completely enclosed in the tube. Foreign material with a size of up to 0.5mm is allowed if there is not more than one inclusion on 300mm tube section. Tactile inclusions are not permitted.

### 2.9 Devitrifications

Devitrifications are optical surface defects caused by recrystallization. On average, 1 defect on a 300mm tube section is allowed. Devitrifications should not exceed a diameter of 1mm on the outside and a diameter of 0.25mm on the inside of the tube.

## 3. Geometric Characteristics:

A tube is defined according to its outer (OD) or inner (ID) diameter as well as its wall thickness (WT) and its total length (L). The respective tolerances can be found in table 2.

The used measuring equipment are ultrasonic wall thickness gauges, caliper gauges and dial gauges.

### 3.1 Ovality

Ovality defines the roundness of a tube and is calculated as follows:

Ovality in % =  $(\text{max OD} - \text{min OD}) / \text{nominal OD} \times 100\%$

### 3.2 Siding (eccentric wall thickness distribution)

Siding describes the wall thickness differences of a tube and is calculated as follows:

Siding in % =  $(\text{max WT} - \text{min WT}) / \text{nominal WT} \times 100\%$

### 3.3 Bow

Bow describes the maximum deviation from a horizontal measuring axis. It is measured centrally over a length of 1.000mm. The maximum bow is 1.5mm.

### 3.4 Length

The tubes are available as FC (Furnace Cut) and TC (Trim Cut). The length tolerances can be found in table 2.

**Dimensional Characteristics:**

OD [mm]	WT [mm]	Standard tolerances				Siding [%]	Ovality [%]
		OD [mm]	WT [mm]	Length FC [mm]	Length TC [mm]		
13-20	1.0-1.5	±0.25	±0.15	±10	±3	8	2
	1.5-2.0	±0.30	±0.25				
> 20-30	1.0-2.0	±0.30	±0.20				
	2.0-3.0	±0.35	±0.35				
> 30-40	1.5-2.5	±0.40	±0.25				
	2.5-4.0	±0.50	±0.40				
> 40-60	2.0-3.0	±0.50	±0.30				
	4.0-5.0	±0.60	±0.40				
> 60-80	2.0-4.0	±0.60	±0.35				
	4.0-6.0	±0.60	±0.45				
> 80-100	2.0-4.0	±0.70	±0.40				
	4.0-6.0	±0.70	±0.50				
> 100-120	2.5-4.0	±1.00	±0.50	±50			
> 120-150	3.0-5.0	±1.50	±0.50				
> 150-180	5.0-7.0	±2.00	±0.50				
> 180-220	5.0-8.0	±2.50	±0.50				
					±10		

table 2

**4. OH content:**

The nominal OH content of the DSC tubes does not exceed 10 ppm.

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**Applicable documents:**

Material specifications  
 General specification for cutting

Revision History		
Rev.	Date	Description of Change
0	01.06.2019	<ul style="list-style-type: none"> <li>new document</li> </ul>