

## 1. General:

This product specification applies to optical and geometric properties of HV tubes of Raesch Quarz (Germany) GmbH. HV tubes are direct drawn feedstock tubes used for processing of large diameter or resized tubes.

## 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.  
A total bubble length of 3% per tube is permitted.
- 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.  
A total bubble length of 3% per tube is permitted.

Limits for enclosed and tactile bubbles:

width [mm]	max length [mm]
0.25 - ≤ 0.50	40
> 0.50 - ≤ 0.75	25
> 0.75 - ≤ 1.00	20
> 1.00 - ≤ 1.75	15

table 1

Tactile bubbles on the inner surface are not permitted.

- 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 Cracks

Cracks are clearly visible defects in the glass wall. At Furnace Cut tubes (FC), cracks are permitted unless the effective length is not affected. Cracks in Trim Cut tubes (TC) are not permitted.

### 2.4 Vapor

Vapor is defined as SiO<sub>2</sub> deposit on the surface, visible to the unaided eye. Only white deposits are permitted.

### **2.5 Discolorations**

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

### **2.6 Stripes**

Stripes are visible optical inhomogeneities resulting from fluctuations in wall thickness. A slight stripe forming is accepted.

### **2.7 Inclusions**

Inclusions are foreign particles partially or completely enclosed in the tube. Foreign material with a size of up to 0.7mm is allowed if there is not more than one on 300mm tube section.

## **3. Geometric Characteristics:**

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

The used measuring instruments 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.

	<b>Product specification</b> <b>HV tubes</b>	SPEC_Z_74 (Rev.0) page 3 of 3
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**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				
220 - 310	5.0-10.0	+/-2.50	+/-0.50				

table 2

**4. OH content:**

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

**Address:**

Raesch Quarz (Germany) GmbH  
 In den Folgen 3  
 D-98704 Ilmenau OT Langewiesen  
 Phone 0049-3677-4696-0 / Fax 0049-3677-4696-3690  
 Mail: info@raesch.net  
 Website: www.raesch.net

**Applicable documents:**

Material Specifications

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