



QSIL Nederland B.V.

Product specification
PH370 Quartz rods for
semiconductor applications

WPS-370R-001

17-02-2016

1 Introduction

1.1 Purpose

The purpose of this specification is to define the properties and quality requirements for PH370 quartz rods for semiconductor applications.

1.2 Scope

This document applies to furnace cut rods in the diameter range of 6 – 35 mm.

1.3 Glass Type

PH370 glass is an undoped quartz glass, manufactured by electrically fusing high purity silica sand.

1.4 Lot identification

The following information is given on each lot (see annex 1 for example):

- product code number (12 digit numeric code)
- campaign number
- lot number
- glass type
- main dimensions of the product (nominal vs. measured values)

In case of a complaint the lot ID (12NC, campaign, lot) of each lot involved should be noted in the complaint announcement.



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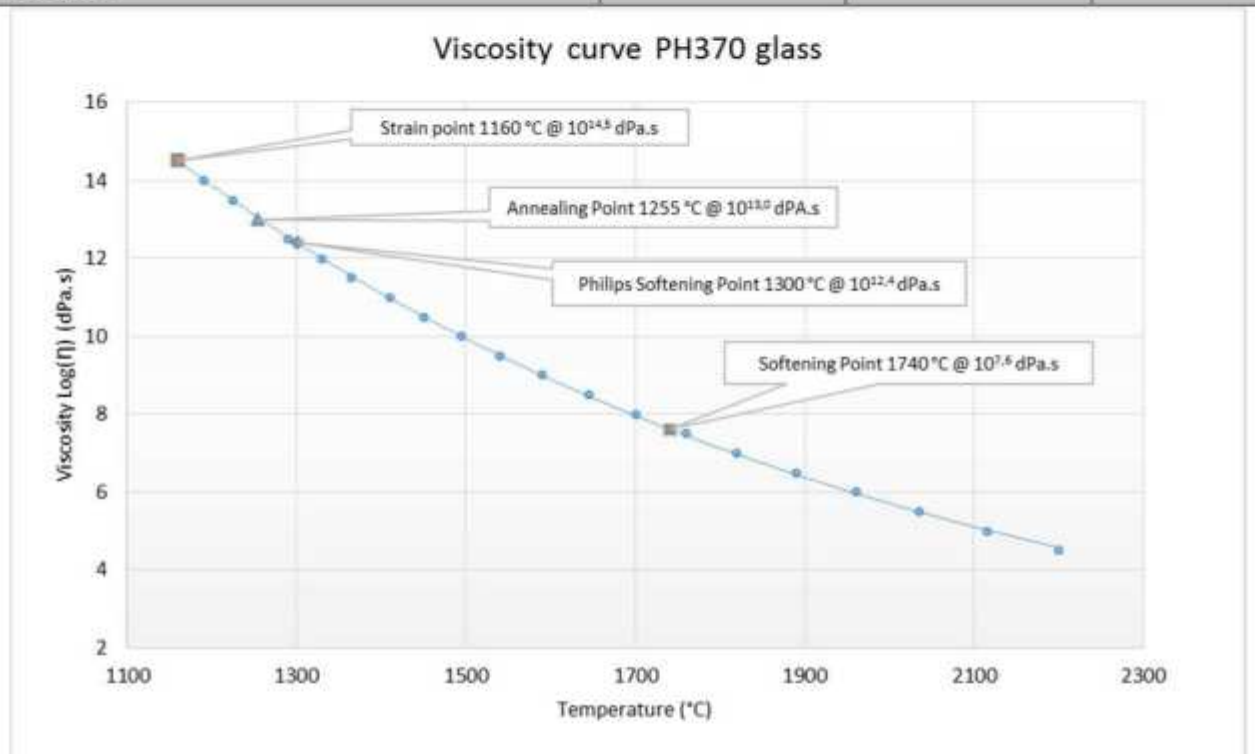
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2 Product requirements

The product specification consists of 3 paragraphs, being physical/chemical properties, dimensional requirements and visual requirements.

2.1 Physical properties

Thermal



Mechanical	Typical	Requirement	Unit
Density (20°C)		2.20	$\cdot 10^3 \text{ kg/m}^3$
Linear Expansion Coefficient (25°C - 300°C)	0.45		$\cdot 10^{-6}/^\circ\text{C}$
Optical			
Index of refraction (20°C, 589.3 nm)	1.46		-
Birefringence coefficient (540 nm)	370		$\cdot 10^{-12} \text{ Pa}^{-1}$



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Chemical	Typical	Requirement	Unit
Hydroxyl content			
Rod dry (RD): For diameter range: diameter ≥ 6.0 – diameter ≤ 35.0 mm.		≤ 35	PPM

2.2 Dimensional requirements

The rod dimensions are specified in the product drawing of each individual product. In table below the controls per parameter are specified. Sampling according to ISO 3951.

Parameter	AQL	Measuring method	Device
Outside diameter	1.0 %	Continuous diameter control towards nominal and sorting on USL and LSL.	In-line measuring OD device
Out of round (max diameter – min diameter)	1.0 %	Continuous measuring and sorting	Calculation In-line measuring data
Furnace cut			
Length	1.0%	Sample check, (Median & Range)	Off-line length measuring device
Bow	1.0%	Sample check	Off-line bow measuring device



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2.3 Visual quality

The following requirements apply to furnace cut products. Sampling according to ISO 2859.

Class I, critical defect

Defect	AQL	Description and standard	Means
Crack		A linear surface crevice, not starting at the end of the rod. <u>Acceptance limits:</u> Any crack visible with the naked eye is not allowed.	TL light source with black background.
Contamination		Substances, not being SiO ₂ , adhering to surface, which only can be removed by additional cleaning. <u>Acceptance limits:</u> Spots, (Length+Width)/2 > 5 mm, are not allowed. Spots, (Length+Width)/2 ≤ 5 mm, are allowed for a maximum of 5 spots per rod.	TL light source with black background.
Foreign material at the surface and in the rod		Foreign material (mostly metal particles). <u>Acceptance limits:</u> Particles, (Length+Width)/2 > 0.5 mm, are not allowed. Particles, (Length+Width)/2 ≤ 0.5 mm, are allowed for a maximum of 5 particles per rod.	TL light source with black background.



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Defect	AQL	Description and standard	Means
Open air lines		An elongated void with a width of > 0.1 mm wide and a length > 0.1 mm, open to the quartz surface or just below the quartz surface with a thin membrane, which can be crushed easily with a fingernail or pencil. <u>Acceptance limits:</u> Any open air line longer the > 0.1 mm and visible with the naked eye is not allowed.	TL light source with black back-ground. Measuring magnifier 8x.
Total 0.4% (sum of class I defect)			

Class II, major defect

Defect	AQL	Description and standard	Means
Discoloration		Discoloration, mostly brown, of the rod <u>Acceptance limits:</u> Internal discoloration grade < 1 is acceptable. (Discoloration samples available on request).	Laboratory testing on 10 cm of rod.
Black or brown colored Lines		Sharp black or brown colored lines in the axial direction of the rod. <u>Acceptance limits:</u> Sharp black or brown colored lines are not acceptable.	TL light source with black back-ground.
Blue or white colored Lines		Sharp blue or white colored lines in the axial direction of the rod. <u>Acceptance limits:</u> Sharp blue or white colored lines are acceptable.	TL light source with black back-ground.



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Defect	AQL	Description and standard	Means
Striation		The following text (in Arial 8 pt.) should be readable through the rod. "This text should be readable"	TL light source with black back-ground.
Total 1.0% (sum of class II defect)			

Class III, other defect

Defect	AQL	Description and standard	Means
Scratches		<p>A narrow line abrasion of the surface which is determined to have depth, as verified with a sharp object. Scratches can occur in the axial direction and in the radial direction.</p> <p><u>Acceptance limits:</u></p> <p>Axial scratches</p> <p>Scratches with a width > 0.2 mm are not allowed.</p> <p>Scratches with a width ≤ 0.2 mm and a length of > 150 mm are not allowed.</p> <p>The sum of the length of all scratches with a width ≤ 0.2 mm and a length of ≤ 150 mm is max. 25% of rod length.</p> <p>Radial scratches</p> <p>Scratches with a length > ½ circumference are not allowed.</p> <p>Scratches with a length ≤ ½ circumference, max 3 allowed per product.</p>	<p>TL light source with black back-ground & ruler.</p> <p>Tip of a sharp knife.</p>



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Defect	AQL	Description and standard	Means
Scuff marks		<p>Lines of abrasion of the surface which is determined <u>not</u> to have depth, as verified with a sharp object.</p> <p><u>Acceptance limits:</u></p> <p>Scuff marks with a width > 15 mm and length > 100 mm are not allowed.</p> <p>Scuff marks, with a width > 15 mm and length > 100, are allowed for a maximum of 6 marks per rod.</p>	TL light source with black back-ground & ruler.
Crystalization		<p>Spots were amorphous quartz is reverting into crystalline quartz.</p> <p><u>Acceptance limits:</u></p> <p>Not allowed is:</p> <p>Width ≤ 0.1 mm and length > 40 mm. Width ≤ 0.2 mm and length > 20 mm. Width ≤ 0.4 mm and length > 10 mm. Width ≤ 0.6 mm and length > 5 mm. Width ≤ 0.8 mm and length > 2.5 mm. Width ≤ 1.0 mm and length > 1.0 mm. Width > 1.0 mm</p>	TL light source with black back-ground. Measuring magnifier 8x.
Closed airlines & air bubbles		<p>A closed airline is an elongated void, > 0.1 mm wide and > 2 mm length, fully enclosed in the quartz material.</p> <p>An air bubble is a round shaped void, > 0.2 mm and ≤ 2.0 mm in diameter, fully enclosed in the quartz material. (For quality inspection purposes a nominal diameter of 1 mm per air bubble is used.)</p> <p><u>Acceptance limits:</u></p> <p>Closed air lines with a length > 7 mm are not allowed. Closed air lines with a width > 3 mm are not allowed. In a sample of 3 pcs the average length of air lines & bubbles ≤ 7 mm per meter.</p>	TL light source with black back-ground & ruler.



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Defect	AQL	Description and standard	Means
Rod end defects (Furnace cut only)			
Protrusions and intrusions.		Protrusions and intrusions are formed during furnace cutting of the rod. <u>Acceptance limits:</u> Sharp protrusions which have height of > 10 mm from the rod end are not allowed. Sharp intrusions which have length of > 10 mm from the rod end mm are not allowed.	TL light source with black back-ground.
Cracks in ends of rod		A linear surface crevice starting at the end of the rod. <u>Acceptance limits:</u> Cracks longer > 10 mm from the rod end are not allowed.	TL light source with black back-ground.
Total 1.5% (sum of class III defect)			



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3 Standard products

Standard rod dimensions		
Nominal diameter range	Tolerance (of nominal diameter)	Out of roundness (of nominal diameter)
Diameter ≥ 6.0 mm and diameter ≤ 35.0 mm	$\pm 1.5\%$	6.0 \leq OD < 10.0 mm: $\leq 1.5\%$ 10.0 \leq OD ≤ 35 mm: ≤ 0.15 mm
Length (furnace cut)	Length ranges (mm)	Tolerance (\pm mm)
For diameter range ≥ 6.0 mm and < 18.0 mm	900 - 1000	± 10 mm
	1150 - 1400	
	1550 - 1800	
For diameter range ≥ 18.0 mm and ≤ 35.0 mm	900 - 1050	
	1150 - 1450	
	1550 - 1850	
BOW	Maximum bow (mm/m)	
For diameter range ≥ 6.0 mm and < 14.0 mm	≤ 1.0	
For diameter range ≥ 14.0 mm and ≤ 35.0 mm	≤ 0.6	
Multiple Bow / Snake	Maximum multiple bow (mm/200mm)	
For diameter range ≥ 18.0 mm and ≤ 35.0 mm	≤ 0.12	



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4 Environmental data

Philips Lighting B.V. Quartz & Special Glass Analysis Report

Number: SW-LAB/RoHS/15-370
 Date: 21-08-2015
 Company: Philips Lighting B.V.
 Winschoten

Request: RoHS Certificate of Compliance Quartz Glass

RoHS Certificate of Compliance Special Glass 2015 – PH370

This document certifies that glass mentioned below are fully RoHS compliant with Directive 2011/65/EU.

Verification analysis are performed to establish of the following components: Pb, Cd, Hg and Cr6⁺.

As ICP can only establish the Cr-total content, the actual Cr6⁺ level will be less than the reported Cr-total content.

The measured levels are (in ppm):

	Date Measured	Valid Until	Oven	Pb	Cd	Hg	Cr-total
PH370	21-08-2015	21-08-2016	SQ-A	< 30	< 30	< 300	< 300

< = detection limit

The maximum permitted concentrations are 0.1% or 1000 ppm (except for cadmium, which is limited to 0.01% or 100 ppm).

Philips Lighting BV
BL Quartz & Special Glass

H.P.M. Huck
Plant Manager

C. Jongeling
QA Manager

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Update of ROHS analysis is available on request.

Annex 1: example Certificate of Conformance

1) By in-line measurements

X = average value $OD_{NS, EW}$ respectively $WT_{N, S, E, W}$ one measurement per individual rod
 S = standard deviation of OD respectively WT calculated over the length of the rod
 S_0 = standard deviation of OD respectively WT calculated over the circumference of the rod

2) By off-line sampling measurements

