 Quartz & Special Glass	Product specification PH321 <i>Glass rods for automotive headlighting halogen lamps</i>	WPS-321-001
		03-04-2018

1 Introduction

1.1 Purpose

The purpose of this specification is to define the properties and quality requirements for QSIL PH321 glass rods for Automotive halogen headlighting lamps.

1.2 Scope

This document applies to furnace cut and fine cut rod.

1.3 Glass Type


PH321 Low viscosity quartz glass. It has a $\pm 300^{\circ}\text{C}$ lower softening point than clear fused quartz, which makes it applicable for high speed processing.

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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2 Product requirements

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

2.1 Physical properties

	Typical	Requirement	Unit
Thermal			
Strain point ($\eta = 10^{14.5}$ dPa.s)	861		°C
Annealing point ($\eta = 10^{13}$ dPa.s)	944		°C
Softening point ($\eta = 10^{7.6}$ dPa.s)	1411		°C
Working point ($\eta = 10^{4.0}$ dPa.s)	2052		°C
Mechanical			
Density (20°C)		2.20	*10 ³ kg/m ³
Linear Expansion Coefficient (25°C - 300°C)	0.53		*10 ⁻⁶ /°C

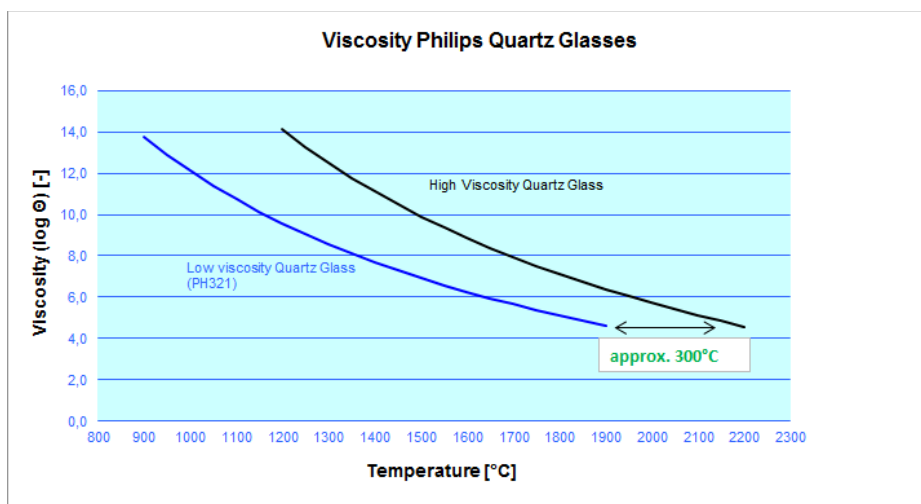



Figure 1 Viscosity

	Typical	Requirement	Unit
Chemical			
β-OH content	20	≤ 30	ppm
Δ β-OH content*	8	≤ 13	ppm

* Difference in β-OH between a baked sample (at 850°C for 3 hours under nitrogen atmosphere) and an unbaked sample. Exact measuring instruction available on request.

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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.

NR	Parameter	AQL	Measuring method	Device
001	Outside diameter	1.0 %	Continuous measuring and sorting. Diameter control towards nominal and sorting on USL and LSL.	In-line measuring device
002	Out of round	1.0 %	Continuous measuring and sorting (max diameter – min diameter).	In-line measuring device
Furnace cut				
005	Length	1.0%	Sample check (Median & Range)	Off-line length measuring device
006	Bow	1.0%	Sample check	Off-line bow measuring device
Fine cut				
005	Overall length*	1.0 %	Sample check (Median & Range)	Off-line length measuring device

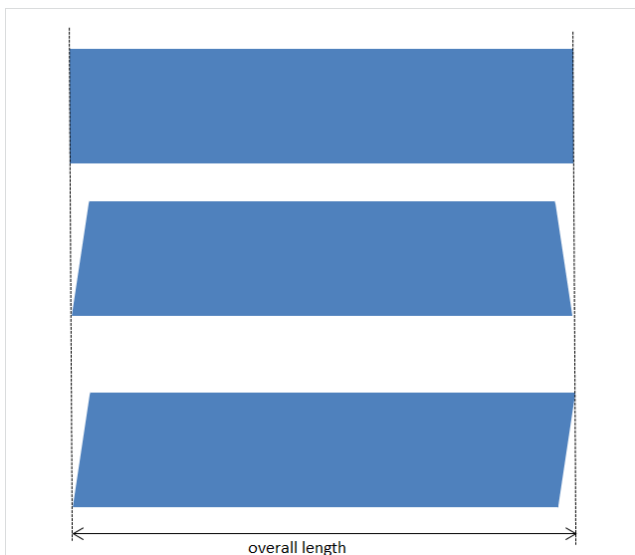



Figure 2 Overall Length

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2.3 Visual quality

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

2.3.1 Furnace cut products

Class I, critical defect


Defect	AQL	Description and standard	Means
Crack		All kinds of crack	TL light source with black background.
Contamination		Non removable contamination adhering to surface, which only can be removed by additional cleaning.	TL light source with black background.
		Total 0.4% (sum of class I defect)	

Class II, major defect

Defect	AQL	Description and standard	Means
Foreign inclusion		Particle > 0.5 mm	TL light source with black back-ground. Measuring magnifier 8x.
		Total 1.0% (sum of class II defect)	

Class III, other defect

Defect	AQL	Description and standard	Means
Inhomogeneity (lines)		Lines, with deviating color and intensity in the axial direction of the tube, are not allowed (according to internal limit sample).	
Closed air lines		A closed airline is an elongated void, > 0.1 mm wide and > 2 mm length, fully enclosed in the quartz material. Statistical process control Based on sample checks the sum of the length of all air lines shall not exceed 60 mm/m.	
		Total 1.5% (sum of class III defect)	

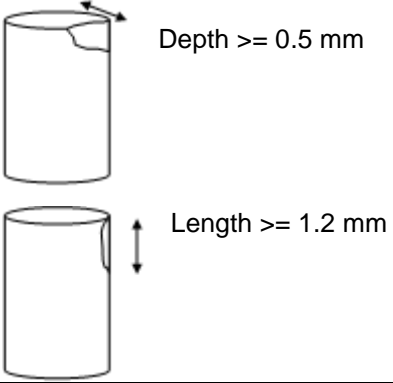

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2.3.2 Fine cut products

Class I, critical defect

Defect	AQL	Description and standard	Means
Crack		All kinds of crack	TL light source with black background.
Contamination		Non removable contamination adhering to surface, which only can be removed by additional cleaning.	TL light source with black background.
		Total 0.4% (sum of class I defect)	

Class II, major defect

Defect	AQL	Description and standard	Means
Foreign inclusion		Particle > 0.5 mm	TL light source with black back-ground. Measuring magnifier 8x.
Chip off		 <p>Depth ≥ 0.5 mm</p> <p>Length ≥ 1.2 mm</p>	TL light source with black back-ground. Measuring magnifier 8x.
Protrusions			TL light source with black back-ground. Measuring magnifier 8x.
		Total 1.0% (sum of class II defect)	

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Class III, other defect


Defect	AQL	Description and standard	Means
Inhomogeneity (lines)		Lines, with deviating color and intensity in the axial direction of the tube, are not allowed (according to internal limit sample).	
Closed air lines		A closed airline is an elongated void, > 0.1 mm wide and > 2 mm length, fully enclosed in the quartz material. Statistical process control Based on sample checks the sum of the length of all air lines shall not exceed 60 mm/m.	
		Total 1.5% (sum of class III defect)	

2.4 Standard products

OD [mm]	Out-of-Round [mm]	Length fine cut [mm]	L furnace cut [mm]
2.0 ± 0.15 mm 2.5 ± 0.15 mm	=< 0.15 mm	5.00 ± 0.20 8.20 ± 0.20 9.00 ± 0.20 9.50 ± 0.20 9.70 ± 0.20	1100 ± 10 1220 ± 10

3 Typical composition PH321 glass

Component	Weight (%)
SiO ₂	99.888
Al ₂ O ₃	0.009
K ₂ O	0.081
BaO	0.022

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4 Environmental data

QSIL Nederland B.V.

H.M. Brouwerstraat 1
9673-2 AG Winschoten
The Netherlands



Number: **SW-LAB/RoHS/17-321**
Date: 09-10-2017
Company: QSIL Nederland B.V. Winschoten
Request: RoHS Certificate of Compliance Quartz Glass

RoHS Certificate of Compliance Quartz Glass 2017 – PH321

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 XRF 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
PH321	2017-09-28	2018-09-28	SQF	<1000	<100	<1000	<1000

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

QSIL Nederland B.V.

H.P.M. Huck
Plant Manager

Update ROHS analysis is available on request
Annex 1: example Certificate of Conformance

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1) By in-line measurements

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

2) By off-line sampling measurements

QUALITY CERTIFICATE Qsil QUARTZ


Productcode: 3222 210 02241 Camp: 235 Lot: 9 Glass: 370 P.O. number: PO-17-0237 Quantity: pcs 3420 Weight: ca.kg 285.5 Dry: ZD

Outside-Diameter: tol. mm 6.00 ± 0.10 Inside-Diameter: tol. mm 2.00 ± 0.02 Wall thickness: tol. mm 2.00 ± 0.03 Length: tol. mm 1510.0 ± 10.0 β-OH ppm 0.3

Dimensions:				mm	Optical Quality
Outside-Diameter:	Inside-Diameter:	Wall thickness:	Length:		(A)
\bar{x} 5.99	\bar{x} 2.00	\bar{x} 2.00	\bar{x} 1510.60		
S 0.008	S 0.004	S 0.008	S 1.020		
S ₀ 0.005	S ₀ 0.004	S ₀ 0.009			

Production date: 30-Jan-2017
Inspection date: 23-Feb-2017

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Annex 2: Instructions for processing PH321

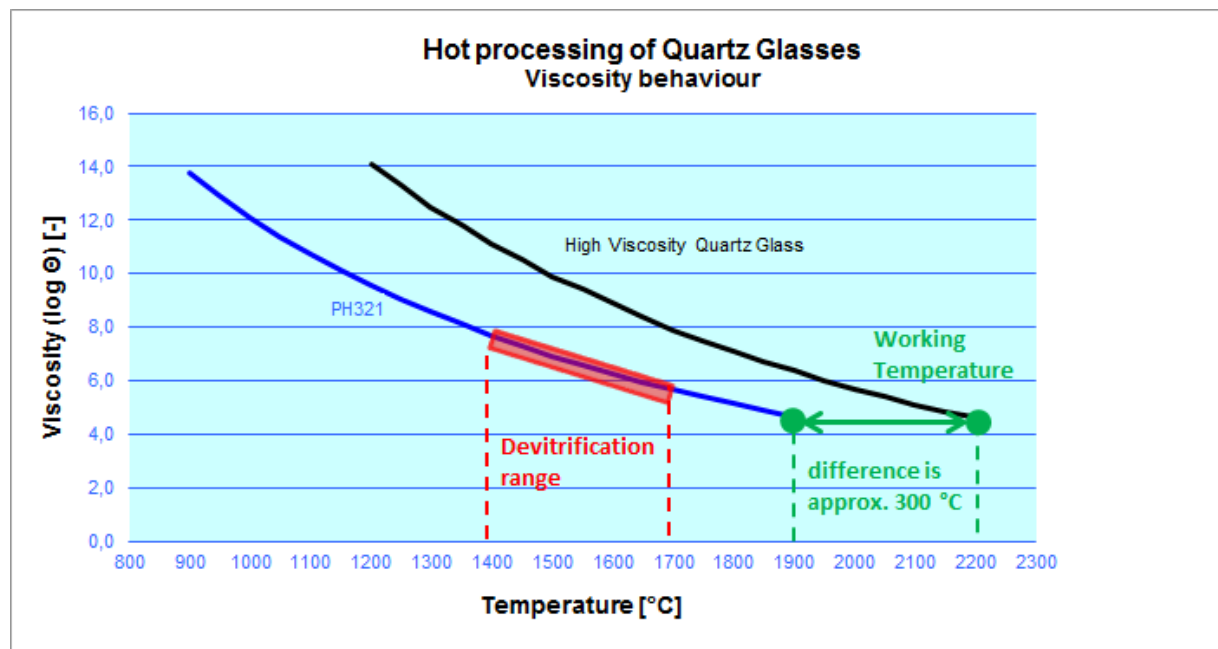
Introduction


PH321 Quartz Glass is doped to lower the viscosity.

Because of this lower viscosity:

- This glass allows fast processing at relative low temperatures
- This glass is more sensitive for devitrification (crystal formation on glass surface)

Devitrification can occur at spots in the product where the glass has been heated to temperatures between approx. 1400 and 1700°C.

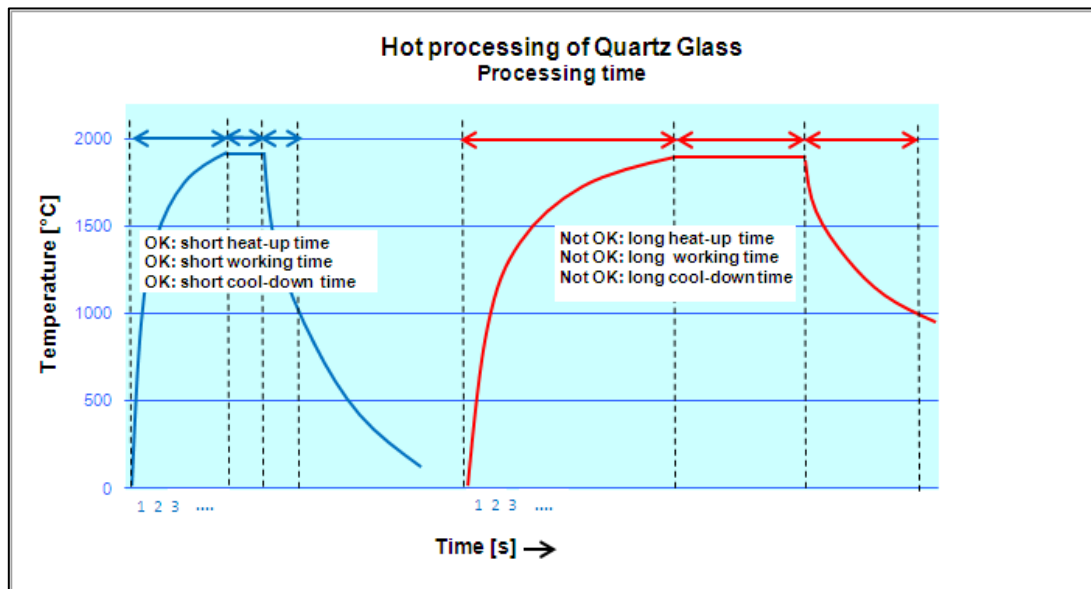
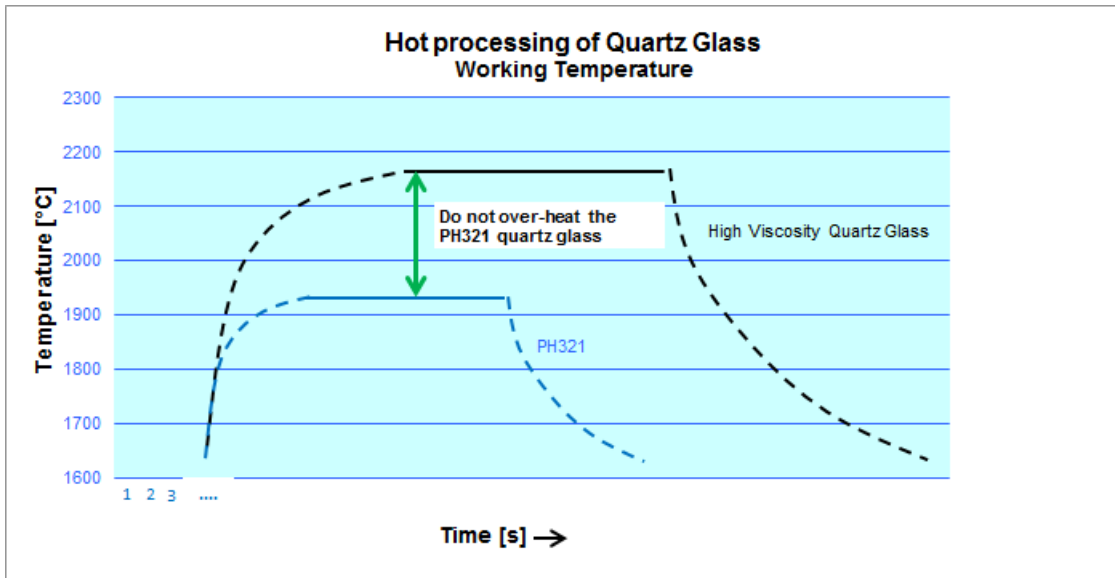


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Instructions for Processing

To prevent devitrification the glass has to be processed:

- At a relative low working temperature
- With short processing time



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Version control		
Version	Date	Change
1	04-12-2015	CP 15120. First publication. Supersedes GLN-X-03-321 and GLV-109-07-203.
2	13-02-2017	Change format QSIL
3	28-02-2018	Change physical properties page 2
4	03-04-2018	Definition of Annealing point changed from $10^{13.4}$ to 10^{13}
2	03-04-2018	Updated viscosity line PH321 in graph Annex 2