



QSIL Nederland B.V.

Product specification PH160 Glass tubes for TUV UV-C lamp application	WPS-160-001
	19-02-2015

## 1 Introduction

### 1.1 Purpose

The purpose of this specification is to define the properties for PH160 for straight (non-collared) tubes produced in PH160 glass.

### 1.2 Scope

This document applies to PH160 glass for TUV UV-C lamps for germicidal and water purification applications.

### 1.3 Glass Type

PH160 High UV transmitting soft glass.

### 1.4 Batch size

The batch size is defined as one packing unit.

### 1.5 Identification

The following information is given on each packing unit:

- product code number, 12 digit numeric code
- glass number
- batch identification number (lot number), including production date
- main dimensions of the product (nominal values)

In case of a customer complaint the batch numbers involved should be noted in the complaint announcement.

### 1.6 Packaging

All products are packed according to company packing standards. Packing instructions can be made available in English on request.

### 1.7 Product handling and storage

The glass tubes are vulnerable for mechanical impact. To reduce chances of breakages during handling the used forks of the lift truck should always ensure evenly weight distribution. Local pressures from the forks can lead to breakage although it might not be visible from the outside.

The tubes should only be handled when wearing gloves, preferably cotton. Wearing gloves prevents the glass from smudging.

It is advised to store the products in storage facility with controlled humidity (maximum of 85%) and temperature (15 – 35°C) for a maximum of 1 year.

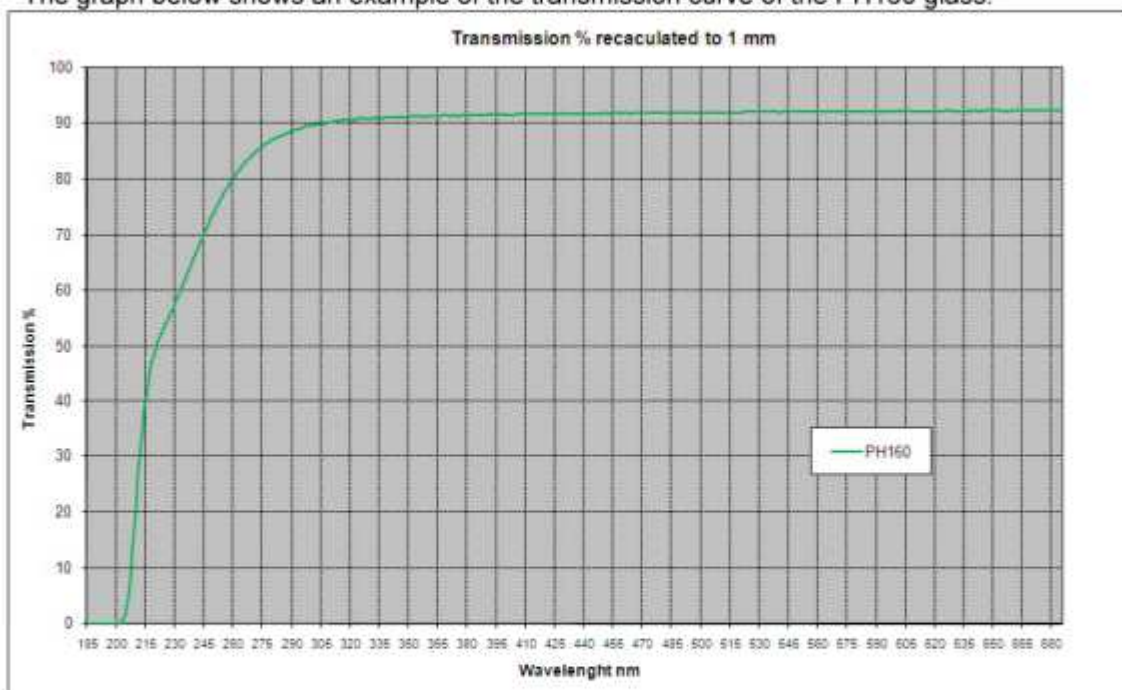
## 2 Product requirements

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

### 2.1 Physical properties

	Typical	Requirement	Unit
<b>Thermal</b>			
Linear Expansion Coefficient (25 °C - 300 °C)	9.85		$\times 10^{-6} / ^\circ\text{C}$
Strain in 34/2		T100+/-100	
Strain point	455		$^\circ\text{C}$
Annealing point	490		$^\circ\text{C}$
Softening point	675		$^\circ\text{C}$
Working point	995		$^\circ\text{C}$
<b>Mechanical</b>			
Density (20 °C)	2.52		$\times 10^3 \text{ kg/m}^3$
<b>Optical</b>			
Transmission at 254 nm at 1mm wall thickness (requirement)		$\geq 75$	%

The graph below shows an example of the transmission curve of the PH160 glass.





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## 2.2 Dimensional requirements

Dimensions are according to the Product Drawing.

The dimensions of the product are checked by performing 5 measurements on each separate tube out of each sample.

This result in an inner spread, called  $S_0$ .

The variation between the tubes of the sample is called short term spread  $S_1$ .

A sample of  $n$  tubes results in the following parameters:

- $X$  arithmetic mean
- $S_1$  short term spread
- $S_0$  average inner spread

**Table 1:** Dimensional parameters of straight tubes (inspection by variables)

NR	Parameter	AQL	Parameter (instruction)	Means
001	Outside diameter	1.0 %	$X_{avg}$ ; $S_1$ [in 0,01 mm]	Measuring stand
002	Out of round	1.0 %	$S_0$ [in 0,01 mm]	Measuring stand
003	Wall Thickness	1.0 %	$X_{avg}$ ; $S_1$ [in 0,01 mm]	Measuring stand
004	Wall Thickness variation	1.0 %	$S_0$ [in 0,01 mm]	Measuring stand
005	Length	1.0 %	$X_{avg}$ ; $S_1$ (always largest value) [in 0,01 mm]	Measuring stand
006	Skewness of cutting edge	1.0 %	$S_0$ [in 0,01 mm]	Measuring stand
007	Bow	1.0 %	$X_{avg}$ (half of total indicator reading) [in 0,01 mm]	Measuring stand



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## 2.3 Visual requirements

**Table 2:** Class I, critical defect

NR	Defect	AQL	Description and standard	Means
101	Crack		All (other) kinds of crack	TL light source with black background.
102	Metal enclosure		Dark colored enclosures in the glass. Dimension $x = [\text{length} + \text{width}] / 2$ - $X > 0.5$ mm is not allowed	TL light source with black background. Measuring magnifier 8x
		<b>Total 0.4% (sum of class I defect)</b>		

**Table 3:** Class II, major defect

NR	Defect	AQL	Description and standard	Means
201	Cutting defect		Defined as step cut, v-chip, cascade > 2 mm are not allowed	TL light source with black background.
202	Splinter		Internal stuck glass splinters (due to cutting of the glass)	TL light source with black background. Measuring magnifier 8x.
204	Damage and scratch		a. scratches in one (obvious) line longer than 75mm b. scratched or damaged spot (scuff) rectangular to and totally around the tube	TL light source with black background. Measuring magnifier 8x.
206	Tension / strain		Tension ring visible on any place in de tube and/or collar.	No sharp tension ring allowed (see example photograph)
207	Stone		Small parts of refractory material enclosed in glass. Dimension $x = [\text{length} + \text{width}] / 2$ - $X \leq 0.5$ mm is accepted - $0.5 < X \leq 1.5$ mm max 1 per meter tube length - $X > 1.5$ mm is not accepted	TL light source with black background. Measuring magnifier 8x.
208	Knot		Clear enclosure Dimension $x = [\text{length} + \text{width}] / 2$ - $X \leq 0.5$ mm is accepted - $0.5 < X \leq 1.5$ mm max 1 per meter tube - $X > 1.5$ mm is not accepted	TL light source with black background. Measuring magnifier 8x.
209	Too lightly glazed		Tube edge not fully glazed	Naked eye
210	Too heavily glazed		Internal diameter glazed tube end too small. (see product drawing for specification)	Internal diameter gage
		<b>Total 1% (sum of class II defect)</b>		



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**Table 4:** Class III, minor/ aesthetic defect

NR	Defect	AQL	Description and standard	Means
301	Contamination		All kinds of contamination which cannot be removed by normal washing process	TL light source with black background.
302	Open and closed airlines		a. Airlines wider than 0.4 mm and longer than 75mm b. Airlines in combination with a glass knot, stone or metal part all kinds	TL light source with black background.
		<b>Total 2,5% (sum of class III defect)</b>		

**Table 5:** Class IV, other defect

NR	Defect	AQL	Description and standard	Means
401	Drawing lines / cords/ faceting	No AQL sampling	Optical distortion in the glass wall. Requirement: max. 60 mm reading on Winschoten cord device.  Results of different cord devices cannot be compared.	Cord measuring device Winschoten. Measurement done in beginning of every shift and in case of doubt.
402	Number of airlines	No AQL sampling	Total number of open and closed air lines over 100 mm tube length.  See section 2.3.1 for requirements.	Visual. Measurement is done daily or in case of doubt.

### 2.3.1 Way of working on airlines

According to defect description 402 the airline level will be controlled. When the amount of airlines of any lengths is within a certain limit, see table 6, batches will be released automatically.

For other dimensions and above the limit the way of working needs to be agreed between parties.

**Table 6.** Reject values for airline level

Product type	Diameter range [ mm ]	Reject level [# airlines/100mm]
PL-S	11.00 -12.50	120
T5	15.50 – 15.75	150
PL-L	17.20	160
T8 (TL-D)	25.50 – 25.85	245
T10 – T12	32.00 – 37.25	350



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## 2.4 Default dimensions for products

In the following two tables the default (most common) dimensions and tolerances are given for reference and consistency on new product drawings. The nominal value for length depends on lamp type and therefore no default value is mentioned. The bow requirement can be converted to a shorter span value using the conversion table (table 8).

Deviating nominal values or tolerances can be applied on request, but only after explicit agreement between customer and supplier.

**Table 7a.** Default dimensions (1)

Type	Parameter	Glass 160	
		Range (value see drawing)	Tolerance
PL-S	Outside diameter	11.0 - 12.5	+/- 0.35
	Out of round	≤ 0.25	
	Wall thickness	0.75 - 0.85	+/- 0.10
	Wall thickness variation	≤ 0.10	
	Length		+/- 3.00
	Skewness / V-chip / Cascade	≤ 0.50	
	Internal diameter @glazed edge	≥ 10.30	
	Bow	≤ 1.5 mm @ 1000mm span	
T5	Outside diameter	15.50 - 15.75	+/- 0.35
	Out of round	≤ 0.25	
	Wall thickness TL miniature	0.57 - 0.70	+/- 0.10
	Wall thickness variation	≤ 0.10	
	Length		+/- 3.00
	Skewness / V-chip / Cascade	≤ 0.50	
	Internal diameter @glazed edge	≥ 13.40	
	Bow	≤ 1.5 mm @ 1000mm span	



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**Table 7b.** Default dimensions (2)

Type	Parameter	Glass 160		
		Range (value see drawing)	Tolerance	
PL-L	Outside diameter	17.20	+/- 0.40	
	Out of round	≤ 0.40		
	Wall thickness	0.85	+/- 0.10	
	Wall thickness variation	≤ 0.10		
	Length		+/- 3.00	
	Skewness	≤ 2.00		
	V-chip / Cascade	≤ 1.00		
	Internal diameter @glazed edge	≥ 14.50		
	Bow	≤ 1.5 mm @ 1000mm span		
TLD (T8)	Basic tube (straight)	Outside diameter	25.50 - 25.85	+/- 0.55
		Out of round	≤ 0.40	
		Wall thickness	0.70 - 0.75	+/- 0.10
		Wall thickness variation	≤ 0.10	
		Length		+/- 3.00
		Skewness	≤ 2.00	
		V-chip / Cascade	≤ 1.00	
		Internal diameter @glazed edge	≥ 21.70	
		Bow	≤ 1.5 mm @ 1000mm span	
TL (T12)	Basic tube (straight)	Outside diameter	32.00 - 37.25	+/- 0.75
		Out of round	≤ 0.60	
		Wall thickness	0.75	+/- 0.15
		Wall thickness variation	≤ 0.15	
		Length		+/- 3.00
		Skewness	≤ 2.00	
		V-chip / Cascade	≤ 1.00	
		Internal diameter @glazed edge	≥ 33.50	
		Bow	≤ 1.2 mm @ 1000mm span	



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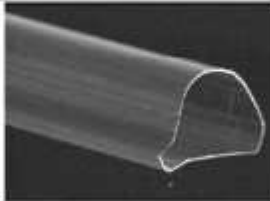

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**Table 8.** Conversion table for bow

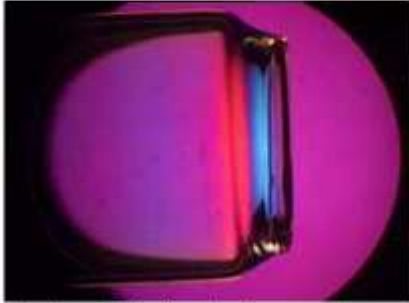
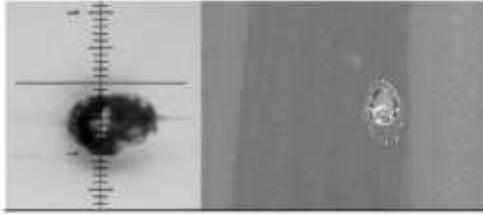
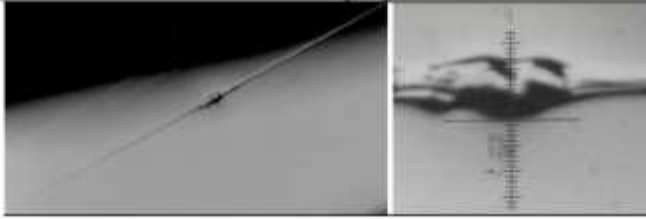
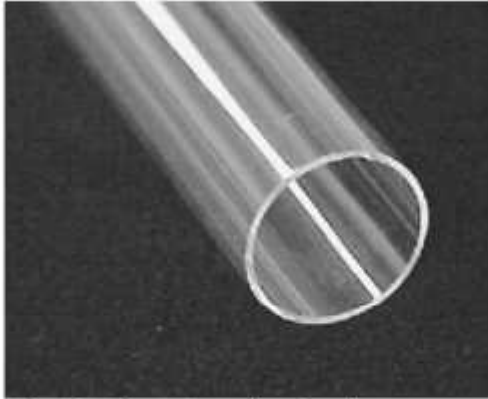
Span	Bow specification when span = 1000 mm																
	0.40	0.50	0.60	0.70	0.80	0.90	1.00	1.10	1.20	1.30	1.40	1.50	1.60	1.70	1.80	1.90	2.00
100	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
200	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
300	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
400	0.10	0.10	0.10	0.20	0.20	0.20	0.20	0.20	0.20	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.40
450	0.10	0.20	0.20	0.20	0.20	0.20	0.30	0.30	0.30	0.30	0.30	0.40	0.40	0.40	0.40	0.40	0.50
500	0.10	0.20	0.20	0.20	0.20	0.30	0.30	0.30	0.30	0.40	0.40	0.40	0.40	0.50	0.50	0.50	0.50
600	0.20	0.20	0.30	0.30	0.30	0.40	0.40	0.40	0.50	0.50	0.60	0.60	0.60	0.70	0.70	0.70	0.80
700	0.20	0.30	0.30	0.40	0.40	0.50	0.50	0.60	0.60	0.70	0.70	0.80	0.80	0.90	0.90	1.00	1.00
800	0.30	0.40	0.40	0.50	0.60	0.60	0.70	0.80	0.80	0.90	0.90	1.00	1.10	1.10	1.20	1.30	1.30
900	0.40	0.50	0.50	0.60	0.70	0.80	0.90	0.90	1.00	1.10	1.20	1.30	1.30	1.40	1.50	1.60	1.70
1000	0.40	0.50	0.60	0.70	0.80	0.90	1.00	1.10	1.20	1.30	1.40	1.50	1.60	1.70	1.80	1.90	2.00
1100	0.50	0.70	0.80	0.90	1.00	1.10	1.30	1.40	1.50	1.60	1.70	1.90	2.00	2.10	2.20	2.30	2.50
1200	0.60	0.80	0.90	1.10	1.20	1.30	1.50	1.60	1.80	1.90	2.10	2.20	2.40	2.50	2.60	2.80	2.90
1300	0.70	0.90	1.10	1.20	1.40	1.60	1.70	1.90	2.10	2.20	2.40	2.60	2.80	2.90	3.10	3.30	3.40
1400	0.80	1.00	1.20	1.40	1.60	1.80	2.00	2.20	2.40	2.60	2.80	3.00	3.20	3.40	3.60	3.80	4.00
1500	0.90	1.20	1.40	1.60	1.80	2.10	2.30	2.50	2.70	3.00	3.20	3.40	3.60	3.90	4.10	4.30	4.50
1600	1.10	1.30	1.60	1.80	2.10	2.40	2.60	2.90	3.10	3.40	3.60	3.90	4.10	4.40	4.70	4.90	5.20
1700	1.20	1.50	1.80	2.10	2.40	2.70	2.90	3.20	3.50	3.80	4.10	4.40	4.70	5.00	5.30	5.50	5.80
1800	1.30	1.70	2.00	2.30	2.60	3.00	3.30	3.60	3.90	4.30	4.60	4.90	5.20	5.60	5.90	6.20	6.50
1900	1.50	1.90	2.20	2.60	2.90	3.30	3.70	4.00	4.40	4.70	5.10	5.50	5.80	6.20	6.50	6.90	7.30
2000	1.60	2.00	2.40	2.80	3.20	3.60	4.00	4.40	4.80	5.20	5.60	6.00	6.40	6.80	7.20	7.60	8.00
2100	1.80	2.30	2.70	3.10	3.60	4.00	4.50	4.90	5.30	5.80	6.20	6.70	7.10	7.50	8.00	8.40	8.90
2200	2.00	2.50	3.00	3.40	3.90	4.40	4.90	5.40	5.90	6.30	6.80	7.30	7.80	8.30	8.80	9.20	9.70
2300	2.20	2.70	3.20	3.80	4.30	4.80	5.30	5.90	6.40	6.90	7.50	8.00	8.50	9.00	9.60	10.10	10.60
2400	2.40	2.90	3.50	4.10	4.70	5.20	5.80	6.40	7.00	7.50	8.10	8.70	9.30	9.80	10.40	11.00	11.60
2500	2.50	3.20	3.80	4.40	5.00	5.70	6.30	6.90	7.50	8.20	8.80	9.40	10.00	10.70	11.30	11.90	12.50



### 3 Examples of defects

Defect	Example picture
<b>Critical</b>	
101. Thermal crack, not from tube end	
102. Metal enclosure	

Defect	Example picture
<b>Majors</b>	
202. Splinter	
204. Damage and scratch	

Defect	Example picture
<b>Majors (cont'd)</b>	
206. Tension	 <p data-bbox="453 757 979 786">A) sharp interface between rings not allowed</p>
207. Stone	
208. Knot	
209. Too lightly glazed	 <p data-bbox="453 1711 842 1744">Defective almost no glazed edge</p>




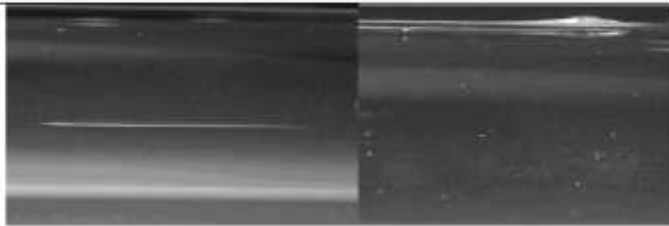
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Defect	Example picture
<b>Minors</b>	
301. Contamination	
302. Open and closed airlines	

Defect	Example picture
<b>Other</b>	
401. Drawing lines	



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## 4 Environmental data

### 4.1 Environmental declaration

#### Restriction of Hazardous Substances Declaration

Based on reference report: PGLS 2009.018	Ref:
	Date: 9-7-2009
	By: B. Sloots

**This is to declare that for:**

**Product:** Soda-barium glass (high UV-transmitting )    **Type:** 160

**Country of origin:** the Netherlands

Known high concern materials according RoHS Enforcement guidance document & relevant IEC standards have been screened and found to comply with directive:

**2002/95/EC Restriction of Hazardous Substances**

And all parts of the product are covered by:

**Philips Restricted Substances Declarations signed by the Suppliers**

Signature

T. Gerretsen:

Date: 16-9-2010

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Product specification  
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#### 4.2 Typical composition PH160 glass

	Weight %
SiO <sub>2</sub>	70.19
Na <sub>2</sub> O	9.55
K <sub>2</sub> O	9.04
BaO	6.98
B <sub>2</sub> O <sub>3</sub>	2.30
Al <sub>2</sub> O <sub>3</sub>	1.54
Cl <sup>-</sup>	0.36
SrO	0.04

#### Version control

Version	Date	Change
1	14-09-2010	First release
2	12-11-2010	Change after customer feedback
3	22-09-2011	Text clarification based on customer feedback
4	04-04-2012	Unchanged but converted to new format. Replaces GLN-X-03-160.
5	18-12-2014	CP 14093. Page 1: product storage for 1 year i.o. approximately 1 year. Page 2, optical, transmission at 254 nm: $\geq 75\%$ ipv $> 75\%$ .
6	19-02-2015	CP 15003. Page 4 and 5: TL light source i.o. light source TL33.