



QSIL Nederland B.V.

Product specification
PH511
*Glass tubes for automotive headlighting
halogen lamps*

WPS-511-001

29-09-2015

1 Introduction

1.1 Purpose

The purpose of this specification is to define the properties and quality requirements for PH511 glass tubes for Automotive halogen headlighting lamps.

1.2 Scope

This document applies to furnace cut and saw cut tubes produced.

1.3 Glass Type

PH511 Low viscosity UV block quartz glass. The glass shows blue luminescence under UV-radiation. 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 ($\eta = 10^{13.5}$ Pa.s)	965		°C
Annealing point ($\eta = 10^{12.4}$ Pa.s)	1020		°C
Softening point ($\eta = 10^{6.65}$ Pa.s)	1535		°C
Working point ($\eta = 10^{3.0}$ Pa.s)	2350		°C
Mechanical			
Density (20°C)		2.21	*10 ³ kg/m ³
Linear Expansion Coefficient (25°C - 300°C)	0.59		*10 ⁻⁶ /°C
Optical			
Index of refraction (20°C, 589.3 nm)	1.46		-
Absorption coefficient α at:			
220 nm	13	≥ 7	cm ⁻¹
320 nm	56	≥ 45	
340 nm	35	≥ 22	
390 nm	0.45	≤ 0.8	
450 nm	0.10	≤ 0.44	
550 - 700 nm	0.05	≤ 0.22	
Transmittance at 1 mm wall thickness including surface reflection losses calculated from α using $T_0=93\%$ at:			
220 nm	23		%
320 nm	0.3		
340 nm	2.7		
390 nm	88.4		
450 nm	91.9		
550 - 700 nm	92.2		



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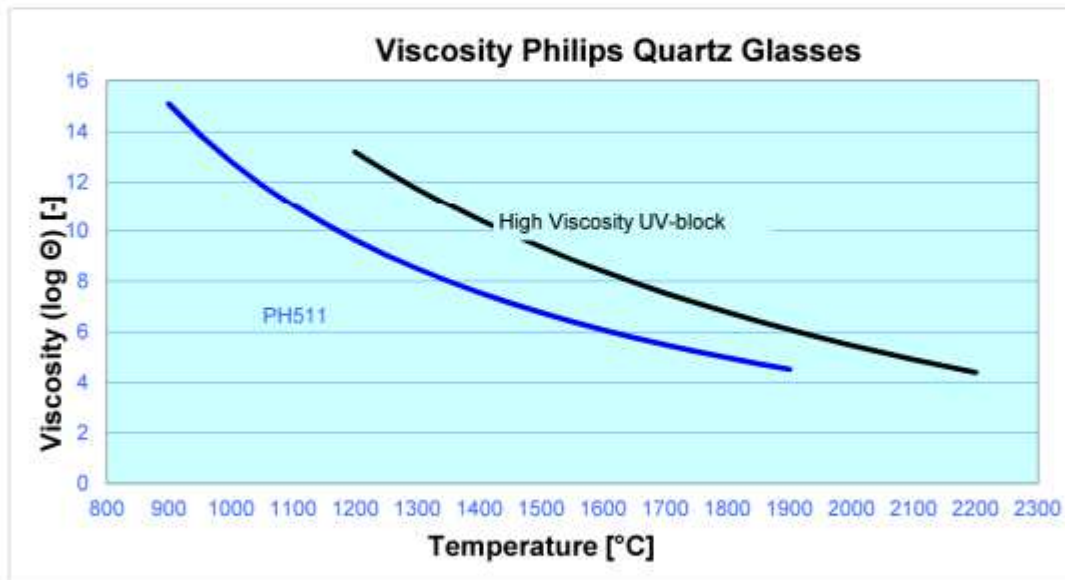


Figure 1 Viscosity

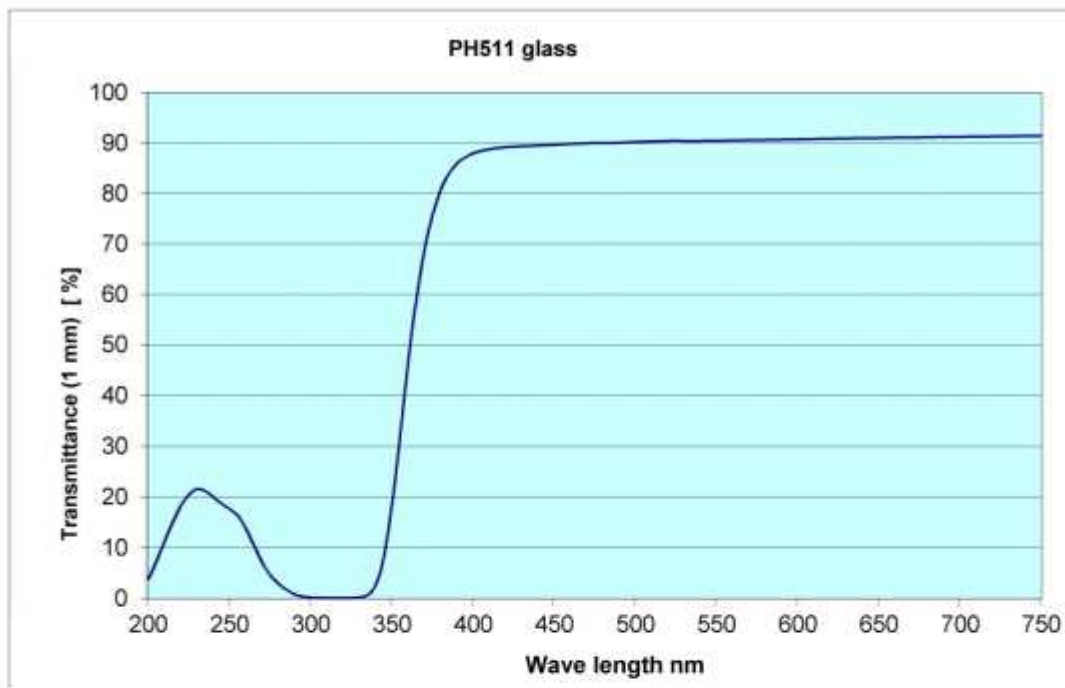


Figure 2 Typical transmittance



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	Typical	Requirement	Unit
Chemical			
β -OH content	30 – 40	≤ 84	PPM
$\Delta \beta$ -OH content*		≤ 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 tube 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
003	Wall thickness	1.0 %	Continuous measuring and sorting. Wall thickness control towards nominal and sorting on USL and LSL.	In-line measuring device
004	Wall siding	1.0 %	Continuous measuring and sorting (max wall thickness – min wall thickness).	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
Saw cut				
005	Length	1.0 %	Sample check, (Median & Range)	Off-line length measuring device
007	Skewness of tube ends	1.0 %	Sample check, (Median & Range) (Max length – min length per tube end).	Off-line length 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		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.
Open air lines		An elongated void, > 0.1 mm wide and > 14 mm long, open to the quartz surface or just below the quartz surface with a thin membrane, which can be crushed easily.	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
Scratches		Individual scratches width > 0.2 mm and length > 150 mm. Sum of length of all scratches with width > 0.2 mm max. 25% of tube length.	TL light source with black back-ground.
Inhomogeneity (lines)		Lines, with deviating color and intensity in the axial direction of the tube (according to internal limit sample).	
Closed air lines		A closed air line is an elongated void, > 0.1 mm wide and > 2 mm length, fully enclosed in the quartz material. Typical air line level in PH511: 20 mm per meter tube. Sorting criteria for individual tubes <ul style="list-style-type: none"> • Air lines with a length > 100 mm are not allowed. • Air lines with a length in the range > 50 mm and <= 100mm. Maximum 2 air lines per tube allowed. Statistical process control <ul style="list-style-type: none"> • The 2 hour moving average of the sum of the length of all air lines, in the range of 2 – 100 mm, shall not exceed 40 mm/m as a moving average value per production interval of 2 hours. 	
Tube end irregularities		Tube end irregularities > 5 mm	
Striation		Ridges and grooves in the axial direction of the tube. According to internal standard (value > 35).	Striation measurement device.
Total 1.5% (sum of class III defect)			

The requirements for saw cut products are under construction.



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2.4 Standard products

Lamp Type	OD [mm]	WT [mm]	L furnace cut [mm]
H1	8.00 ± 0.12	1.00 ± 0.08	1220, 1475, 1480, 1493 1495, 1500, 1505, 1520 ± 5
H3	10.7 ± 0.16	1.05 ± 0.08	
H4	14.2 ± 0.21	1.20 ± 0.10	
H7	10.7 ± 0.16	1.20 ± 0.10	



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3 Environmental data

LabGC
Laboratory for Glass and Ceramics
Analysis Report

Number: **SW-LAB/RoHS/13-004**
Date: 28-10-2013
Company: Philips Lighting B.V.
Winschoten

Request: **RoHS Certificate of Compliance Quartz Glass**

RoHS Certificate of Compliance Special Glass 2013 – PH511

This document certifies that glass mentioned below are fully RoHS compliant with Directive 2002/95/EG and ISO/TS 16949.

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	Date Sample	Oven	Pb	Cd	Hg	Cr-total
PH511	28-10-13	22-10-13	SQE	< 0,2	< 0,02	<0,3	< 0,3

< = 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

This certificate is valid until: 28-10-2014

1

Update ROHS analysis is available on request.



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4 Typical composition PH511 glass

Component	Weight (%)
SiO ₂	99.08
CeO ₂	0.58
Al ₂ O ₃	0.03
K ₂ O	0.24
BaO	0.07



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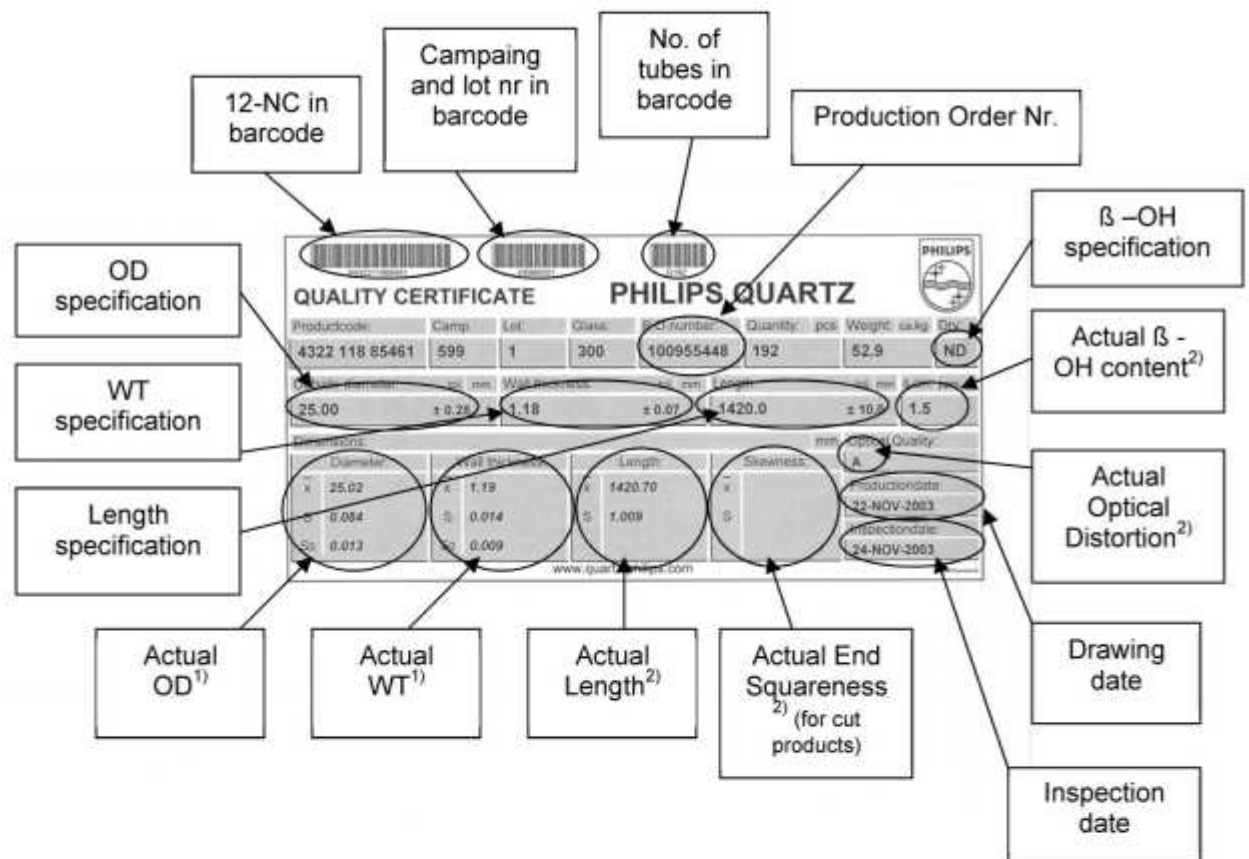
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Annex 1: example Certificate of Conformance

1) By in-line measurements

X = average value $OD_{NS, EW}$ respectively $WT_{N, S, E, W}$ one measurement per individual 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



Annex 2: Instructions for processing PH511

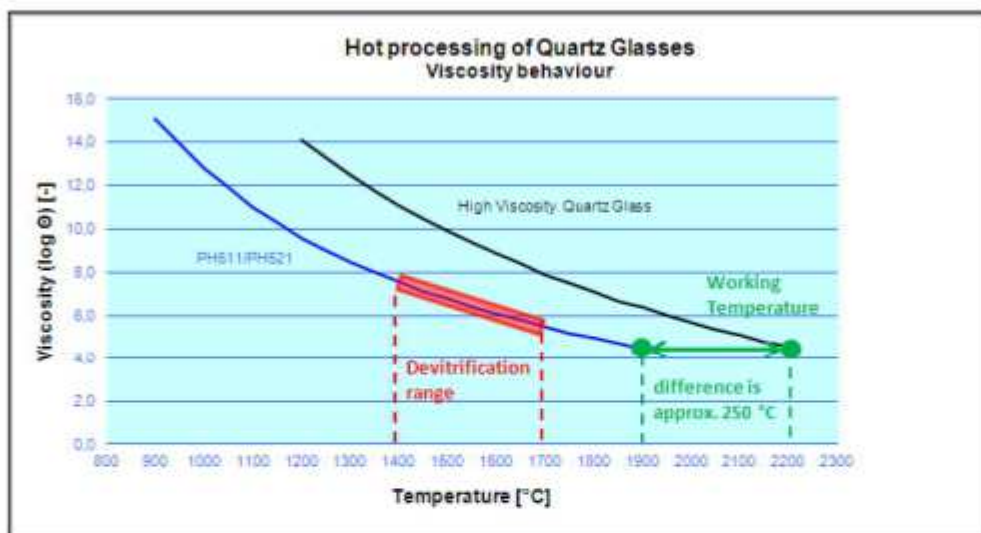
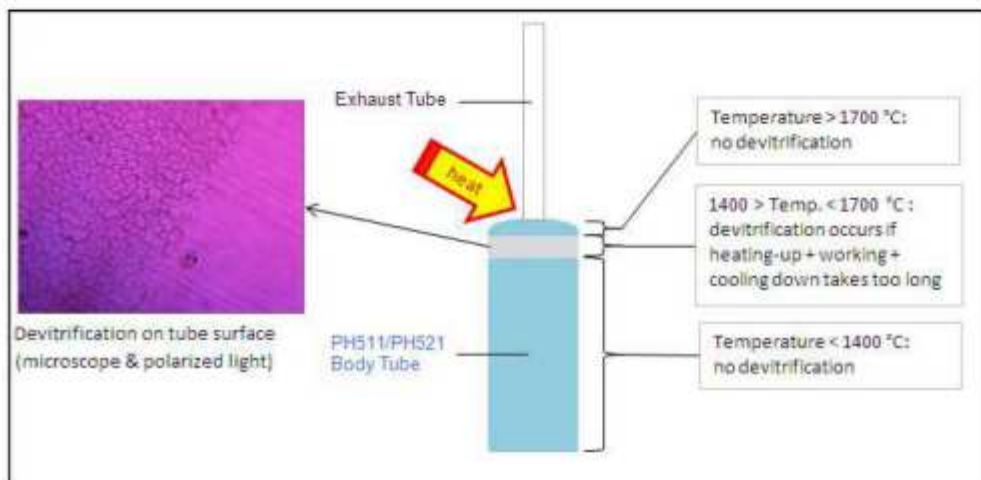
Introduction

PH511 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)

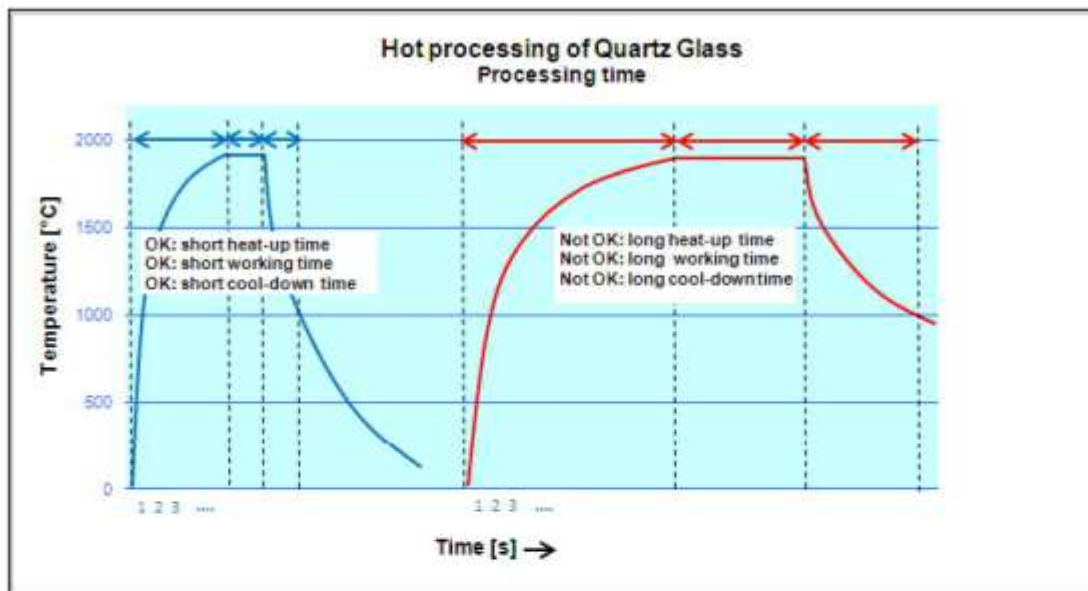
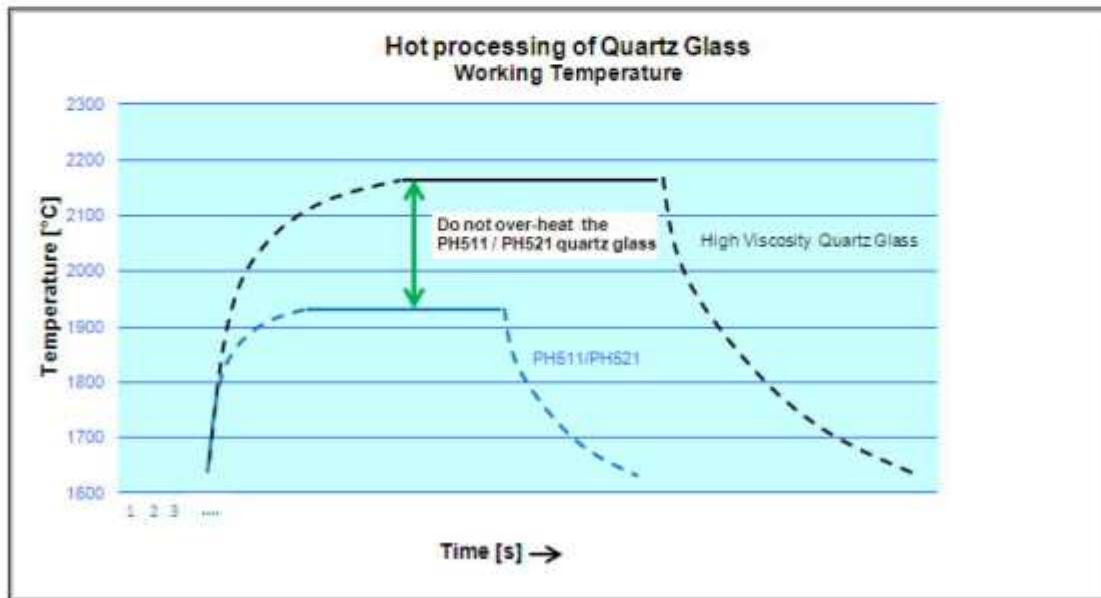
Devitrification can occur at spots in the product where the glass has been heated to temperatures between approx. 1400 and 1700°C.



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	29-09-2015	CP 15102. First publication. Replaces GLN-X-03-511 and GLV 106-07-272.