PHILIPS

# Philips Lighting Components

H.M.Brouwerstraat 1, 9672 AG Winschoten, The Netherlands

## PH078 glass

Introduction

Philips PH078 glass is an Alkali Lead glass (35% lead).
This glass is used for production of Cathode Ray Tubes (x-ray absorbing electron cannon envelope) , chemical electrodes (good chemical resistance, high specific resistance) and envelopes for small incandescent lamps.

**Technical data of Philips 078 glass**

### *Thermal properties*

| | | | |
|---|---|---|---|
| Coeffiënt of expansion | 25-300 °C | $10^{-6}$ °C$^{-1}$ | 9,8 |
| | 25°C to $t_g$ | $10^{-6}$ °C$^{-1}$ | 10,7 |
| | 25°C to $t_g$ +10 | $10^{-6}$ °C$^{-1}$ | 11,1 |
| | 25°C to $t_g$ +15 | $10^{-6}$ °C$^{-1}$ | 11,3 |
| Transformation temperature($t_g$) | | °C | 465 |
| Liquidus temperature | | °C | 700 |
| Conductivity | | W.m$^{-1}$.°C$^{-1}$ | - |
| Viscosity data | | | |
| Strain point | $10^{14,5}$ dPa.s | °C | 445 |
| Annealing point | $10^{13}$ dPa.s | °C | 475 |
| Philips soft. point | $10^{12,4}$ dPa.s | °C | 492 |
| Softening point | $10^{7,6}$ dPa.s | °C | 650 |
| Working point | $10^{4,0}$ dPa.s | °C | 960 |
| Melting point | $10^{2,0}$ dPa.s | °C | 1385 |
| Stress in standardglass 01/1 | | nm.cm$^{-1}$ | T50-C100 |

### *Mechanical Properties*

| | | | |
|---|---|---|---|
| Density | 20°C | $10^3$ kg.m$^{-3}$ | 3,30 |
| Young's modulus | 20°C | GPa | 59 |
| E-Modulus(shear) | 20°C | GPa | |
| Poisson's ratio | 20°C | | 0,24 |
| Surface tension (at $10^4$ dPa.s) | | $10^3$ N.m $^{-1}$ | |

### *Electrical properties*

| | | | |
|---|---|---|---|
| Volume resistivity | $^{10}$log ρ 250 °C | Ω.cm | 10,5 |
| | $^{10}$log ρ 350 °C | Ω.cm | 8,4 |
| $t_{k100}$ | | °C | 375 |
| Dielectric constant | at 20 °C and 1 MHz | | 8,1 |
| Loss tangent | at 20 °C and 1 MHz | (x$10^{-4}$) | 16,4 |
| Lin. coeff. of X-ray absorption | at 20,6 kV / 0,6A | cm$^{-1}$ | >101 |

### *Optical properties*

| | | |
|---|---|---|
| Index of refraction $n_D$. | at λ = 589,3 nm | 1,596 |

Data subject to change without notice.

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## PH160 glass

Introduction

Philips 160 glass is a sodium-barium-silicate glass, available as clear machine-drawn tubing.
It has a high transmittance in the short UV region of the spectrum.
At a wavelength of 253,7 nm (mercury vapour spectral line), the minimum transmittance 75% at a wall thickness of 1 mm.
The thermal expansion properties are matched to seal to Philips 291 stem tubing.
Main application areas are:
- envelopes for low-pressure mercury vapour germicidal lamps.

**Technical data of Philips 160 glass**

### *Thermal properties*

| | | | |
|---|---|---|---|
| Coeffiënt of expansion | 25-300 °C | $°C^{-1}(x10^{-6})$ | 9,9 |
| Transformation temperature | | °C | 470 |
| Conductivity | 20°C | $W.m^{-1}.°C^{-1}$ | 0,95 |
| Viscosity data | | | |
| Strain point | $10^{14,5}$ dPa.s | °C | 460 |
| Annealing point | $10^{13}$ dPa.s | °C | 490 |
| Softening point | $10^{7,6}$ dPa.s | °C | 670 |
| Working point | $10^{4}$ dPa.s | °C | 1000 |
| Melting point | $10^{2}$ dPa.s | °C | 1460 |

### *Mechanical Properties*

| | | | |
|---|---|---|---|
| Density | 20°C | $kg.m^{-3}(x10^{3})$ | 2,53 |
| Young's modulus | | GPa | 65 |
| Poisson's ratio | | | 0,25 |

### *Electrical properties*

| | | | |
|---|---|---|---|
| Volume resistivity | $^{10}$log ρ 250 °C | Ω.cm | 8,0 |
| | $^{10}$log ρ 350 °C | Ω.cm | 6,3 |
| $^{t}$k 100 | $10^{8}$ Ω.cm | °C | 250 |
| Dielectric constant | at 20 °C and 1 MHz | | - |
| Loss tangent | at 20 °C and 1 MHz | $(x10^{-4})$ | - |

### *Optical properties*

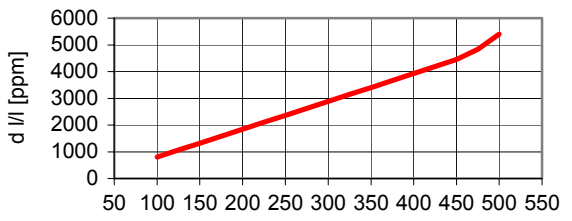
| | | | |
|---|---|---|---|
| Index of refraction $n._{D}$. | at λ = 589,3 nm | | 1,508 |
| Transmittance (thickness 1 mm) including surface losses | | | See graph |

Data subject to change without notice.

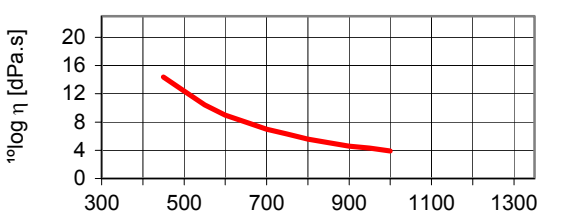
H.M.Brouwerstraat 1, 9672 AG Winschoten, The Netherlands

# PH160 glass

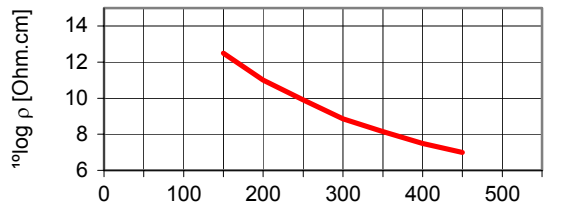
**Thermal expansion curve**



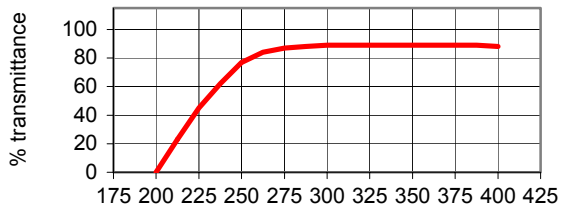

**Viscosity curve**




**Electrical resistivity**




**UV transmittance (1mm)**



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# Philips Lighting Components

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## PH175 glass

**Introduction**

Philips 175 glass is a dark-blue alkali-lead glass, available as machine-drawn tubing. It has high transmittance characteristics in the near UV-A region of the spectrum. At a wavelength of 365 nm the typical transmittance is 80% at a thickness of 1mm. The transmittance is negligible in the visible region of the spectrum. The thermal expansion is adapted to Philips 291 stem tubing. Main application area is:

- envelopes for low-pressure mercury vapour 'black light blue' lamps.

**Technical data of Philips 175 glass**

***Thermal properties***

| | | | |
|---|---|---|---|
| Coefficiënt of expansion | 25-300 °C | $°C^{-1}(x10^{-6})$ | 10,0 |
| Transformation temperature | | °C | 430 |
| Conductivity | 20 °C | $W.m^{-1}.°C^{-1}$ | - |
| Viscosity data | | | |
| Strain point | $10^{14,5}$ dPa.s | °C | 410 |
| Annealing point | $10^{13}$ dPa.s | °C | 440 |
| Softening point | $10^{7,6}$ dPa.s | °C | 615 |
| Working point | $10^{4}$ dPa.s | °C | 950 |
| Melting point | $10^{2}$ dPa.s | °C | 1450 |

***Mechanical Properties***

| | | | |
|---|---|---|---|
| Density | 20°C | $kg.m^{-3}(x10^{-3})$ | 2,88 |
| Young's modulus | | GPa | 63 |
| Poisson's ratio | | | 0,22 |

***Electrical properties***

| | | | |
|---|---|---|---|
| Volume resistivity | $^{10}\log \rho$ 250 °C | Ω.cm | 8,2 |
| | $^{10}\log \rho$ 350 °C | Ω.cm | 6,4 |
| $^{t}k$ 100 | $10^{8}$ Ω . cm | °C | 260 |
| Dielectric constant | at 20 °C and 1 MHz | | - |
| Loss tangent | at 20 °C and 1 MHz | $(x10^{-4})$ | - |

***Optical properties***

| | | | |
|---|---|---|---|
| Index of refraction $n_D$. | at $\lambda$ = 589,3 nm | | - |
| Transmittance (thickness 1 mm) | | | See |
| Including surface losses | | | graph |

Data subject to change without notice.

# Philips Lighting Components

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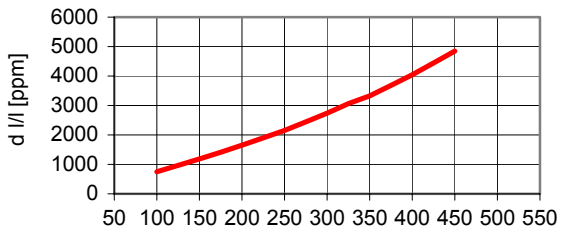
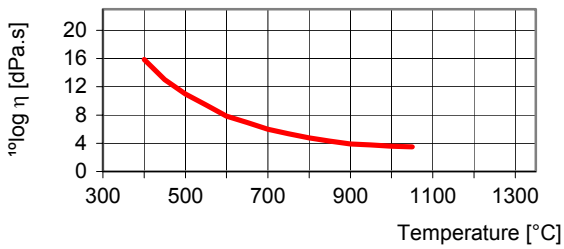
## PH175 glass

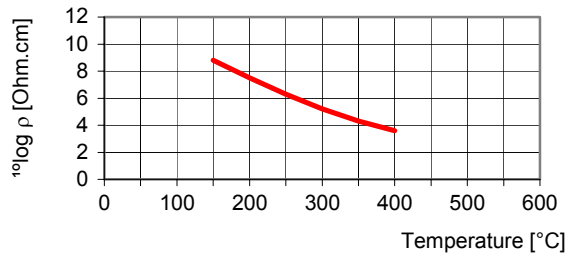
**Thermal expansion curve**



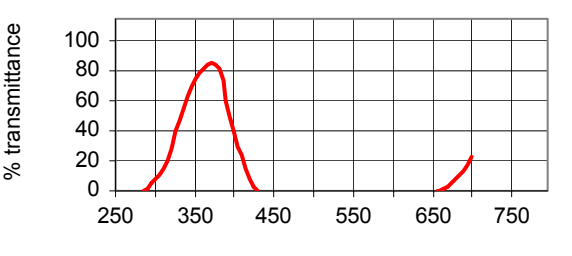

**Viscosity curve**




**Electrical resistivity**




**Transmittance (1mm)**



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## PH212 glass

Introduction

Philips 212 glass is a borate glass.
This glass is used as internal layer in the composite tubing for low pressure sodium vapour discharge lamps. The glass is available as fritts.
212-glass is resistant to the attack of sodium vapour and does not absorb argon. The glass is very sensitive to moisture.

**Technical data of Philips 212 glass**

### *Thermal properties*

| | | | |
|---|---|---|---|
| Coefficient of expension | 25-300 °C | $10^{-6}$ °C$^{-1}$ | 10,70 |
| | 25°C to $t_g$ | $10^{-6}$ °C$^{-1}$ | 12,00 |
| | 25°C to $t_g$ +10 | $10^{-6}$ °C$^{-1}$ | 12,60 |
| | 25°C to $t_g$ +15 | $10^{-6}$ °C$^{-1}$ | 13,00 |
| Transformation temperature($t_g$) | | °C | 540 |
| Liquidus temperature | | °C | 760 |
| Conductivity | 20°C | W.m$^{-1}$.°C$^{-1}$ | - |
| Viscosity data | | | |
| Strain point | $10^{14,5}$ dPa.s | °C | 535 |
| Annealing point | $10^{13}$ dPa.s | °C | 550 |
| Philips soft.point | $10^{12,4}$ dPa.s | °C | 555 |
| Softening point | $10^{7,6}$ dPa.s | °C | 640 |
| Working point | $10^{4}$ dPa.s | °C | 760 |
| Melting point | $10^{2}$ dPa.s | °C | 895 |
| Stress in standardglass 34/2 | | nm.cm$^{-1}$ | C50 – T50 |

### *Mechanical Properties*

| | | | |
|---|---|---|---|
| Density | 20°C | $10^{3}$ kg.m$^{-3}$ | 3,70 |
| E modulus | 20°C | GPa | - |
| Poisson's ratio | 20°C | | - |

### *Electrical properties*

| | | | |
|---|---|---|---|
| Volume resistivity | $^{10}$log ρ 450 °C | Ω.cm | 8,1 |
| | $^{10}$log ρ 550 °C | Ω.cm | 6,8 |
| $t_{k100}$ | | °C | 455 |
| Dielectric constant | 20°C, 1MHz | | - |
| Loss tangent | 20°C, 1MHz | | - |

### *Optical properties*

| | | | |
|---|---|---|---|
| Index of refraction $n._D$. | at λ = 589,3 nm | | - |
| Transmittance (thickness 1 mm) including surface losses | | | - |

Data subject to change without notice.

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**Philips Lighting Components**

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# PH220 glass

Introduction

Philips 220 glass is a soda lime glass. This glass is used as a base glass for two-ply sodium resistant tubing for low pressure sodium vapour discharge lamps.
The available form is tubing.
220-glass does not show any discolouration in a reducing flame.

**Technical data of Philips 220 glass**

***Thermal properties***

| | | | |
|---|---|---|---|
| Coeffiënt of expansion | 25-300 °C | $10^{-6}$ °C$^{-1}$ | 10,30 |
| | 25°C to $t_g$ | $10^{-6}$ °C$^{-1}$ | 11,60 |
| | 25°C to $t_g$ +10 | $10^{-6}$ °C$^{-1}$ | 12,30 |
| | 25°C to $t_g$ +15 | $10^{-6}$ °C$^{-1}$ | 12,80 |
| Transformation temperature($t_g$) | | °C | 500 |
| Liquidus temperature | | °C | 760 |
| Conductivity | | W.m$^{-1}$.°C$^{-1}$ | - |
| Viscosity data | | | |
| Strain point | $10^{14,5}$ dPa.s | °C | 490 |
| Annealing point | $10^{13}$ dPa.s | °C | 520 |
| Philips soft.point | $10^{12,4}$ dPa.s | °C | 530 |
| Softening point | $10^{7,6}$ dPa.s | °C | 680 |
| Working point | $10^{4,0}$ dPa.s | °C | 970 |
| Melting point | $10^{2,0}$ dPa.s | °C | 1390 |
| Stress in standardglass 34/2 | | nm.cm$^{-1}$ | C150…0 |

***Mechanical Properties***

| | | | |
|---|---|---|---|
| Density | 20°C | $10^3$ kg.m$^{-3}$ | 2,60 |
| Young's modulus | 20°C | GPa | 73,2 |
| E-Modulus(shear) | 20°C | GPa | 24,7 |
| Poisson's ratio | 20°C | | 0,233 |
| Surface tension (at $10^4$ dPa.s) | | $10^3$ N.m $^{-1}$ | 355 |

***Electrical properties***

| | | | |
|---|---|---|---|
| Volume resistivity | $^{10}$log ρ 250 °C | Ω.cm | 6,5 |
| | $^{10}$log ρ 350 °C | Ω.cm | 5,1 |
| $t_{k100}$ | | °C | 175 |
| Dielectric constant | at 20 °C and 1 MHz | | - |
| Loss tangent | at 20 °C and 1 MHz | (x$10^{-4}$) | - |

***Optical properties***

| | | | |
|---|---|---|---|
| Index of refraction $n._D$. | at λ = 589,3 nm | | 1,526 |
| Transmittance (thickness 1 mm) including surface losses | | | - |

Data subject to change without notice.

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## PH276 glass

Introduction

Philips PH276 glass is a Zinc-borosilicate glass, available as frits.
The main application is in Cathode Ray Tubes as isolation studs in electron cannons (cathode carrier).

**Technical data of Philips 276 glass**

### *Thermal properties*

| | | | |
|---|---|---|---|
| Coeffiënt of expansion | 25-300 °C | $10^{-6}$ °C$^{-1}$ | 4,7 |
| | 25°C to $t_g$ | $10^{-6}$ °C$^{-1}$ | 5,9 |
| | 25°C to $t_g$ +10 | $10^{-6}$ °C$^{-1}$ | 6,3 |
| | 25°C to $t_g$ +15 | $10^{-6}$ °C$^{-1}$ | 6,8 |
| Transformation temperature($t_g$) | | °C | 560 |
| Liquidus Temperature | | °C | |
| Conductivity | | W.m$^{-1}$.°C$^{-1}$ | - |
| Viscosity data | | | |
| Strain point | $10^{14,5}$ dPa.s | °C | 555 |
| Annealing point | $10^{13}$ dPa.s | °C | 565 |
| Philips soft.point | $10^{12,4}$ dPa.s | °C | 575 |
| Softening point | $10^{7,6}$ dPa.s | °C | 650 |
| Working point | $10^{4,0}$ dPa.s | °C | |
| Melting point | $10^{2,0}$ dPa.s | °C | |
| Stress in standard glass 28/4 | | nm.cm$^{-1}$ | C25 ±75 |

### *Mechanical Properties*

| | | | |
|---|---|---|---|
| Density | 20°C | $10^3$ kg.m$^{-3}$ | 3,73 |
| Young's modulus | 20°C | GPa | - |
| E-Modulus(shear) | 20°C | GPa | - |
| Poisson's ratio | 20°C | | - |
| Surface tension (at $10^4$ dPa.s) | | $10^3$ N.m $^{-1}$ | - |

### *Electrical properties*

| | | | |
|---|---|---|---|
| Volume resistivity | $^{10}$log ρ 250 °C | Ω.cm | 13,5 |
| | $^{10}$log ρ 350 °C | Ω.cm | 11,1 |
| | $^{10}$log ρ 450 °C | Ω.cm | 9,4 |
| | $^{10}$log ρ 550 °C | Ω.cm | 7,9 |
| $t_{k100}$ | | °C | |
| Dielectric constant | at 20 °C and 1 MHz | | - |
| Loss tangent | at 20 °C and 1 MHz | (x$10^{-4}$) | - |

### *Optical properties*

| | | | |
|---|---|---|---|
| Index of refraction $n._D$. | at λ = 589,3 nm | | - |

Data subject to change without notice.

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# Philips Lighting Components

H.M.Brouwerstraat 1, 9672 AG Winschoten, The Netherlands

## PH290 glass

Introduction

Philips PH290 glass is a soda lime glass. This glass is used as a base glass for production of envelopes for incandescent and fluorescent lamps.

**Technical data of Philips 290 glass**

### *Thermal properties*

| | | | |
|---|---|---|---|
| Coeffiënt of expansion | 25-300 °C | $10^{-6}$ °C$^{-1}$ | 9,7 |
| | 25°C to $t_g$ | $10^{-6}$ °C$^{-1}$ | 10,9 |
| | 25°C to $t_g$ +10 | $10^{-6}$ °C$^{-1}$ | 11,3 |
| | 25°C to $t_g$ +15 | $10^{-6}$ °C$^{-1}$ | 11,6 |
| Transformation temperature($t_g$) | | °C | 510 |
| Liquidus Temperature | | °C | <820 |
| Conductivity | | W.m$^{-1}$.°C$^{-1}$ | - |
| Viscosity data | | | |
| Strain point | $10^{14,5}$ dPa.s | °C | 490 |
| Annealing point | $10^{13}$ dPa.s | °C | 520 |
| Philips soft.point | $10^{12,4}$ dPa.s | °C | 535 |
| Softening point | $10^{7,6}$ dPa.s | °C | 690 |
| Working point | $10^{4,0}$ dPa.s | °C | 1005 |
| Melting point | $10^{2,0}$ dPa.s | °C | 1445 |
| Stress in standardglass 34/2 | | nm.cm$^{-1}$ | T350±50 |

### *Mechanical Properties*

| | | | |
|---|---|---|---|
| Density | 20°C | $10^3$ kg.m$^{-}$3 | 2,48 |
| Young's modulus | 20°C | GPa | - |
| E-Modulus(shear) | 20°C | GPa | - |
| Poisson's ratio | 20°C | | - |
| Surface tension (at $10^4$ dPa.s) | | $10^3$ N.m $^{-1}$ | - |

### *Electrical properties*

| | | | |
|---|---|---|---|
| Volume resistivity | $^{10}$log ρ 250 °C | Ω.cm | 8,4 |
| | $^{10}$log ρ 350 °C | Ω.cm | 6,4 |
| $t_{k100}$ | | °C | 165 |
| Dielectric constant | at 20 °C and 1 MHz | | - |
| Loss tangent | at 20 °C and 1 MHz | (x$10^{-4}$) | - |

### *Optical properties*

| | | | |
|---|---|---|---|
| Index of refraction $n._D$. | at λ = 589,3 nm | | - |
| Transmittance (thickness 1 mm) including surface losses | | | - |

Data subject to change without notice.

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# Philips Lighting Components

H.M.Brouwerstraat 1, 9672 AG Winschoten, The Netherlands

## PH291 glass

Introduction

Philips 291 glass is a 20% Lead glass. This glass is used for production of exhaust tubes and flares for incandescent and fluorescent lamps.
Envelopes for small lamps.

**Technical data of Philips 291 glass**

### *Thermal properties*

| | | | |
|---|---|---|---|
| Coeffiënt of expansion | 25-300 °C | $10^{-6}$ °C$^{-1}$ | 9,30 |
| | 25°C to $t_g$ | $10^{-6}$ °C$^{-1}$ | 10,00 |
| | 25°C to $t_g$ +10 | $10^{-6}$ °C$^{-1}$ | 10,30 |
| | 25°C to $t_g$ +15 | $10^{-6}$ °C$^{-1}$ | 10,60 |
| Transformation temperature($t_g$) | | °C | 440 |
| Liquidus temperature | | °C | <900 |
| Conductivity | | W.m$^{-1}$.°C$^{-1}$ | - |
| Viscosity data | | | |
| Strain point | $10^{14,5}$ dPa.s | °C | 410 |
| Annealing point | $10^{13}$ dPa.s | °C | 445 |
| Philips soft. point | $10^{12,4}$ dPa.s | °C | 460 |
| Softening point | $10^{7,6}$ dPa.s | °C | 635 |
| Working point | $10^{4,0}$ dPa.s | °C | 1000 |
| Melting point | $10^{2,0}$ dPa.s | °C | 1505 |
| Stress in standardglass 34/2 | | nm.cm$^{-1}$ | 0…T100 |

### *Mechanical Properties*

| | | | |
|---|---|---|---|
| Density | 20°C | $10^3$ kg·m$^{-3}$ | 2,81 |
| Young's modulus | 20°C | GPa | 62,9 |
| E-Modulus(shear) | 20°C | GPa | 26,0 |
| Poisson's ratio | 20°C | | 0,21 |
| Surface tension (at $10^4$ dPa.s) | | $10^3$ N.m $^{-1}$ | 250 |

### *Electrical properties*

| | | | |
|---|---|---|---|
| Volume resistivity | $^{10}$log ρ 250 °C | Ω.cm | 8,6 |
| | $^{10}$log ρ 350 °C | Ω.cm | 6,8 |
| $t_{k100}$ | | °C | 285 |
| Dielectric constant | at 20 °C and 1 MHz | | - |
| Loss tangent | at 20 °C and 1 MHz | (x$10^{-4}$) | - |

### *Optical properties*

| | | | |
|---|---|---|---|
| Index of refraction $n._D$. | at λ = 589,3 nm | | 1,539 |
| Transmittance (thickness 1 mm) including surface losses | | | - |

Data subject to change without notice.

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# Philips Lighting Components

H.M.Brouwerstraat 1, 9672 AG Winschoten, The Netherlands

## PH319 glass

Introduction

Philips 319 glass is a sodium-barium-silicate glass, available as clear machine-drawn tubing.
It has a high transmittance in the UV-A and UV-B regions of the spectrum. At a wavelength of 297 nm the typical transmittance at 1 mm thickness is 75%. The thermal expansion is matched to Philips 291 stem tubing.
Main application areas are:
-envelopes for low-pressure mercury vapour lamps for medical treatment and for industrial applications (weathering tunnels).

**Technical data of Philips 319 glass**

***Thermal properties***

| | | | |
|---|---|---|---|
| Coeffiënt of expansion | 25-300 °C | $°C^{-1}(x10^{-6})$ | 9,9 |
| Transformation temperature | | °C | 470 |
| Conductivity | 20°C | $W.m^{-1}.°C^{-1}$ | - |
| Viscosity data | | | |
| Strain point | $10^{14,5}$ dPa.s | °C | 460 |
| Annealing point | $10^{13}$ dPa.s | °C | 490 |
| Softening point | $10^{7,6}$ dPa.s | °C | 670 |
| Working point | $10^{4}$ dPa.s | °C | 1000 |
| Melting point | $10^{2}$ dPa.s | °C | 1460 |

***Mechanical Properties***

| | | | |
|---|---|---|---|
| Density | 20°C | $kg.m^{-3}(x10^{3})$ | 2,53 |
| Young's modulus | | GPa | - |
| Poisson's ratio | | | - |

***Electrical properties***

| | | | |
|---|---|---|---|
| Volume resistivity | $^{10}\log \rho$ 250 °C | Ω.cm | 8,0 |
| | $^{10}\log \rho$ 350 °C | Ω.cm | 6,3 |
| $^{t}k$ 100 | $10^{8}$ Ω.cm | °C | 250 |
| Dielectric constant | at 20 °C and 1 MHz | | - |
| Loss tangent | at 20 °C and 1 MHz | $(x10^{-4})$ | - |

***Optical properties***

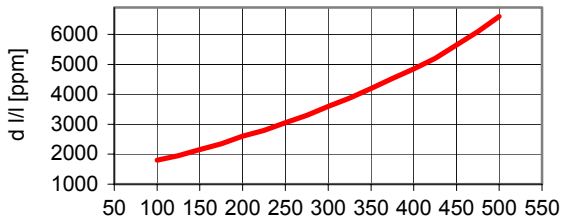
| | | | |
|---|---|---|---|
| Index of refraction $n_D$. | at $\lambda$ = 589,3 nm | | 1,508 |
| Transmittance (thickness 1 mm) including surface losses | | | See graph |

Data subject to change without notice.

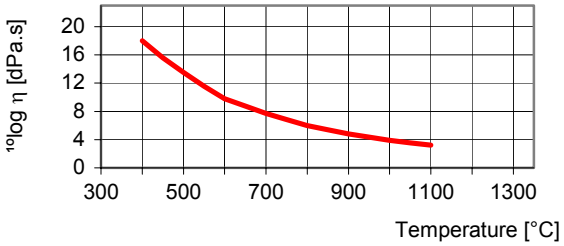
H.M.Brouwerstraat 1, 9672 AG Winschoten, The Netherlands

# PH319 glass

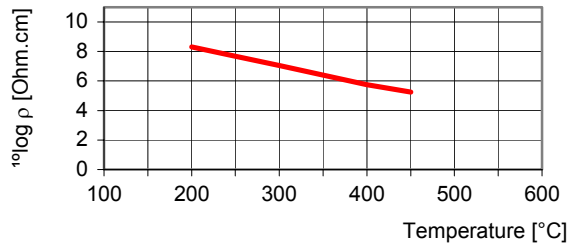
**Thermal expansion curve**



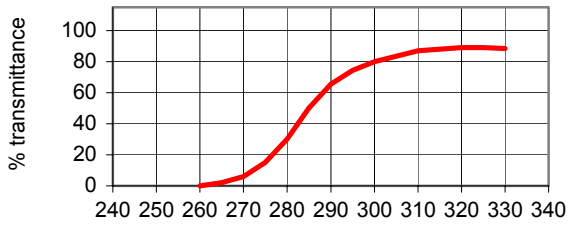

**Viscosity curve**




**Electrical resistivity**




**UV transmittance (1mm)**



PHILIPS

# Philips Lighting Components

H.M.Brouwerstraat 1, 9672 AG Winschoten, The Netherlands

## PH330 glass

Introduction

Philips 330 glass is a Soda Barium glass available as tubing. PH330 is a high VIS-transmitting soft glass.
This glass is used as a base glass for production of envelopes for low pressure fluorescent lamps and neon applications.

**Technical data of Philips 330 glass**

### *Thermal properties*

| | | | |
|---|---|---|---|
| Coeffiënt of expansion | 25-300 °C | $10^{-6}$ °C$^{-1}$ | 9,9 |
| | 25°C to $t_g$ | $10^{-6}$ °C$^{-1}$ | |
| | 25°C to $t_g$ +10 | $10^{-6}$ °C$^{-1}$ | |
| | 25°C to $t_g$ +15 | $10^{-6}$ °C$^{-1}$ | |
| Transformation temperature($t_g$) | | °C | 480 |
| Liquidus Temperature | | °C | |
| Conductivity | | W.m$^{-1}$.°C$^{-1}$ | - |
| Viscosity data | | | |
| Strain point | $10^{14,5}$ dPa.s | °C | 455 |
| Annealing point | $10^{13}$ dPa.s | °C | 490 |
| Philips soft.point | $10^{12,4}$ dPa.s | °C | 505 |
| Softening point | $10^{7,6}$ dPa.s | °C | 675 |
| Working point | $10^{4,0}$ dPa.s | °C | 995 |
| Melting point | $10^{2,0}$ dPa.s | °C | 1450 |
| Stress in standard glass 34/2 | | nm.cm$^{-1}$ | T100±100 |

### *Mechanical Properties*

| | | | |
|---|---|---|---|
| Density | 20°C | $10^3$ kg.m$^{-3}$ | 2,53 |
| Young's modulus | 20°C | GPa | |
| E-Modulus(shear) | 20°C | GPa | |
| Poisson's ratio | 20°C | | |
| Surface tension (at $10^4$ dPa.s) | | $10^3$ N.m $^{-1}$ | |

### *Electrical properties*

| | | | |
|---|---|---|---|
| Volume resistivity | $^{10}$log ρ 250 °C | Ω.cm | 8,1 |
| | $^{10}$log ρ 350 °C | Ω.cm | 6,4 |
| $t_{k100}$ | | °C | 260 |
| Dielectric constant | at 20 °C and 1 MHz | | - |
| Loss tangent | at 20 °C and 1 MHz | (x$10^{-4}$) | - |

### *Optical properties*

| | | | |
|---|---|---|---|
| Index of refraction $n._D$. | at λ = 589,3 nm | | 1,5 |
| Absorption coefficient | 200-310nm | cm$^{-1}$ | >55 |
| Transmittance (thickness 1 mm) | at 330nm | % | 1,0 |
| including surface losses | 350nm | % | 50,0 |
| | 380nm | % | 90,0 |
| | 400-700nm | % | 91,6 |

Data subject to change without notice.

PHILIPS

# Philips Lighting Components

H.M.Brouwerstraat 1, 9672 AG Winschoten, The Netherlands

## PH360 glass

Introduction

Philips 360 glass is a Barium Strontium glass. This glass is used as a base glass for production of envelopes for incandescent and fluorescent lamps as well as for exhaust tubes and flares.

**Technical data of Philips 360 glass**

### *Thermal properties*

| | | | |
|---|---|---|---|
| Coeffiënt of expansion | 25-300 °C | $10^{-6}$ °C$^{-1}$ | 9,20 |
| | 25°C to $t_g$ | $10^{-6}$ °C$^{-1}$ | 10,55 |
| | 25°C to $t_g$ +10 | $10^{-6}$ °C$^{-1}$ | 10,85 |
| | 25°C to $t_g$ +15 | $10^{-6}$ °C$^{-1}$ | 11,05 |
| Transformation temperature($t_g$) | | °C | 475 |
| Liquidus Temperature | | °C | <800 |
| Conductivity | | W.m$^{-1}$.°C$^{-1}$ | - |
| Viscosity data | | | |
| Strain point | $10^{14,5}$ dPa.s | °C | 455 |
| Annealing point | $10^{13}$ dPa.s | °C | 485 |
| Philips soft.point | $10^{12,4}$ dPa.s | °C | 500 |
| Softening point | $10^{7,6}$ dPa.s | °C | 675 |
| Working point | $10^{4,0}$ dPa.s | °C | 1020 |
| Melting point | $10^{2,0}$ dPa.s | °C | 1490 |
| Stress in standardglass 34/2 | | nm.cm$^{-1}$ | T300±100 |

### *Mechanical Properties*

| | | | |
|---|---|---|---|
| Density | 20°C | $10^3$ kg.m$^{-3}$ | 2,62 |
| Young's modulus | 20°C | GPa | 72,5 |
| E-Modulus(shear) | 20°C | GPa | 29,5 |
| Poisson's ratio | 20°C | | 0,23 |
| Surface tension (at $10^4$ dPa.s) | | $10^3$ N.m $^{-1}$ | 310 |

### *Electrical properties*

| | | | |
|---|---|---|---|
| Volume resistivity | $^{10}$log ρ 250 °C | Ω.cm | 8,8 |
| | $^{10}$log ρ 350 °C | Ω.cm | 6,9 |
| $t_{k100}$ | | °C | 290 |
| Dielectric constant | at 20 °C and 1 MHz | | - |
| Loss tangent | at 20 °C and 1 MHz | (x$10^{-4}$) | - |

### *Optical properties*

| | | | |
|---|---|---|---|
| Index of refraction $n._D$. | at λ = 589,3 nm | | 1,523 |
| Transmittance (thickness 1 mm) including surface losses | | | - |

Data subject to change without notice.

# Philips Lighting Components

H.M.Brouwerstraat 1, 9672 AG Winschoten, The Netherlands

# PH368 glass

Introduction

Philips 368 glass is a Barium Strontium glass. This glass is used as a base glass for production of envelopes for suntanning lamps.

**Technical data of Philips 368 glass**
(typical values)

### *Thermal properties*

| | | | |
|---|---|---|---|
| Coeffiënt of expansion | 25-300 ºC | $10^{-6}$ ºC$^{-1}$ | 9,25 |
| | 25ºC to $t_g$ | $10^{-6}$ ºC$^{-1}$ | 10,50 |
| | 25ºC to $t_g$ +10 | $10^{-6}$ ºC$^{-1}$ | 10,90 |
| | 25ºC to $t_g$ +15 | $10^{-6}$ ºC$^{-1}$ | 11,20 |
| Transformation temperature($t_g$) | | ºC | 480 |
| Liquidus Temperature | | ºC | <840 |
| Conductivity | | W.m$^{-1}$.ºC$^{-1}$ | - |
| Viscosity data | | | |
| Strain point | $10^{14,5}$ dPa.s | ºC | 455 |
| Annealing point | $10^{13}$ dPa.s | ºC | 490 |
| Philips soft.point | $10^{12,4}$ dPa.s | ºC | 505 |
| Softening point | $10^{7,6}$ dPa.s | ºC | 675 |
| Working point | $10^{4,0}$ dPa.s | ºC | 1020 |
| Melting point | $10^{2,0}$ dPa.s | ºC | 1490 |
| Stress in standardglass 34/2 | | nm.cm$^{-1}$ | T300±100 |

### *Mechanical Properties*

| | | | |
|---|---|---|---|
| Density | 20ºC | $10^3$ kg.m$^{-3}$ | 2,62 |
| Young's modulus | 20ºC | GPa | 72,5 |
| E-Modulus(shear) | 20ºC | GPa | 29,9 |
| Poisson's ratio | 20ºC | | 0,21 |
| Surface tension (at $10^4$ dPa.s) | | $10^3$ N.m$^{-1}$ | 335 |

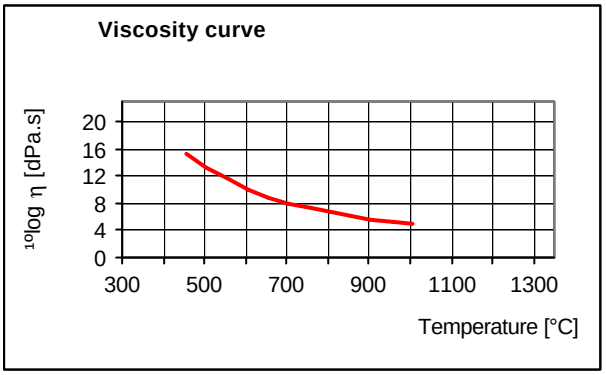
### *Electrical properties*

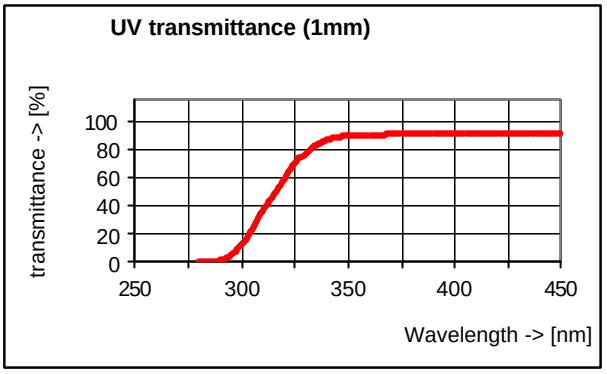
| | | | |
|---|---|---|---|
| Volume resistivity | $^{10}$log ρ 250 ºC | ? .cm | 8,9 |
| | $^{10}$log ρ 350 ºC | ? .cm | 7,0 |
| $t_{k100}$ | | ºC | 290 |
| Dielectric constant | at 20 ºC and 1 MHz | | - |
| Loss tangent | at 20 ºC and 1 MHz | (x$10^{-4}$) | - |

### *Optical properties*

| | | | |
|---|---|---|---|
| Index of refraction $n._D$. | at λ = 589,3 nm | | 1,523 |
| Transmittance (thickness 1 mm) including surface losses | at λ = 312.6 nm | % | 42,5±3 |

Data subject to change without notice.


Viscosity curve
¹⁰log η [dPa.s]
20
16
12
8
4
0
300
500
700
900
1100
1300
Temperature [°C]


UV transmittance (1mm)
transmittance -> [%]
100
80
60
40
20
0
250
300
350
400
450
Wavelength -> [nm]

## Philips Lighting Components

H.M.Brouwerstraat 1, 9672 AG Winschoten, The Netherlands

# PH910 glass

Introduction

Philips PH910 glass is a two-ply glass consisting of a soda lime glass envelope, coated at the inside with a thin (typ. 0,1mm) sheet of borate glass.
The PH910 glass is available as tubing.

The main application for PH910 two-ply glass is for burners of sodium vapour discharge lamps. The PH212 protects the soda lime against the attack of sodium vapour in this application. The PH212 does not absorb Argon. Because of the sensitivity to moisture of the borate glass, PH910 tubes have to be kept in a dry environment after unpacking.

Separate sheets for the soda lime glass and the borate glass are available as PH220 and PH212 datasheets.