

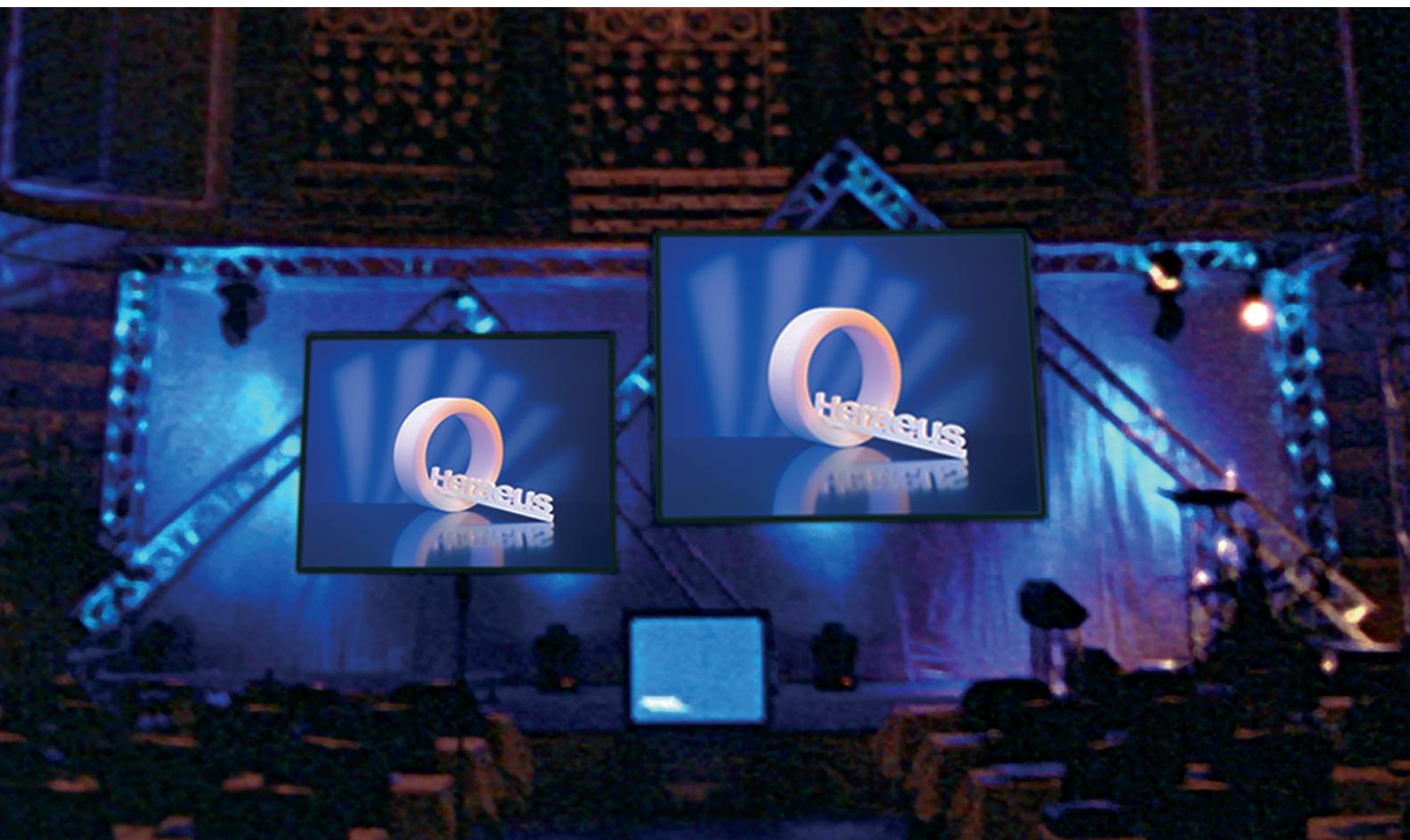
Heraeus



**Quartz Glass for Ultra High
Pressure and High Intensity
Discharge Lamps**

Heraeus Quarzglas

Advanced Material for Highest Demands



Improved lighting performance and efficiency, a compact size and long lifetime should be available at favourable costs

Projection – imaging your life

New projection technologies, e.g. back-illumination, are driving the various digital illumination solutions. At the same time, they continuously increase the reliability and quality of the signal produced. The trends in this modern technology, e.g. projectors, TV and electronic cinema, support large-area pictures, higher brightness, wider viewing angles and a more compact size. All these features should be available at favourable costs.

One key element of the new digital projection applications is a high-intensity discharge lamp. A point-like arc combined with lifetimes of usually several thousand hours, especially in rear projection TVs, is required to meet consumers' needs. The light source, normally a mercury short-arc lamp with a quartz envelope,

operates with power loads up to 300 W/cm, leading to surface temperatures over 1000°C and fill gas pressures over 200 bars.

Modern projection systems need to be compact in size and should produce high-resolution images of high brightness. The trend is hence more compact lamps with higher power and higher light output. As a result, the wall load continually increases. At the same time, a longer lamp lifetime and a constant light output is required in new applications, especially in rear projection TVs.

> 200 Watt

> 200 bar

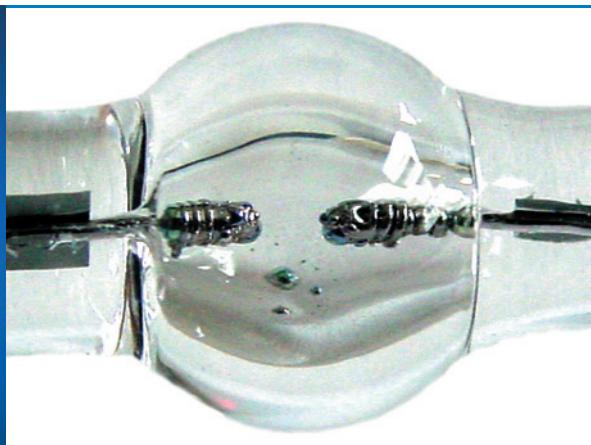
> 1000°C

> 10000 hours

Customized quartz solutions from Heraeus for UHP-application

Heraeus has supplied high-quality quartz glass for over one hundred years. For the demands of modern projection technology, Heraeus offers an advanced quartz glass that meets the high requirements of ultra-high-pressure (UHP) lamps. The new HLQ-170 is an improved quartz material based on proven HLQ grades. It combines typical HLQ features, e.g. the excellent heat resistance and workability, with new properties:

- reduced discoloration after annealing
 - minimum hydroxyl (OH-) and hydrogen content
- In addition HLQ-170 supports the highly automatic production of lamps by providing tightest geometric tolerances.
- In view of such high requirements, the economical and technical advantages of obtaining quartz lamp tubes from a well-experienced producer such as Heraeus Quarzglas are obvious.
- higher purity, especially a low alkaline and iron content
 - higher re-crystallisation resistance
 - a low bubble and defect content



Reduced electrode distance in new lamp types result in higher wall loads and higher wall temperatures.

UHP Lamps Need High Performance Quartz Glass

| | | | | | | | | | | | | | | | | | | | | | | | | | | |
|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 1 | H | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | Li | 4 | Be | | | | | | | | | | | | | | | | | | | | | | | |
| 11 | Na | 12 | Mg | | | | | | | | | | | | | | | | | | | | | | | |
| 19 | K | 20 | Ca | 21 | Sc | 22 | Ti | 23 | V | 24 | Cr | 25 | Mn | 26 | Fe | 27 | Co | 28 | Ni | 29 | Cu | 30 | Zn | 31 | Ga | 32 |
| 37 | Rb | 38 | Sr | 39 | Y | 40 | Zr | 41 | Nb | 42 | Mo | 43 | Tc | 44 | Ru | 45 | Rh | 46 | Pd | 47 | Ag | 48 | Cd | 49 | In | 50 |
| 55 | Cs | 56 | Ba | 57 | Lu | 58 | Hf | 59 | Ta | 60 | W | 61 | Re | 62 | Os | 63 | Ir | 64 | Pt | 65 | Au | 66 | Hg | 67 | Tl | 68 |
| 87 | Fr | 88 | Ra | | | | | | | | | | | | | | | | | | | | | | | |

Using own purification technologies, Heraeus produces quartz glass of purities up to 99.999 %

Short-arc lamps are an integral part of modern projection systems. Permanent development is needed to ensure a performance that meets the high requirements. To suit the decreasing lamp size and increasing power, high-performance materials and lamp components must be employed. In addition to electrodes and filling gas, the quartz glass bulb is one key element with a very strong impact on lamp performance. Quartz glass in UHP lamps needs to withstand the extreme operating conditions, i.e. temperatures higher than 1000°C, pressures more than 200 bars and a power more than 200 W!

High purity – crucial for a long lamp lifetime

Due to the high operating temperature and wall load, standard fused quartz glass approaches its limits. Typical

problems that limit the lifetime of your lamp applications are:

- explosion due to mechanical instability of wall related to thermal loads reaching the limits of quartz bulbs
- ignition and operation problems caused by outgassing hydroxyl and hydrogen from the quartz glass bulb
- increasing absorption and heat dissipation caused by discoloration of quartz glass
- wall blackening caused by alkalines, especially sodium, lowering the tungsten solubility
- re-crystallization starting at alkaline seeds in quartz bulb during cooling due to phase transformation

HLQ-170: High-Performance Low-Alkaline Quartz Glass Made by Heraeus

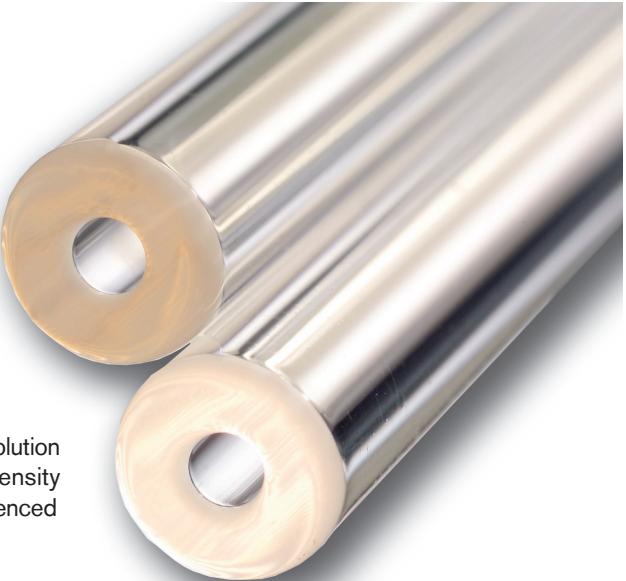
Heraeus developed HLQ-170, a new clear fused quartz tubing, especially designed for high-temperature and high-pressure lamps, e.g. UHP lamps in digital projection and rear projection TVs and high-performance lamps for the automotive industry.

The technical advantages of HLQ-170 in these applications are based on its superior properties:

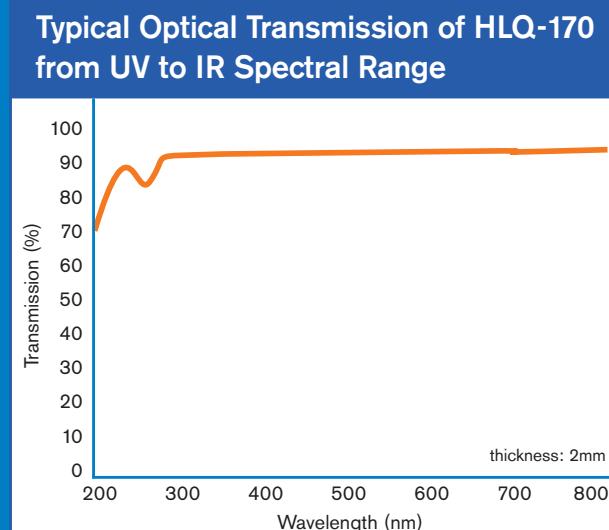
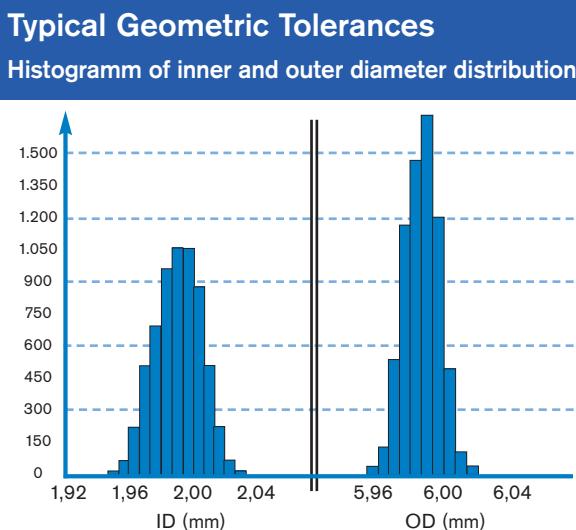
- tight tolerances of wall thickness and diameter
- extremely low bubble and defect content
- lowest hydroxyl and hydrogen content
- high transmittance and reduced discoloration after annealing
- highest purity, especially a low alkaline content
- high heat resistance and high re-crystallization resistance

HLQ-170 is the customized quartz solution for ultra high pressure and high-intensity discharge lamps from the well-experienced producer Heraeus Quarzglas.

For highest demands, Heraeus offers HLQ-270, a high-performance quartz material with a further reduced total alkaline content < 250 ppb. Moreover, HLQ-270 is drawn without die or mandrel, featuring maximum homogeneity and blemish-free surfaces without any contamination. Please contact us for more information!



As a result of charge transfers caused by impurities or trace elements like iron, quartz glass may exhibit discoloration. High purity of HLQ-170 and HLQ-270 solves this problem.



| Typical Impurity Content in ppb (ng/g) of HLQ-170 | Li | Na | K | Mg | Ca | Fe | Cu | Cr | Mn | Al |
|---|-----|-----|-----|----|-----|----|-----|-----|-----|------|
| | 100 | 200 | 250 | 50 | 300 | 80 | <10 | <10 | <10 | 8000 |

Heraeus Production Process – Three Steps to Advanced Performance Materials

For over one hundred years Heraeus has accelerated innovations in optics, semiconductors and lamps by providing highest-quality quartz glass tailored to the different applications.

As the largest integrated quartz glass manufacturer, Heraeus offers different fusion methods and inhouse purification of raw materials. Manufacture of electrically fused HLQ-170 includes:

Inhouse Purification

HLQ-170 is based on purest pegmatitic quartz grain sources. In addition, special inhouse treatment guarantees more efficient reduction of alkaline and trace element contents before quartz glass fusion.

The typical contents of alkaline, calcium and iron are tabulated on page 5. The result are less seeds for defect or re-crystallization centres and a longer lifetime of our quartz tubes.

Electrical Fusion

The high purity grain is fused in a very pure tungsten crucible under reducing atmosphere by electrical heating. Electrically fused quartz glass has a high viscosity and a high heat resistance. The quartz glass tubes are pulled with a special tool from the melt. This ensures tightest geometric tolerances and highest visual quality.

HLQ-170 quartz tubing is available in a wide range of diameters and wall thicknesses. Developed especially for high-temperature and high-pressure application, we support tightest geometric tolerances for small tube geometries, e.g. 4 x 1 mm, 6 x 2 mm and 7.4 x 2 mm.

Annealing

A low hydroxyl and hydrogen content is one of the most important features of quartz glass in high-intensity discharge lamps.

Using a special thermal treatment, HLQ-170 is offered with a hydroxyl (OH-) content of less than 0.3 ppm.

Properties of Electrically-Fused Quartz Glass

| | |
|--|--|
| Density | 2.203 g/cm ³ |
| Modulus of elasticity (at 20 °C) | 7.25 x 10 ⁴ N/mm ² |
| Poisson's ratio | 0.17 |
| Compressive strength | 1.150 N/mm ² |
| Tensile strength | 50 N/mm ² |
| Bending strength | 67 N/mm ² |
| Torsional strength | 30 N/mm ² |
| Softening temperature | 1.710°C |
| Annealing temperature | 1.220°C |
| Strain temperature | 1.125°C |
| Max. working temperature continuous short-term | 1.160°C 1.300°C |



Heraeus is using own purification technology to produce highest quality grain for electrical fusion of HLQ-170 quartz glass tubes.

Heraeus – Quartz Glass Tailored to Lamp Applications

| Properties | | HLQ 170 | HLQ 200 | HLQ 210 | HLQ 270 | HLQ 235 | HLQ 250 | HLQ 382 | M 235 plus | M 382 plus | Heralux plus | Heralux vuv | Suprasil 310 | Suprasil 300 |
|---|---|---------|---------|---------|---------|---------|---------|---------|------------|------------|--------------|-------------|--------------|--------------|
| highest UV and VUV transmission | | | | | | | | | | | | ● | ● | |
| highest resistance to VUV irradiation | | | | | | | | | | | ● | ● | | |
| ozone free | | | | | | ● | ● | | ● | | | | | |
| uv blocking | | | | | | | | ● | | ● | | | | |
| highest devitrification resistance | ● | | ● | ● | | | | | | | | | | |
| highest temperature resistance | ● | | ● | ● | | | | | | | | | | |
| high and highest homogeneity | | | ● | ● | | | | | ● | ● | ● | ● | ● | ● |
| nearly perfect surface | | | ● | ● | | | | | ● | ● | ● | ● | ● | ● |
| highest chemical purity | ● | | | | ● | | | | | ● | ● | ● | ● | ● |
| economic grade | ● | ● | | | | ● | ● | ● | | | | | | |
| Applications | | | | | | | | | | | | | | |
| 172 nm excimer lamps | | | | | | | | | | | | ● | ● | |
| low pressure lamps with 185 nm emission | | | | | | | | | | | | ● | ● | ● |
| high transmittance long-life sleeves for 185 nm and 254 nm applications | | | | | | | | | | | | ● | ● | ● |
| low pressure lamps | | | ● | | | ● | ● | | | | | | | |
| sleeves for 254 nm disinfection | | | ● | | | ● | ● | | | | | | | |
| medium pressure lamps | | | ● | ● | | ● | ● | | | | ● | ● | | |
| metal halide lamps | ● | ● | | | | ● | | | | | | | | |
| highest pressure lamps and HID lamps, e.g. for projection or automotive | ● | ● | | | ● | | | | | | | | | |
| short arc lamps, e.g. for i-line steppers, cinema and stage | ● | ● | ● | ● | | | | | ● | | ● | ● | | |
| long arc lamps, e.g. for laser excitation | | | ● | ● | | | | | ● | ● | ● | ● | ● | |
| infrared lamps | | | ● | | | | | | | | | | | |

Heraeus Quarzglas offers a wide spectrum of high-quality quartz glass tubes for lamp and lighting applications. Heraeus is the only quartz glass manufacturer able to fuse three different quartz glass types with different specific properties: electrically-fused quartz glass (HLQ-grades), flame-

fused quartz glass (Heralux and M-Grades) and synthetic fused silica (Suprasil). The selection shows our full range of quartz glass grades. All grades are available in annealed version. During annealing free hydrogen and unstable hydroxyl (OH) groups are removed. HLQ-grades are available

with an OH content < 1 ppm. Flame-fused quartz glass and Suprasil 310 contain stable OH-groups which improve the resistance to UV damage and solarisation. Suprasil 300 is dried by the use of chlorine which results in an OH content < 1 ppm. Please contact us for more information.

Germany

Heraeus Quarzglas GmbH & Co. KG

Lamp Materials
Reinhard-Heraeus Ring 29
D-63801 Kleinostheim
Phone: (+49) 61 81 35 62 48
Fax: (+49) 61 81 35 72 00
E-Mail: sales.lampmaterials@heraeus-quarzglas.com
www.heraeus-quarzglas.com

Great Britain

Heraeus QuartzTech Ltd.

Sales Lamp Materials
4 Tannery House
Tannery Lane Send
Surrey GU 23 7 EF

Phone: (+44) 14 83 21 33 21
Fax: (+44) 14 83 21 33 29
E-Mail: byfleet.sales@heraeus.com

China

Heraeus ShinEtsu Quartz China, Inc.

Sales Lamp Materials
989 DongFang Road
ZhongDa Square, Room 2704
PuDong. ShangHai, 200122, China

Phone: (+86) 21 68 67 02 24 ext 809
Fax: (+86) 21 68 75 14 34
E-Mail: sales.lampmaterials@heraeus-hsqc.com

France

Heraeus S.A

Sales Lamp Materials
12, Avenue du Quebec-Batl 2
B.P. 630 Villebon
F-91945 Courtaboeuf Cedex
Phone: (+33) 1 69 18 48 31
Fax: (+33) 1 69 28 82 43
E-Mail: dominique.pequinot@heraeus.com

USA

Heraeus Quartz America LLC

Sales Lamp Materials
100 Heraeus Blvd.
Buford, GA 30518

Phone: (+1) 67 87 14 43 50
Fax: (+1) 67 87 14 43 58
E-Mail: sales@heraeus-optics.com

Japan

Shin-Etsu Quartz Products Co., Ltd.

Sales Lamp Materials
Shinjuku San-ei Building,
12th Floor
1-22-2, Nishi-Shinjuku
Shinjuku-ku, Tokyo 160-0023

Phone: (+81) 3 33 48 19 13
Fax: (+81) 3 33 48 49 19
E-Mail: d2sales@sqp.co.jp