Heraeus

HSQ 400
Stabilized
Electrically Fused
Quartz Glass

Heraeus Quarzglas

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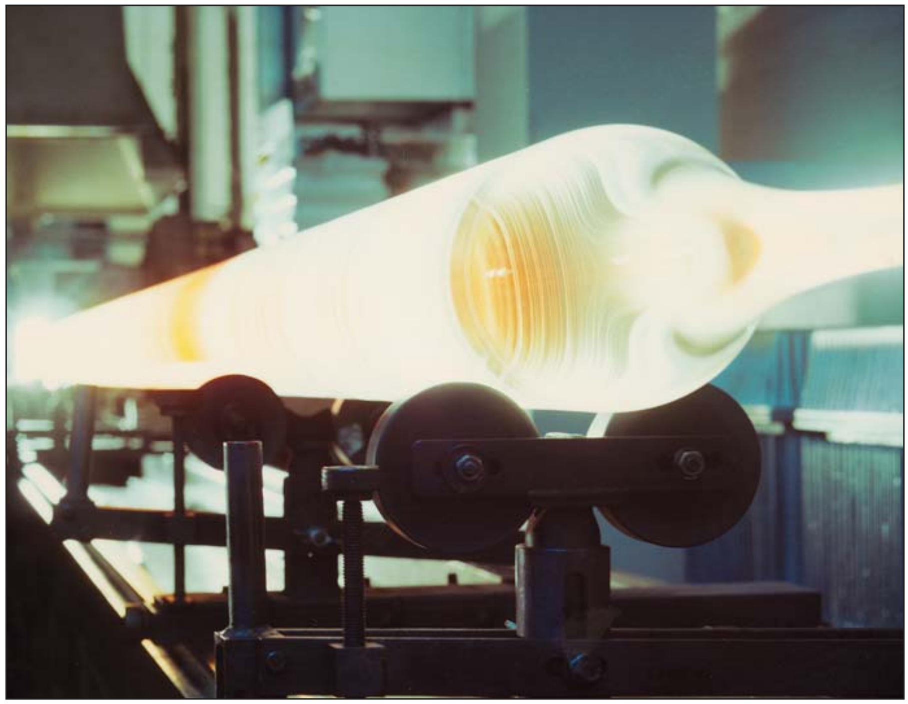
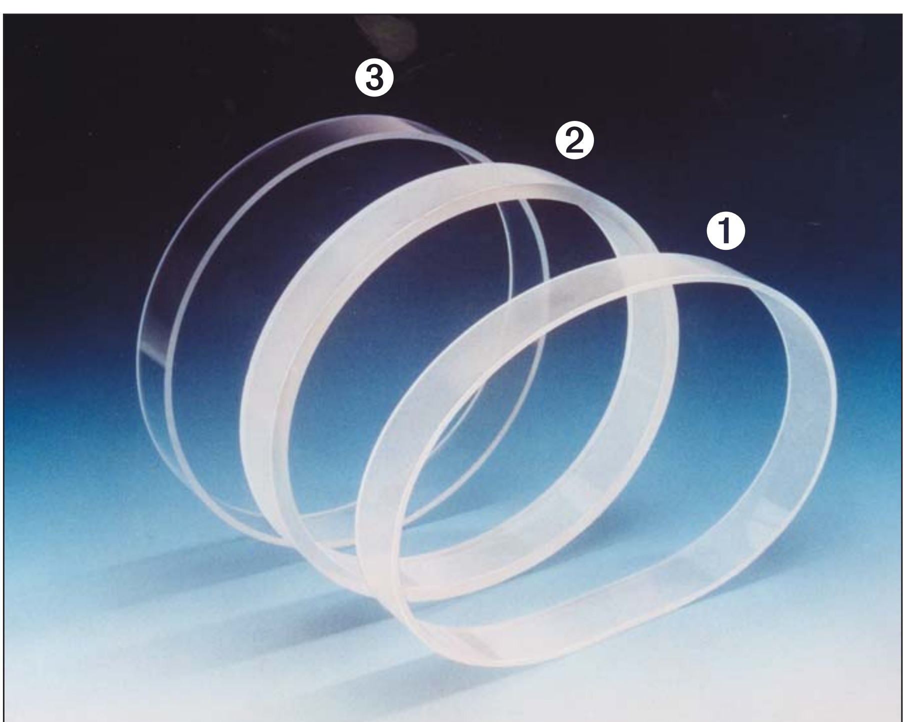
General Product Description

With HSQ 400, the maximum use temperature of fused quartz furnace tubes can be extended well past the point where the material would normally deform under its own weight. HSQ 400 takes advantage of the ability of quartz glass to revert to a crystalline state under the right conditions. Stabilization is achieved by inducing a thin (approx. 20 µm) uniform layer of cristobalite to form on the outer tube surface upon its first exposure to elevated temperature. Cristobalite is a stable high temperature phase of silica with a melting point of 1710°C.

Technical Information

HSQ 400 offers in addition to the properties of standard fused quartz - high purity, low thermal expansion, good optical transmittance, high temperature resistance, low bubble content - the advantage of long process lifetime at high temperatures.





Visual, dimensional and mechanical characteristics are similar to HSQ 300. As with non-stabilized quartz, care must be taken to keep the tubes clean, but because the stabilized layer is thin, HF exposure should be limited to 5 min in 5 % HF.

New HSQ 400 tubes are visually indistinguishable from non-stabilized tubes and behave identically in glass forming processes such as splicing, welding, shaping and annealing.

Mechanical Properties

Sagging tests performed at a high temperature for 18 hours demonstrate the better performance of HSQ 400 tubes.

The picture shows a ring section (1) which has not been stabilized compared to an HSQ 400 ring section (2) exposed to 1280°C for 18 h. The last ring section (3) shows the shape prior to testing.

Viscosity

HSQ 300 electrically fused quartz glass is the standard base material to which the HSQ 400 treatment is applied. This is because HSQ 300 has the highest viscosity of all standard quartz glass materials. However, it is also possible to stabilize any other type of fused quartz or fused silica.

HSQ 400 is most effective at preventing deformation of the tube cross section. As a result, it is still important to ensure that process tubes are well supported along their lengths. Similarly, this product is also best suited for use with horizontal process tubes. Performance will also be optimized if the tube wallthickness is as heavy as possible.

Product Range

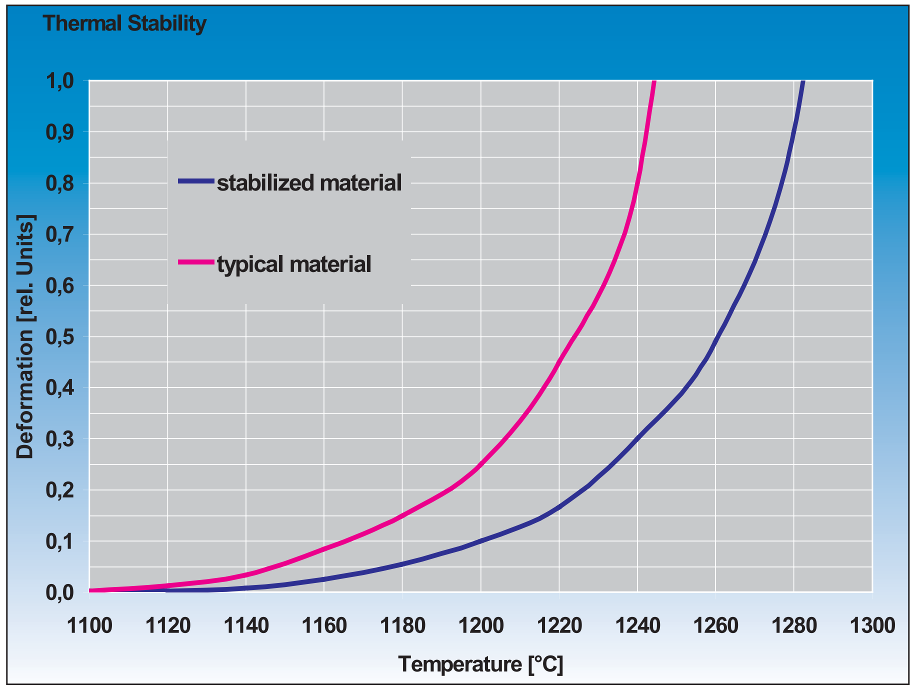
Stabilized Tubes
Outer diameter 60 - 350 mm Wall thickness 2.8 - 15 mm

Chemical Purity

Typical Trace Elements and OH content in Quartz Glass (ppm by weight oxide)

Element	Contents
Al	15.0
Ca	0.5
Cr	< 0.05
Cu	< 0.05
Fe	0.1
K	0.4
Li	0.6
Mg	0.05
Mn	< 0.05
Na	0.3
Ti	1.1
Zr	0.7

OH Content	< 30



'Running In'

The formation of the cristobalite layer is a consequence of a special preparation of the outer surface. By carefully heating or 'running in' the tube, a thin crystalline (cristobalite) shell is formed that physically supports the tube cross-section.

The crystal formation commences immediately when the tube is exposed to a temperature of 1150°C or above. Because the nucleating agent is a material that has an extremely low ability to diffuse in fused quartz, there is no chance of it causing process contamination.

The 'running in' process for a stabilized tube is as follows. Preferably the tube should be exposed to a temperature of about 1280°C for several hours or even overnight in order to promote the rapid formation of the cristobalite layer.

There may be some deformation that occurs before the cristobalite layer has finally developed. If so the tube should be turned through 90° so that subsequent processing temperatures can compensate for this.

If a completely circular cross section is desired then the 'running in' time should be extended to 12 - 24 h at 1280°C, followed by a 90° rotation.

As the tube is used the cristobalite layer will slowly increase in thickness thus greatly enhancing the mechanical stability of the process tube. It is very important that the tube is not cooled below 300°C once it has been run in.

Below this temperature the cristobalite will undergo a phase transformation resulting in cracking and reduced thermal stability.

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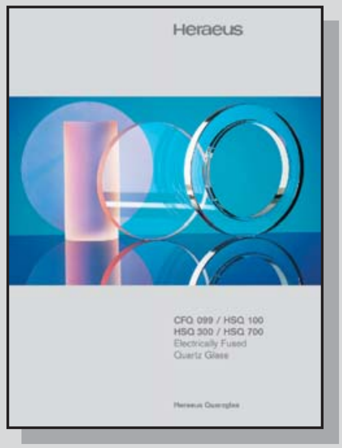

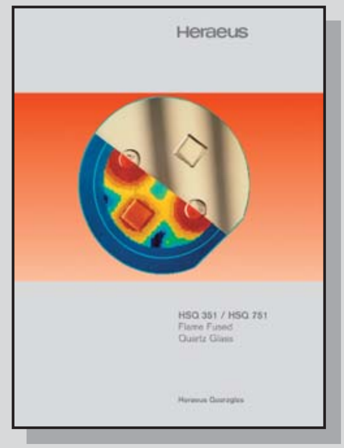

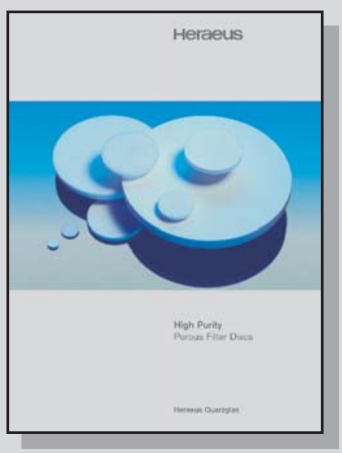

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