Optiq-100™

Fused Quartz Tubing.

High strength tubing for optical waveguide applications.

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GENERAL ELECTRIC'S NEW — HIGH STRENGTH—WAVEGUIDE TUBING

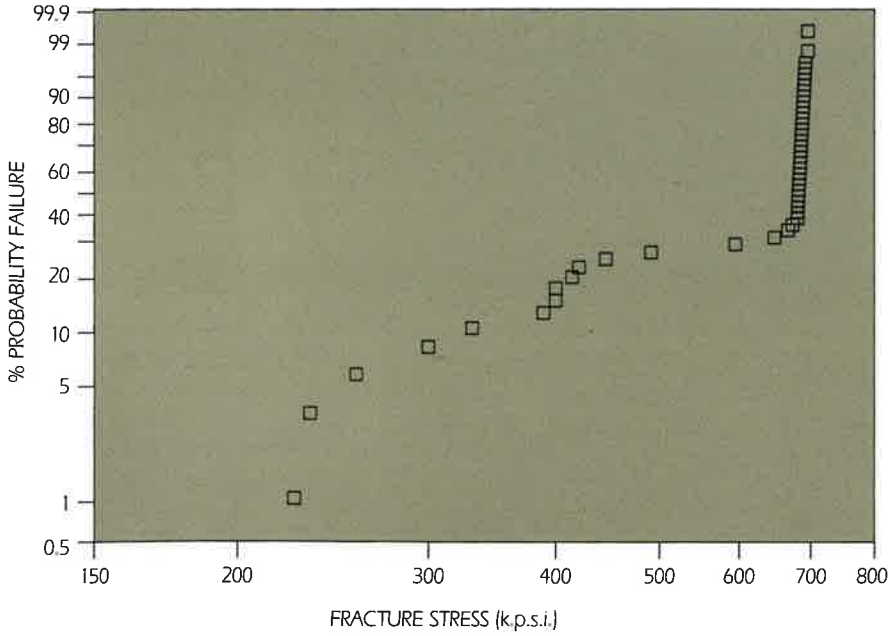
Using advanced fusion technology, General Electric has developed a new fused quartz tube — Optiq-100 — that specifically addresses optical and mechanical performance critical to the optical fiber manufacturer. For both deposition and sleeving, GE Optiq-100 tubing provides the basis for cost-competitive fiber manufacture.

Demonstrated high strength.

It is well established that fiber tensile-strength performance can be limited by stress-concentrating particulate inclusions originating in the deposition or cladding tube.

By merging the varied disciplines of GE engineering, R&D, and manufacturing, the Quartz Products Department has developed an innovative continuous fusion process that dramatically reduces particulate inclusions in fused quartz tubing and virtually eliminates air lines and bubbles. Recent laboratory analyses of more than 50 km of fiber drawn from Optiq-100 tubing revealed 0.035 breaks/km at 100 k.p.s.i. A typical 50-point Weibull plot is included here to illustrate the first of these test results.

Weibull probability plot for fiber drawn from Optiq-100 Tubing



- GE Optiq-100 tubing collapsed over synthetic rod & drawn to fiber.
- 100 k.p.s.i. screened fiber.
- 1 meter gauge lengths @ 1.6 in./min.

Assured optical properties.

Fiber optical properties are most directly influenced by chemical purity and water content.

Chemical purity.

During the early sixties, GE developed a proprietary, raw material beneficiation process that provided the semiconductor industry with reproducible, high-purity, transparent fused quartz. Further developments of that technology enable GE to produce an extremely consistent trace-impurity chemistry for fiber optic tubing. Reproducible chemistry, in turn, minimizes variations in impurity-dependent properties, such as viscosity, an important factor in reproducible deposition.

Low OH^-.

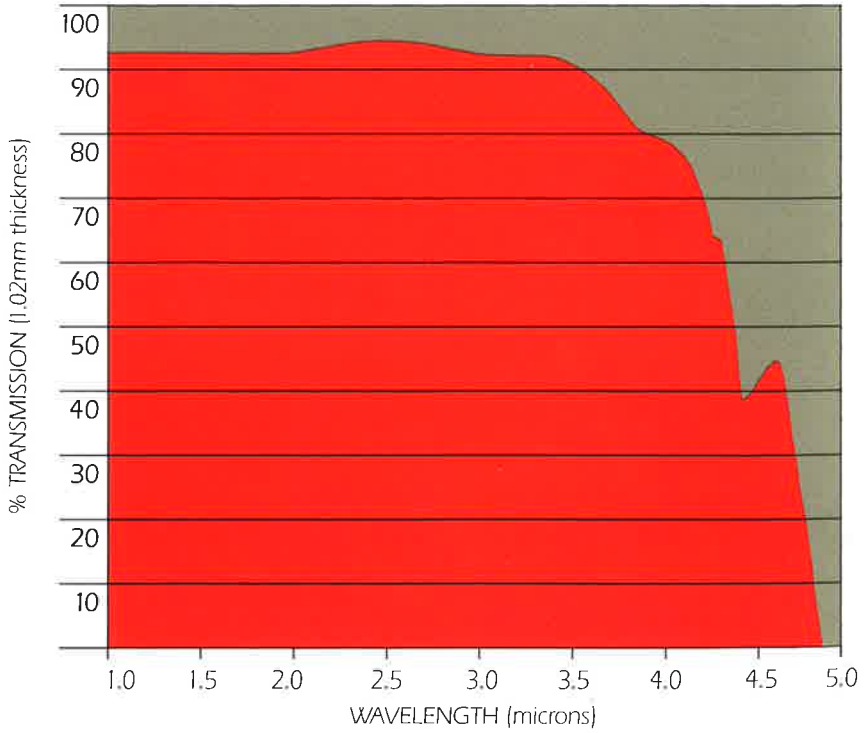
Additionally, General Electric's continuous fusion process produces tubing that is essentially free of OH^- ions. Consequently, fiber contamination by IR-absorbing OH^- groups is virtually eliminated. Upon special request, GE has the unique capability to provide sub-ppm OH^- for the most demanding fiber designs.

Trace Element Composition

Element	Parts Per Million By Weight (Raw Material, Except Where Noted) Average	Range
Al	15.2	13.0 - 19.0
Ca	0.5	0.2 - 1.7
Fe	0.3	0.1 - 0.6
K	1.5	1.0 - 2.5
Li	1.0	0.3 - 1.4
Mg	0.2	0.1 - 0.3
Na	1.3	0.3 - 2.5
Ti	0.9	0.6 - 1.2
Zr	1.5	0.7 - 2.2
***OH^-**	**1.00**	**0 - 3.0**

* Finished Product

I.R. Spectral Transmission Curve Illustrating Low OH^- Content of Optiq-100 Fused Quartz Tubing



Enhanced processing.

Tight dimensional tolerances.

Fiber geometry control is strongly influenced by tubing dimensional tolerances. General Electric's manufacturing process couples stringent fusion process controls with the industry's most comprehensive laser gauging techniques to deliver dimensional tolerances that meet or exceed specifications.

Optiq-100 tubing provides the within-tube and between-tube dimensional control necessary for circularly concentric preforms and fibers and for critical sleeving operations.

Low OH^-.

The low hydroxyl content and controlled high purity of Optiq-100 tubing results in its high viscosity. Relative to other tubes, this consistent refractoriness can minimize deformation during the deposition stage and permit the use of higher fire-polishing temperatures to remove surface impurities.

Further, low hydroxyl content results in a more thermally transparent tube, requiring deposition adjustments to accommodate this improved thermal efficiency.

Dimensional Tolerances

Within a Tube:	
Outside Diameter	± 2%
Wall Thickness	± 5%
Ovality	1.5% Max.
Bow	.8mm/meter
Siding $\frac{\text{(Max. Wall-Min. Wall)}}{\text{Nominal Wall}}$	6% Max.
Length	± 3%
Cross Section Variation	≤ 4%

Among Tubes:

Sample results of average Cross Sectional Area (CSA) variations among tubes indicate:

- 50% of tubes are within 1% nominal CSA.
- 85% of tubes are within 2% nominal CSA.
- 100% of tubes are within 4% nominal CSA.

Typical Physical Properties

Properties	English and Metric System Value	International System Of Units (SI) Value
Density	2.2 gm/cm³	2.2 x 10^3 kg/m³
Hardness	5.5-6.5 Mohs' Scale 570 KHN_{100}	
Softening Point	1683°C	1956°K
Annealing Point	1215°C	1488°K
Strain Point	1120°C	1393°K

Quartz Products Department

A Commitment to Fiber Optics.

GE is committed to helping you produce optical fibers at lower costs with higher yields.

GE offers upfront consultation, start-up and application assistance, continuing R&D, and volume product availability — total-scope assistance that will help you establish and maintain a strong and highly competitive stance in the marketplace.

Let us know how we may assist you.

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