

Preforms

Designs for step-index and graded-index



Description

Using highly pure fused silica materials, the LEONI subsidiary j-fiber develops and produces high-quality preforms according to customer specifications. They are the basis for the manufacturing and application of high-performance special fibers and standard fibers.

Whether your goal is the transmission of high data rates or high-power laser transmission: We can adjust the required waveguide design to your demands, from prototype to series production.

We thereby specify the preform design and configuration in core profile (step or graded index) and dopant option (Germanium, Fluorine, Boron, or Rare-earth elements) in order to achieve the needed numerical aperture. In addition we can provide the required geometry of the preform and determine the shape of core and cladding for application-specific assembly according to your needs.

Process technology

Each preform is produced with the suited technology:

Step 1 → choice of the appropriate core material, either from our raw material production of undoped fused silica with high or low OH content or by direct coating of doped fused silica.

Step 2 → Production of the final waveguide preform, either our own MCVD process (inner coating) for graded-index and step-index fibers or a PBVD process (outer coating) for large core step-index fibers.

Quality

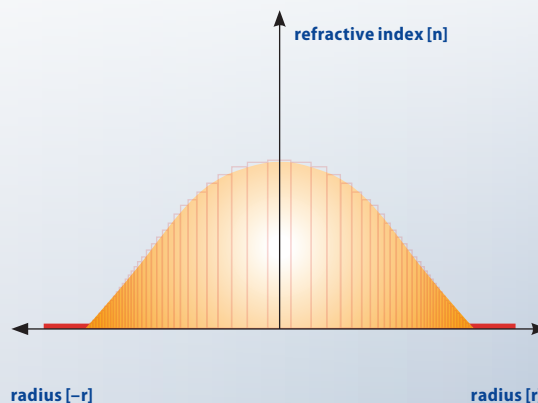
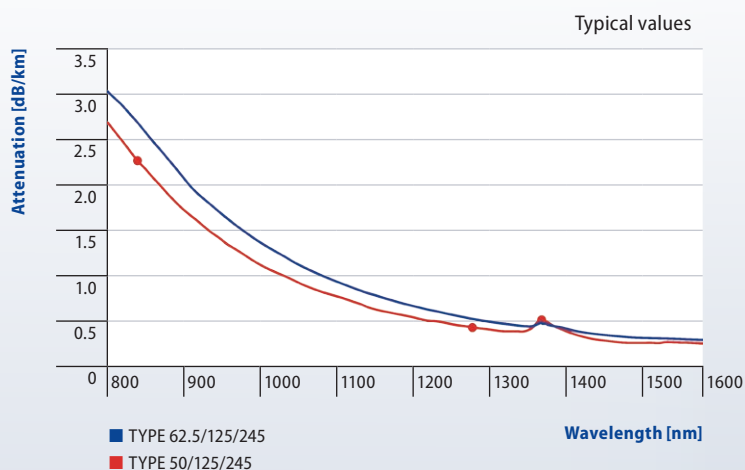
Every preform is subject to a strict quality monitoring that also includes the testing of the goal parameters.

The result is a preform with best performance properties during the drawing of fibers for demanding applications.

Multimode preforms 50/125 and 62.5/125

Graded-index
Preforms

Typical spectral attenuation of a multimode fiber



LEONI offers graded-index preforms for high-performance multimode fibers in the 50/125 and 62.5/125 designs.

The innovative MCVD production technique for preforms ensures that the specified fiber performance properties are fulfilled. On request graded-index preforms are delivered with a handle, which allows the fixing of the preform in the drawing tower.

Bubble size s/mm

	acceptable number per preform
in the core	not allowed
in the cladding	
s ≤ 0.3	no count
0.3 < s ≤ 0.8	5
0.8 < s ≤ 2.0	2
s > 2.0	0

Performance properties	Preform design	
	50/125	62.5/125
Core composition	SiO ₂ / GeO ₂	SiO ₂ / GeO ₂
Refractive index profile	nearly parabolic	
Refractive index delta	13.7 × 10 ⁻³	25.9 × 10 ⁻³
Tolerance of Delta within a rod	2.0 × 10 ⁻³	3.0 × 10 ⁻³
Numerical aperture	0.200 ± 0.015	0.275 ± 0.015
Preform Ø (O.D.) [mm]	39.0	26.0
O.D. tolerance from rod to rod [mm]	± 2.0	
O.D. tolerance within a rod [mm]	± 0.5	
Preform length [mm]	600 – 1200	
Preform bow [mm/m]	≤ 0.7	
Preform non-circularity [%]	≤ 1.0	
Clad concentricity error of O.D. [%]	≤ 1.2	

Target fiber specifications	50/125		62.5/125	
	850 nm	1300 nm	850 nm	1300 nm
Core diameter [µm] (± 2.5)	50		62.5	
Core non-circularity [%]	≤ 5.0			
Core / clad concentricity error [µm]	≤ 1.5			
Cladding Ø [µm] (± 2.0)	125			
Cladding non-circularity [%]	≤ 1.0			
Attenuation* [dB/km]	850 nm	≤ 2.4	850 nm	≤ 2.9
	1300 nm	≤ 0.6	1300 nm	≤ 0.8
	1383 nm	≤ 2.0	1383 nm	≤ 2.0
Bandwidth** [MHz · km]	850 nm	≥ 500	850 nm	≥ 160
	1300 nm	≥ 500	1300 nm	≥ 500

* Highly dependent on optimised drawing conditions.

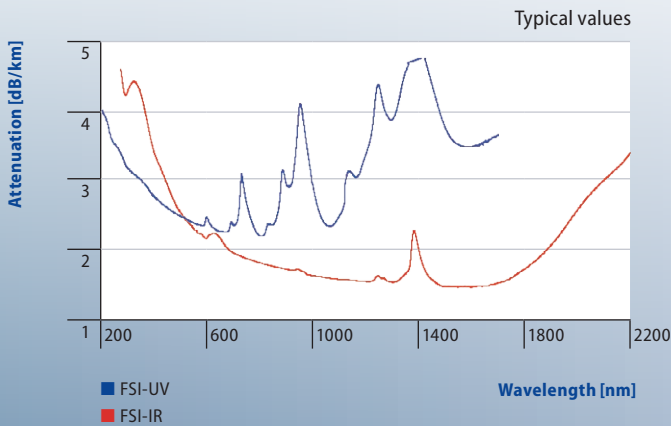
** Min. 70% of the fiber output meets the specified target fiber values.

Further bandwidth combinations available on request.

Fluorine-doped step-index preforms (FSI)

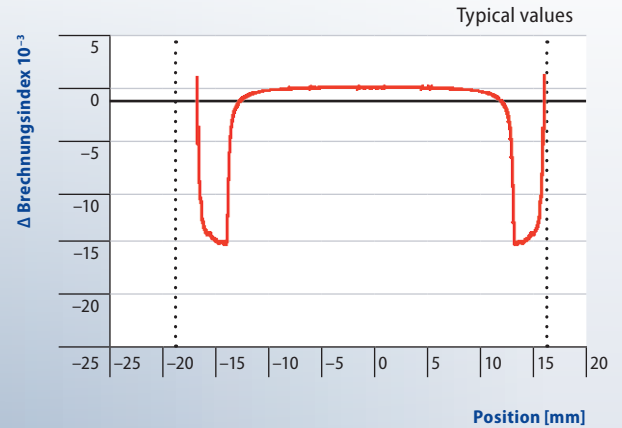
Step-index
Preforms

Spectral attenuation



Refractive index profile

example of CCDR 1.4



FSI preforms are used for the manufacturing of special fibers with undoped core and doped cladding. These fibers are applied in diverse industrial and medical sectors as well as in research and development.

FSI preforms can be fitted to the customer's demands concerning UV or IR laser transmission, spectroscopy and high-power laser transmission. In addition, LEONI offers individual solutions, that can be specified regarding the characteristic parameters such as the type of core and cladding material, cladding thickness and composition (single or multiple cladding) and numerical aperture (NA).

Applications

Highly suitable as basic material for drawing high-performance special fibers for:

- UV-VIS to IR laser transmission
- High-power lasers
- Spectroscopy

Standard properties		Specific values
Core composition		SiO ₂
Cladding composition		SiO ₂ /F
Refractive index profile		step-index
Refractive index delta		max. $(17 \pm 3) \times 10^{-3}$
Numerical aperture (NA)*		0.12 ± 0.02 0.15 ± 0.02 0.22 ± 0.02 0.26 ± 0.02
Preform Ø (O.D.) [mm]		20 – 70
O.D. tolerance within the preform [%]	20 – 29 mm	± 4.0
	30 – 39 mm	± 3.0
	40 – 70 mm	± 2.0
Preform length [mm]		400 – 1200
Preform non-circularity [%]		≤ 2.0
O.D. concentricity error		< 10
Cladding to core diameter ratio (CCDR)		1.040 – 1.400
Tolerance of CCDR value**:	1.04 – 1.09	+0.010/–0.005
	1.10 – 1.39	± 0.015
	> 1.4***	± 2.5

* Further NA values and tolerances available on request

** Further tolerances available on request

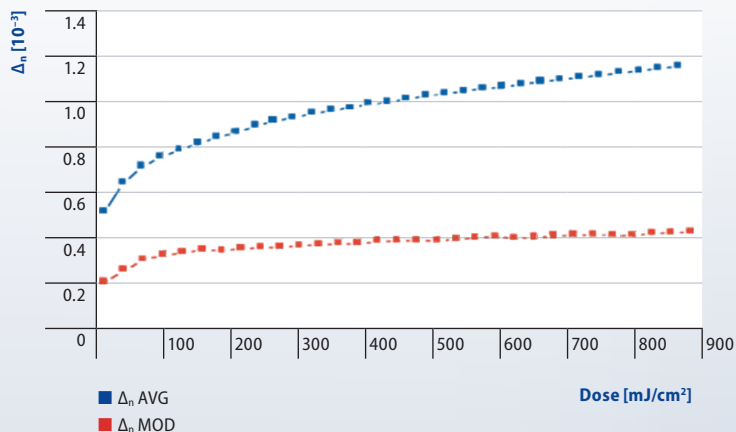
*** Multiple cladding

Germanium-doped step-index preforms



Example of a highly photosensitive fiber
with high Germanium doping (irradiation wavelength 248 nm)

Typical values



Source: IPHT e.V. Jena, Germany

The j-fiber group offers preforms with Germanium-doped core for the manufacturing of special step-index fibers. In order to ensure the specified fiber transmission properties, the preforms are produced using j-fiber's own MCVD technique.

The highly photosensitive singlemode preforms were developed for the efficient production of fibers for FBG inscribing.

On request, the step-index preforms are available with a handle for fixing the preform during the drawing process.

Properties	Singlemode	Singlemode (photosensitive)	Multimode
Core composition	SiO ₂ / GeO ₂		
Cladding composition	SiO ₂		
Refractive index profile	step		
Refractive index delta	$(3.5 - 7.8) \cdot 10^{-3}$	$(8.8 - 31.0) \cdot 10^{-3}$	$(3.5 - 20.0) \cdot 10^{-3}$
Numerical aperture (± 0.02)	0.10 – 0.15	0.16 – 0.30	0.10 – 0.24
Core / cladding diameter ratio	1:14 – 1:18 *	1:18 – 1:26 **	1:1.1 – 1:6
Preform outer Ø [mm]	10 – 40	15 – 25	10 – 40
Outer Ø	Tolerance from rod to rod [%]		
	±10.0		
Outer Ø	Tolerance within a rod [%]		
	±4.0		
Preform length [mm]	400 – 1200	400 – 1200	600 – 1200
Preform deflection [mm/m]	≤ 1		
Preform ovality [%]	≤ 2.0		
Core / cladding concentricity error regarding outer Ø [%]	≤ 1.2		

* The preforms can be optimised for the desired operating wavelength or mode field.

** Cut-off wavelengths of 800 nm up to 1500 nm (± 50 nm) and mode field diameters between 4 µm and 12 µm approx. are available.