

FSI Type Preforms

FSI - fluorine doped step-index optical preforms manufactured by j-plasma GmbH are used for the production of specialty fibers. These fibers are widely deployed in electronic, medical, research and development applications.

FSI preforms can be customized to meet different applications, including UV or IR laser transmissions, spectroscopy and high power transmissions.

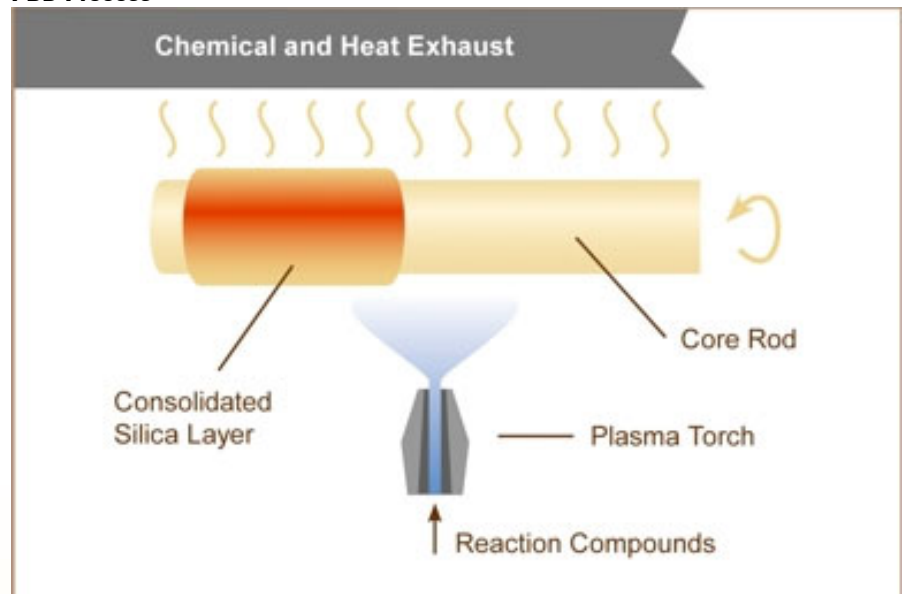
We can further offer customized solutions for special requirements of key preform characteristics such as core and cladding material, cladding thickness, cladding structure (single or double cladding) and numerical aperture (NA).

Process Method

The FSI Preforms are manufactured by the Plasma Based Deposition (PBD) process.

Extremely pure synthetic fused silica rods are deposited with fluorine doped silica layers to obtain a preform with a step-index profile. A plasma torch is used as a heating source for the chemical reaction of SiCl_4 , O_2 and a fluorine containing gas. The high temperature plasma leads to chemical deposition conditions that supports a high fluorine concentration in the deposited cladding layers.

PBD Process



For further information about our FSI Type Preforms and other j-plasma products and services, please contact us:

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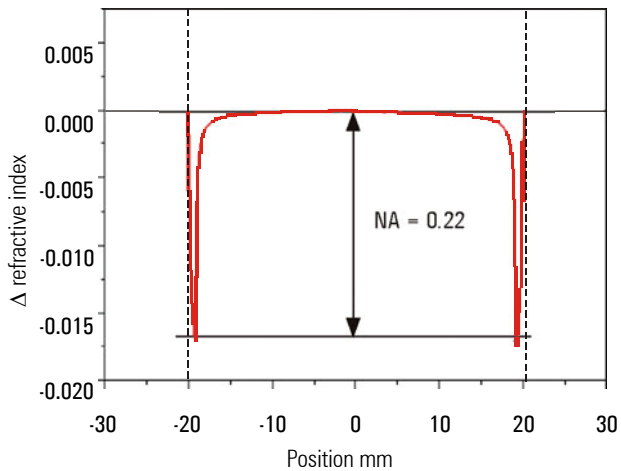
Custom Preform Designs

FSI preforms are available in a wide range of customer and application specific designs. Upon request preforms can be fabricated with:

- single doped cladding layer or double cladding layer
- different doping concentration for inner and outside layer for different numerical aperture
- outside layers with pure silica
- various core materials
- various preform outside diameters to meet customer drawing facility requirements (from 20mm to 70mm range)

Key Preform Characteristics

Profile Scheme



Numerical Aperture (NA)

The numerical aperture is defined by the difference between the refractive index of the core material and the cladding material of the step-index fiber.

Whereas the refractive index of the core is defined by the pure quartz material the refractive index of the cladding material is determined by the fluorine concentration.

$$NA = \sqrt{n_{\text{core}}^2 - n_{\text{cladding}}^2}$$

Available numerical apertures:

0.22 +/- 0.02 standard NA (undoped core material)
lower and higher NA values are available on request

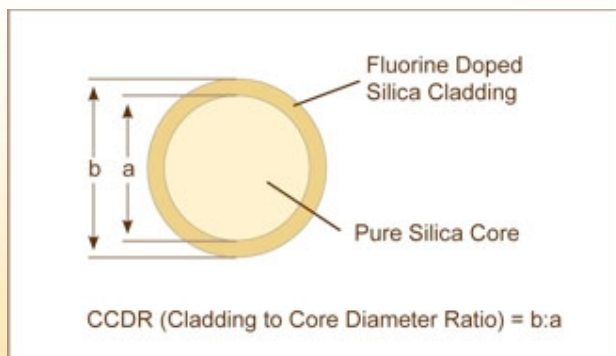
Cladding to Core Diameter Ratio (CCDR)

The CCDR value is depending on the desired wavelength application. The cladding thickness in the fiber should be at least ten times the longest wavelength of interest for a fiber with a NA of 0.22.

The cladding needs to have a sufficient thickness to avoid that light which is reflected at the core/cladding interface penetrates the cladding and reaches the outer diameter of the fiber.

Available Cladding to Core Diameter Ratio (CCDR)

1.04 up to 1.40

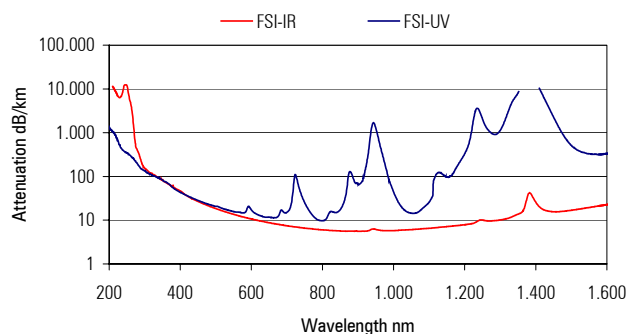


Core Materials

The transmission of the optical fiber produced from FSI preforms is determined primarily by the properties of the core material. Preforms with core material of high OH content (about 1000ppm) are typically used for application in the UV-visible spectral regions. Low OH content core material (about 1ppm) is used for spectral regions visible to IR transmission. Depending on the core material the fiber allows for transmission in a wide spectral range from 200nm to 2000nm. Therefore the optimum core material is selected depending on the wavelength range of the desired application.

Preform Type	Wavelength range, nm	Feature	Application
FSI — UV	200	Ideal for transmission in UV and visible range	High power laser transmission Medical application Spectroscopy
	350		
	633		
	800		
FSI — IR	633	Ideal for transmission in visible and near IR range	Research & Development
	725		
	800		
	1064		
	2100		

Spectral Attenuation



Appearance

The general appearance of the preform shall be dust free and flawless. There shall be no bubbles in the cladding material. The core material has the bubble class 0 according to DIN 58927. The maximum bubble diameter in the core material is < 0.1mm. There shall be no substantial surface damage or contamination. Other specifications are available upon request.

Mass

- Chargeable mass (m) is calculated with the formula:

$$m[\text{g}] = 2.2 \times 3.14 \times (\text{outer diameter} [\text{cm}]/2)^2 \times (\text{effective length} [\text{cm}])$$

2.2 = specific weight of SiO₂ [g/cm³]

- The "effective length" is the length of that piece of the preform where every parameter is within stated preform specifications.
- j-fiber does not guarantee the following parameters as they are dependent upon individual draw conditions:
 - fiber yield
 - fiber strength

Inspection Documents

Preform ID	Refractive Index Delta
Mass	Diameter Average
Effective Length	Diameter Min./Max.
Numerical Aperture	CCDR

The inspection documents will be supplied with each shipment. The preform data can also be transmitted electronically and precede each shipment (MS Windows, floppy disk, email etc.)

Packaging

Every preform is individually packaged as such to withstand normal transportation hazards and handling. Each preform is identified by an ID number written on an adhesive label.

All fibers and preforms are subject to j-plasma's ongoing process and quality improvement programs ensuring excellent performance and high reliability. We reserve the right to make changes to the above specification without notice.

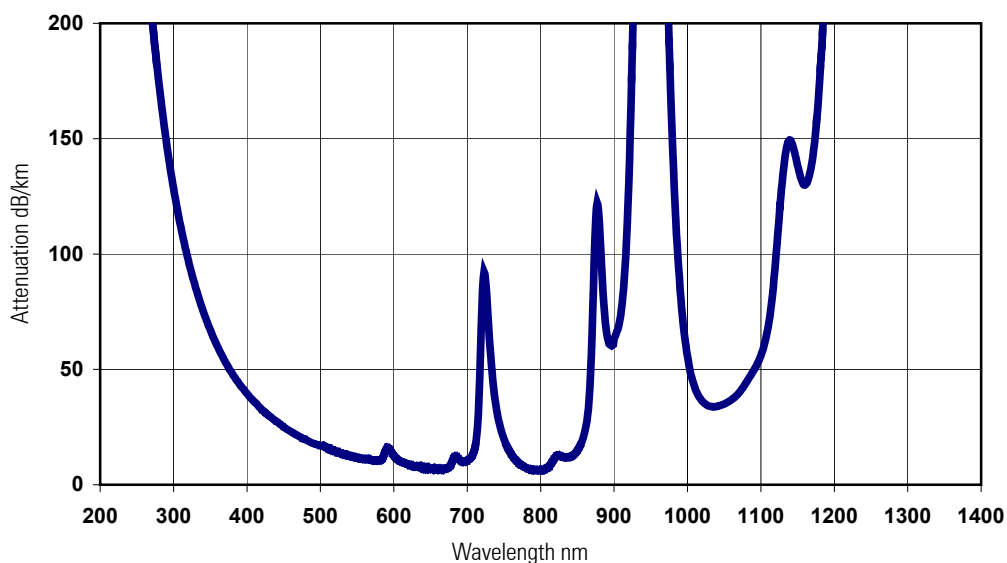
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Data sheet: FSI-UV type preforms

Typical Attenuation Curve:



Features & Benefits

- Designed to provide high power laser transmission in a wide spectral range from 200nm to 800nm for use in electronical, medical, spectroscopy, research and development applications
- Provides unsurpassed stability and reliability in high power laser transmission in UV and visible
- Features pure synthetic quartz glass as core material and a cladding of fluorine doped silica layers
- Available with high OH content core material (about 1000ppm) for applications in UV-visible spectral region

Custom preform designs upon request

- Customized types of core and cladding materials and designs
- Single doped cladding layer or double cladding structure
- Different fluorine doping concentration for inner and outside layers
- Outside layers with pure silica
- Higher or lower numerical aperture
- Higher CCDR values

Target Fiber Specifications

	Spec. Values					Unit
	210	248	308	350	800	
Attenuation Typical	≤800	≤320	≤130	≤70	≤7	dB/km
Attenuation Maximum	≤1400	≤500	≤200	≤100	≤10	dB/km

Standard Characteristics

	Spec. Values	Unit
Core Composition	SiO ₂	
Cladding Composition	SiO ₂ /F	
Refractive Index Profile	Step-index	
Refractive Index Delta	(17 ± 3) × 10 ⁻³	
Numerical Aperture	0.22 ± 0.02	
Preform Diameter (O.D.)	20 - 70	mm
Tolerance of O.D. within a Rod:		
O.D. 20 - 29 mm	± 4.0	%
O.D. 30 - 39 mm	± 3.0	%
O.D. 40 - 70 mm	± 2.0	%
Preform Length	400 - 1200	mm
Preform Non-Circularity	≤ 2.0	%
Clad Concentricity Error of O.D	< 1.0	%
Cladding Core Diameter Ratio (CCDR)	1.040 - 1.400	
Tolerance of CCDR:		
CCDR 1.04 - 1.09	+ 0.010 / - 0.005	
CCDR 1.10 - 1.40	± 0.015	

Ordering Information

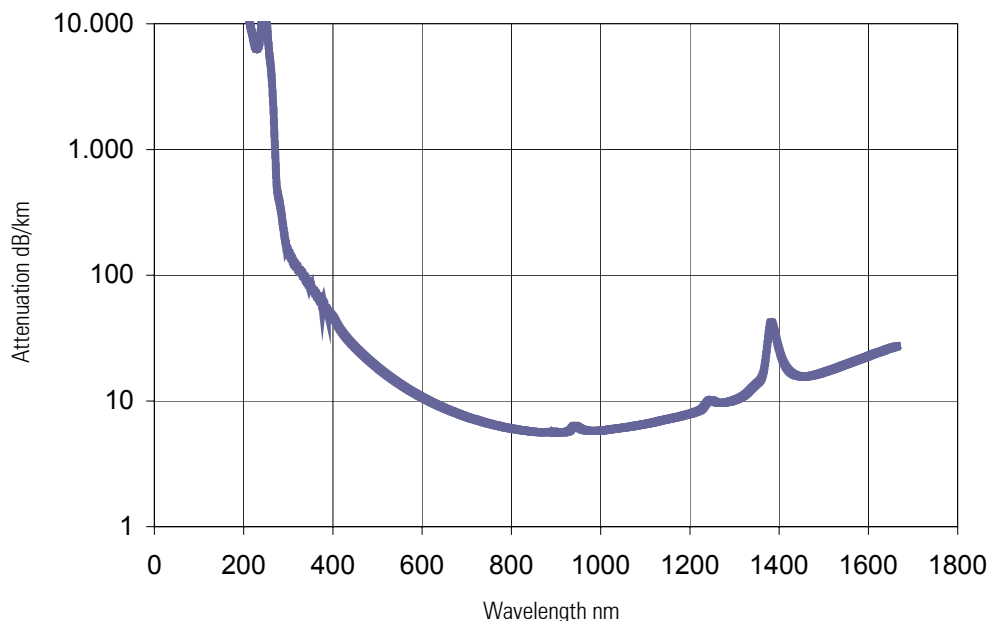
To order j-plasma optical preform please call, fax or email us and specify the following parameters:

Preform Type:	j-plasma FSI-UV preform
Preform Diameter:	20.0mm to 70.0mm
Preform Length:	400mm to 1200mm
Preform Quantity:	kg
Other:	desired ship date, special requests

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Data sheet: FSI-IR type preforms

Typical Attenuation Curve:



Features & Benefits

- Designed to provide high power laser transmission in a wide spectral range from 550nm to 2000nm for use in electronical, medical, spectroscopy, research and development applications
- Provides unsurpassed stability and reliability in high power laser transmission in the IR
- Features pure synthetic quartz glass as core material and a cladding of fluorine doped silica layers
- Available with low OH content core material (less than 1 ppm) for applications in IR spectral region

Custom preform designs upon request

- Customized types of core and cladding materials and designs
- Single doped cladding layer or double cladding structure
- Different fluorine doping concentration for inner and outside layers
- Outside layers with pure silica
- Higher or lower numerical aperture
- Higher CCDR values

Target Fiber Specifications

	Spec. Values				Unit
	633	850	1064	1385	
Attenuation Typical	≤ 12	≤ 4	≤ 5	≤ 30	dB/km
Attenuation Maximum	≤ 20	≤ 6	≤ 7	≤ 60	dB/km

Standard Characteristics

	Spec. Values	Unit
Core Composition	SiO ₂	
Cladding Composition	SiO ₂ /F	
Refractive Index Profile	Step-index	
Refractive Index Delta	(17 ± 3) × 10 ⁻³	
Numerical Aperture	0.22 ± 0.02	
Preform Diameter (O.D.)	20 - 70	mm
Tolerance of O.D. within a Rod:		
O.D. 20 - 29 mm	± 4.0	%
O.D. 30 - 39 mm	± 3.0	%
O.D. 40 - 70 mm	± 2.0	%
Preform Length	400 - 1200	mm
Preform Non-Circularity	≤ 2.0	%
Clad Concentricity Error of O.D	< 1.0	%
Cladding Core Diameter Ratio (CCDR)	1.040 - 1.400	
Tolerance of CCDR:		
CCDR 1.04 - 1.09	+ 0.010 / - 0.005	
CCDR 1.10 - 1.40	± 0.015	

Ordering Information

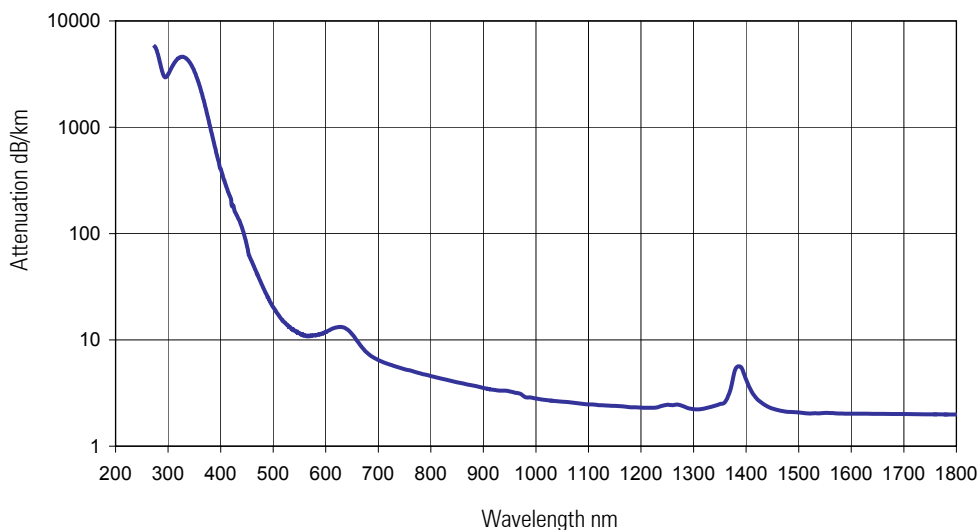
To order j-plasma optical preform please call, fax or email us and specify the following parameters:

Preform Type:	j-plasma FSI-IR preform
Preform Diameter:	20.0mm to 70.0mm
Preform Length:	400mm to 1200mm
Preform Quantity:	kg
Other:	desired ship date, special requests

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Data sheet: FSI-IR type preforms – Premium

Typical Attenuation Curve:



Features & Benefits

- Designed to provide high power laser transmission in a wide spectral range from 550nm to 2000nm for use in electronical, medical, spectroscopy, research and development applications
- Provides unsurpassed stability and reliability in high power laser transmission in the IR
- Features pure synthetic quartz glass as core material and a cladding of fluorine doped silica layers
- Available with very low OH content (less than 0.3 ppm) to provide lowest attenuation for application in IR spectral region

Custom preform designs upon request

- Customized types of core and cladding materials and designs
- Single doped cladding layer or double cladding structure
- Different fluorine doping concentration for inner and outside layers
- Outside layers with pure silica
- Higher or lower numerical aperture
- Higher CCDR values

Target Fiber Specifications

	Spec. Values				Unit
	633	850	1064	1385	
Attenuation Typical	≤ 13	≤ 3	≤ 1.5	≤ 7	dB/km
Attenuation Maximum	≤ 15	≤ 4	≤ 3	≤ 20	dB/km

Standard Characteristics

	Spec. Values	Unit
Core Composition	SiO ₂	
Cladding Composition	SiO ₂ /F	
Refractive Index Profile	Step-index	
Refractive Index Delta	(17 ± 3) × 10 ⁻³	
Numerical Aperture	0.22 ± 0.02	
Preform Diameter (O.D.)	20 - 70	mm
Tolerance of O.D. within a Rod:		
O.D. 20 - 29 mm	± 4.0	%
O.D. 30 - 39 mm	± 3.0	%
O.D. 40 - 70 mm	± 2.0	%
Preform Length	400 - 1200	mm
Preform Non-Circularity	≤ 2.0	%
Clad Concentricity Error of O.D	< 1.0	%
Cladding Core Diameter Ratio (CCDR)	1.040 - 1.400	
Tolerance of CCDR:		
CCDR 1.04 - 1.09	+ 0.010 / - 0.005	
CCDR 1.10 - 1.40	± 0.015	

Ordering Information

To order j-plasma optical preform please call, fax or email us and specify the following parameters:

Preform Type:	j-plasma FSI-IR premium
Preform Diameter:	20.0mm to 70.0mm
Preform Length:	400mm to 1200mm
Preform Quantity:	kg
Other:	desired ship date, special requests

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