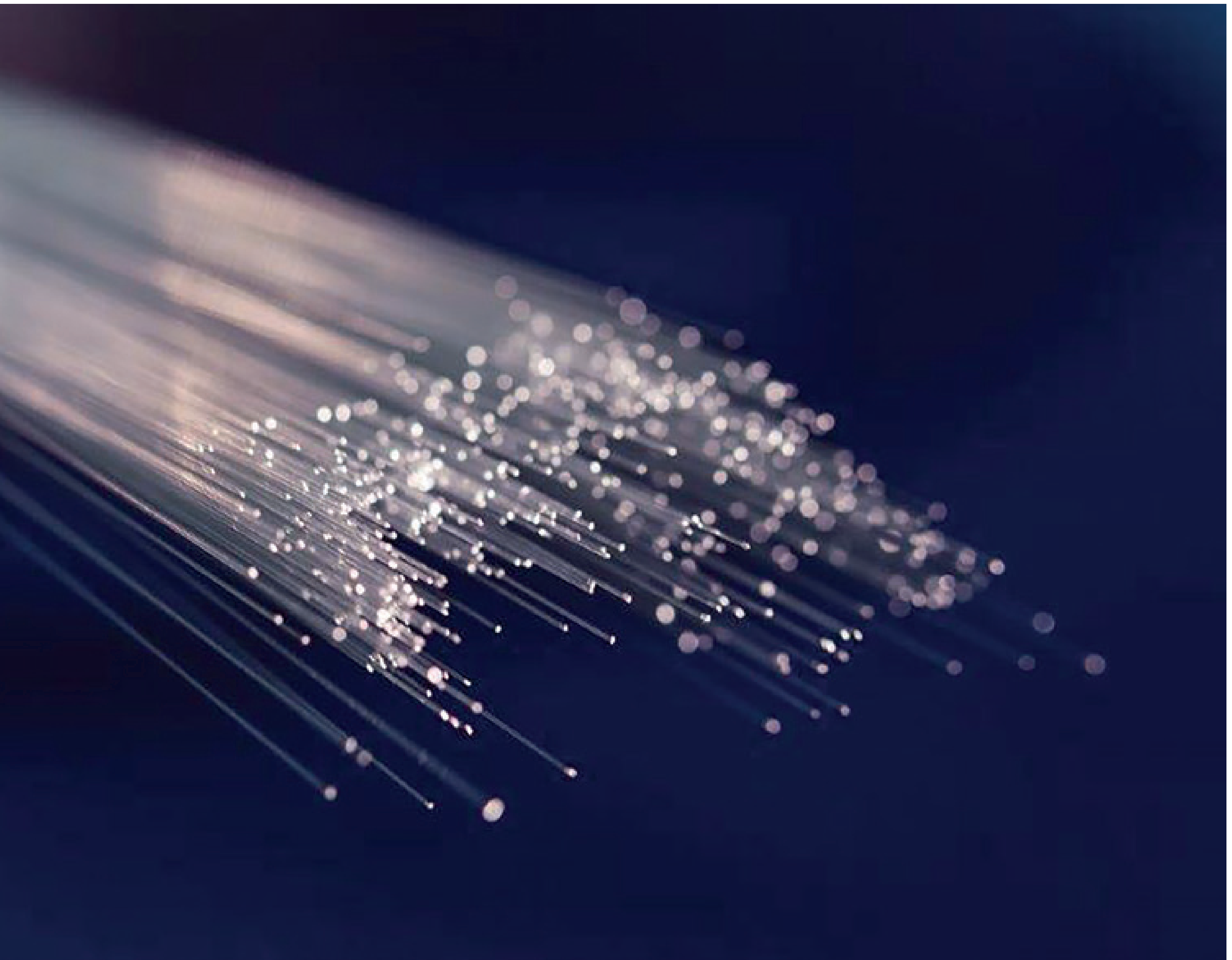
Innovative Fiber Optics
Every Step of the Way™

CeramOptec®



A full range of services for your needs

CeramOptec® offers customised solutions in fiber optic technology, from individual fibers to ready-to-use cable assemblies.

With over 30 years' experience in the development and production of optical fibers and everything that goes with it, we are a trusted partner for industry and research. We develop our precision-made solutions in-house, from preform manufacturing to finished cables and bundles, as this allows us to provide you with effective, expert support and meet your individual requirements efficiently. We offer a one-stop solution for all your fiber optics needs. Many prestigious clients rely on our products. We hope that this brochure will provide you with a sound basis for your decision, and we would be delighted to tell you more about our products and processes in person.

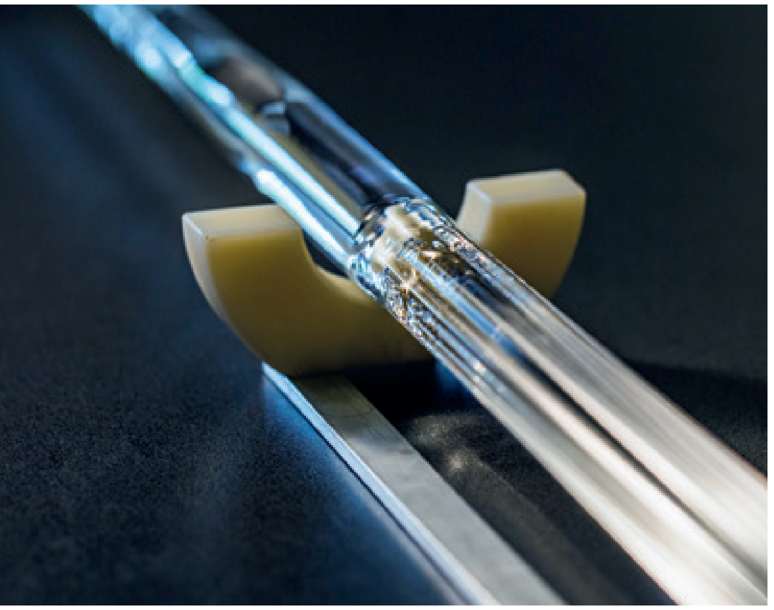
Your advantages

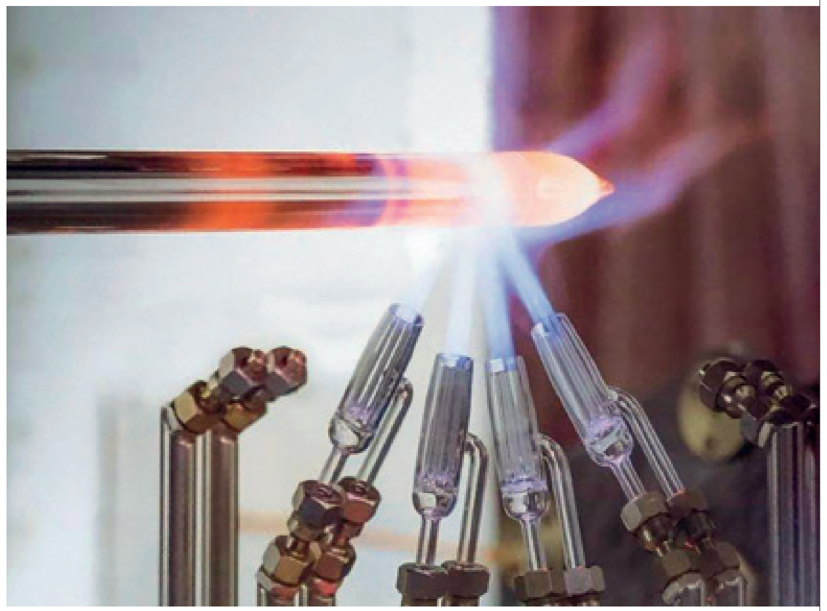
- Over 500 Optran® UV and Optran® WF fibers in stock
- Non-standard diameters and NA values available
- Option of fully customised fiber production
- A complete solution for all your performance needs
- ISO 9001 compliant manufacturing environment
- CE mark

From initial enquiry to the finished product

ENQUIRY > TECHNICAL DEVELOPMENT > PROTOTYPING > PRODUCTION

Quartz glass preforms
by POVD and PCVD procedures





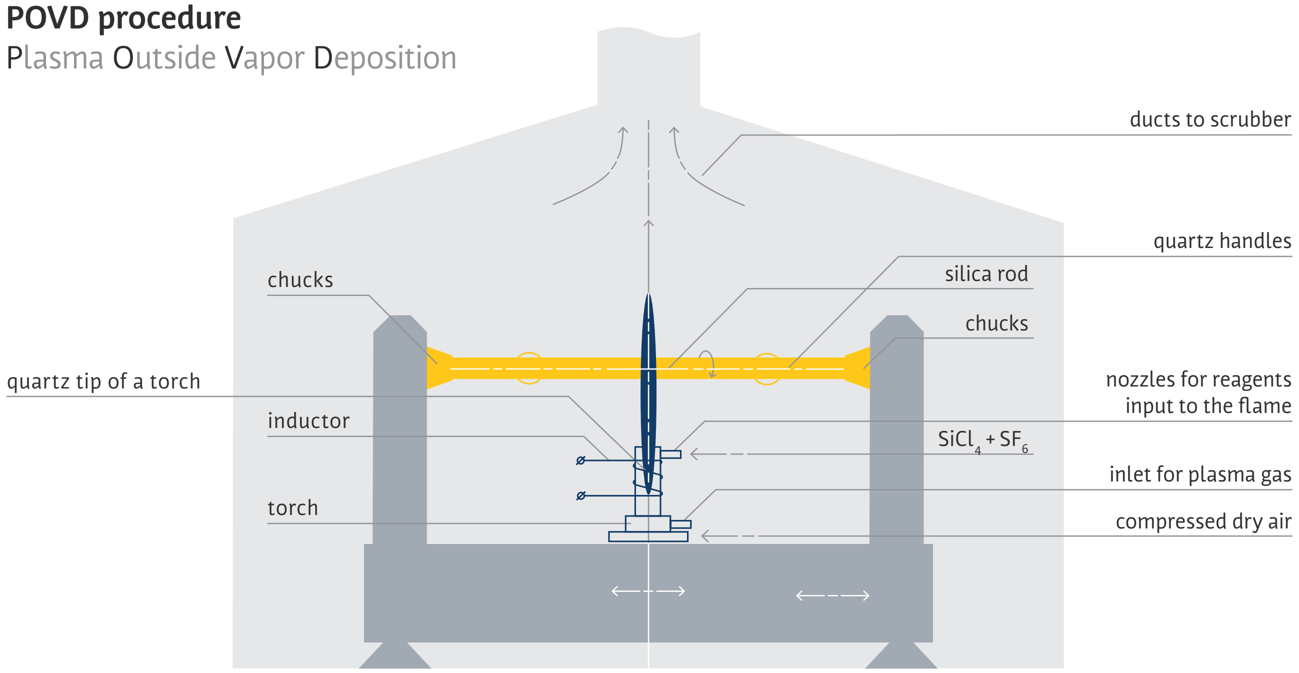
As one of the few suppliers on the market, CeramOptec® covers the entire manufacturing chain from the preform to the assembled fiber bundle. The preform sets both the optical properties as well as the geometry of the glass fiber drawn from it. Our in-house production gives us full control over these important parameters and enables us to adapt them quickly and flexibly to your requirements.

The use of two different processes for preform production – the POVD and the PCVD process – opens up a wide range of technical options and enables us to achieve particularly demanding special shapes.

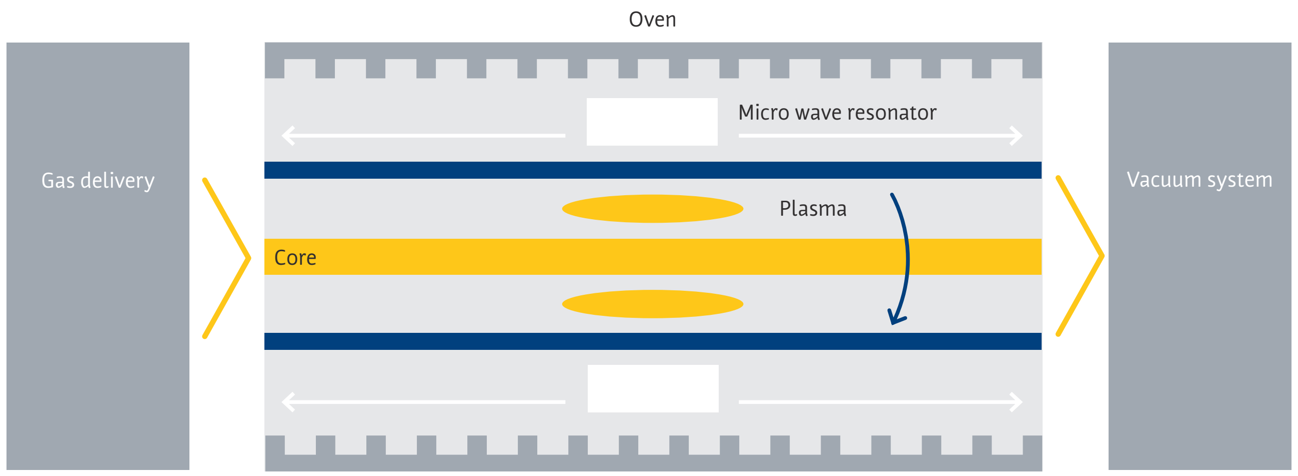
POVD and PCVD are plasma technologies for the production of preforms with a quartz glass core and quartz glass cladding. They enable layers to be formed on the surface of the core material of pure or fluorine-doped quartz glass with a refractive index difference Δn of up to -0.028. With CeramOptec's manufacturer-specific POVD procedure, a gas mixture consisting of $SiCl_4$ and a suitable fluorine compound is introduced into the plasma stream. The plasma is generated using a high-frequency induction plasma torch that moves along the coating rod. In the PCVD process, CeramOptec uses a microwave-generated plasma that is overlaid by a high-temperature zone of about 1100 °C.

As a result of both processes, thin, fluorine-doped quartz layers are deposited from the gas phase on the surface of the quartz glass core. In this way, preforms with lengths of 300–1100 mm are produced in the POVD and PCVD production lines.

POVD procedure
Plasma Outside Vapor Deposition



PCVD procedure
Plasma Chemical Vapor Deposition

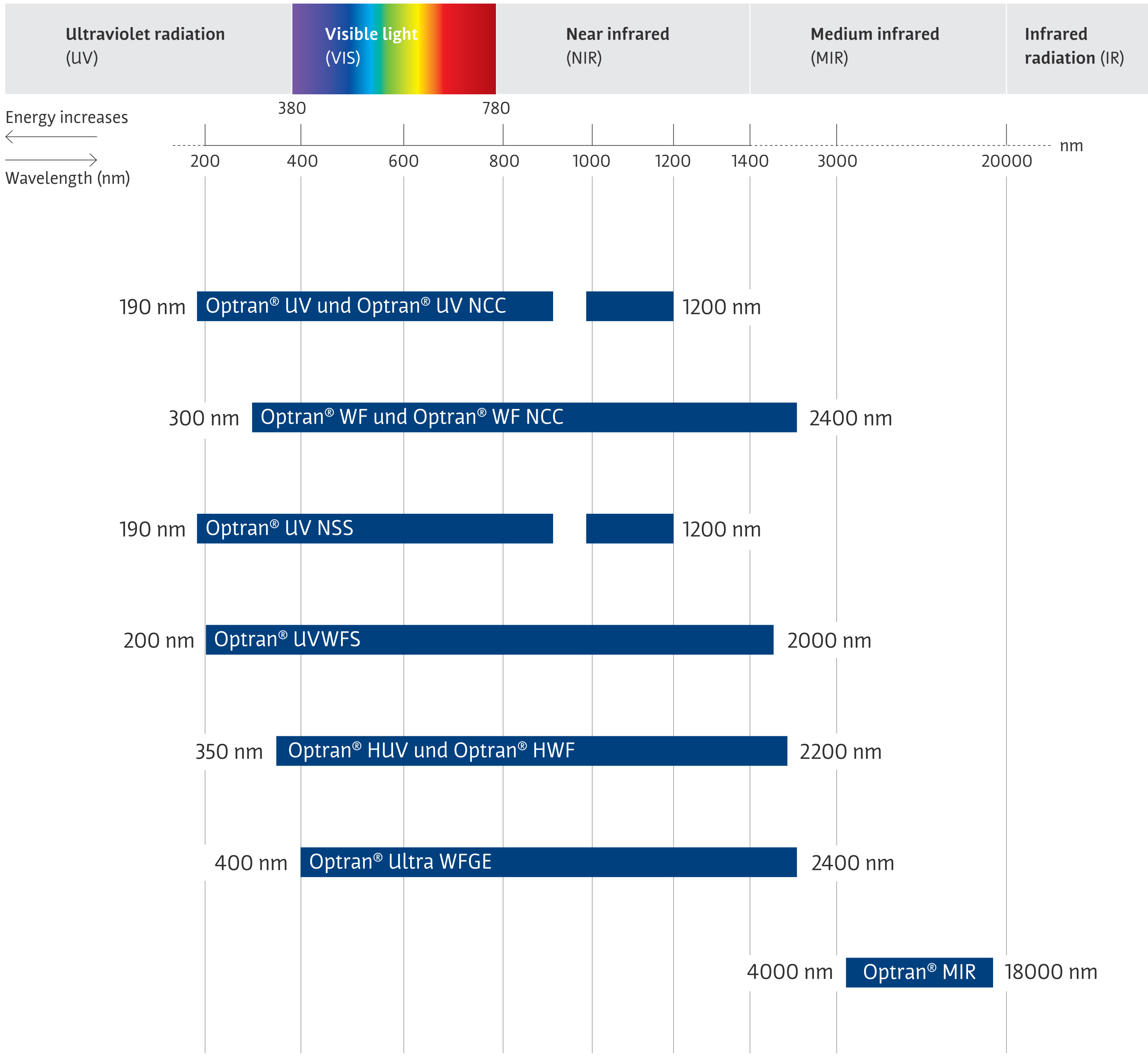


Technical data

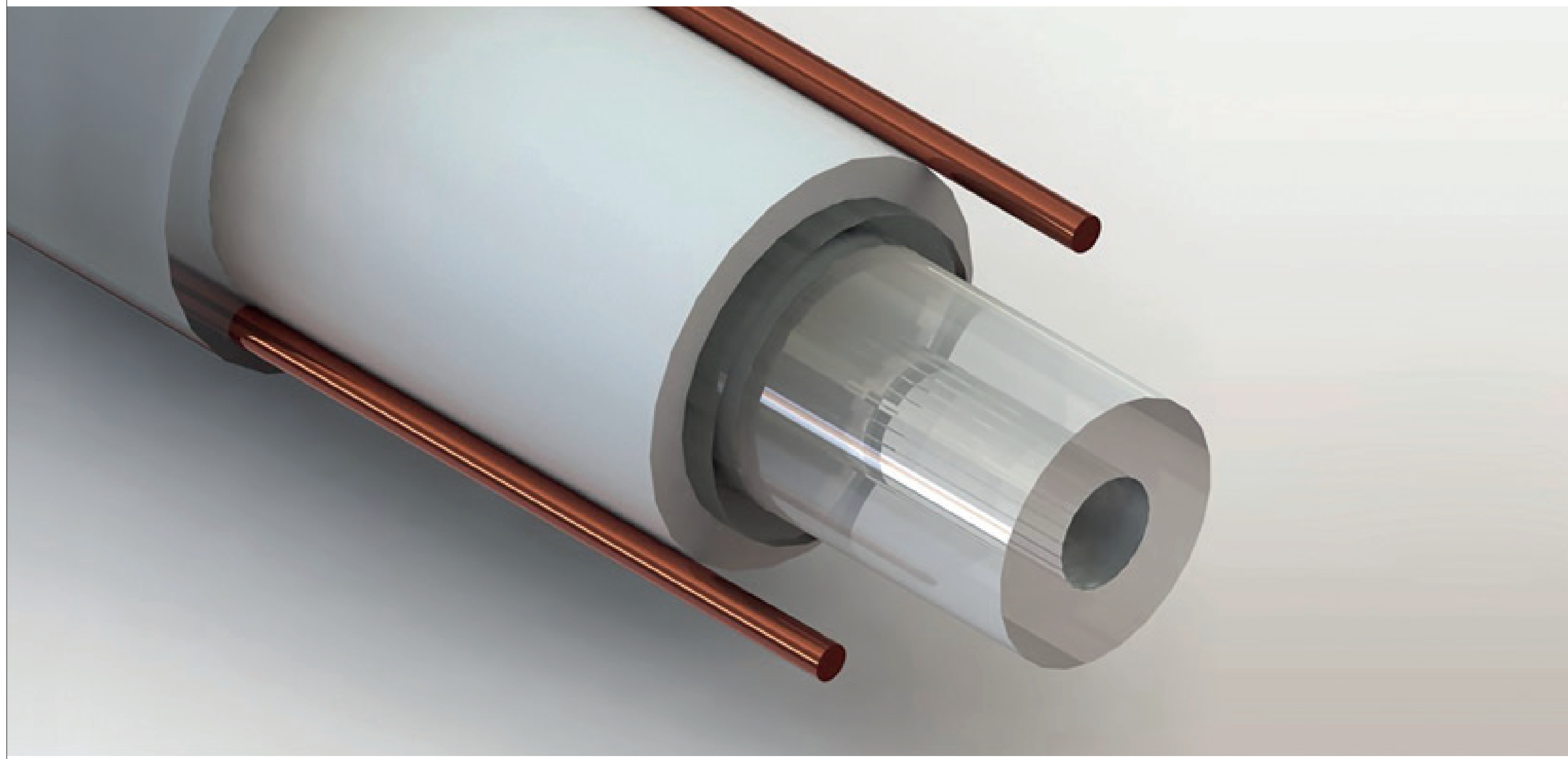
Numerical aperture (NA)	0,12 ± 0,02 | 0,22 ± 0,02 | 0,28 ± 0,02 or customised
Preform diameter	20–40 mm
Standard Kern / Mantel-Verhältnisse	**1:1,04 | 1:1,06 | 1:1,1 | 1:1,15 | 1:1,2 | 1:1,25 | 1:1,4** or customised
OH content	high (> 700 ppm) low (< 1 ppm) 0,25 und < 0,1 ppm available on request
Core geometry	round, square, rectangular, hexagonal, octagonal or customised
Production process	POVD (Plasma Outside Vapor Deposition) PCVD (Plasma Chemical Vapor Deposition)

Fiber overview
Choose the right one

Different types of optical wavequides are used at different wavelengths depending on their transmission properties.



Safety Fiber
More safety for users of fiber-coupled high-performance lasers



Copper wire conductors with a jacket facilitate the design of active protective devices

A new fiber design from CeramOptec increases user safety in connection with fiber-coupled high-performance lasers. Copper wirers in a polyamide jacket support the configuration of active protective devices that interrupt the laser circuit in the event of fiber breakage or connection problems and protect the user from leaking radiation.

Since the two copper wires are applied together with the polyamide sheathing after the fiber drawing process, the new fiber concept can be implemented for all standardized CeramOptec glass fibers. All-rounders such as the standard Optran© UV/WF fibers are also available as safety fibers, as are the homogenizing Optran© NCC fibers with polygonal core geometry. For optimum coverage of all bending radii and temperature zones, safety fibers are available with copper wire conductors of 50, 100 and 150 micrometers. Custom configurations are also available on request.

Optran® UV, Optran® WF

Silica / silica fiber

Superior performance and fiber optic properties from UV to IR wavelengths: CeramOptec®'s Optran® UV / WF fibers are available in a range of core diameters and assemblies, tailored to your specific application needs.

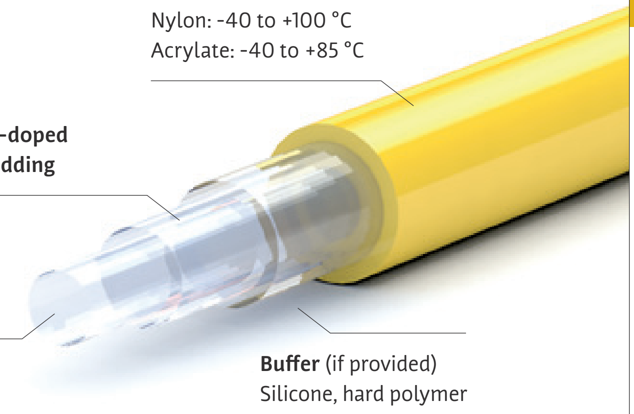
Standard

Wavelength

Optran® UV	190 – 1200 nm
Optran® WF	300 – 2400 nm

Numerical aperture (NA)

Low	0,12 ± 0,02
Standard	0,22 ± 0,02
High	0,28 ± 0,02



Technical data

Wavelength / spectral range	Optran® UV: 190 – 1200 nm Optran® WF: 300 – 2400 nm
Numerical aperture (NA)	0,12 ± 0,02 | 0,22 ± 0,02 | 0,28 ± 0,02 or customised
Operating temperature	-190 bis +350 °C
Core diameter	Available from 25 to 2000 µm
Standard core / cladding ratios	**1:1,04 | 1:1,06 | 1:1,1 | 1:1,15 | 1:1,2 | 1:1,25 | 1:1,4** or customised
OH content	Optran® UV: high (> 700 ppm) Optran® WF: low (< 1 ppm) Fibers with OH contents < 0,25 ppm are available upon request
Standard prooftest	100 kpsi (nylon, ETFE, acrylate jacket) | 70 kpsi (polyimide jacket)
Minimum bending radius	50 × cladding diameter (short-term mechanical stress) 150 × core diameter (during use with high laser power)
Product code	See glossary, p. 27
Attenuation values	in relation to wavelength: see p. 18

Applications

First choice for applications including spectroscopy, medical diagnostics, medical technology, laser delivery systems and many more.

Optran® UV NSS

Silica / silica fiber with hermetic carbon layer

CeramOptec® is glad to offer a new product for UVC spectral range. Improved solarization resistance and extra stability of UV NSS fiber open wide variety of applications.

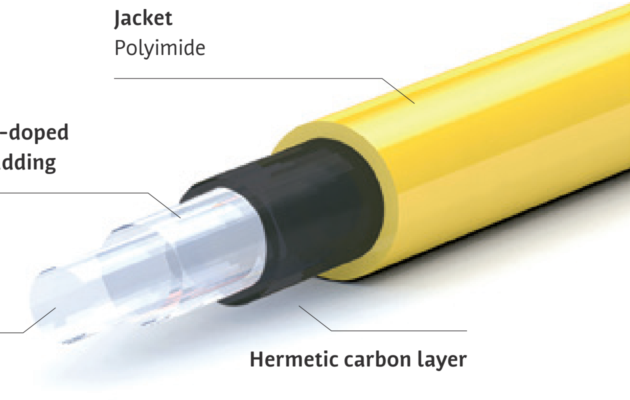
High solarization resistance

Wavelength

Optran® UV NSS	190 – 1200 nm

Numerical aperture (NA)

Low	0,12 ± 0,02
Standard	0,22 ± 0,02
High	0,28 ± 0,02



Technical data

Wavelength / spectral range	Optran® UV NSS: 190 – 1200 nm
Numerical aperture (NA)	0,12 ± 0,02 | 0,22 ± 0,02 | 0,28 ± 0,02 or customised
Operating temperature	-190 to +150 °C
Core diameter	Available from 100 to 600 µm
Standard core / cladding ratios	**1:1,06 | 1:1,1 | 1:1,2 | 1:1,4** or customised
OH content	High (> 700 ppm)
Standard prooftest	70 kpsi (polyimide jacket)
Minimum bending radius	50 × cladding diameter (short-term mechanical stress) 300 × core diameter (during use with high laser power)
Attenuation values	in relation to wavelength: see p. 18

Applications

First choice for applications including spectroscopy, semiconductor technology, laser delivery systems and many more.

Optran® UV NCC, Optran® WF NCC
Silica / silica non-circular core fiber

These fibers are ideal for laser applications, among others, where the shape and homogenity of the output beam is decisive. CeramOptec® offers these fibers in rectangular, square, octagonal and other core / cladding geometries for additional advantages compared to our UV / WV range. Laser beam-shaping optics can be avoided.

Homogeneous power distribution

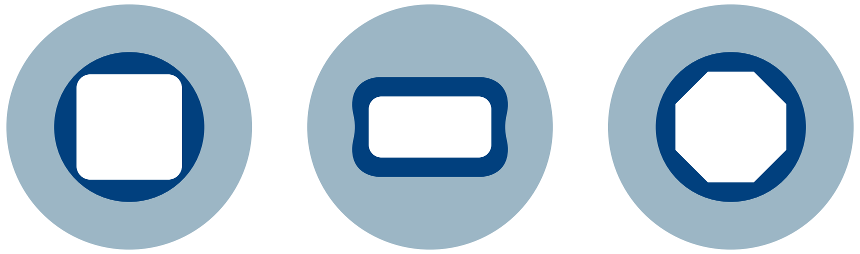
Wavelength

Optran® UV NCC	190–1200 nm
Optran® WF NCC	300–2400 nm

Numerical aperture (NA)

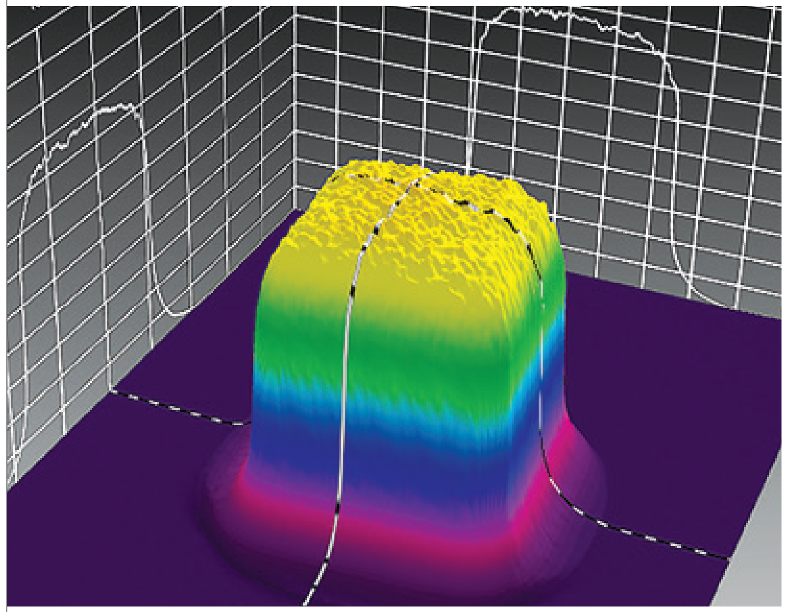
Low	0,16 ± 0,02
Standard	0,22 ± 0,02
High	0,28 ± 0,02

Different core and cladding geometries available
such as square, rectangular or octagonal

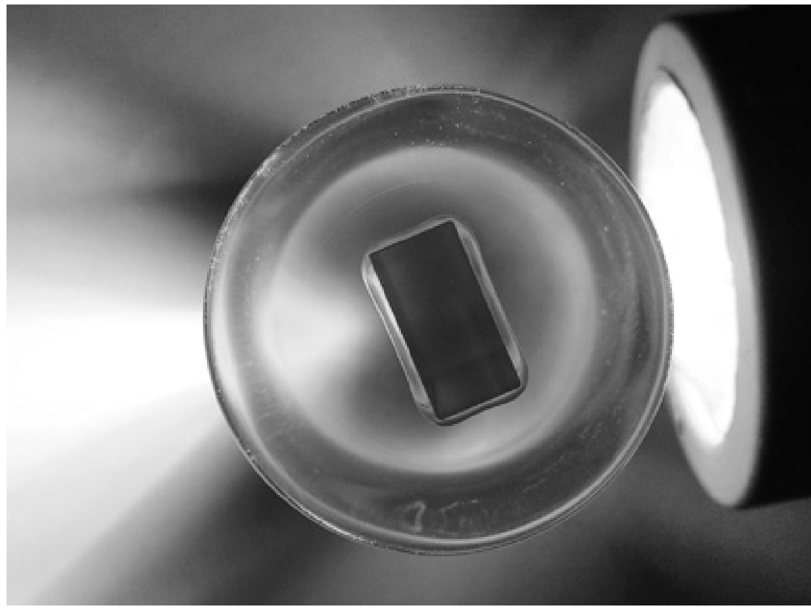


Technical data

Wavelength / spectral range	Optran® UV NCC: 190–1200 nm Optran® WF NCC: 300–2400 nm
Numerical aperture (NA)	0,16 ± 0,02 | 0,22 ± 0,02 | 0,28 ± 0,02 or customised
Operating temperature	-190 to +350 °C
Core diameter	Geometries and diameters upon request
OH content	Optran® UV NCC: high (> 700 ppm) Optran® WF NCC: low (< 1 ppm) Fibers with OH content < 0,25
Standard prooftest	100 kpsi (nylon, ETFE, acrylate cladding) 70 kpsi (polyimide cladding)
Minimum bending radius	50 × cladding diameter (short-term mechanical stress) 150 × core diameter (during use with high laser power)
Attenuation values	in relation to wavelength: see p. 18

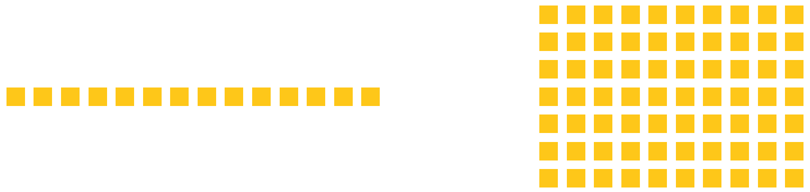


Fibers with a rectangular core geometry homogenize the intensity distribution. The image shows the intensity distribution on the focal level, using NCC fibers with core diameter of 800 × 800 µm.

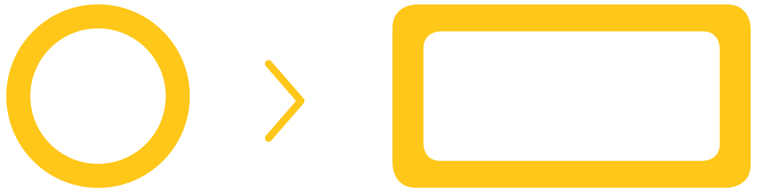


Fiber with rectangular core geometry.

Pure fused silica / F-doped fused silica square and rectangular shaped fibers
Fibers which deviate from the traditional round form with a square or rectangular shape offers advantages due to providing maximum packing density for input and output. These fibers are very suitable for connections to angular sources and receivers. The angular shaped core provides consistent short-distance homogenization input power distribution. Our angular fibers are also available in rectangular shapes with large side ratios and a small corner radius, thanks to our special PCVD-technology.



Large NCC's are ideal for applications which require a combination of flexibility and large cross sections in silica fibers, e.g. a diode laser delivery system.



Applications
First choice for applications for beam shaping e.g. including surface treatment or for lighting.

Optran® UVWFS broadband fiber

Silica / silica fibers for applications from UV-C to IR-B

CeramOptec® is glad to offer a new extremely low loss fiber for the 200 nm to 2000 nm wavelength range. UVWFS fiber owns properties of UV and WF fibers and can be used for a variety of applications.

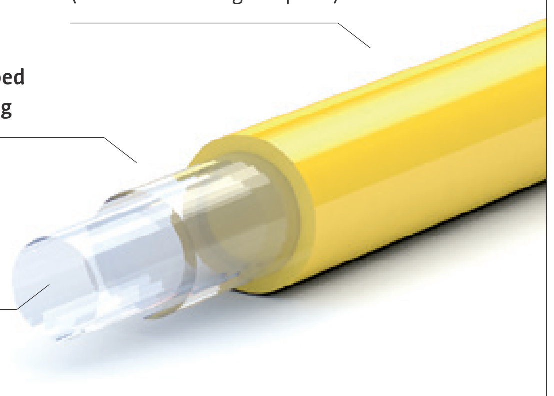
Broadband

Wavelength

Optran® UVWFS	200 – 2000 nm

Numerical aperture (NA)

Low	0,12 ± 0,02
Standard	0,22 ± 0,02
High	0,28 ± 0,02



Technical data

Wavelength / spectral range	Optran® UVWFS: 200 – 2000 nm
Numerical aperture (NA)	0,12 ± 0,02 | 0,22 ± 0,02 | 0,28 ± 0,02 or customised
Operating temperature	-190 to +350 °C
Core diameter	Available from 100 to 800 µm | standard 200 µm
OH content	Optran® UVWFS: ~ 5 ppm
Standard core / cladding ratios	**1:1,06 | 1:1,1 | 1:1,2 | 1:1,4** oder kundenspezifisch
Standard prooftest	70 kpsi (polyimide jacket)
Minimum bending radius	50 × cladding diameter (short-term mechanical stress) 150 × core diameter (during use with high laser power)
Attenuation values	in relation to wavelength: see p. 19

Applications

CeramOptec® UVWFS optical fiber is the first choice for many applications where you work with different wavelengths simultanously: spectroscopy, analytical instruments, sensing applications, astronomy, aerospace and avionics, military applications and many more.

Optran® HUV, Optran® HWF

Silica fiber with hard polymer cladding

CeramOptec® offers its Optran® HUV / HWF fibers as a cost-effective alternative to silica / silica fibers. They provide high numerical aperture values, minimal bend losses and efficient connectorisation for a wide range of applications.

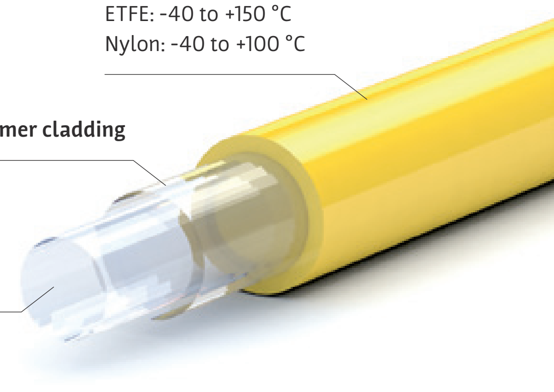
High NA at a low price

Wavelength

Optran® HUV / HWF	350 – 2200 nm

Numerical aperture (NA)

Standard	0,37 ± 0,02
High	0,48 ± 0,02
	0,52 ± 0,02
	0,57 ± 0,02



Technical data

Wavelength / spectral range	Optran® HUV and Optran® HWF: 350 – 2200 nm
Numerical aperture (NA)	0,37 ± 0,02 | 0,48 ± 0,02 | 0,52 ± 0,02 | 0,57 ± 0,02
Operating temperature	-40 to +150 °C
Core diameter	Available from 100 to 2000 µm
OH content	Optran® HUV: high (> 700 ppm) Optran® HWF: low (< 1 ppm)
Standard prooftest	100 kpsi
Minimum bending radius	50 × cladding diameter (short-term mechanical stress) 150 × core diameter (during use with high laser power)
Attenuation values	in relation to wavelength: see p. 19

Applications

First choice for applications from illumination to photodynamic therapy and many more.

Optran® Ultra WFGE
Ge-doped silica / silica fiber

The CeramOptec® Optran® Ultra WFGE fibers stand out through maximum numerical aperture values, unmatched performance and a broad spectral range. There is a large choice of core diameters and solutions tailored to your specific needs are available upon request.

High NA for demanding applications

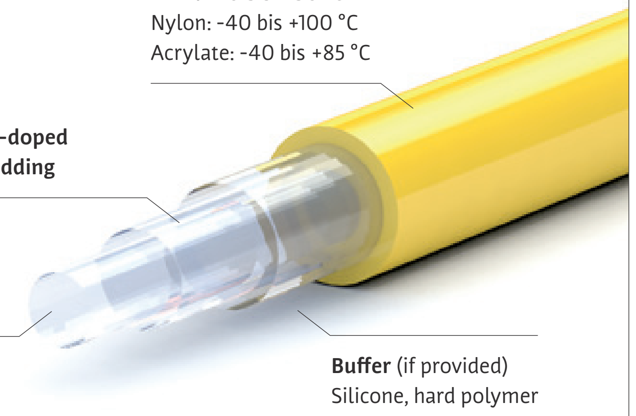
Wavelength

Optran® Ultra WFGE	400–2400 nm

Numerical aperture (NA)

Standard	0,37 ± 0,02

Higher NA on request



Technical data

Wavelength / spectral range	Optran® Ultra WFGE: 400–2400 nm
Numerical aperture (NA)	0,37 ± 0,02
Operating temperature	-190 to +350 °C
Core diameter	Available from 50 to 1000 µm
Standard core / cladding ratios	**1:1,04 | 1:1,06 | 1:1,1 | 1:1,15 | 1:1,2 | 1:1,25 | 1:1,4** or customised
Standard prooftest	100 kpsi (nylon, ETFE, acrylate jacket) 70 kpsi (polyimide jacket)
Minimum bending radius	50 × cladding diameter (short-term mechanical stress) 150 × core diameter (during use with high laser power)
Attenuation values	in relation to wavelength: see p. 18

Applications

First choice for applications including spectroscopy, laser technology, research, photodynamic therapy and many more.

Optran® MIR
Silver halide fiber

This unique fiber, which comprises a photosensitive compound (AgCl, AgBr), is ideal for the mid-infrared (MIR) range.

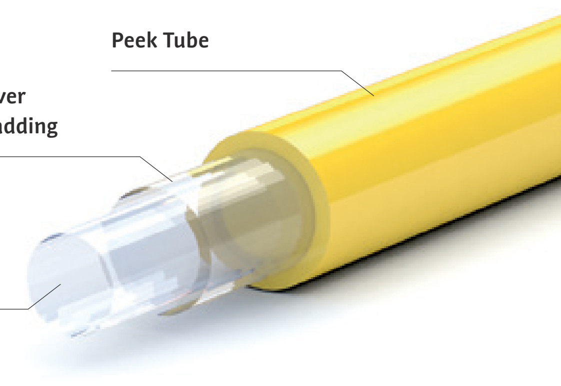
Middle infrared range

Wavelength

Optran® MIR	4–18 µm

Numerical aperture (NA)

Low	0,13 ± 0,02
Standard	0,25 ± 0,02
High	0,35 ± 0,02



Technical data

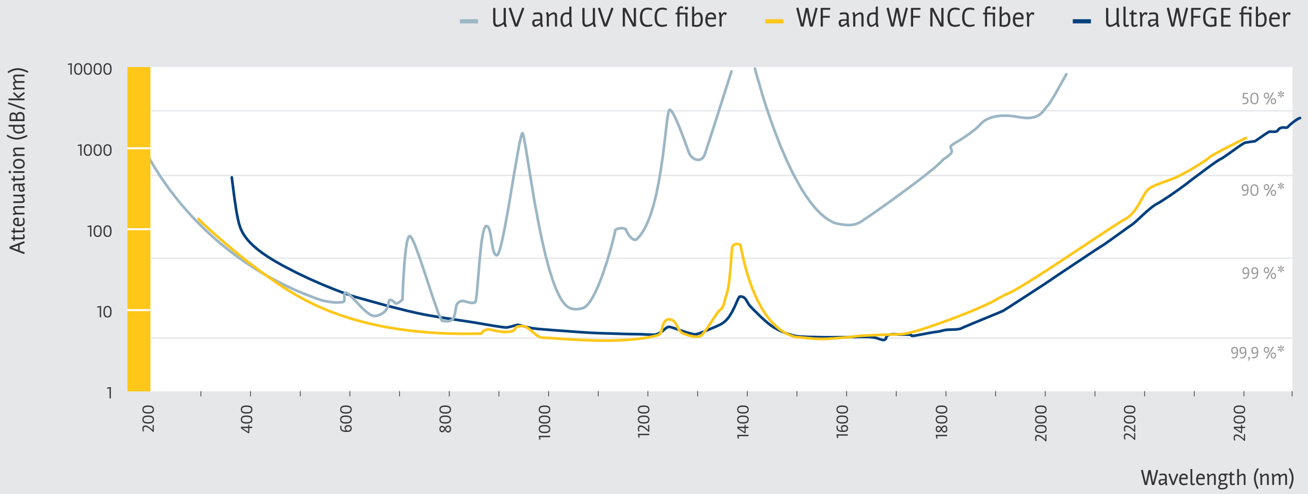
Wavelength / spectral range	Optran® MIR: 4–18 µm
Numerical aperture (NA)	0,13 ± 0,02 | 0,25 ± 0,02 | 0,35 ± 0,02
Operating temperature	-60 to + 110 °C
Standard diameter	Core / cladding (µm) 400 / 500 µm | 600 / 700 µm | 860 / 1000 µm
Calculation index (core)	2,1
Reflective losses @ 10.6 µm	25 %
Minimum bending radius	100 × cladding diameter
Highest power	30 Watt
Attenuation values	in relation to wavelength: see p. 19

Applications

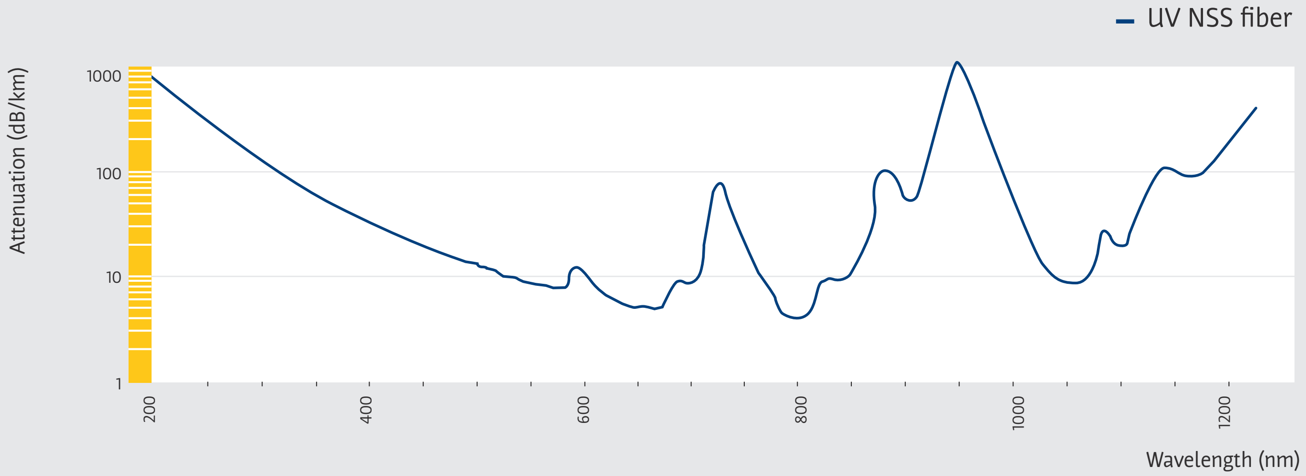
First choice for applications including CO_2-laser guides, FTIR spectroscopy, laser surface treatments and many more.

At a glance
Comparison of attenuation values

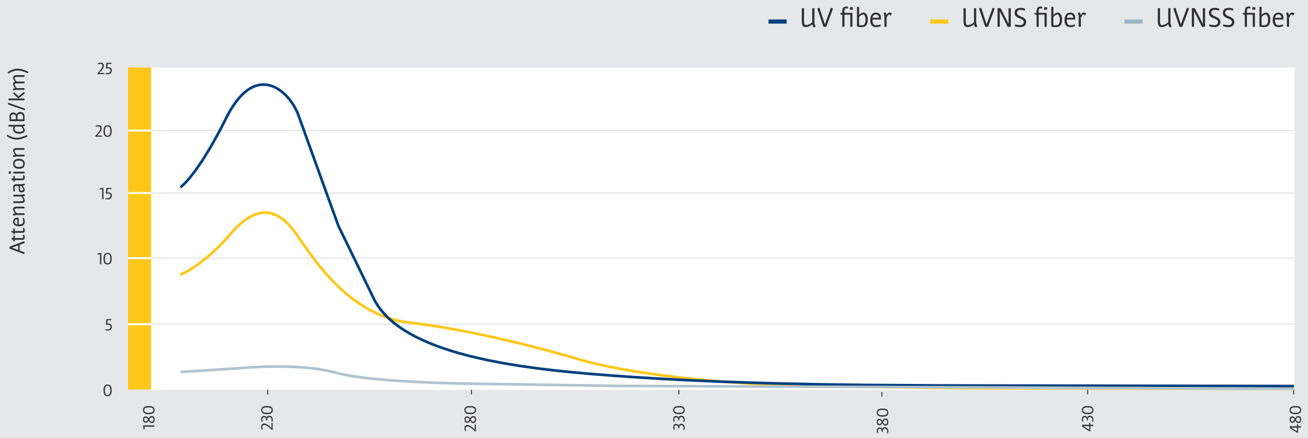
Optran® UV, WF / UV NCC, WF NCC / Ultra WFGE



Optran® UV NSS

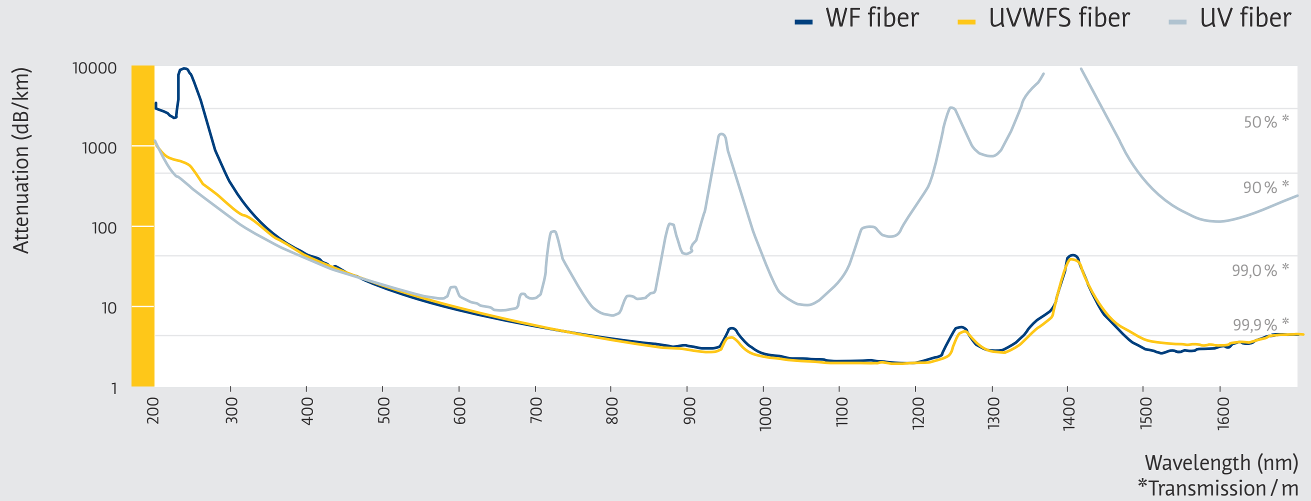


Optran® UV NSS (Comparison of solarization resistance)

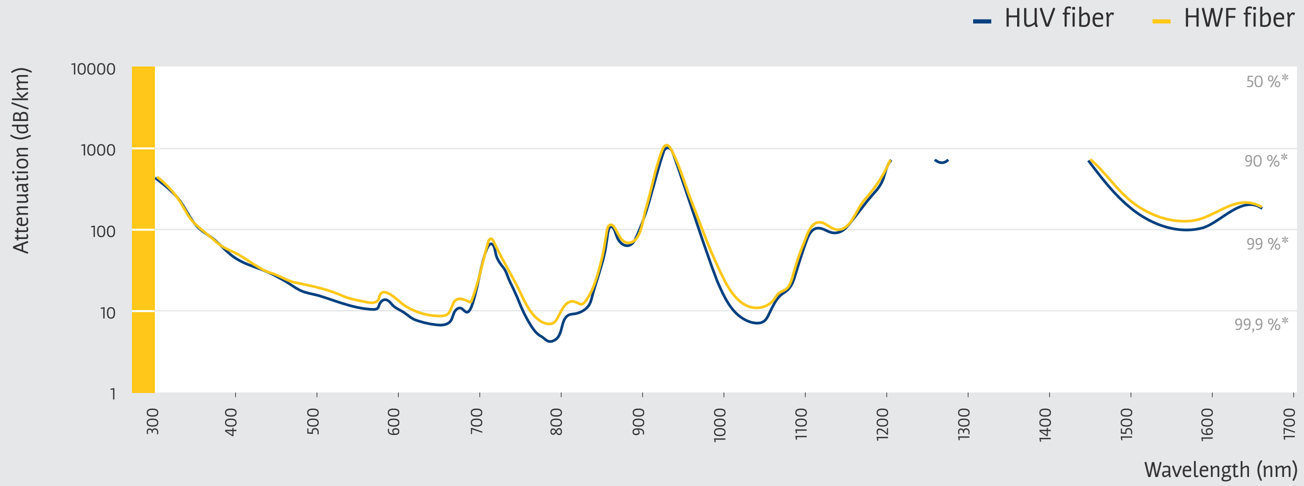


Attenuation caused by radiation with ArF laser/1000J/cm²

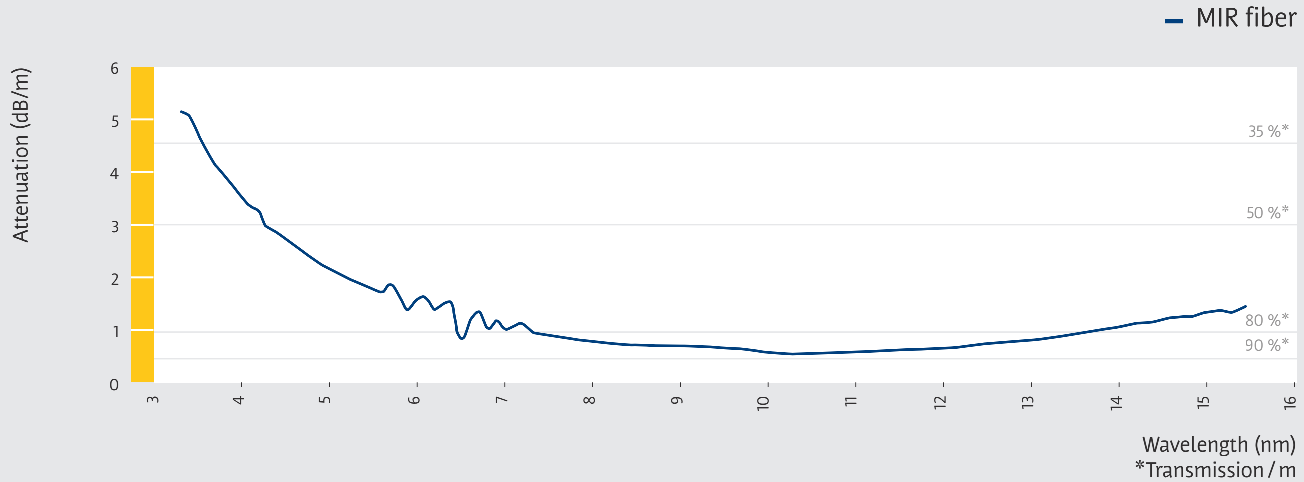
Optran® UVWFS broadband fiber



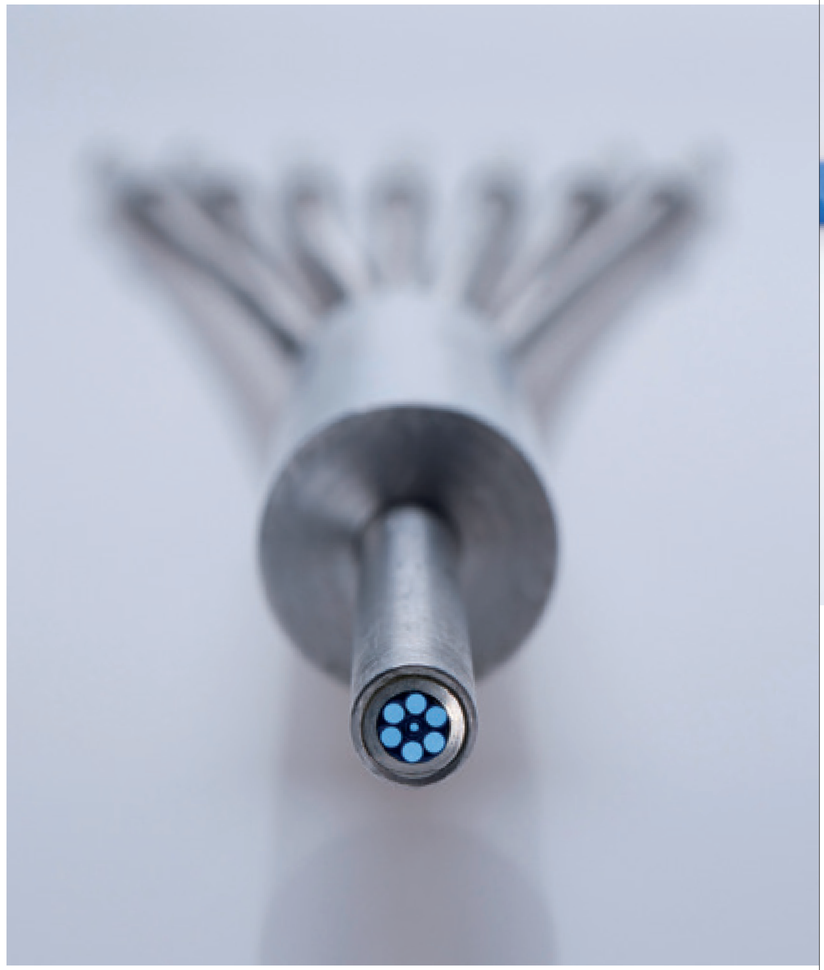
Optran® HUV, Optran® HWF



Optran® MIR



Fiber bundles
Multi-fiber assemblies

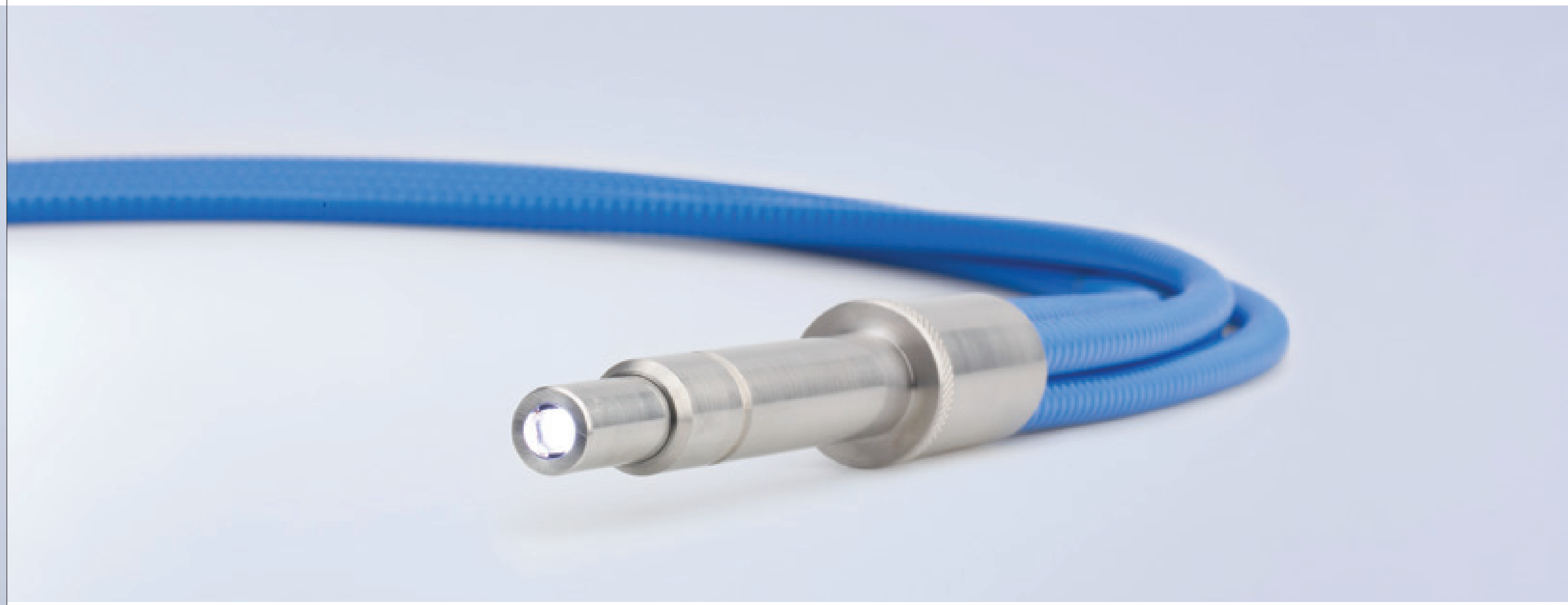


CeramOptec®'s fiber bundles are designed for superior quality and optimum fiber optic properties. We optimise your bundles for various parameters, including NA and packing efficiency. Our fiber assemblies can be flexibly configured and tailored precisely to your application needs.

Options

Available fibers	All fibers from our range
Active bundle surface geometries	Circular | Semi-circular | Square | Rectangular | Line | Ring | Segmented ring
Bundle design	Single-branch | Dual-branch | Multi-branch
Bundle variant	Glued | Fused | Sorted | AR coated
Connectors	SMA | FC / PC | ST and others upon customer request

PowerLightGuide bundles
Fused end bundles



CeramOptec®'s fused-end PowerLightGuide bundles set the benchmark for consistently high long-term performance. The fusing process completely eliminates inter-fiber spaces and thus positions CeramOptec®'s PowerLightGuide bundles among the most sophisticated fiber bundles on the market. As the bundles do not rely on adhesive, they are resistant to temperatures of more than +600 °C, making them the first choice for demanding applications!

Wavelength

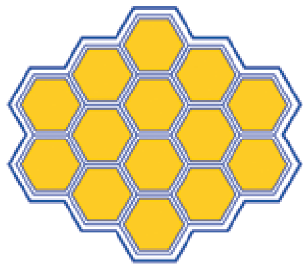
PowerLightGuides	190 – 2400 nm

Numerical aperture (NA)

Low	0,12 ± 0,02
Standard	0,22 ± 0,02
High	0,37 ± 0,02

Advantages

- High transmission
- No inter-fiber spaces
- Large active diameter
- Wide range of ready-to-use assemblies available
- Long service life
- Even distribution in multi-branch bundles
- High temperature resistance above +600 °C

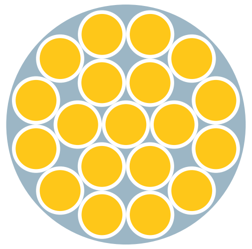


Bundles made from end-fused fibers show no gaps between individual fibers, since the fibers attain a hexagonal shape during the fusing process.

Fiber bundles
Overview

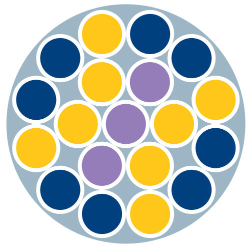
Gluing

Glued fiber bundles offer the greatest flexibility in terms of achievable diameters and geometries.



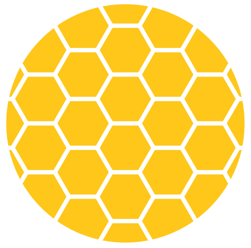
Sorting

A sorting of the fibers allows an even power distribution on several bundle arms and can increase the measuring precision by a spatial mapping of the fibers.



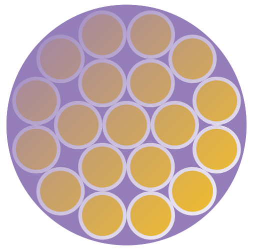
Fusion

For bundles of fused fibers all gaps between the fibers are removed, resulting in an increase of the filling factor and therefore the transmission byup to 20 %.



AR coating

An AR coating almost completely eliminates reflection losses at the fiber ends, which can increase transmission by about 7 %.



Fiber cables

Single-fiber assemblies

CeramOptec® offers a comprehensive range of cables and high-power cables tailored to your specific application needs. As we maintain complete control over the entire process, from preform manufacturing to the finished product, we are able to supply cables that meet the most demanding requirements regarding quality and fiber optic properties.

Advantages

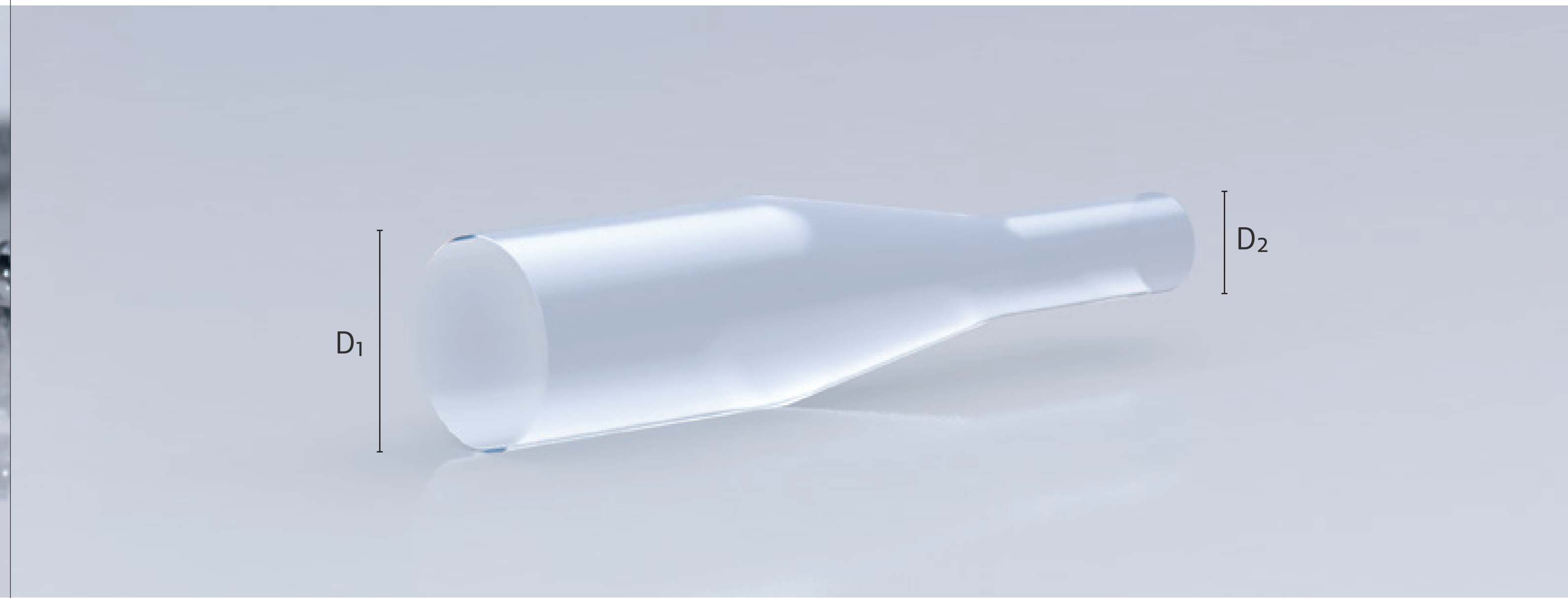
- Broad temperature range
- High resistance against laser damage
- Special jackets available for high temperatures, high vacuum and harsh chemicals
- All dielectric, non-magnetic design
- Various lengths available

Options

Available fibers	All fibers from our range
Connectors	SMA | FC/PC | ST and others upon customer request, including ferrules
Protection tubes	PVC | PTFE | Kevlar | C-Flex | Kevlar-reinforced PVC | Metal | Steel and others
Cable variation	AR coating possible

Fiber taper products

Optran® UV, WF, Ultra WFGE



CeramOptec®'s fused tapered fibers can be deployed from the deep UV to the NIR range. Taper products are required where input and output diameters differ. CeramOptec® offers a wide range of options, including for special applications.

Advantages

- Broad temperature range
- High resistance against laser damage
- Special jackets available for high temperatures, high vacuum and harsh chemicals
- All dielectric, non-magnetic design

Formula

A tapered optical fiber acts as a beam diameter and numerical aperture converter, with the input beam being converted according to the following formula:

$$NA_2 := \frac{D_1}{D_2} NA_1$$

NA_1: Input NA | NA_2: Output NA
D_1: Input diameter | D_2: Output diameter
The output NA is limited by the NA of the fiber used, which may result in a loss of light.

Technical data

Available fibers	Optran® UV | Optran® WF | Optran® WFGE
Wavelength	From deep UV to NIR
Core diameter	50 to 1500 µm
Standard taper ratios	2:1 | 3:1 | 4:1 | 5:1 or customised
Standard prooftest	100 kpsi
Minimum bending radius	5–100 mm (depending on the selected fiber diameter)

Instructions for use

Fibers, fiber cables, fiber bundles

Please note the following information to ensure the long-term safe use of your fiber products:

Safety

1. The NA of the laser beam must be smaller than the NA of the fiber.
2. The laser beam must be directed towards the core diameter or fused bundle, as connectors or adhesive between the bundles may otherwise overheat.
3. It is recommended to have the laser energy distributed evenly (instead of a Gaussian distribution).

Application

1. Clean the fiber endface before switching on the laser.
2. Ensure that the ferrule and receptacle are entirely free from any contamination, as contaminants may burn in.
3. The cable / bundle surface may be cleaned with isopropyl alcohol, ideally under a microscope using a cotton bud.
4. Ensure that the optical axes are correctly aligned and not at an angle to each other, and that the focal point is correctly aligned. It is recommended to verify the alignment using a He-Ne laser.
5. Ensure that the minimum bending radius is complied with to prevent fiber breakage.

Our Glossar

We have explained some important concepts of fiber optics below.

Please do not hesitate to contact us if you have any questions.

Fiber optics	The branch of optical technology concerned with the transmission of radiant power through fibers made of transparent materials such as glass, fused silica or plastic.
Optical fiber	(Also optical waveguide, fiber optic cable, optical cable) – a thin filament of drawn or extruded glass or plastic having a central core and a cladding of lower-index material to promote internal reflection.
Fiber bundle	A rigid or flexible, concentrated assembly of glass or plastic fibers used to transmit light.
Core	The light conducting portion of an optical fiber. It has a higher refractive index than the cladding.
Cladding	Low refractive index material that surrounds the core of an optical fiber. It contains the core light while protecting against surface scattering. The cladding can consist of fused silica, plastic or specialty materials.
Numerical aperture (NA)	In fiber optics, the NA describes the range of angles at which light can enter and exit the system. NA is an important parameter in applied fiber optics.
Ultraviolet	The invisible region of the spectrum beyond the violet end of the visible region. Wavelengths range from 1 to 400 nm.
Visible spectrum	The region of the electromagnetic spectrum to which the retina is sensitive and by which the eye sees. It extends from about 400 to 700 nm in wavelength.
Attenuation	The phenomenon of the loss of average optical power in an optical fiber or medium.
Bend loss	Loss of power in an optical fiber due to bending of the fiber. Usually caused by exceeding the critical angle required for total internal reflection by internal light paths.
Transmission	In optics, the conduction of radiant energy through a medium. Often denotes the percentage of energy passing through an element or system relative to the amount that entered.

1 2 3 4 5 6

Product code key using the example of **WF 300/330 (H)(B)N (28)**

1	**Fiber type**	UV = Optran® UV | WF = Optran® WF | NSS = Optran® NSS | NCC = Optran® NCC HUV = Optran® HUV | HWF = Optran® HWF | WFGE = Optran® WFGE | MIR = Optran® MIR
2	**Standard core / cladding ratios**	Core ø (µm) / Cladding ø (µm)
3	**Buffer**	H = hard polymer buffer | No information = silicone buffer
4	**Colour**	B = black | BL = blue | W = white | Y = yellow | R = red | G = green No information = transparent
5	**Jacket material**	A = acrylate jacket (no buffer) | N = nylon jacket (silicone or hard polymer jacket) T= ETFE jacket (silicone or hard polymer buffer) | P = polyimide jacket (no buffer)
6	**Numerical aperture (NA)**	12 = 0,12 | 28 = 0,28 | No information = 0,22 (standard)

By the way:
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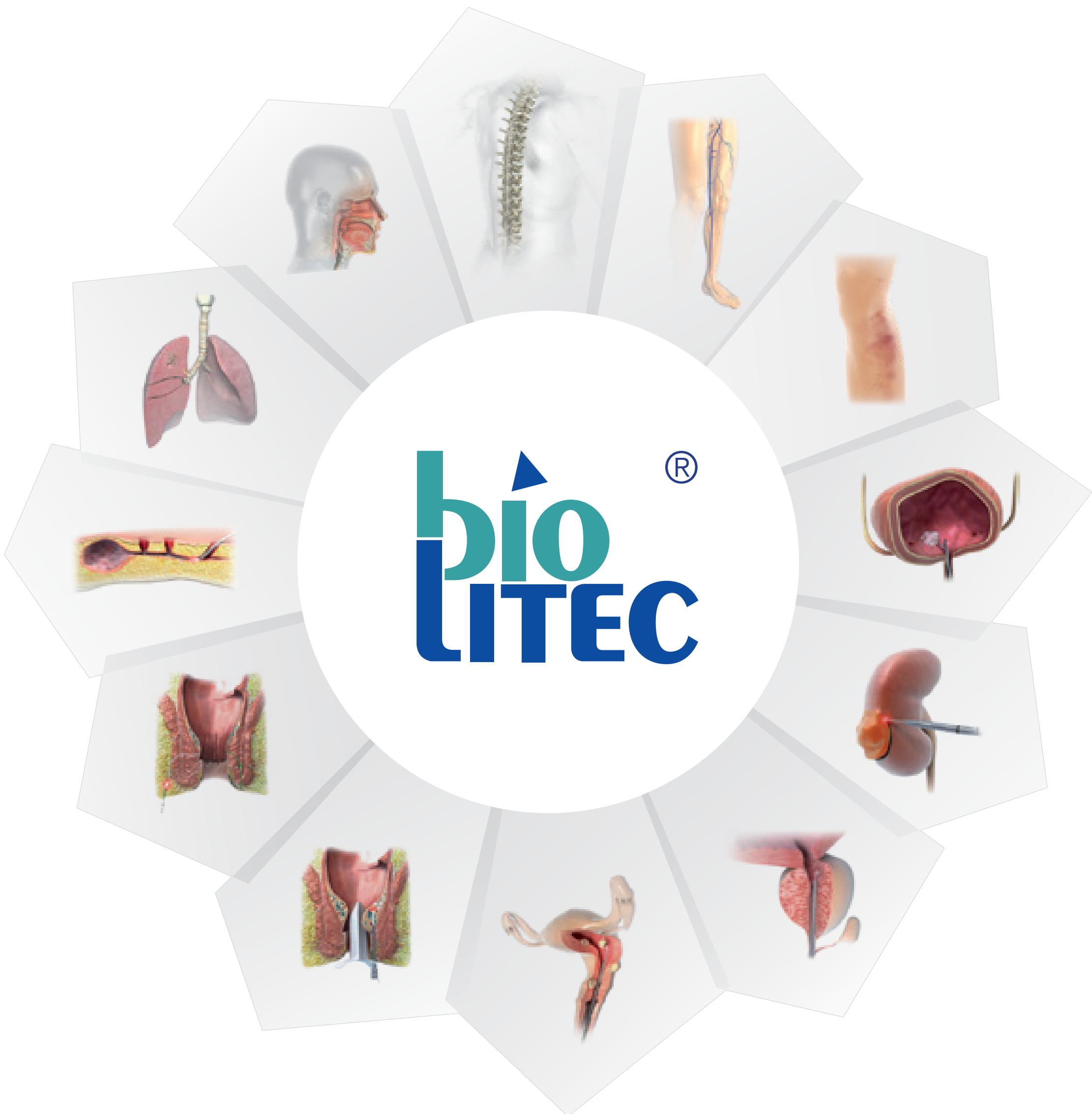

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