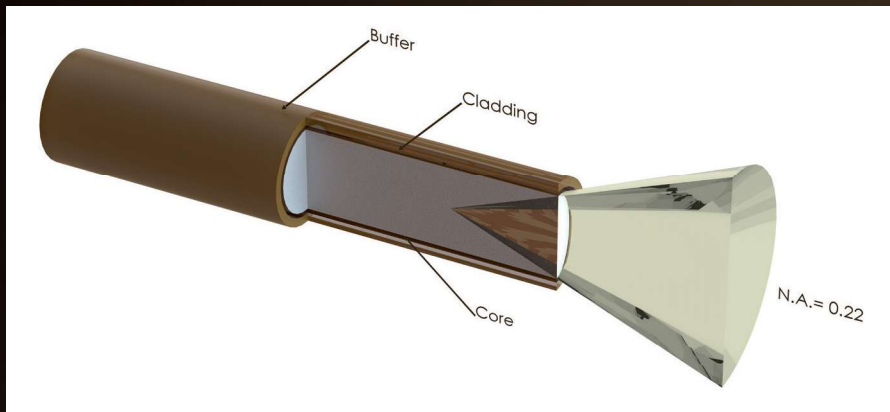


# FIBER-OPTIC DESIGN



## Core

For spectroscopic applications, generally, multi-mode step index silica fibers are used. These range in core thickness from 50 to 1000 microns. The core is made out of pure silica. Other fiber cores with much higher absorption are made out of certain glass types or plastics. These are not offered in this catalog.

First a distinction is made between silica with high or low OH content. Silica fibers with high OH (600-1000 PPM) are used in the UV/VIS wavelength range because of the low absorption in the UV. They are

referred to as UV/VIS fibers. For Deep-UV applications (below 230 nm) special solarization resistant fibers can be used.

The water content causes strong absorption peaks in the NIR wavelength range. In order to get good fibers for the NIR range, the "water" is removed from the silica. This results in low OH fibers (<2 PPM) with low absorption in the NIR. They are referred to as VIS/NIR fibers.

Best of both worlds are the so-called broadband fibers, which can be used for the UV-NIR range (200-2500 nm), the product code for these fibers is UVIR. Avantes has standardized on this broadband type of fiber.

## Cladding

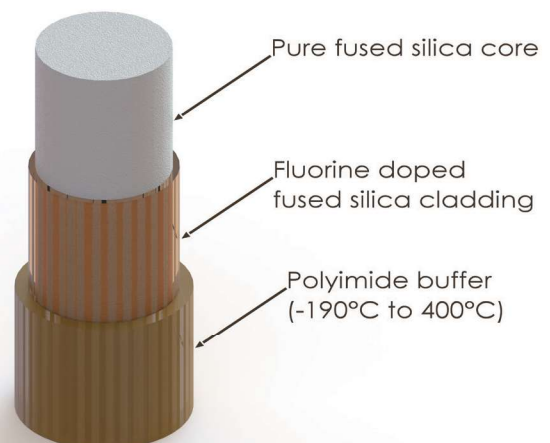
In order to get the light guiding effect the core is cladded with a lower index of refraction material. For the highest quality fibers with the lowest absorption this is a fluorine-doped silica, the so-called silica-silica or all-silica fibers with a numerical aperture (NA) of 0.22.

## Buffers

Without further protection fibers would easily break, because of small scratches or other irregularities on the surface. Therefore a next layer, the buffer, is added. This buffer also determines under what circumstances the fiber can be used. Temperature range, radiation, vacuum, chemical environment and bending are factors to be considered.

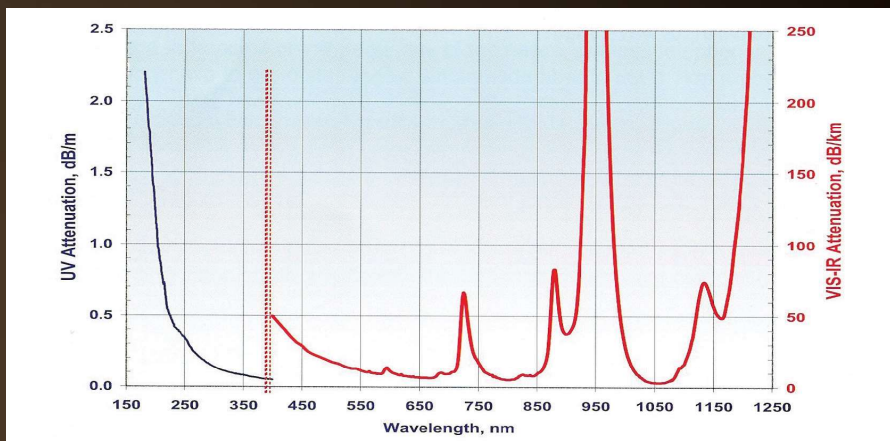
Polyimide buffers offer a wide temperature range (-190 to 400°C) and superior solvent resistance. Also, this material is non-flammable. Drawbacks are sensitivity to micro bending and the difficulty to remove it.

## Fiber Design

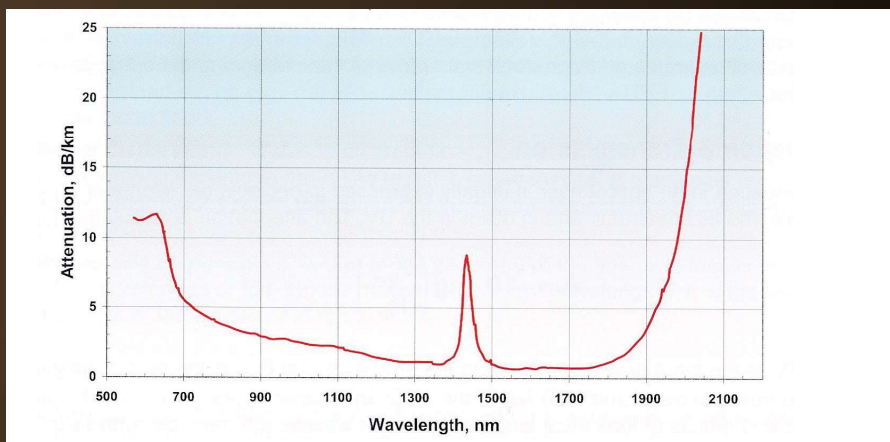


## Technical Data

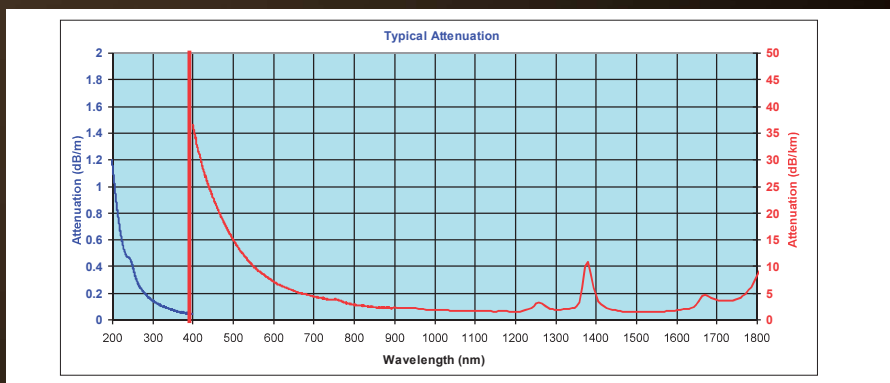
<b>Fiber Material</b>	Standard
<b>Temperature Range</b>	-190 °C to +400°C
<b>Fiber type</b>	Step index Multimode
<b>Core Numerical Aperture</b>	0.22 ± 0.02
<b>Buffer</b>	Polyimide
<b>Available Diameters</b>	50/100/200/400/600/800/1000 µm
<b>Laser damage resistant core</b>	1,3 kW/mm <sup>2</sup> CW at 1060 nm, up to 10 J, pulsed
<b>Bend radius</b>	momentary 100 x clad radius long term 600 x clad radius



Transmission UV/VIS fibers



Transmission VIS/NIR fibers



Transmission UV/VIS/NIR broadband

# Solarization-Resistant Fibers for Deep-UV Applications

Most spectroscopic applications with fiber-optics have been restricted to wavelength ranges above 230 nm, because standard silica fibers with an undoped core and fluorine doped cladding are frequently damaged by exposure to deep-UV light (below 230 nm). This solarization effect is induced by the formation of "color centers" with an absorbance band of 214 nm. These color centers are formed when impurities (like Cl) exist in the core

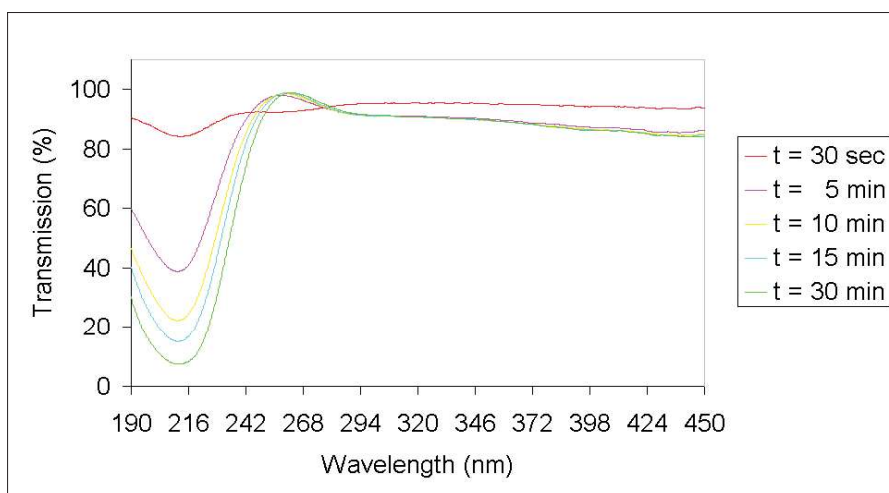
fiber material and form unbound electron pairs on the Si atom, which are affected by the deep-UV radiation.

For this purpose, solarization resistant fibers, which were hydrogen loaded, were developed. The broadband fibers Avantes uses are Solarization Resistant. This means that these fibers provide long-term stability at 30-40% transmission (for 215 nm). Small degradation of the transmis-

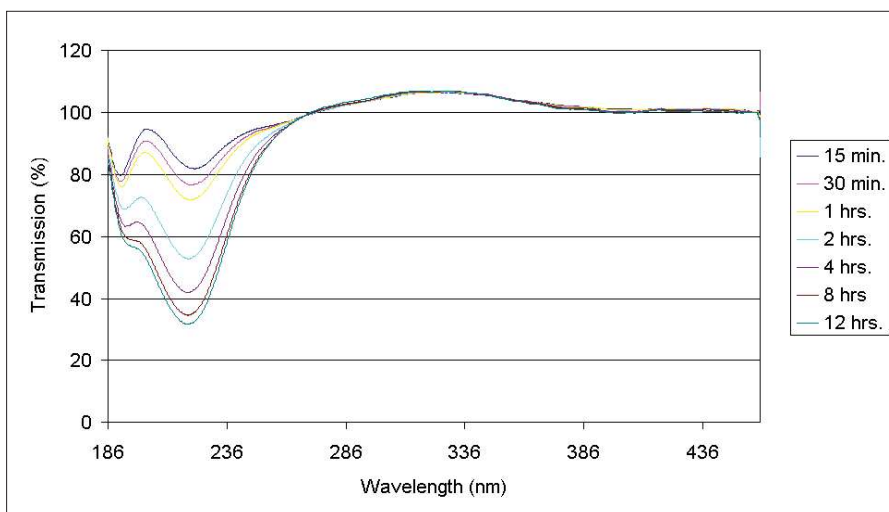
sion can still take place.

First couple of hours of these fibers show a high drop in transmission (100% to 40%). In order to have a stable transmission from the start one can order the PRESOL option. When PRESOL is ordered with a fiber or probe Avantes pre-solarized the product for an 10-hrs period, to have a constant transmission of 30-40% @ 215 nm.

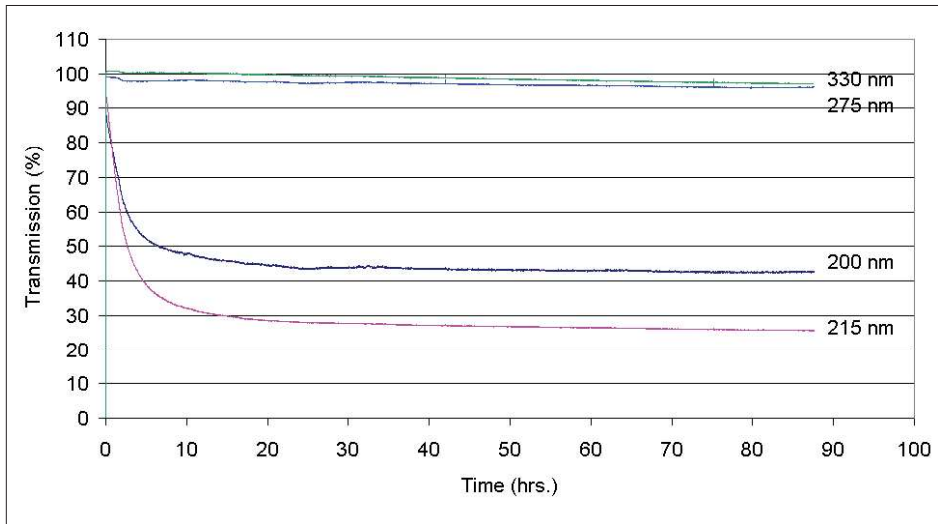
Solarization UV



Solarization UVIR

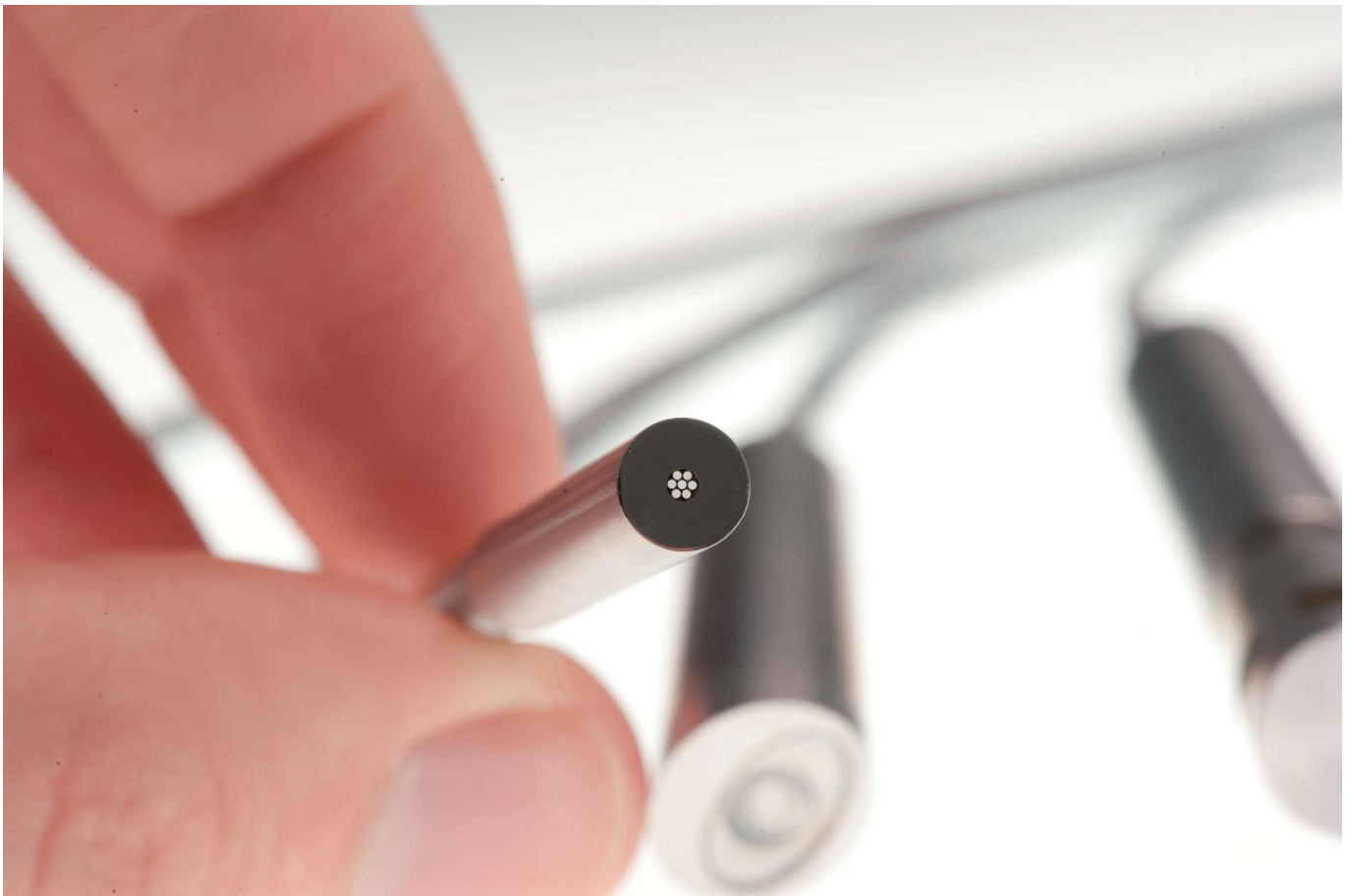


### Solarization UVIR



### Ordering Information

- PRESOL** • Presolarization of UVIR fiber





# Fiber-Optic Jacketing

For different applications Avantes offers different jacketing material. Standard fiber-optic cables and bifurcated cables are protected by a Kevlar reinforced polypropylene inner tubing with PVC red outer jacket. All of our standard reflection probes are protected by a flexible stainless steel jacket with interlocking profile (BX) or a

chrome-plated brass outer jacket, with hooked profile (ME) for optimal strain relief with silicon or PTFE inner tubing. For waterproof and some medical applications stainless steel spiral jacketing with glassilk and gray outer silicon rubber coating can be provided. Inside this jacket silicon or PTFE inner tubing is used as well. For

heavy industrial environments we advise the metal stainless steel (-BX) jacketing. It features a tensile strength of 950N. Some specifics on the jacketing can be found in the following technical information.

Contact us if you have any special conditions requirements.

## Technical Data

Jacketing material	Kevlar reinforced PVC	Chrome plated brass (ME)	Stainless Steel (BX)	Silicon coated stainless steel (MS)
Inner Tubing	Polypropylene	Silicon/PTFE	Silicon/PTFE	Silicon/PTFE
Outer dimensions	3.8 mm	5.0 mm	6.0 mm	5.8 mm
Min. bending radius	18 mm	18 mm	35 mm	18 mm
Temperature Range	-20°C to +65°C	-65°C to +250°C	-65°C to +250°C	-60°C to +180°C
Tensile Strength	150 N	350 N	950 N	70 N
Application	Standard	Industrial	Heavy Industrial	Waterproof IP67

## Ordering Information

-ME	flexible chrome-plated brass outer jacket, with hooked profile
-BX	Heavy industrial stainless steel jacket, with fully interlocking profile
-MS	stainless steel spiral jacket with glassilk and gray outer silicon rubber coating

Standard



-MS



-ME



-BX



# Fiber-Optic Probe Properties

Avantes offers a broad standardized product range of fiber optics as described in this catalogue. For special cases Avantes also offers modification to this fiber-optic cables and probes to customers request. Most materials we use in our fiber-optic assemblies can be replaced with others to improve specific chemical or thermal resistance or to enhance vacuum or pressure properties. Please contact our fiber design engineers with your specific request.

In the following paragraphs some of the most essential technical parameters are listed for the materials we use.

## Thermal Resistance

The thermal resistance of a fiber-optic assembly depends on some of the materials used:

1. Fiber: the standard fiber design has a polyimide buffer, covering a wide thermal range -190 to 400 °C.
2. Jacketing: the standard jacketing is PVC based and has a small temperature range (-20°C to 65°C), for higher temperatures a flexible metal jacketing (-BX/ME) with silicone inner tubing (up to 250°C) or stainless steel tubing (not flexible, to 750°C) is recommended.

3. Probe ends: connectors and ferrules are standard made of metal and have a wide temperature range. For special plastics, like PVC, PEEK and Teflon a limited temperature range is applicable.

4. Bonding epoxy: the standard epoxy used is a heat curing bonding epoxy with a temperature range of -60°C to 175°C. The curing temperature is standard 100 °C, for high temperature ranges (order code -HT), the curing temperature is 200°C. For the HTX (extreme high temperature) fibers and probes ceramic solution are available to realize a process that can withstand temperatures up to 500°C.

## Technical Data

Temperature range	Fiber	Jacketing	Probe end	Bonding
-20°C to +65°C	Standard Polyimide	Standard PVC	Standard metal/ PVC/PEEK	Standard Epoxy
-30°C to +100°C	Standard Polyimide	Metal (-BX/ME) or silicone (-MS)	Standard metal/ PEEK	Standard Epoxy
-60°C to +200°C (HT)	Standard Polyimide	Metal (-BX/ME) or silicone (-MS)	Standard metal/ PEEK	High temperature curing epoxy

## Ordering Information

- HT • High Temperature version (up to 200°C)

All of our fiber-optic cables are available with SMA, ST and/or FC/PC connectors.

### Chemical resistance

The chemical resistance of a fiber-optic assembly depends on some of the materials used:

1. Fiber, the standard fiber design has a polyimide buffer, which normally will not be in contact with the sample; the quartz core provides good resistance against most solvents.
2. Jacketing, the standard jacketing is PVC based and has a relative good chemical resistance. The -BX stainless steel and -ME chrome plated brass jacketing also have a good chemical resistance, but are not waterproof. The Silicone metal jacketing (-MS) is recommended for waterproof environment, biomedical applications, etc. The PEEK and PTFE jacketing have the best chemical resistance.
3. Probe ends, connectors and ferrules are standard made of stainless steel (316)

and are not very well suitable in corrosive environment. For most corrosive environments PEEK or Hastelloy® C276 are recommended.

4. Bonding, the standard heat-curing two-component epoxy used is resistant to water, inorganic acids and salts, alkalis and many aggressive organic solvents and most petrochemical products, and an extended range of organic and inorganic environments.

The table below gives a summary for the chemical resistance for most materials used. It has been drawn up on the basis of relevant sources in accordance with the state of the art; no claim to completeness. The data constitutes recommendations only, for which no liability can be accepted. Please contact us if you have any doubt about the materials to use for your application.

### Technical Data

Chemical environment	Fiber		Jacketing		Probe end		Epoxy
Acids weak	Standard Polyimide	±	-BX/ME	±	St. steel 316 PEEK Hastelloy® C276	-	+
			-MS	+		+	
Acids strong	Standard Polyimide	-	-PEEK	+	St. steel 316 PEEK Hastelloy® C276	+	±
			-PVC	±		+	
Bases weak	Standard Polyimide	±	-BX/ME	+	St. steel 316 PEEK Hastelloy® C276	+	+
			-MS	+		+	
Bases strong	Standard Polyimide	-	-PEEK	+	St. steel 316 PEEK Hastelloy® C276	+	+
			-PVC	+		+	
Aromatic carbons	Standard Polyimide	+	-BX/ME	+	St. steel 316 PEEK Hastelloy® C276	+	+
			-MS	+		+	
Alcohols	Standard Polyimide	±	-PEEK	+	St. steel 316 PEEK Hastelloy® C276	+	+
			-PVC	+		+	
Ketons/Ethers	Standard Polyimide	+	-BX/ME	+	St. steel 316 PEEK Hastelloy® C276	+	±
			-MS	-		+	
			-PEEK	+		+	
			-PVC	-		±	

+ = good resistance

± = conditional resistant

- = not resistant

### Options

- PK • PEEK Probe material replaces Stainless Steel
- HY • Hastelloy® C276 Probe material replaces Stainless Steel

# Fiber-Optic Connectors

## SMA Connectors

We supply all of our standard fiber-optic cables, bundles and probes with SMA-905 connectors that easily fit into our complete range of spectrometers, light sources and accessories.

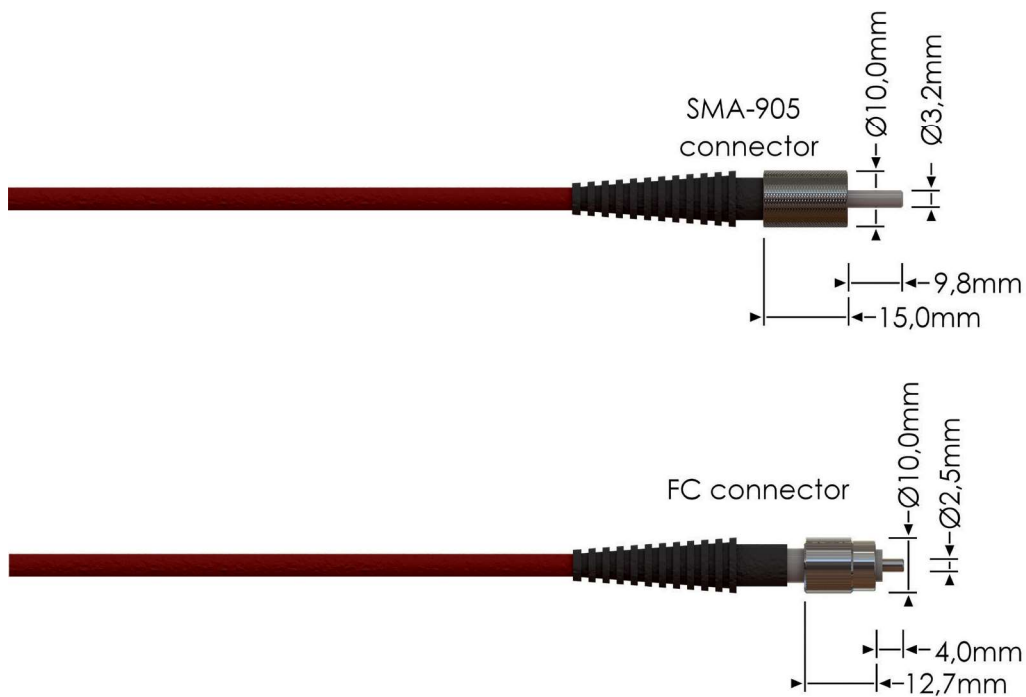
The SMA-905 connectors are screw-fitted and can be rotated over 360 degrees. The typical insertion loss for the connectors is 0.5 dB. The maximum filling diameter for bundles is 2.46 mm

## FC/PC Connectors

Optional FC/PC-connectors can be mounted to our fiber-optic products. The multi-mode FC/PC connectors have an extremely low insertion loss of < 0.2 dB. The FC/PC connector cannot rotate, always mounts into the same fixed position and therefore has a high reproducibility.

## Ordering Information

- FC/PC** • FC/PC connector instead of standard SMA



# Fiber-Optic Cables

Avantes offers a wide range of fiber-optic cables, which can be made in a variety of lengths and configurations to meet your needs. For common applications, a 2 meter length is sufficient. For this reason it is our standard fiber length.

Avantes offers SMA-905 or FC/PC connectors and these can be the same or different on both ends. For some applications, special round to linear fiber cables are recommended in which a bundle of fibers configured in a round pattern on one end and a linear array on the other end. The linear array (typically 1 mm in height) is aligned with the slit height of the spectrometer which is also 1 mm. This fiber configuration provides maximized light throughput for applications requiring high-sensitivity.

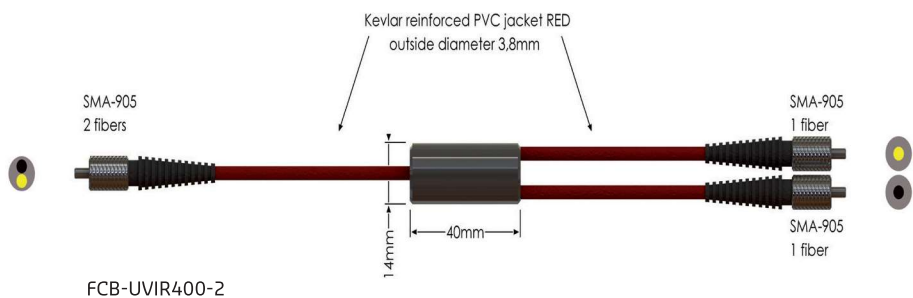
Fiber-optic cable types and diameters are recommended based upon the wavelength range being measured and the sensitivity required for a measurement. In general different fibertypes can be classified. For the UV range high OH UV/VIS fiber is used. For customers working below 240 nm in the UV, special high OH UV/VIS fiber called solarization resistant fiber (SR) is available. For longer wavelengths low OH VIS/NIR fiber is recommended. Best of both worlds can be achieved with our broadbandfiber, which is our standard. This gives you the combined performance of the UV, UV-SR and IR fibers.

Avantes also offers a variety of jacketing options including Kevlar reinforced PVC sleeving with PTFE inner tubing (standard), chrome plated brass monocoil, stainless

steel BX, silicone coated stainless steel monocoil and other special jacketings upon request. For applications requiring high temperature resistance, special high temperature epoxy (HT) is available and should be specified at the time of order.

Recommended wavelengths for different cables:

- 200-2500 nm: UV/VIS/NIR (UVIR)
- UV/IR available in core sizes 100, 200, 400, 600  $\mu\text{m}$
- 200-800 nm: Solarization resistant (-SR)
- 250-800 nm: UV/VIS (UV)
- 350-2500 nm: VIS/NIR (IR)



## Ordering Information

<b>FC-IR008-2 or -1</b>	• Cable with 8 $\mu\text{m}$ Fiber, 2 or 1m length, SMA terminations
<b>FC-xx050-2 or -1*</b>	• Cable with 50 $\mu\text{m}$ Fiber, 2 or 1m length, SMA terminations
<b>FC-UVIR100-2 or -1</b>	• Cable with 100 $\mu\text{m}$ Fiber, 2 or 1m length, SMA terminations
<b>FC-UVIR200-2 or -1</b>	• Cable with 200 $\mu\text{m}$ Fiber, 2 or 1m length, SMA terminations
<b>FC-UVIR400-2 or -1</b>	• Cable with 400 $\mu\text{m}$ Fiber, 2 or 1 m length, SMA terminations
<b>FC-UVIR600-2 or -1</b>	• Cable with 600 $\mu\text{m}$ Fiber, 2 or 1m length, SMA terminations
<b>FC-xx800-2 or -1*</b>	• Cable with 800 $\mu\text{m}$ Fiber, 2 or 1m length, SMA terminations
<b>FC-xx1000-2 or 1*</b>	• Cable with 1000 $\mu\text{m}$ Fiber, 2 or 1m length, SMA terminations
<b>FCB-xx050-2 or 1*</b>	• Bifurcated cable 2x50 $\mu\text{m}$ , 2 or 1m length, SMA terminations
<b>FCB-UVIR100-2 or 1</b>	• Bifurcated cable 2x100 $\mu\text{m}$ , 2 or 1m length, SMA terminations
<b>FCB-UVIR200-2 or 1</b>	• Bifurcated cable 2x200 $\mu\text{m}$ , 2 or 1m length, SMA terminations
<b>FCB-UVIR400-2 or 1</b>	• Bifurcated cable 2x400 $\mu\text{m}$ , 2 or 1m length, SMA terminations
<b>FCB-UVIR600-2 or 1</b>	• Bifurcated cable 2x600 $\mu\text{m}$ , 2 or 1m length, SMA terminations

Other lengths and fiber types are available.  
 \*Specify xx = UV for UV/VIS fiber cables, IR for VIS/NIR



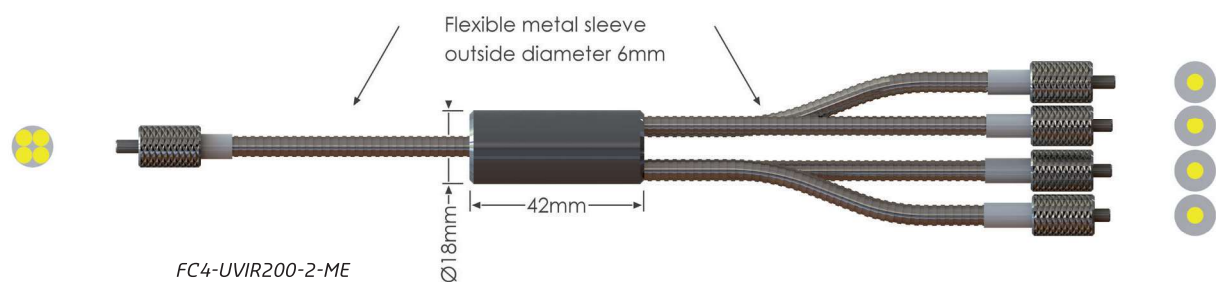
# Multi-Furcated Fiber-Optic Cables

Simultaneous multi-point measurements and Avantes multi-channel spectro-meters, require multi-furcated fiber-optic cables. These assemblies can function as a combiner or splitter of light as they have multiple legs on one side which converge into a single connector on the opposite side. Avantes offers virtually any combination possible, which can be adapted to your requirements.

Typical setups that require multi-furcated cables are:

- One sampling point such as an integrating sphere, cosine corrector or collimating lens being measured with several spectrometers (individual AvaSpecs or Multi-channel).
- Multiple illumination fibers splitting out from one light source to different sampling points.

Various types of connectors, jacketings and fiber sizes are available for these multi-furcated fiber cables. Contact us to configure and quote you on your specific needs.



## Ordering Information

<b>FC4-UVIR200-2</b>	• Four-furcated cable, 4x200 µm broadband fibers , all legs SMA terminated, total 2 m long, splitting point in the middle
<b>FC4-UVIR400-2</b>	• As FC4-UVIR200-2, but with 4x400 µm broadband fibers
<b>FC4-UVIR600-2</b>	• As FC4-UVIR200-2, but with 4x600 µm broadband fibers
<b>FC5-UVIR200-2</b>	• Five-furcated cable, 5x200 µm broadband fibers, all legs SMA terminated, total 2 m long, splitting point in the middle
<b>FC5-UVIR400-2</b>	• As FC5-UVIR200-2, but with 5x400 µm broadband fibers
<b>FC6-UVIR200-2</b>	• Six-furcated cable, 6x200 µm broadband fibers, all legs SMA terminated, total 2 m long, splitting point in the middle
<b>FC6-UVIR400-2</b>	• As FC6-UVIR200-2, but with 6x400 µm broadband fibers
<b>FC8-UVIR200-2</b>	• Eight-furcated cable, 8x200 µm broadband fibers , all legs SMA terminated, total 2 m long, splitting point in the middle
<b>FC8-UVIR400-2</b>	• As FC8-UVIR200-2, but with 8x400 µm broadband fibers

*Other lengths available on request*

# Reflection Probes (Standard)



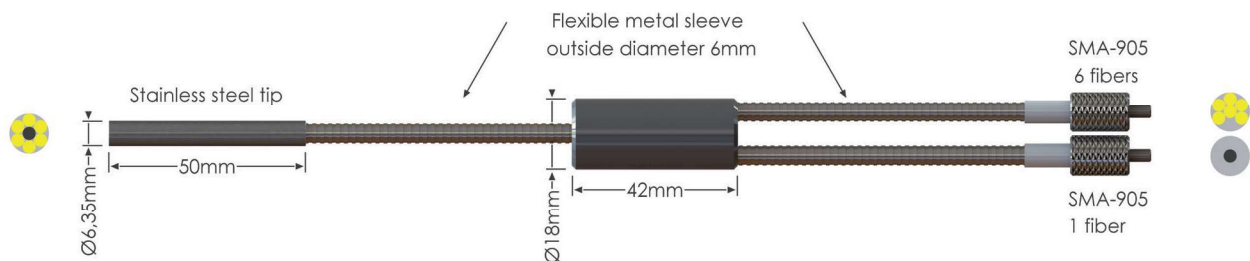
To obtain spectral information of the diffuse, or specular materials, reflection probes are used. The light from a light source is sent through six illumination fibers to the sample and the reflection is measured by a 7<sup>th</sup> fiber in the center of the reflection probe tip. The 7<sup>th</sup> fiber is coupled to a spectrometer configured to the appropriate wavelength range of interest. More illumination fibers can be added to get more energy from the light source and therefore increase the reflection signal level.

For measurements under an angle of 90°, the FCR-90-Option was developed. It's a special adapter with a mirror positioned at 45° and can be easily mounted on the tip of Avantes standard reflection probes.

The FCR-COL is an adjustable UV/VIS/ NIR collimating and focusing lens which enables focusing the measurement spot at an extended distance.

## Technical Data

Fibers	7 fibers 200 mm or 400 mm core, 6 light-fibers, 1 read fiber, N.A.= 0.22. Standard 2 m length, splitting point in the middle.
Wavelength range	200-2500 nm (UV/VIS/NIR)
Connectors	SMA-905 connectors (2x)
Probe end	Stainless steel 316 cylinder, 50 mm long x 6.35 mm diameter. Optionally -PK for PEEK or -HY for Hastelloy® C276 (on request)
Jacketing	The optical fibers are protected by a silicon inner tube and a flexible stainless steel (BX, O.D. 6.0 mm) or chrome plated brass (ME, O.D. 5.0 mm) outer jacket. The jacketing also gives stress relieve.
Temperature	-30°C to 100°C. (-HT version 200 °C)
Pressure	Probe head 50 bar @ 25 °C
Bending	Minimum bend radius: Short term (few seconds) 20-40 mm, long term: 120 -240 mm



## Ordering Information

FCR-7UVIR200-2-BX/ME*	• Reflection probe, 7 x 200 µm broadband fibers, 2 m length, SMA term.
FCR-7UVIR400-2-BX/ME*	• Reflection probe, 7 x 400 µm broadband fibers, 2 m length, SMA term.
FCR-90-Option	• 90° Reflection add-on reflector for use with all 1/4" reflection probes
FCR-COL	• Adjustable UV/VIS/NIR Collimating/focusing lens for FCR probes

\* please specify jacket material

## Options

-HT	• High Temperature version (up to 200°C)
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# Reflection Probes with Multiple Legs

For some measurements, a reflection probe is needed that can be coupled to two spectrometers and a light source. A good example is a reflection measurement in the UV/VIS and NIR range. For these situations, Avantes offers our reflection probes with multiple legs.

The light from a light source is coupled into a fiber bundle, consisting out of 17 illumination fibers which transport the

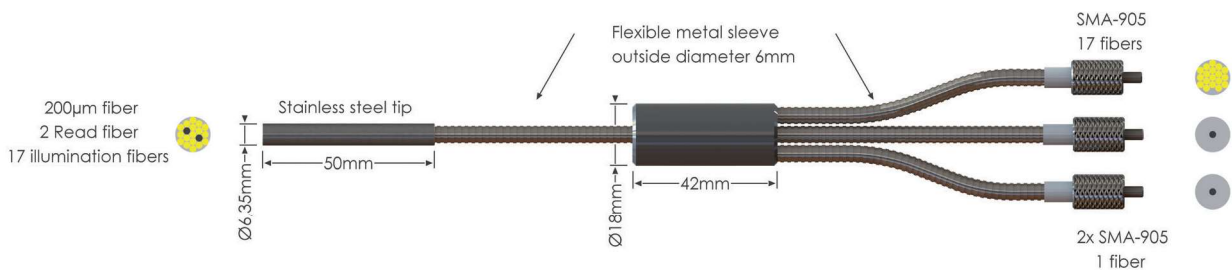
light to the end of the probe. The reflected light is uniformly reflected into the two read fibers, each of which is connected to a spectrometer.

For measurements under a 90° angle, the FCR-90-Option has been developed. It is an adapter with a mirror mounted at 45° and can be easily mounted to the tip of these reflection probes.

To accurately focus a small measurement spot from a higher distance, the FCR-COL adjustable US/VIS/NIR collimating/focusing lens is available and can be mounted to the tip of these probes.

### Technical Data

<b>Fibers</b>	19 fibers 200 µm core, 17 light-fibers, 2 read fibers in 2 separate legs, N.A.= 0.22. Standard 2 m length, splitting point in the middle.
<b>Wavelength range</b>	200-2500 nm (UV/VIS/NIR)
<b>Connectors</b>	SMA-905 connectors (3x)
<b>Probe end</b>	Stainless steel 316 cylinder, 50 mm long x 6.35 mm diameter. Optionally -PK for PEEK or -HY for Hastelloy® C276 (on request)
<b>Jacketing</b>	The optical fibers are protected by a silicon inner tube and a flexible stainless steel (BX, O.D. 6.0 mm) or chrome plated brass (ME, 5.0 mm) outer jacket. The jacketing also gives stress relieve.
<b>Temperature</b>	-30°C to 100°C. (-HT version 200°C)
<b>Pressure</b>	Probe head 50 bar @ 25°C
<b>Bending</b>	Minimum bend radius: Short term (few seconds) 20 mm, long term: 120 mm



### Ordering Information

<b>FCR-19UVIR200-2-BX/ME*</b>	• Reflection probe UV/VIS/NIR, 17 x 200 µm UV/VIS/NIR illumination fibers, 2 read UV/VIS/NIR fibers in separate legs, 2 m length, 3 SMA term.
<b>FCR-90-Option</b>	• 90° Reflection add-on reflector for use with all 1/4" reflection probes
<b>FCR-COL</b>	• Adjustable UV/VIS/NIR Collimating/focusing lens FCR probes

\* please specify jacket material

### Options

<b>-HT</b>	• High Temperature version (up to 200°C)
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# Reflection Probes with Reference

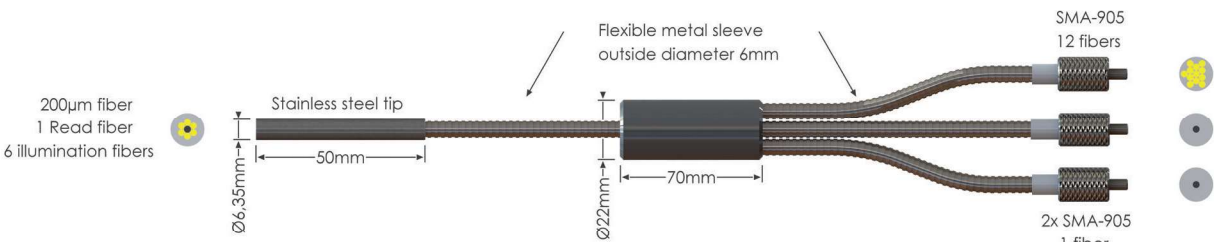
In order to correct fluctuations and drift from your light source, periodic referencing is required. To facilitate this, Avantes offers this series of reflection probes with a self-referencing feature. The light coming from the light source is bundled into 12 fibers, which are split into two 6 fiber

bundles. One of these bundles is carried to the probe end for sample measurements and the other bundle of 6 are directed to a white reflection tile built into the probe to provide a light source reference. This reference leg is connected to a slave spectrometer channel dedicated to light source

referencing or may be routed to a single channel via a fiber-optic (contact a Sales Engineer about this special configuration). On the measurement side the probe end has a 7<sup>th</sup> fiber which reflects light back to the master spectrometer channel.

## Technical Data

<b>Fibers</b>	14 fibers 200 µm core, 12 light-fibers, 2 x 1 read fiber, N.A.= 0.22. Standard 2 m length, splitting point in the middle.
<b>Wavelength range</b>	200-2500 nm (UV/VIS/NIR)
<b>Connectors</b>	SMA-905 connectors (3x)
<b>Probe end</b>	Stainless steel 316 cylinder, 50 mm long x 6.35 mm diameter . Optionally -PK for PEEK or -HY for Hastelloy® C276 (on request).
<b>Jacketing</b>	The optical fibers are protected by a silicon inner tube and a flexible stainless steel (BX, O.D. 6.0 mm) or chrome plated brass (ME, 5.0 mm) outer jacket. The jacketing also gives stress relieve.
<b>Temperature</b>	-30°C to 100°C. (-HT version 200°C)
<b>Pressure</b>	Probe head 50 bar @ 25°C
<b>Bending</b>	Minimum bend radius: Short term (few seconds) 20 mm, long term: 120 mm



## Ordering Information

- FCR-14UVIR200-2-REF-BX/ME\*** • Reflection probe with reference, 14 x 200 µm broadband fibers, 2 m length, SMA term.
- \* please specify jacket material

## Options

- HT** • High Temperature version (up to 200°C)

# Reflection Probes with Small Tips

For some medical and semiconductor applications, a (very) small tip is desired to do reflectance measurements. Avantes offers two standard diameters of small tip reflection probes, 1.5 and 2.5 mm and each tip is normally 100 mm long.

The probe is configured with an illumination leg with six 200 µm fiber cables which connects to a fiber coupled light source

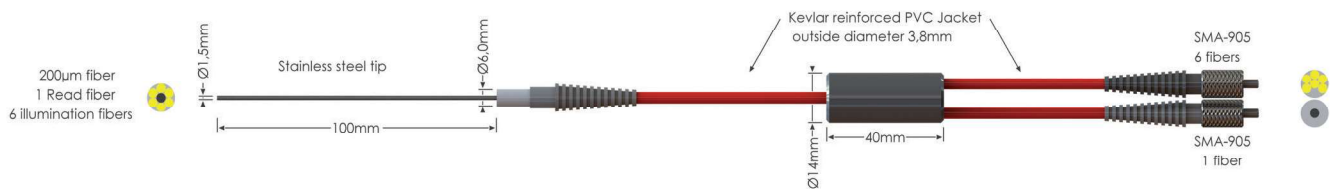
and a single 200 µm read fiber cable to measure the reflection via connection to a spectrometer.

A special angled fiber holder (AFH-15) is available for the 1.5 mm diameter reflection probe. This device enables reflection measurements under angles of 15, 30, 45, 60, 75 and 90 degrees. For more information, see 'Reflection probe holders'.



## Technical Data

<b>Fibers</b>	7 fibers 200 µm core, 6 light-fibers, 1 read fiber, N.A.= 0,22. Standard 2 m length, splitting point in the middle.
<b>Wavelength range</b>	200-2500 nm (UV/VIS/NIR)
<b>Connectors</b>	SMA-905 connectors (2x)
<b>Probe end</b>	Stainless steel cylinder, 100 mm long x 1.5 or 2.5 mm diameter.
<b>Jacketing</b>	The optical fibers are protected by a Kevlar reinforced PTFE jacket with PVC sleeving. OD: 3.8 mm
<b>Temperature</b>	-20°C to 65°C
<b>Bending</b>	Minimum bend radius: Short term (few seconds) 20 mm, long term: 120 mm



## Ordering Information

<b>FCR-7UVIR200-2-1.5x100</b>	• Reflection probe, 1.5 mm tip, UV/VIS, 7 x 200 µm broadband fibers, 100 mm long, 2 m length, SMA
<b>FCR-7UVIR200-2-2.5x100</b>	• Reflection probe, 2.5 mm tip, UV/VIS, 7 x 200 µm broadband fibers, 100 mm long, 2 m length, SMA

For diffuse or specular reflection measurements, take a look at our reflection probe holders!



# Reflection Probes for Powders and Thick Fluids



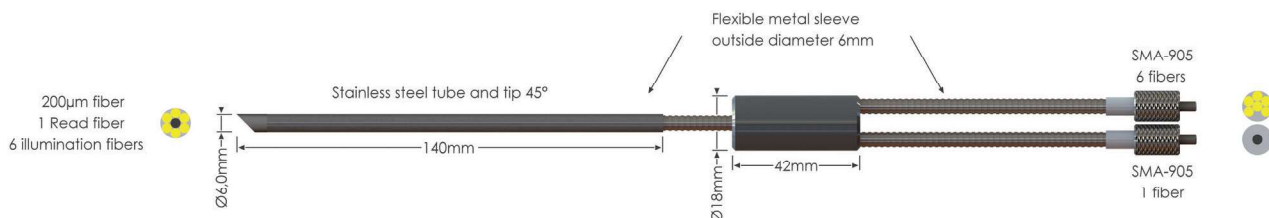
For effective measurement of reflection in powders and thick fluids, Avantes offers this specially designed series of reflection probes. The probes allow the user to simply dip the probe into the powder or thick fluids to do the measurements.

The illumination leg of the probe is connected to a light source and carries light

to the sample via a bundle of six fibers. At the probe tip, a 45 degree fused silica window illuminates the sample and collects the indirect reflections which are carried by a single fiber to the spectrometer. The 45 degree angle of the probe prevents the measurements of direct back reflection from the window, thus improving the dynamic range of your measurement.

## Technical Data

<b>Fibers</b>	7 fibers 200 $\mu$ m core, 6 light-fibers, 1 read fiber, N.A.= 0.22. Standard 2 meter length
<b>Wavelength range</b>	200-2500 nm (UV/VIS/NIR)
<b>Connectors</b>	SMA-905 connectors (2x)
<b>Probe end</b>	Stainless steel 316 cylinder, 140 mm long x 6.0 mm diameter. The probe end contains a 5 mm diam. x 1 mm thick fused silica window. Waterproof. Optionally -PK for PEEK or -HY for Hastelloy® C276 (on request).
<b>Jacketing</b>	The optical fibers are protected by a silicon inner tube and a flexible stainless steel (BX, O.D. 6.0 mm) or chrome plated brass (ME, O.D. 5.0 mm) outer jacket. The jacketing also gives stress relieve.
<b>Temperature</b>	-30°C to 100°C. (-HT version 200°C)
<b>Pressure</b>	Probe head 10 bar @ 25°C
<b>Bending</b>	Minimum bend radius: Short term (few seconds) 20 mm, long term: 120 mm



## Ordering Information

**FCR-7UVIR200-2-45-BX/ME\***

- Reflection probe for powders and turbid fluids

*\* please specify jacket material*

## Options

**-HT**

- High Temperature version (up to 200°C)

Did you know  
Avantes is specialized  
in custom made  
fiber-optic cables?

# 1/2" Industrial Reflection Probes for Powders and Thick Fluids

For industrial applications that need reflection measured in thick liquids or powders, this probe is the ideal choice. The stainless steel cylinder and probe end make it withstand extreme situations. The tip is exchangeable and waterproof. Optionally PEEK or Hastelloy® C276 can be used as tip material.

The light enters from the light source through six bundled fibers to the probe end, where it lights the material to be analyzed through a sapphire window angled at 45 degrees. This angle prevents any light to be reflected from the window. The light is selectively reflected through the seventh fiber in the probe. This fiber leads to the connected spectrometer.



## Technical Data

<b>Fibers</b>	7 fibers 200 µm core, 6 light-fibers, 1 read fiber, N.A.= 0.22, standard 2 meter length
<b>Wavelength Range</b>	200-2500 nm (UV/VIS/NIR)
<b>Connectors</b>	SMA-905 connectors (2x)
<b>Probe End</b>	Stainless steel cylinder, 120 mm long x 12.7 mm (1/2") diameter. The probe end contains a ca. 10 mm diam. x 1 mm thick sapphire window. The probe tip is exchangeable and waterproof. Optionally -PK for PEEK or -HY for Hastelloy® C276
<b>Jacketing</b>	The optical fibers are protected by a silicon inner tube and a flexible stainless steel (BX, O.D. 6.0 mm) or chrome plated brass (ME, 5.0 mm) outer jacket. The jacketing also gives stress relieve.
<b>Temperature</b>	-40 °C to 100 °C. (-HT version 200°C)
<b>Pressure</b>	Probe head 10 bar @ 25°C
<b>Bending</b>	Minimum bend radius: Short term (few seconds) 20 mm, long term: 120 mm

## Ordering Information

<b>FCR-7UVIR200-2-45-IND</b>	• 1/2" Reflection probe for powders and turbid fluids
<b>FCR-TIP45</b>	• 1/2" Replacement tip with sapphire window for UV/VIS/NIR

# 1/2" Industrial Fluorescence Probes

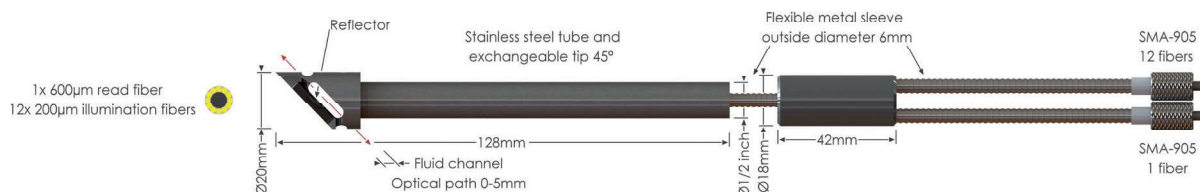


For effective measurement of fluorescence, Avantes offers this specially designed reflection probe. It features 12 excitation fibers of 200  $\mu\text{m}$  around a 600  $\mu\text{m}$  read fiber, which transports the fluorescence signal back to the spectrometer.

To turn the 45° reflection probe into a fluorescence probe, a special reflector accessory, FCR-FLTIP-IND, is attached to the probe end. It prevents ambient light to enter the probe and backscatters the excitation light. This increases the typically low fluorescence signal. The fluid channel path can be varied between 0 and 5 mm.

## Technical Data

<b>Fibers Illumination</b>	12 fibers of 200 $\mu\text{m}$ , UV/VIS
<b>Fibers Detection</b>	1 fiber 600 $\mu\text{m}$
<b>Wavelength Range</b>	200-2500 nm (UV/VIS/NIR)
<b>Connector</b>	2 x SMA-905
<b>Probe End</b>	Stainless steel 316 cylinder, 128 mm long x 12,7 mm (1/2") diameter. The probe end contains a ca. 10 mm diameter x 1 mm thick sapphire window with anti-reflection coating. The probe tip is exchangeable and waterproof. Optionally -PK for PEEK or -HY for Hastelloy® C276
<b>Fluorescence Accessory</b>	See drawing below
<b>Jacketing</b>	The optical fibers are protected by a silicon inner tube and a flexible stainless steel (BX, O.D. 6.0 mm) or chrome plated brass (ME, 5.0 mm) outer jacket. The jacketing also gives stress relieve. Optionally a waterproof, steel reinforced, silicon jacket can be provided
<b>Temperature</b>	-30°C to 100°C. (-HT version 200°C)
<b>Pressure</b>	Probe head 10 bar @ 25°C
<b>Bending</b>	Minimum bend radius: Short term (few seconds) 60 mm, long term: 360 mm



## Ordering Information

<b>FCR-UVIR200/600-2-IND</b>	• 1/2" Reflection Probe for fluorescence applications
<b>FCR-FLTIP-IND</b>	• Fluorescence Reflector Accessory for 1/2" FCR-UVIR200/600-2-IND probes

## Options

<b>-HT</b>	• High Temperature version (up to 200°C)
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All our broadband fiber-optic cables are solarization resistant.

# Mini Transmission Dip Probes

For absorption measurements in miniaturized centrifuge tubes or vessels, Avantes offers the mini transmission dip probe. It features a miniaturized tip which is 130 mm long and 3.2 mm in diameter.

The mini transmission dip probe has a fixed 5 or 10 mm optical path length. It is available in a UV/VIS/NIR (200-2500 nm) version. The probe features Avantes ME, chrome plated brass, jacketing.

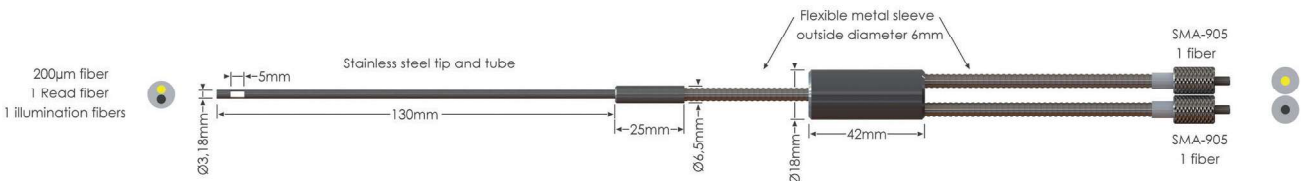
Optionally the probe can be configured with a longer stainless steel or Hastelloy® tip, and/or other jacketing options. The probe has two SMA connectors (FC/PC also available) for convenient coupling to the Avantes line of spectrometers and light sources.

Please contact us for special requirements.



### Technical Data

<b>Fibers</b>	1 illumination and 1 detection fiber, both 200 µm, standard 2 meters length
<b>Wavelength Range</b>	200-2500 nm (UV/VIS/NIR)
<b>Connectors</b>	2 x SMA-905
<b>Probe End</b>	Stainless steel 316 cylinder, 130 mm long x 3.2 mm (1/8") diameter. The probe end contains 5 mm physical, 10 mm optical path, or a 2.5 mm physical gap (5 mm optical path). Optionally -HY for Hastelloy® C276
<b>Jacketing</b>	The optical fibers are protected by a silicon inner tube and a flexible stainless steel (optional BX, O.D. 6.0 mm) or chrome plated brass (standard ME, 5.0 mm) outer jacket. The jacketing also gives stress relieve.
<b>Temperature</b>	-40 °C to 100 °C. (-HT version 200°C)
<b>Pressure</b>	Probe head 10 bar @ 25°C
<b>Bending</b>	Minimum bend radius: Short term (few seconds) 20 mm, long term: 120 mm



### Ordering Information

<b>FDP-2UVIR200-2-2.5-mini</b>	• 1/8" Mini Dip Probe, 2.5 mm path length (optical 5 mm), 2 m length
<b>FDP-2UVIR200-2-5-mini</b>	• 1/8" Mini Dip Probe, 5 mm path length (optical 10 mm), 2 m length

### Options

<b>-BX</b>	• Stainless steel jacket
<b>-HT</b>	• High Temperature version (up to 200°C)

# Transmission Dip Probes

For online and inline absorbance measurements in fluids, transmission dip probes are used. When dipping or permanently mounting the probe end into the fluid, absorbance can be measured.

A standard SMA-905 connector is used to couple light into a fiber bundle, typically consisting out of six fibers (other configurations available upon request). The light

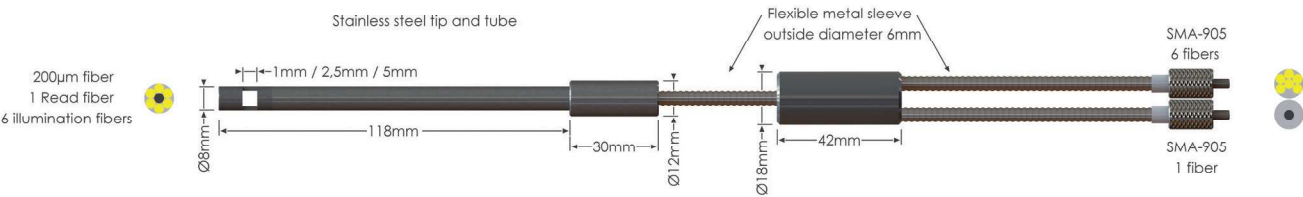
is transmitted to the probe end, where it crosses the predetermined gap and is then reflected against a diffuse white reflective material back onto the receiving read fiber, which is coupled, to a spectrometer on the second leg of the probe.

The read fiber is placed in the center of the illumination fiber bundle to provide the best collection efficiency for the probe.

Both bundles are housed in flexible stainless steel jacketing and the probe tip is also made of stainless steel. At the mid-point of the assembly a ferrule is used to split the fibers into their respective legs (illumination and read) which are terminated in SMA-905 connectors.

## Technical Data

<b>Fibers</b>	6 illumination fibers, 1 detection fiber, all 200 µm, standard 2 meters
<b>Wavelength range</b>	200-2500 nm (UV/VIS/NIR)
<b>Connectors</b>	SMA-905 connectors (2x)
<b>Tips</b>	Replacement tips are available with 1, 2.5 and 5 mm spacing, i.e. an optical path of 2,5 and 10 mm and contain a 5 mm diam. x 1 mm thick fused silica window
<b>Probe end</b>	Stainless steel 316 cylinder, 100 mm long x 8,0 mm diameter. Waterproof.
<b>Jacketing</b>	The optical fibers are protected by a silicon inner tube and a flexible stainless steel (optional BX, O.D. 6.0 mm) or chrome plated brass (standard ME, 5.0 mm) outer jacket. The jacketing also gives stress relieve.
<b>Temperature</b>	-30°C to 100°C. (-HT version 200°C)
<b>Pressure</b>	Probe head 10 bar @ 25°C
<b>Bending</b>	Minimum bend radius: Short term (few seconds) 20 mm, long term: 120 mm



## Ordering Information

<b>FDP-7UVIR200-2-yy</b>	• Transmission Dip Probe, yy (1, 2.5, 5 mm) gap, 2 m length, SMA term.
<b>FDP-TIP-yy</b>	• Replacement tips, 1 mm, 2.5 mm, 5 mm gap for probe (fill in gap length for yy, note optical path =2*yy)

## Options

<b>-BX</b>	• Stainless steel jacket
<b>-HT</b>	• High Temperature version (up to 200°C)



# Transmission Dip Probes with Variable Path Length

For more flexibility during absorbance measurements in fluids, this fiber-optic probe features a variable and adjustable path length. The gap between the fiber and the diffuser can be set anywhere between 0.25 and 10 mm.

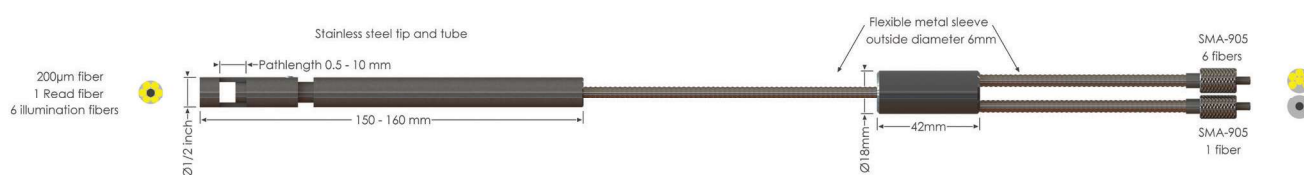
A standard SMA-905 connector is used to couple light into a fiber bundle, typically consisting out of six fibers (other configurations available upon request). The light is transmitted to the probe end, where it crosses the predetermined gap and is then reflected against a diffuse white reflective material back onto the receiving read fiber which is coupled to a spectrometer on the second leg of the probe.

The read fiber is placed in the center of the illumination fiber bundle to provide the best collection efficiency for the probe. Both bundles are housed in flexible stainless steel jacketing and the probe tip is also made of stainless steel. At the mid-point of the assembly a ferrule is used to split the fibers into their respective legs (illumination or read) which are terminated in SMA-905 connectors.



## Technical Data

<b>Fibers</b>	6 illumination fibers, 1 detection fiber, all 200 µm, standard 2 meters
<b>Wavelength range</b>	200-2500 nm (UV/VIS/NIR)
<b>Connectors</b>	SMA-905 connectors (2x)
<b>Optical Path</b>	0.25 - 10 mm physical gap, i.e. an optical path of 0.5-20 mm
<b>Probe end</b>	Stainless steel 316, 150-160 mm long x 12,7 mm (½") diameter. Waterproof.
<b>Jacketing</b>	The optical fibers are protected by a silicon inner tube and a flexible stainless steel (optional BX, O.D. 6.0 mm) or chrome plated brass (standard ME, 5.0 mm) outer jacket. Optionally a waterproof, steel reinforced, silicon tubing can be provided (-MS)
<b>Temperature</b>	-30°C to 100°C. (-HT version 200°C)
<b>Pressure</b>	Probe head 10 bar @ 25°C
<b>Bending</b>	Minimum bend radius: Short term (few seconds) 20 mm, long term: 120 mm



## Ordering Information

<b>FDP-7UVIR200-2-VAR</b>	• Transmission Dip Probe in stainless steel with variable tip length, 2 m length, SMA term.
<b>FDP-TIP-VAR</b>	• Replacement Stainless Steel tip for Transmission dip probe with variable tip length

## Options

<b>-BX</b>	• Stainless steel jacket
<b>-HT</b>	• High Temperature version (up to 200°C)

# Custom Fiber Assemblies and Probes



For some applications a very specific fiber or probe is needed. Avantes has almost 20 years of experience in designing the custom probes for unique applications. Avantes has significant expertise in designing fiber-optics for high temperature (HTX), high pressure (HP), vacuum and other difficult conditions. Avantes wide variety of standard and custom materials can be configured to provide a fiber assembly which can meet the challenges of your environment.

On the left are some examples of our special designs. Please contact us to discuss your needs.



## High temperature UV/VIS/NIR probe with gas connection

The universities of Bochum (Germany) and Utrecht (The Netherlands) approached us with a problem doing high temperature measurements at low pressure of dehydrogenation of propane: an ideal situation for the creation of cokes. Therefore every time the probe was contaminated with coke residue on the tip, meaning they could only do a single test after which they had to replace the probe.

Avantes responded by designing this high temperature probe. It's resistant to temperatures of 700 degrees centigrade or more and features a connection for gas insertion into the probe. So far, during one test the probe was used over 150 hours continuously, with temperatures of 550-600 degrees. The gas used was nitrogen. The result was a clean tip, re-usable probe and very happy customers.

## Chemical resistant reflection probe

In chemical environments, standard reflection probes have a huge disadvantage: many chemicals interfere with the glue used to construct the probes. This version eliminates this disadvantage: all connections are mechanical, sapphire windows and o-rings are used. The material used is stainless steel 310, which is chemical resistant as well.

A reflection probe is inserted into the back of this probe: it serves as a protective sleeve. The path length is variable and up to 30 mm.

# Collimating Lenses

To convert divergent beams of light into a parallel beam, a collimating lens is needed. Avantes collimating lenses are optimized for the UV/VIS/NIR range (200-2500 nm) and have anodized aluminum housings.

The COL-UV/VIS and COL-90-UV/VIS have a 6 mm diameter lens with a confocal length of 8.7 mm. The COL-90-UV/VIS is used when a 90-degree exit angle is needed. The focal point for the COL-UV/VIS and COL-90-UV/VIS can be adjusted. The COL-

UV/VIS can also be ordered with an FC/PC connector.

The COL-UV/VIS-25 is the big brother of the COL-UV/VIS. It has a lens diameter of 25 mm and a confocal length of 50 mm. This larger collimating lens is suitable for collection of light in free space.

## COL-UV/VIS



## COL-90-UV/VIS



### Technical Data

	COL-UV/VIS	COL-90-UV/VIS	COL-UV/VIS-25
<b>Lens Diameter</b>	6 mm		25 mm
<b>Lens confocal length</b>	8.7 mm		50 mm
<b>Lens Material</b>	UV grade Fused Silica		
<b>Wavelength range</b>	200-2500 nm		
<b>Fiber connection</b>	SMA-905, UNS 1/4" (standard, FC/PC also possible)		
<b>Mirror reflectivity</b>	n.a.	>90% (200-1100 nm)	n.a.
<b>Housing Material</b>	Aluminum black anodized		
<b>Thread</b>	UNF 3/8"-24	n.a.	
<b>Temperature range</b>	-30°C to 100°C (-HT version 200°C)		

### Ordering Information

<b>COL-UV/VIS</b>	• Collimating lens for UV/VIS/NIR, incl. SMA adapter and adj. focus
<b>COL-UV/VIS-FCPC</b>	• Collimating lens for UV/VIS/NIR, incl. FC/PC adapter, adj. focus
<b>COL-90-UV/VIS</b>	• Collimating lens under 90 degrees for UV/VIS/NIR, incl. SMA adapter
<b>COL-UV/VIS-25</b>	• Collimating lens 25 mm for UV/VIS/NIR, incl. SMA adapter and adj. focus

A collimating lens  
can be used to collect more  
light into a fiber-optic cable.

# Cosine Correctors

## CC-VIS/NIR



To collect light from a 180° angle, cosine correctors are used. This eliminates optical interface problems associated with the light collection sampling geometry inherent to other sampling devices such as bare fiber-optics, collimating lenses or integrating spheres.

Avantes offers four different models of cosine correctors: The CC-UV/VIS and CC-VIS/NIR have a 3.9 mm active area, and dimensions of 18 mm (L) X 6.5 mm (OD). The CC-UV/VIS is made of Teflon which is especially suited for measurements in the 200-800 nm range, whereas the CC-VIS/NIR covers the full UV/VIS/NIR range of 200-2500 nm and is made of Radin Quartz.

The CC-UV/VIS/NIR-8MM works as the CC-VIS/NIR, but has an active area of 8.0 mm and dimensions of 29 mm (L) X 12 mm (OD). The specialized CC-UV/VIS/NIR-5.0 has a 20 mm active area is used for solar measurement applications requiring a 5° angular field of view has a 20 mm active area and is much larger than the other cosine correctors measuring 317 mm (L) X 38 mm (OD).

### Technical Data

	CC-UV/VIS	CC-VIS/NIR	CC-UV/VIS/NIR-8MM	CC-UV/VIS/NIR-5.0
<b>Active area</b>	3.9 mm	3.9 mm	8.0 mm	20.0 mm
<b>Diffusing material</b>	Teflon (200-800 nm), ca. 1 mm thick	Radin Quartz (200-2500 nm), ca. 1.5 mm thick		
<b>Dimensions</b>	6.5 mm diameter, 18 mm long		12 mm diameter, 29 mm long	38 mm diameter, 317 mm long
<b>Sampling geometry</b>	Accepts light at/from 180° FOV			Accepts light at 5° FOV
<b>Connector</b>	SMA-905			
<b>Temperature</b>	-30 °C to +100 °C			

### Ordering Information

<b>CC-UV/VIS</b>	• Cosine Corrector for UV/VIS, incl. SMA adapter
<b>CC-VIS/NIR</b>	• Cosine Corrector for UV/VIS/NIR, incl. SMA adapter
<b>CC-UV/VIS/NIR-8MM</b>	• Cosine Corrector for UV/VIS/NIR, 8 mm area, incl. SMA adapter
<b>CC-UV/VIS/NIR-5.0</b>	• Cosine Corrector for UV/VIS/NIR, 5.0° FOV, incl. SMA adapter

A cosine corrector collects light from an angle of 180°, ideal in situations with scattered light.

# Vacuum Feedthroughs

These feedthroughs are designed for the use with fiber-optics in vacuum chambers, such as for plasma and coating deposition monitoring. They can be used in chambers with wall thicknesses of 5-40 mm and vacuum levels up to 10<sup>-7</sup> millibar.

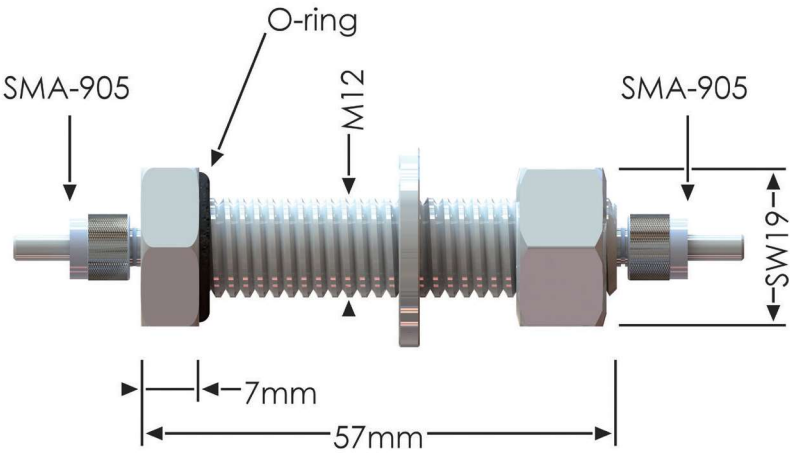
The feedthrough assembly consists of an M12 housing with Viton® O-ring and two SMA fiber-optic interconnects to allow easy coupling to fiber-optic cables and probes. In order to connect these assemblies to fiber-optic cables inside/ outside the chamber, two extra SMA fiber

interconnects (ME-FI-SM-MM) should be ordered separately.

The vacuum feedthrough can be delivered for all fiber diameters, from 50µm up to 1000 µm for UV/VIS/NIR. A high temperature version of the vacuum feedthrough(-HT) is also available enabling the device to withstand temperatures up to 200°C.



### FC-VFT



### Technical Data

Fibers	1 fiber, diameter 50 µm, 100 µm, 200 µm, 400 µm, 600 µm, 800 µm or 1000 µm
Wavelength range	200-800 nm (UV/VIS), 350-2500 (VIS/NIR) or 200-2500 nm (UV/VIS/NIR)
Connectors	Standard SMA-905 connectors (2x)
Wall thickness of vacuum chamber	5-40 mm
Vacuum	Max. 10 <sup>-7</sup> mbar
Temperature	-40°C to 100°C (-HT version 200°C)

### Ordering Information

FC-VFT-xx50	• Vacuum feedthrough for 50 µm fibers, incl. SMA adapter, needs 2 extra SMA interconnects
FC-VFT-UVIR100	• As FC-VFT-xx50, for 100 µm broadband fibers
FC-VFT-UVIR200	• As FC-VFT-xx50, for 200 µm broadband fibers
FC-VFT-UVIR400	• As FC-VFT-xx50, for 400 µm broadband fibers
FC-VFT-UVIR600	• As FC-VFT-xx50, for 600 µm broadband fibers
FC-VFT-xx800	• As FC-VFT-xx50, for 800 µm fibers
FC-VFT-xx1000	• As FC-VFT-xx50, for 1000 µm fibers
ME-FI-SM-MM	• SMA fiber interconnect, 2 pieces needed for each vacuum feedthrough

Specify xx = UV for UV/VIS fiber cables, IR for VIS/NIR

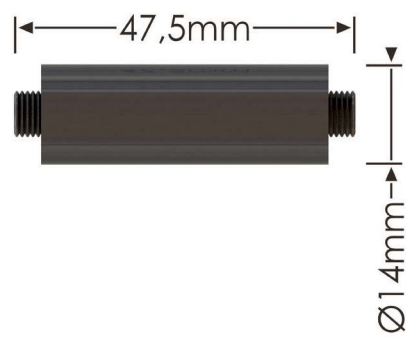
### Options

-HT	• High Temperature version (up to 200°C)
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# Fiber-Optic Homogenizers

## MMA-UV/VIS-SMA Homogenizer



When connecting a multi-furcated fiber to a spectrometer or light source, light entering/exiting each of the fiber legs may or may not be uniform, so a fiber-optic homogenizer can be used to mix the signals to provide more uniform signal.

The compact MMA-UV/VIS-SMA fiber-optic homogenizer is made of anodized aluminum and has female SMA-905 connectors on both ends. Internally, a highly transmissive Suprasil-Rod with a diameter of 1 or

3 mm transmits the light from one end to the other (from bundle to single fiber) and perfectly mixes the modes.

The fiber-optic homogenizer can also be used as a mode stripper.

### Technical data

Wavelength Range	200-2000 nm
Optical Rod Diameter Stabdurchmesser	3 mm or 1 mm
Lens Material	Suprasil 1
Housing Material I	Aluminum anodized
Fiber Connection	SMA-905, UNS 1/4"
Dimensions	Length 47.5 mm, Diameter 14 mm
Temperature	-30 °C to +100 °C

### Ordering Information

MMA1-UV/VIS-SMA	• Homogenizer / Modestripper 1 mm UV/VIS diameter for SMA Connectors
MMA3-UV/VIS-SMA	• Homogenizer / Modestripper 3 mm UV/VIS diameter for SMA Connectors

# Fiber Microscope Adapters



To easily mount an Avantes fiber-optic spectrometer to a microscope, a C-mount adapter is available. It connects to an SMA or FC/PC fiber-optic cable and features an outside diameter

of 38 mm, 35 mm long to slide inside the tube of a microscope. A special adapter with C-mount 1 inch-32 thread is available as AVS-MFA-SMA to screw onto a microscope.

### Technical Data

	AVS-MFA-SMA	AVS-CMOUNT-SMA	AVS-CMOUNT-FCPC
Fiber-optic connection	SMA	SMA	FC/PC
Microscope mount	1 inch-32 Cmount thread	38 mm diameter	38 mm diameter
Material	Black anodized aluminum		

### Ordering Information

AVS-MFA-SMA	• C-mount adapter for Olympus, SMA connector
AVS-CMOUNT-SMA	• C-mount adapter, SMA connector
AVS-CMOUNT-FCPC	• C-mount adapter, FC/PC connector

# Reflection Probe Holders

## RPH-1 Reflection Probe Holder

The RPH-1 is to be used with our standard reflection probes, which are 6.5 mm in diameter. The holder enables positioning of the probe tip in two angles: 45 degrees for diffuse reflection measurements and 90 degrees (normal to sample) for specular reflection. This assembly is mostly used to facilitate color measurements.

A setscrew is included to mount the probe into position. The RPH-1 is a small device, measuring only 60 by 30 by 30 millimeters. It's made of black anodized aluminum.



## AFH-15 Angled Fiber Holder

To do an angled measurement with a small 1.5 mm reflection probe or 1.5 mm stainless steel ferrule terminated fibers, the AFH-15 is the ideal accessory. Offering angles including 15°, 30°, 45°, 60°, 75° and 90°, reflection measurements with differing incident and collection angle can be easily

made with multiple, separate fibers for illumination and detection.

All 11 holes have a diameter of 1.6 mm and are equipped with a setscrew to mount the probes or fibers into position. The AFH-15 is made of black anodized aluminum.



## AFH-Ocular

Measurements on a small spot (less than 0.5 mm) can be challenging but the AFH-Ocular makes the job easier. The ocular enables visual location of the measurement spot on your sample. The holder is used in conjunction with our miniaturized reflection probe (FCR-7UV100-2-1x25) which has 7 x 100 µm fibers in a 6 around

1 configuration and the tip is 1 mm in diameter x 25 mm long.

Please note that a black cover over the ocular (not included) should be used during measuring to prevent ambient light from reaching the measurement spot.

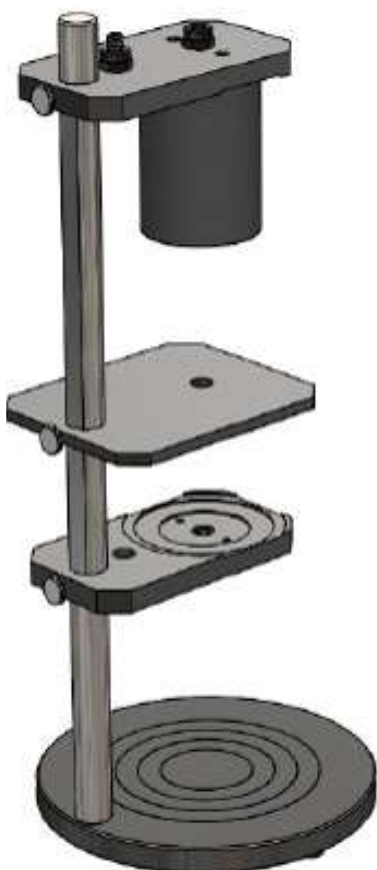


## Ordering Information

<b>RPH-1</b>	• Reflection probe holder for 45/90 degree mounting of 6.5 mm reflection probes
<b>AFH-15</b>	• Angled fiber probe holder for measuring under different angles, needs 1.5 mm ferrule terminated fibers.
<b>FC-UVIR200-2-1.5x40</b>	• Fiber cable, 200 µm UVIR fiber, 2 m long, one end with SMA connector, other end with stainless steel ferrule, OD=1.5 mm x 40 mm length.
<b>AFH-Ocular</b>	• Angled fiber probe holder for precise measurements under 45 degrees incl. Ocular
<b>FCR-7UVIR100-2-1x25</b>	• Reflection probe with 7x100 µm UVIR fibers to 1x25 mm stainless steel ferrule, 2 meter long with PVC/Kevlar protection sleeve and 2 SMA connectors

We offer three years  
limited warranty on all  
Avantes spectrometers,  
light sources (excl. bulbs)  
and accessories.

## T/R Stages for Transmission and Reflection



This transmission and reflection stage is the ideal companion to make it easier to perform reflection and transmission measurements. The TR-Stage is a great accessory to perform and create multiple measurement set-ups.

The TR-stage consists of 3 different elements:

- The top plate can hold a COL-UV/VIS (included) or a 6.35 mm reflection probe. It also has a cover to shield against ambient light.

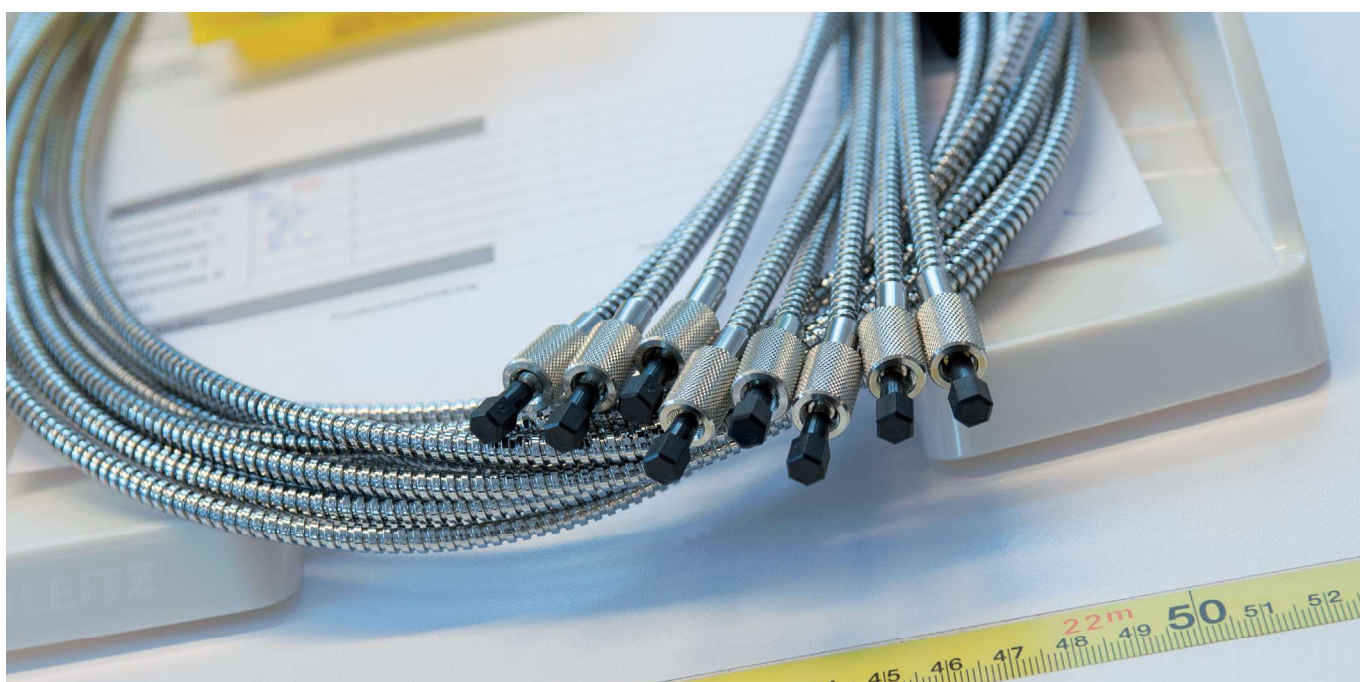
- The middle plate is intended to place the sample on.

- The bottom plate can be used to mount or position a COL-UV/VIS, AvaSphere-xx-IRRAD (xx= 30 or 50) or WS-2 Reference tile. With an additional plate, the TR-LSHAL-Holder, it can be used in combination with the AvaSphere-50-LS-HAL-12V as well (not included).

### Ordering Information

**TR-Stage**  
**TR-LSHAL-Holder**

- Transmission stage for use with 30/50 mm Avasphere, WS-2 reference tile, COL-UV/VIS or 6.35mm probe.
- Additional AvaSphere-50-LS-HAL-12V holder for TR-Stage



# Fiber Interconnects

To connect one fiber to another, a fiber interconnect is needed. They can be useful for coupling patch cords to fiber-optic probes and other devices, or for any multiple-fiber application where coupling of standard optical fibers and accessories is preferable to creating costly and complex fiber-optic assemblies.

## Bulkheads

Avantes bulkhead adaptors for TO-5 and TO-18 packages are ideal for coupling an LED to a fiber-optic cable: the back side has space for an LED.

### ME-FI-SM-MM SMA interconnect



### ME-FI-FC/PC-MM FC/PC interconnect



### ME-SM-BC SMA Bulkhead



### ME-FCPC-BC FC/PC Bulkhead



## Ordering Information

ME-FI-SM-MM	• SMA Fiber interconnect, panel mountable
ME-FI-FCPC-MM	• FC/PC Fiber interconnect, panel mountable
ME-SM-BC	• SMA bulkhead adapter to TO-18
ME-SM-BC-S	• SMA bulkhead adapter to TO-5
ME-FCPC-BC	• FC/PC Bulkhead adapter