

Fiber Optics



Introduction

The use of fiber optics as light guidance allows a great modularity and flexibility in the setup of an optical measurement system. Optical fibers can be made of many materials, such as plastic, glasses and silicates (SiO_2). For high quality fiber optics, as used in spectroscopic applications, synthetic fused silica (amorphous silicon dioxide) is used, that can be intentionally doped with trace elements to adjust the optical properties of the glass.

The basic principle of light transport through an optical fiber is total internal reflection. This means that the light within the numerical aperture of a fiber ($\text{NA} = \text{input acceptance cone}$) will be reflected and transported through the fiber. The size of the numerical aperture depends on the materials used for core and cladding.

Two basic types of silica fibers can be distinguished; single-mode and multi-mode fibers, depending on the propagation state of the light, traveling down the fiber. For most spectro-

scopic applications multi-mode fibers are used. Multi-mode fibers can be divided into 2 subcategories, step-index and graded-index. A relatively large core and high NA allow light to be easily coupled into the fiber, which allows the use of relatively inexpensive termination techniques. Step-index fibers are mainly used in spectroscopic applications.

Graded-index multimode fibers have a refractive index gradually decreasing from the core out through the cladding. Since the light travels faster in material with lower refractive index, the modal dispersion (amount of pulse-spreading) will be less. These graded-index fibers are mainly used in telecommunication application, where bandwidth at long distance (2-15 km) plays an important role.

In the following paragraphs some basic fiber optic components and properties will be discussed.

Fiber Optic Design

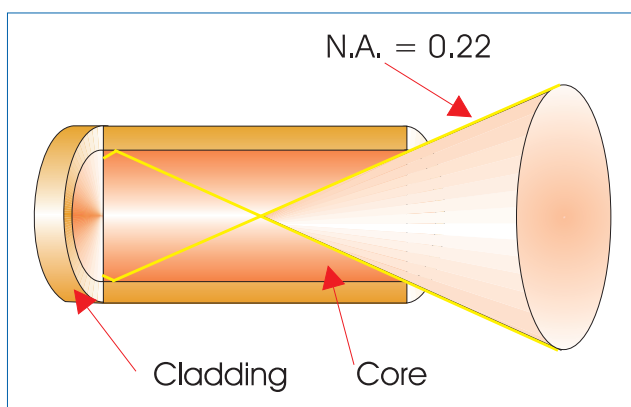


Figure 18 Numerical Aperture

Core

For spectroscopic applications, generally, multi-mode step index silica fibers are used. These range in core thickness from 50 microns to 1 mm. 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 appropriate 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.

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 (-100 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.

For extreme temperatures (-270 to 700°C) metal buffers are used. CuBALL buffers can withstand a continuous high temperature up to 500 °C and intermittent even up to 700°C. Low outgassing makes them also excellent for use in UHV environments.

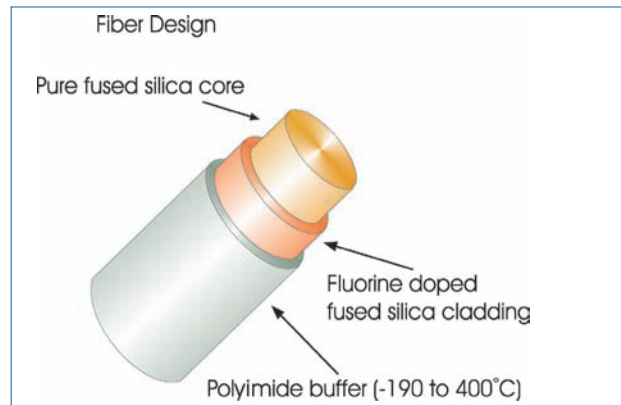


Figure 19 Fiber optic design

Technical Data

Fiber Material	Standard	HTX
Temperature Range	-190 °C to +400°C	-270 °C to +700°C
Fiber type	Step index Multimode	
Core Numerical Aperture	0.22 ± 0.02	
Buffer	Polyimide	CuBALL metal
Available Diameters	50/100/200/400/600µm	200/400/600/1000µm
Laser damage resistant core	1,3 kW/mm ² CW at 1060 nm, up to 10 J, pulsed	CW up to 100kW/cm ² For pulsed lasers (<1µs) 500kW/cm ²
Bend radius	momentary 100 x clad radius long term 600 x clad radius	momentary 40 x clad radius long term 100 x clad radius

Figure 20 Transmission UV/VIS Fibers

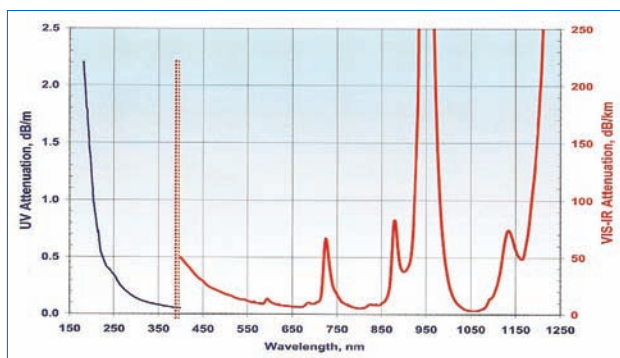
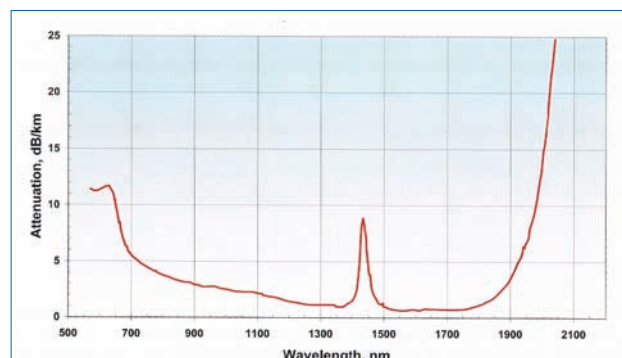


Figure 21 Transmission VIS/NIR Fibers



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.

Not long ago, solarization resistant fibers, which were hydrogen loaded, were developed (UVI). The disadvantage for these fibers is the limitation on smaller fiber diameters and limited lifetime, caused by the H₂ outgassing from the fiber.

Recently, with the availability of a modified core preform, a new fiber became available (UVM). This fiber provides long-term stability at 30-40 % transmission (for 215 nm).

All fiber optic probes, cables and bundles with core diameters of 50 µm, 100 µm, 200 µm, 400 µm, 600 µm and 800 µm can be delivered with solarization resistant fibers. All assemblies, made by Avantes, are pre-solarized for an 8-hrs period, to have a constant transmission of 30-40% @ 215 nm.

Figure 22 Solarization standard UV400 fiber

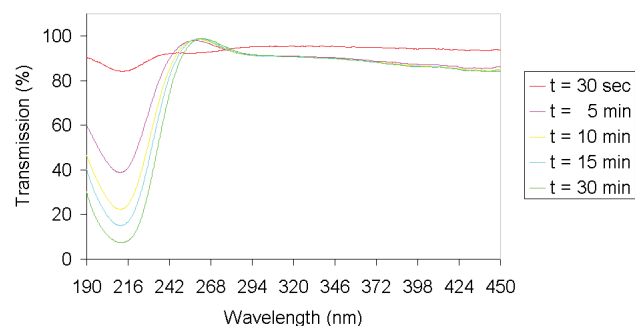


Figure 24 Solarization UV100-SR fiber

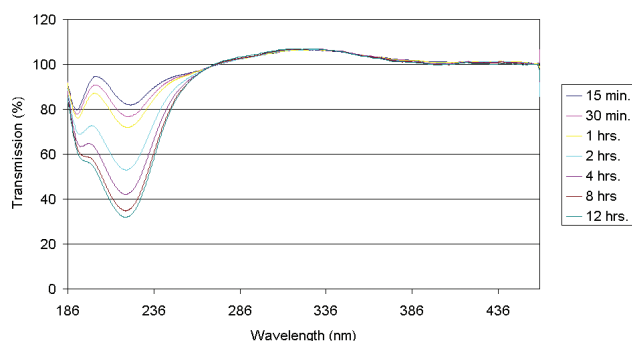
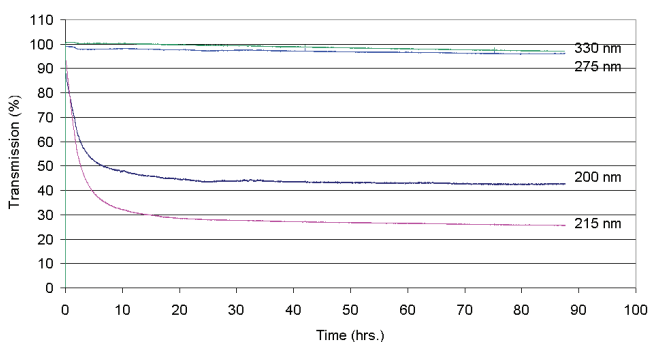


Figure 23 Solarization UV100-SR fiber



ORDERING INFORMATION

-SR

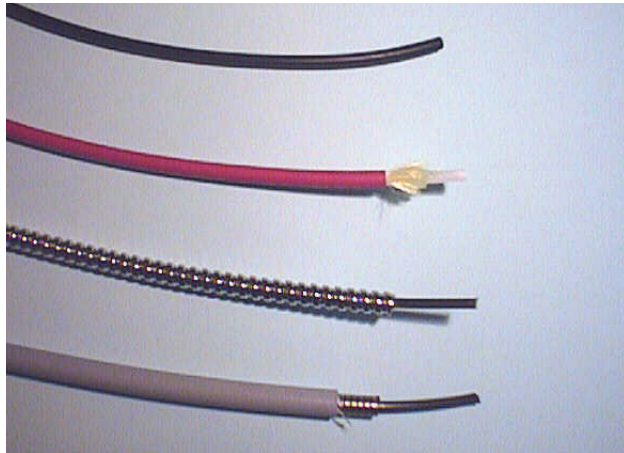
solarization resistant fiber for DUV applications

Fiber Optic Sleeves

For different applications Avantes offers different sleeving material. Standard our 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 chrome-plated brass outer tube, with hooked profile for optimal strain relief with silicon or PTFE inner tubing. For waterproof and some medical applications stainless steel spiral tubing with glassilk and gray outer silicon rubber coating can be provided. Inside this tubing silicon or PTFE inner tubing is used as well. Especially for small, flexible, endoscopic probes we use a PVC rubber sleeving. Some specifics on the sleeves can be found in the following technical information.

Contact us if you have any special conditions requirements.

Fiber Optic sleeving material



Standard - Kevlar reinforced PVC



ME - Chrome plated brass



MS - Silicon coated stainless steel



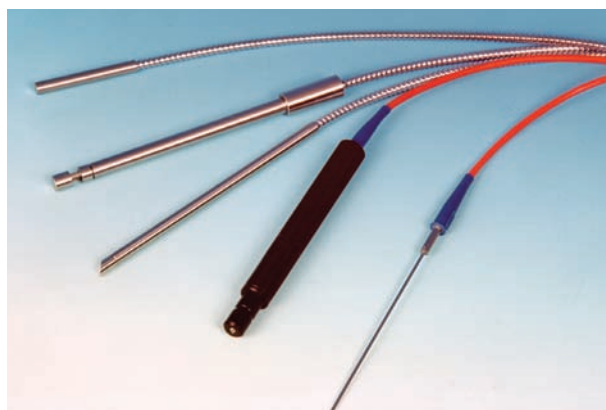
Technical Data

Sleeve material	Kevlar reinforced PVC	Chrome plated brass	Silicon coated stainless steel	PVC
Inner Tubing	Polypropylene	Silicon/PTFE	Silicon/PTFE	n.a.
Outer dimensions	3.8 mm	5.0 mm	5.8 mm	2.0 mm
Temperature Range	-20 °C to +65 °C	-65 °C to +250 °C	-60 °C to +180 °C	-20 °C to +65 °C
Tensile Strength	150 N	350 N	70 N	n.a.
Application	Standard	Heavy Industrial	Waterproof IP67	Medical

ORDERING INFORMATION

-ME	flexible chrome-plated brass outer tube, with hooked profile
-MS	stainless steel spiral tubing with glassilk and gray outer silicon rubber coating

Fiber Optic Probe properties



All Avantes fiber optic cables and probes can be modified 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 our standard materials.

Thermal resistance

The thermal resistance of a fiber optic assembly depends on the following components:

1. Fiber, the standard fiber design has a polyimide buffer, covering a wide thermal range -190 to 400 °C. For higher temperatures CuBALL metal fiber buffer (to 500 °C) fibers are recommended.
2. Sleaving, the standard sleaving is PVC based and has a small temperature range (-20 °C to 65 °C), for higher temperatures a flexible metal sleaving (-ME) with silicone inner tubing is recommended (up to 250 °C) or stainless steel tubing (not flexible, to 750 °C).
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 silver soldering is used, a process that can withstand temperatures up to 500 °C.

Technical Data

Temperature range	Fiber	Sleaving	Probe end	Bonding
-20°C to $+65^{\circ}\text{C}$	Standard Polyimide	Standard PVC	Standard metal/ PVC/PEEK/PTFE	Standard Epoxy
-30°C to $+100^{\circ}\text{C}$	Standard Polyimide	Metal (-ME) or silicone (-MS)	Standard metal/ PEEK/PTFE	Standard Epoxy
-60°C to $+200^{\circ}\text{C}$ (HT)	Standard Polyimide	Metal (-ME) or silicone (-MS)	Standard metal/ PEEK/PTFE	High temperature curing Epoxy
-100°C to $+500^{\circ}\text{C}$ (HTX)	CuBALL coated	SS-tubing or none	metal	Silver soldering

ORDERING INFORMATION

-HT	High temperature version (up to 200°C)
-HTX	Extreme High Temperature version (up to 500°C)

Chemical resistance

The chemical resistance of a fiber optic assembly depends on the following components:

1. Fiber, the standard fiber design is a silica/silica fiber and has a polyimide buffer, which normally will not be in contact with the sample; the quartz core provides good resistance against most solvents.
2. Sleeving, the standard sleeving is PVC based and has a relative good chemical resistance. The -ME chrome plated brass sleeving also has a good chemical resistance, but is not waterproof. The Silicone metal sleeving (-MS) is recommended for waterproof environment, biomedical applications, etc. The PEEK and PTFE sleeving 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, PTFE or Hastelloy® C276 are recommended.

4. Bonding, the standard heat-curing 2 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 good summary for the chemical resistance for our standard materials. The table 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		Sleeving		Probe end		Epoxy
Acids weak	Silica/Silica	+	-ME -MS -PEEK -PVC	± + + +	St. steel 316 PEEK PTFE Hastelloy® C276	- + + +	+
Acids strong	Silica/Silica	+	-ME -MS -PEEK -PVC	- ± + ±	St. steel 316 PEEK PTFE Hastelloy® C276	- + + +	±
Bases weak	Silica/Silica	+	-ME -MS -PEEK -PVC	+ + + +	St. steel 316 PEEK PTFE Hastelloy® C276	+ + + +	+
Bases strong	Silica/Silica	+	-ME -MS -PEEK -PVC	+ + + +	St. steel 316 PEEK PTFE Hastelloy® C276	+ + + +	+
Aromatic carbons	Silica/Silica	+	-ME -MS -PEEK -PVC	+ + + +	St. steel 316 PEEK PTFE Hastelloy® C276	+ + + +	+
Alcohols	Silica/Silica	+	-ME -MS -PEEK -PVC	+ ± + +	St. steel 316 PEEK PTFE Hastelloy® C276	+ + + +	+
Ketons/Ethers	Silica/Silica	+	-ME -MS -PEEK -PVC	+ - + -	St. steel 316 PEEK PTFE Hastelloy® C276	+ + + ±	±

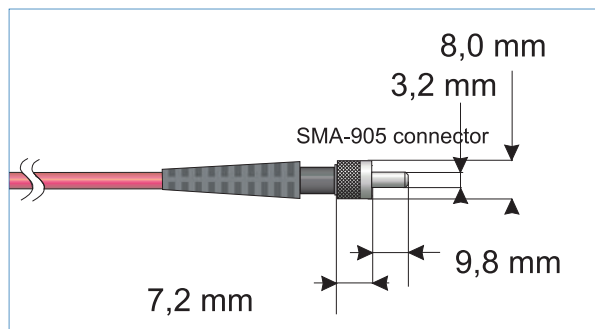
+ = good resistance ± = conditional resistant - = not resistant

ORDERING INFORMATION

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

Fiber Optic Connectors

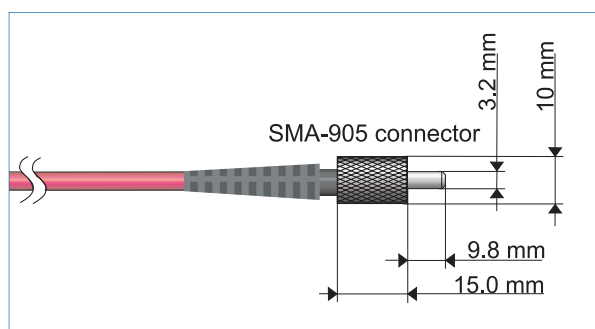
Standard SMA



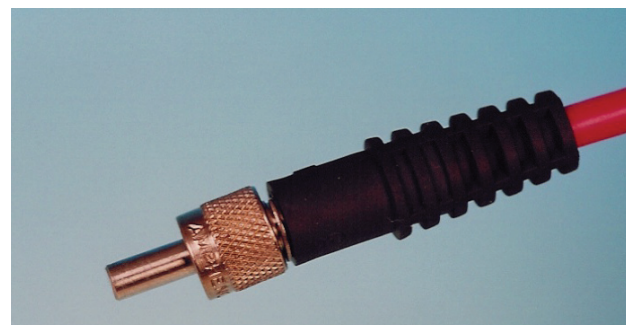
SMA connectors

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.

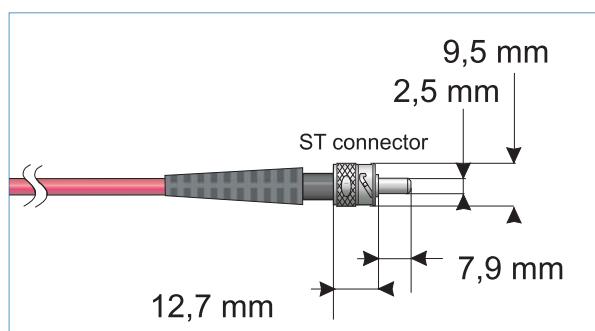
SMA with extended ferrule



Standard SMA connector



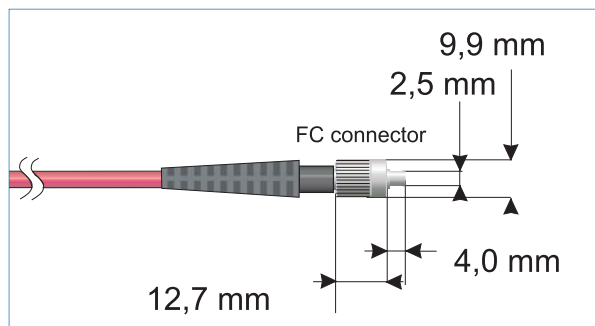
ST connectors



ST connectors

Optional ST-connectors can be mounted to our fiber optic products. ST-connectors easily mount with their bayonet type of fitting, and can therefore not rotate, i.e. they mount in a fixed position. The maximum filling diameter is 1.5 mm, typical insertion loss is 0.3 dB.

FC/PC connectors



FC/PC connectors

Optional FC/PC-connectors can be mounted to our fiber optic products. The multimode 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

-ST	ST connector instead of standard SMA
-FC/PC	FC/PC connector instead of standard SMA



Fiber Optic Cables

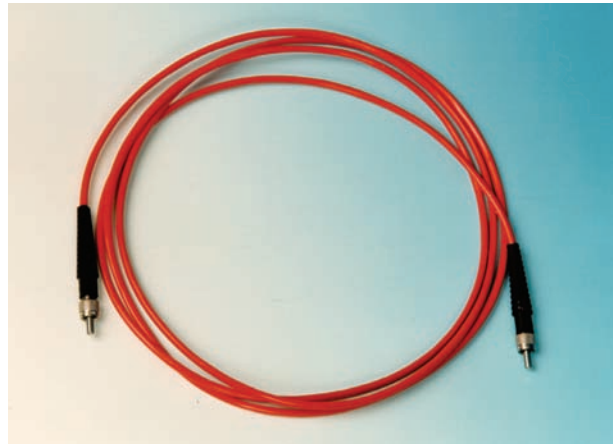
Fiber optic cables can be made in different lengths up to several hundred meters. The standard length is 2 meters, contact us for specific requirements.

Different type of connectors, such as SMA905, ST or FC/PC connectors can be applied. The fibers are also available for different wavelength regions, like Deep UV solarization resistant fibers, UV/VIS fibers and VIS/NIR fibers.

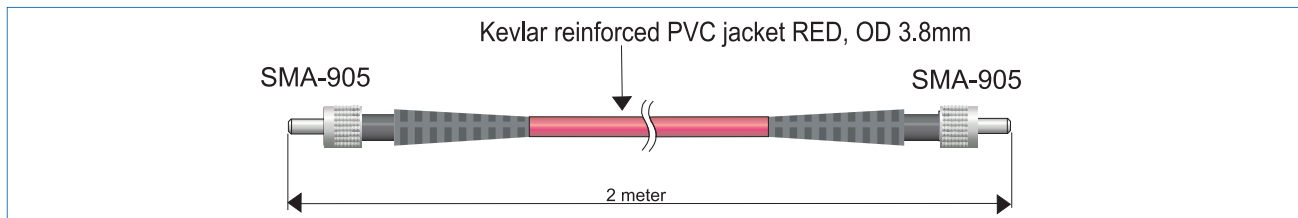
We offer different shielding, like Kevlar reinforced PVC sleeving with PTFE inner tubing (standard) or metal shielding with PVC-XY or PTFE inner tubing for higher temperature and more industrial applications.

Depending on the intended wavelength range a UV/VIS (200-800 nm) or a VIS/NIR (350-2000 nm) fiber is used. In the following table replace xx by respectively UV or IR. For deep UV use specify -SR (solarization resistant).

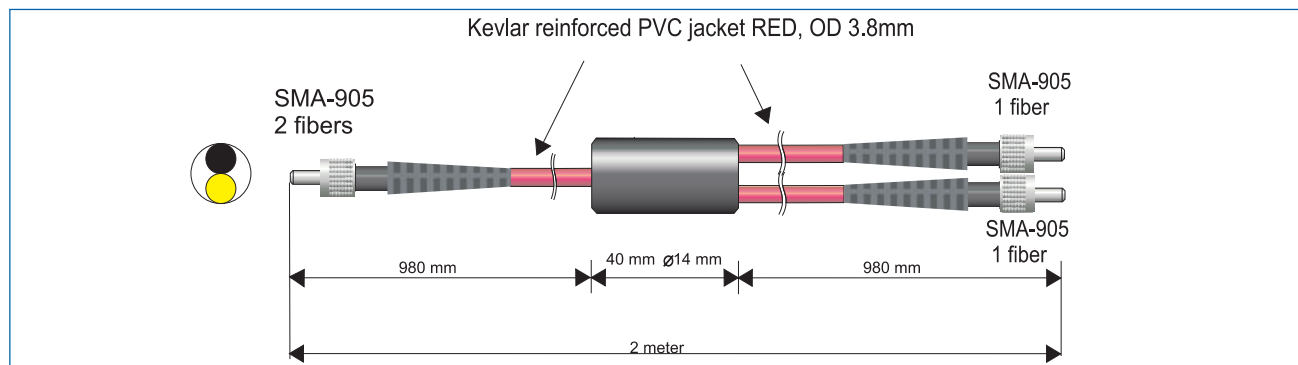
Fiber Optic cable



Patch cords



Bifurcated cables



ORDERING INFORMATION

FC-IR008-2	Cable with 8 μm Fiber, 2 m length, SMA terminations
FC-xx050-2	Cable with 50 μm Fiber, 2 m length, SMA terminations
FC-xx100-2	Cable with 100 μm Fiber, 2 m length, SMA terminations
FC-xx200-2	Cable with 200 μm Fiber, 2 m length, SMA terminations
FC-xx400-2	Cable with 400 μm Fiber, 2 m length, SMA terminations
FC-xx600-2	Cable with 600 μm Fiber, 2 m length, SMA terminations
FC-xx800-2*	Cable with 800 μm Fiber, 2 m length, SMA terminations
FC-xx1000-2*	Cable with 1000 μm Fiber, 2 m length, SMA terminations
FCB-xx50-2	Bifurcated cable 2x50 μm , 2 m length, SMA terminations
FCB-xx100-2	Bifurcated cable 2x100 μm , 2 m length, SMA terminations
FCB-xx200-2	Bifurcated cable 2x200 μm , 2 m length, SMA terminations
FCB-xx400-2	Bifurcated cable 2x400 μm , 2 m length, SMA terminations
FCB-xx600-2	Bifurcated cable 2x600 μm , 2 m length, SMA terminations

Other lengths and fiber types are available. * 800-1000 μm with Acrylate buffer.

Multi-furcated Fiber Optic Cables

For many applications a fiber optic cable with multiple fibers in one connector is required. These so-called multi-furcated fiber cables can be offered in many different configurations, most of them are standard 2m length, on one side an SMA connector with all fibers, on the other side separate legs each of them terminated with an SMA connector.

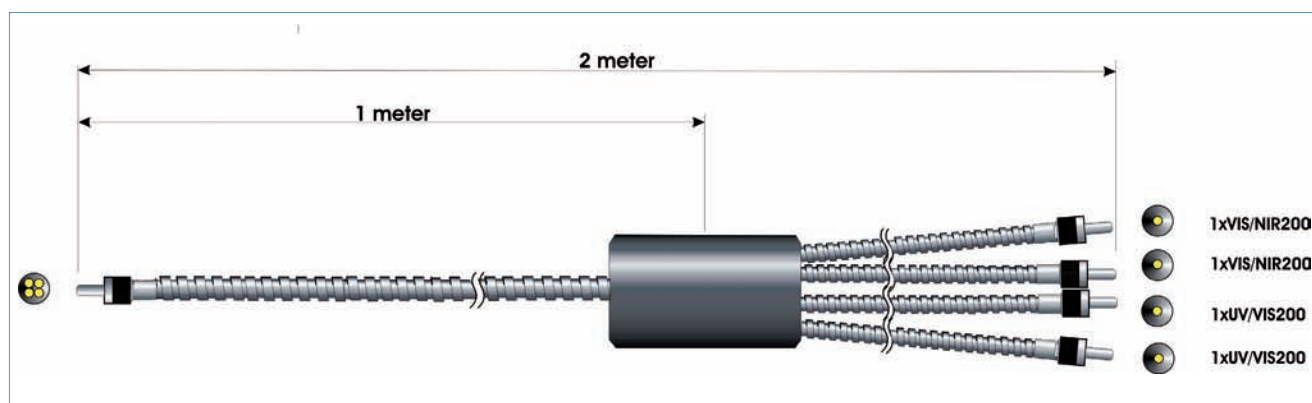
Typical setups that require these type of cables are:

- Multi-channel spectrometers connecting to one sampling point, such as an integrating sphere, cosine corrector or collimating lens.
- Multiple illumination fibers coming from one light source to different sampling points.

These multi-furcated fibers can be offered with all types of connectors, sleeves, and fiber sizes.



FC4-UV/IR200-2-ME



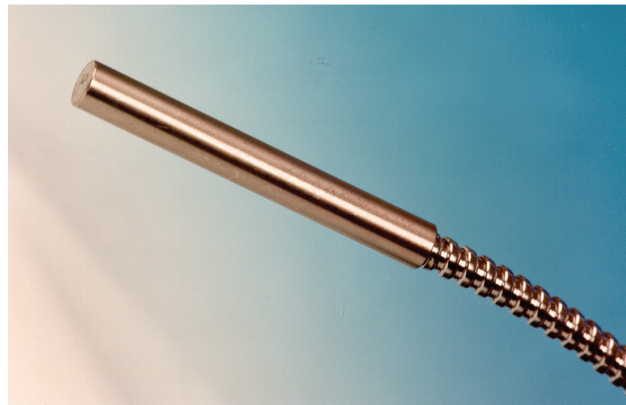
ORDERING INFORMATION	
FC4-xx200-2	Four-furcated cable, 4x200 μm fibers, all legs SMA terminated, total 2m long, splitting point in the middle, specify xx=UV or IR or UV/IR
FC4-xx400-2	Four-furcated cable, 4x400 μm fibers, all legs SMA terminated, total 2m long, splitting point in the middle, specify xx=UV or IR or UV/IR
FC4-xx600-2	Four-furcated cable, 4x600 μm fibers, all legs SMA terminated, total 2m long, splitting point in the middle, specify xx=UV or IR or UV/IR
FC5-xx200-2	Five-furcated cable, 5x200 μm fibers, all legs SMA terminated, total 2m long, splitting point in the middle, specify xx=UV or IR or UV/IR
FC5-xx400-2	Five-furcated cable, 5x400 μm fibers, all legs SMA terminated, total 2m long, splitting point in the middle, specify xx=UV or IR or UV/IR
FC6-xx200-2	Six-furcated cable, 6x200 μm fibers, all legs SMA terminated, total 2m long, splitting point in the middle, specify xx=UV or IR or UV/IR
FC6-xx400-2	Six-furcated cable, 6x400 μm fibers, all legs SMA terminated, total 2m long, splitting point in the middle, specify xx=UV or IR or UV/IR
FC8-xx200-2	Eight-furcated cable, 8x200 μm fibers, all legs SMA terminated, total 2m long, splitting point in the middle, specify xx=UV or IR or UV/IR
FC8-xx400-2	Eight-furcated cable, 8x400 μm fibers, all legs SMA terminated, total 2m long, splitting point in the middle, specify xx=UV or IR or UV/IR

Other lengths available on request.

Reflection Probes (Standard)

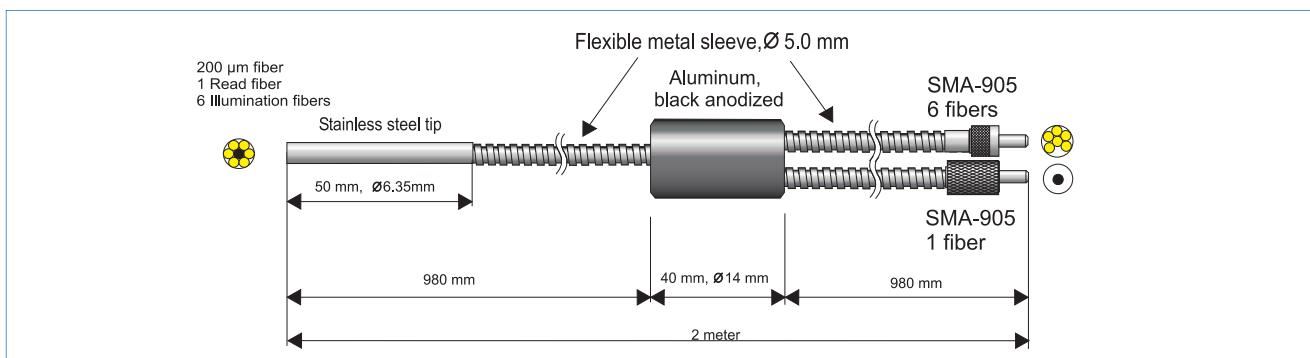
The FCR-7xx200-2 is a standard reflection probe to get spectral information of diffuse or directly reflecting or back-scattering materials.

Via a standard SMA905 connector light from a light source is coupled into a fiber bundle, consisting of 6 fibers and carried to the probe end. The surface will selectively reflect light back into a 7th fiber. This fiber transfers the data to the output SMA905 connector, which can be coupled to a spectrometer. A higher number of fibers are possible to couple more energy from the light source and to increase the signal level. For measurements under 90° the FCR-90-Option, a special adapter with a mirror under 45°, was developed, which can be easily mounted on the tip of the reflection probe. The FCR-COL is available to focus the measurement spot on an extended distance.



Technical Data

Fibers	7 fibers 200 µm or 400 µm core, 6 light-fibers, 1 read fiber, N.A. = 0.22. Standard 2 m length, splitting point in the middle.
Wavelength range	200-800 nm (UV/VIS) or 350-2000 nm (VIS/NIR)
Connectors	SMA905 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
Tubing	The optical fibers are protected by a silicon inner tube and a flexible chrome plated brass outer tubing. The tubing also gives stress relief. OD: 5.0 mm
Temperature	-30 °C to 100 °C. (-HT version 200 °C, -HTX version 500 °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-7xx200-2-ME	Reflection probe, 7 x 200µm fibers, 2 m length, SMA term.
FCR-7xx400-2-ME	Reflection probe, 7 x 400µm fibers, 2 m length, SMA term.
FCR-90-Option	90° Reflection add-on reflector for use with all ¼" reflection probes
FCR-COL	Adjustable UV/VIS/NIR Collimating/focusing lens for FCR probes
Options	
-HT	High Temperature version (up to 200°C)
-HTX	Extreme High Temperature version (up to 500°C)
-PK	PEEK Probe material replaces Stainless Steel
-HY	Hastelloy® C276 Probe material replaces Stainless Steel

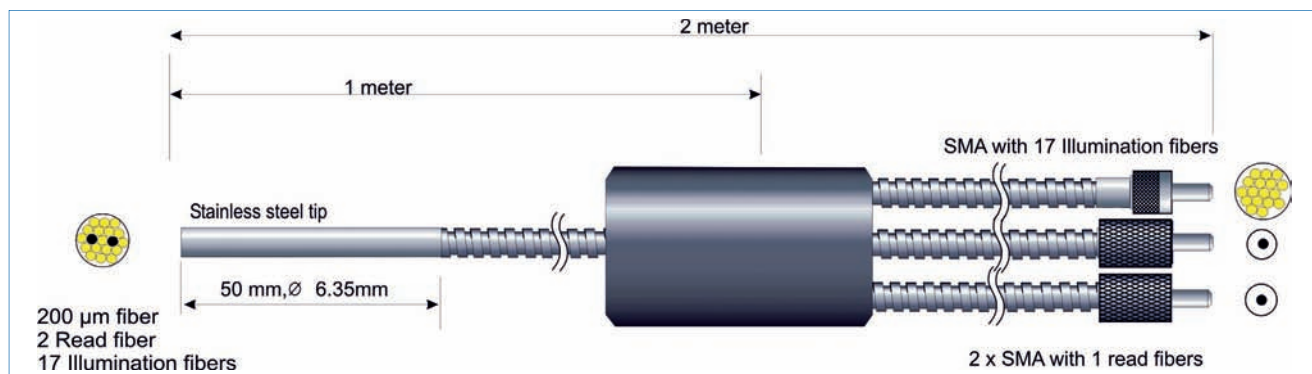
Reflection probes with multiple legs

For applications where a reflection probe is needed that connects to multiple spectrometer channels, special reflection probes are available with multiple read fibers. A typical example can be a reflection measurement in the UV/VIS and NIR range. The light from a light source is coupled into a fiber bundle, consisting of 17 fibers and carried to the probe end. The surface will selectively reflect light back into 2 fibers. These 2 read fibers are standard terminated with an SMA905 connector. One fiber is connected to the UV/VIS spectrometer channel and one fiber to the NIR spectrometer channel. For measurements under 90° the FCR-90-Option, a special adapter with a mirror under 45°, was developed, which can be easily mounted on the tip of the reflection probe. The FCR-COL is available to focus the measurement spot on an extended distance.



Technical Data

Fibers	19 fibers 200 µm core, 17 light-fibers, 2 read fibers in 2 separate legs, N.A.= 0.22. Standard 2m length, splitting point in the middle.
Wavelength range	200-800 nm (UV/VIS) or 350-2000 (VIS/NIR)
Connectors	SMA905 connectors (3x)
Probe end	Stainless steel 316 cylinder, 50 mm long x 6.35 mm diameter. Optionally –PK for PEEK or –HY for Hastelloy® C276
Tubing	The optical fibers are protected by a silicon inner tube and a flexible chrome plated brass outer tubing. The tubing also gives stress relieve. OD: 5.0 mm
Temperature	-30°C to 100°C. (-HT version 200 °C, -HTX version 500 °C)
Pressure	Probe head 50 bar @ 25 °C
Bending	Minimum bend radius: Short term (few seconds) 20 mm, long term: 120 mm

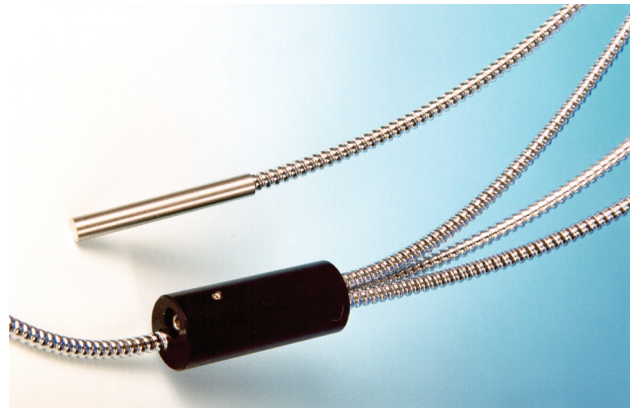


ORDERING INFORMATION

FCR-19UV200-2-ME	Reflection probe UV/VIS, 17 x 200µm illumination fibers, 2x1 read fiber in separate legs, 2 m length, 3 SMA term
FCR-19IR200-2-ME	Reflection probe VIS/NIR, 17 x 200µm illumination fibers, 2x1 read fiber in separate legs, 2 m length, 3 SMA term
FCR-19UVIR200-2-ME	Reflection probe UV/VIS/NIR, 8 x UV/VIS / 9 x VIS/NIR 200µm illumination fibers, 1 read UV/VIS, 1 read VIS/NIR fiber in separate legs, 2 m length, 3 SMA term.
FCR-90-Option	90° Reflection add-on reflector for use with all ¼" reflection probes
FCR-COL	Adjustable UV/VIS/NIR Collimating/focusing lens FCR probes
Options	
-HT	High Temperature version (up to 200°C)
-HTX	Extreme High Temperature version (up to 500°C)
-PK	PEEK Probe material replaces Stainless Steel
-HY	Hastelloy® C276 Probe material replaces Stainless Steel

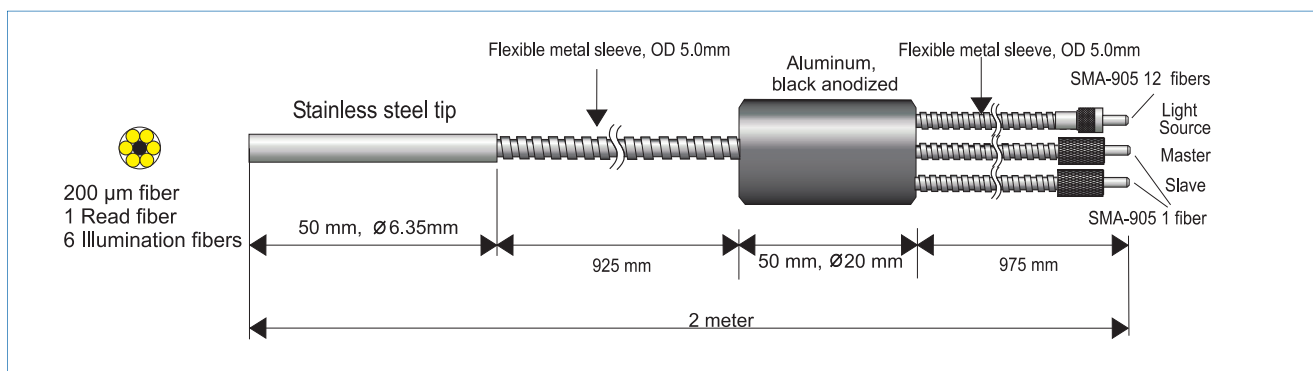
Reflection Probes with Reference

The FCR-14xx200-2-REF is a special reflection probe to get spectral information of diffuse or direct reflecting materials. The reference leg was added to be able to correct fluctuations of the lightsource by a second spectrometer channel. Via a standard SMA905 connector light is coupled into a fiber bundle, consisting of 12 fibers. These 12 fibers are split into 2x 6 fibers, 6 fibers carried to the probe end and 6 fibers reflecting on white diffuse material inside the coupler, then back reflecting into 1 fiber of the reference leg, connected through an SMA905 connector to the slave channel of the spectrometer. The probe end will selectively reflect light back into a 7th fiber. This fiber transfers the data to the output SMA905 connector, which can be coupled to the master channel of the spectrometer.



Technical Data

Fibers	14 fibers 200 μ m core, 12 light-fibers, 2 x 1 read fiber, N.A.= 0.22. Standard 2m length, splitting point in the middle.
Wavelength range	200-800 nm (UV/VIS) or 350-2000 (VIS/NIR)
Connectors	SMA905 connectors (3x)
Probe end	Stainless steel 316 cylinder, 50 mm long x 6.35 mm diameter . Optionally –PK for PEEK or –HY for Hastelloy® C276.
Tubing	The optical fibers are protected by a silicon inner tube and a flexible chrome plated brass outer tubing. The tubing also gives stress relieve. OD: 5.0 mm
Temperature	-30°C to 100°C. (-HT version 200 °C, -HTX version 500 °C)
Pressure	Probe head 50 bar @ 25 °C
Bending	Minimum bend radius: Short term (few seconds) 20 mm, long term: 120 mm



ORDERING INFORMATION

FCR-14xx200-2-REF-ME	Reflection probe with reference, 14 x 200 μ m fibers, 2 m length, SMA term.
Options	
-HT	High Temperature version (up to 200°C)
-HTX	Extreme High Temperature version (up to 500°C)
-PK	PEEK Probe material replaces Stainless Steel
-HY	Hastelloy® C276 Probe material replaces Stainless Steel

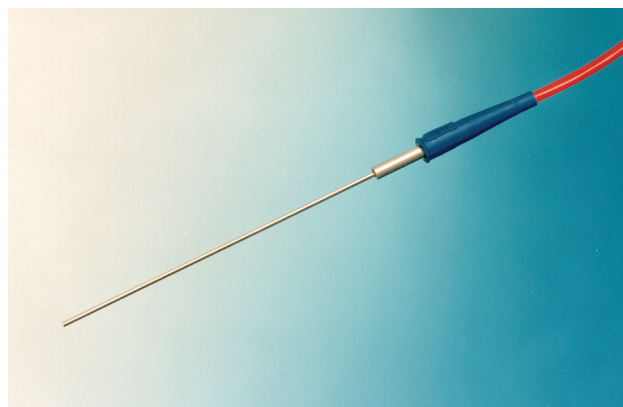
Reflection Probes with small Tips

The FCR-7xx200-2-1,5/2,5x100 is a reflection probe with a small tip to get spectral information of diffuse or direct reflecting materials. This probe is implemented in many medical applications.

Via a standard SMA905 connector light is coupled into a fiber bundle, consisting of 6 fibers and carried to the probe end.

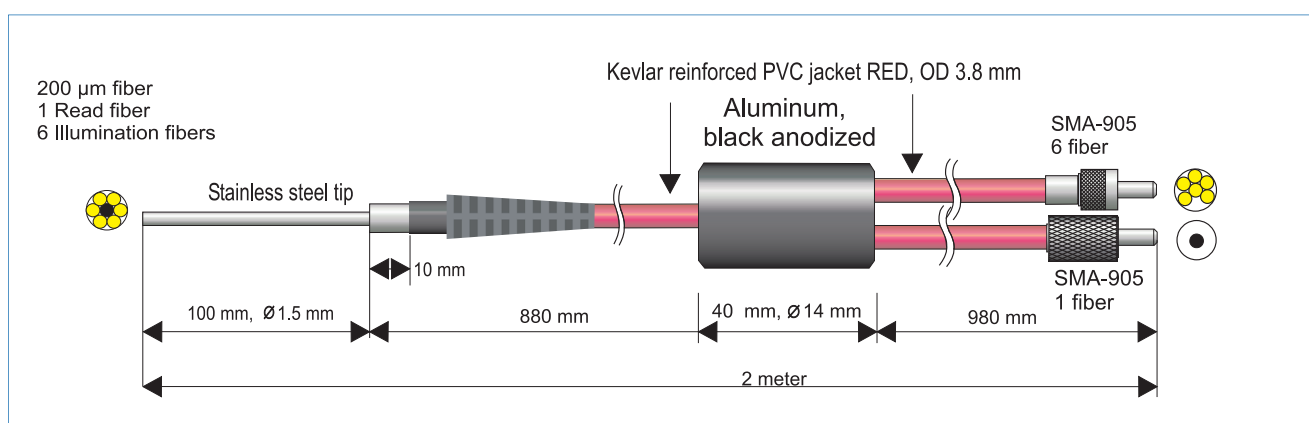
The surface will selectively reflect light back into a 7th fiber. This fiber transfers the data to the output SMA905 connector, which can be coupled to a spectrometer or spectral analyzer.

A special Angled Fiber Holder (AFH-15) is available for the 1.5 mm diameter reflection probe to enable reflection measurements under 15°, 30°, 45°, 60°, 75° and 90°, for more information see Reflection Probe Holders at the end of this section.



Technical Data

Fibers	7 fibers 200 µm core, 6 light-fibers, 1 read fiber, N.A. = 0.22. Standard 2 m length, splitting point in the middle.
Wavelength range	200-800 nm (UV/VIS) or 350-2000 nm (VIS/NIR)
Connectors	SMA905 connectors (2x)
Probe end	Stainless steel cylinder, 100 mm long x 1.5 or 2.5 mm diameter.
Tubing	The optical fibers are protected by a Kevlar reinforced PTFE tubing with PVC sleeving. OD: 3.8 mm
Temperature	-20 °C to 65 °C.
Bending	Minimum bend radius: Short term (few seconds) 20 mm, long term: 120 mm



ORDERING INFORMATION

FCR-7UV200-2-1,5x100	Reflection probe, 1,5 mm tip, UV/VIS, 7 x 200µm fibers, 100 mm long, 2 m length, SMA
FCR-7IR200-2-1,5x100	Reflection probe, 1,5 mm tip, VIS/NIR, 7 x 200µm fibers, 100 mm long, 2 m length, SMA
FCR-7UV200-2-2,5x100	Reflection probe, 2,5 mm tip, UV/VIS, 7 x 200µm fibers, 100 mm long, 2 m length, SMA
FCR-7IR200-2-2,5x100	Reflection probe, 2,5 mm tip, VIS/NIR, 7 x 200µm fibers, 100 mm long, 2 m length, SMA

Reflection Probes for Powders and Thick Fluids

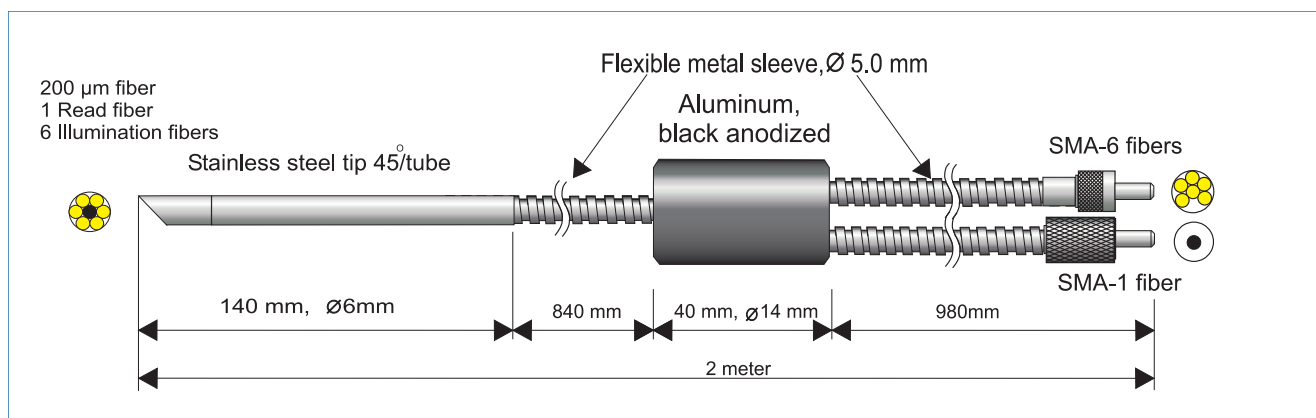
The FCR-7xx200-2-45 is a reflection probe to get spectral information about powders or highly absorbing fluids. The probe end is simply dipped into the powder or liquid to do the measurements.

Via a standard SMA905 connector light is coupled into a fiber bundle, consisting of 6 fibers and carried to the probe end, where it lights up the material to be analyzed through a silica window under 45 degrees. This angle is necessary to avoid direct reflections from the window. The powder or fluid will selectively reflect light back into a 7th fiber. This fiber transfers the data to the output SMA905 connector, which can be coupled to a spectrometer.



Technical Data

Fibers	7 fibers 200 µm core, 6 light-fibers, 1 read fiber, N.A. = 0.22, standard 2 meter length
Wavelength range	200-800 nm (UV/VIS) or 350-2000 nm (VIS/NIR)
Connectors	SMA905 connectors (2x)
Probe end	Stainless steel 316 cylinder, 130 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
Tubing	The optical fibers are protected by a silicon inner tube and a flexible chrome plated brass outer tubing. The tubing also gives stress relief. OD: 5,0 mm
Temperature	-30°C to 100°C. (-HT version 200 °C)
Pressure	Probe head 10 bar @ 25 °C
Bending	Minimum bend radius: Short term (few seconds) 20 mm, long term: 120 mm



ORDERING INFORMATION

FCR-7xx200-2-45-ME	Reflection probe for powders and turbid fluids
Options	
-HT	High Temperature version (up to 200°C)
-PK	PEEK Probe material replaces Stainless Steel
-HY	Hastelloy® C276 Probe material replaces Stainless Steel

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

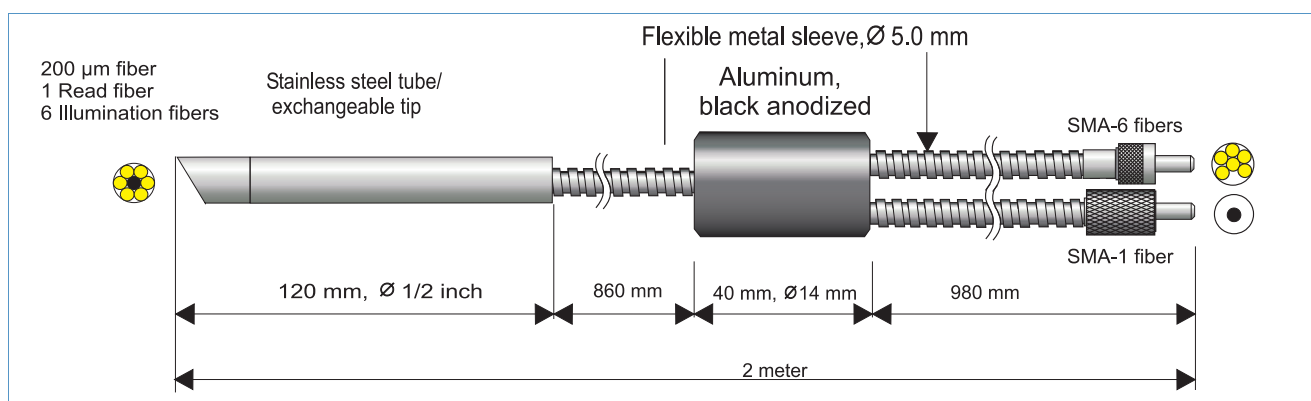
The FCR-7xx200-2-45-IND is a heavy-duty reflection probe with exchangeable tip to get spectral information about powders or thick fluids. The probe end is simply dipped into the powder or liquid to do the measurements.

Via a standard SMA905 connector light is coupled into a fiber bundle, consisting of 6 fibers and carried to the probe end, where it lights up the material to be analyzed through a silica window under 45 degrees. This angle is necessary to avoid direct reflections from the window. The powder or fluid will selectively reflect light back into a 7th fiber. This fiber transfers the data to the output SMA905 connector, which can be coupled to a spectrometer.



Technical Data

Fibers	7 fibers 200 µm core, 6 light-fibers, 1 read fiber, N.A. = 0.22, standard 2 meter length
Wavelength range	200-800 nm (UV/VIS) or 350-2000 nm (VIS/NIR)
Connectors	SMA905 connectors (2x)
Probe End	Stainless steel cylinder, 128 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
Tubing	The optical fibers are protected by a silicon inner tube and a flexible chrome plated brass outer tubing. The tubing also gives stress relieve. OD: 5.0 mm Optionally a waterproof, steel reinforced, silicon tubing can be provided
Temperature	-30 °C to 100 °C. (-HT version 200 °C)
Pressure	Probe head 10 bar @ 25 °C
Bending	Minimum bend radius: Short term (few seconds) 20 mm, long term: 120 mm



ORDERING INFORMATION	
FCR-7xx200-2-45-IND	1/2" Reflection probe for powders and turbid fluids
FCR-TIP45	1/2" Replacement tip with sapphire window for UV/VIS/NIR
Options	
-HT	High Temperature version (up to 200°C)
-PK	PEEK Probe material replaces Stainless Steel
-HY	Hastelloy® C276 Probe material replaces Stainless Steel

1/2" Industrial Fluorescence Probe

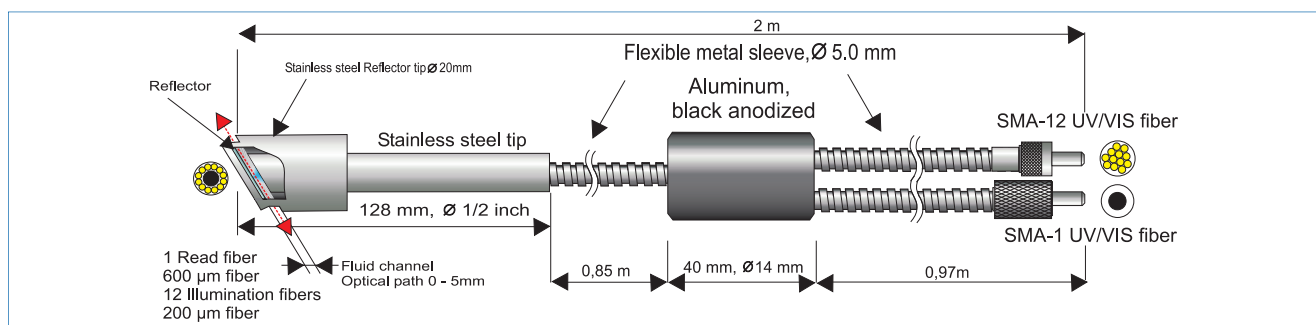
For fluorescence applications a special reflection probe was developed with 12 excitation fibers of 200µm around a 600µm read fiber, which takes the fluorescence signal back to the spectrometer.

A special reflector accessory FCR-FLTIP-IND is attached to the probe end to turn the 45° reflection probe into a fluorescence probe. The accessory prevents ambient light entering the probe and backscatters the excitation light to increase the fluorescence signal. The fluid channel path can be varied between 0 and 5 mm.



Technical Data

Fibers Illumination	12 fibers of 200µm, UV/VIS
Fibers Detection	1 fiber 600µm
Wavelength Range	200-800 nm (UV/VIS) or 350-2000 nm (VIS/NIR)
Connector	2 x SMA 905
Probe End	Stainless steel 316 cylinder, 128 mm long x 12,7 mm (1/2") diameter. The probe end contains a ca. 10 mm diam. 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
Fluorescence Accessory	See drawing below
Tubing	The optical fibers are protected by a silicon inner tube and a flexible chrome plated brass outer tubing. The tubing also gives stress relieve. OD: 5,0 mm Optionally a waterproof, steel reinforced, silicon tubing can be provided
Temperature	-30 °C to 100 °C. (-HT version 200 °C)
Pressure	Probe head 10 bar @ 25 °C
Bending	Minimum bend radius: Short term (few seconds) 60 mm, long term: 360 mm



ORDERING INFORMATION

FCR-UV200/600-2-IND	½" Reflection Probe for fluorescence applications
FCR-FLTIP-IND	Fluorescence Reflector Accessory for ½" FCR-UV200/600-2-IND probes
Options	
-HT	High Temperature version (up to 200°C)
-PK	PEEK Probe material replaces Stainless Steel
-HY	Hastelloy® C276 Probe material replaces Stainless Steel

Micro Transmission Dip Probe

The Micro Transmission Dip Probe is a miniature transmission probe for micro-liter sampling.

The miniaturized tip of only 1.6 mm diameter enables sampling in all micro centrifuge tubes available on the market.

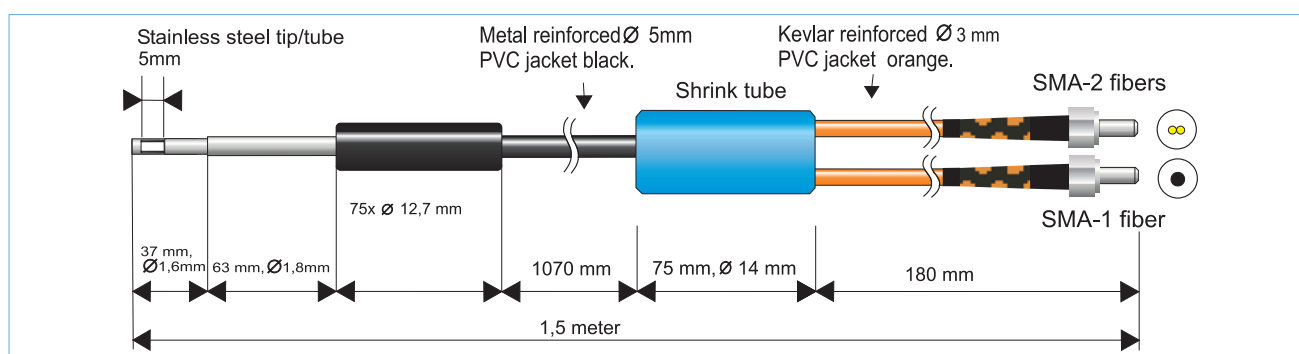
The micro Dip Probe has a 10 mm optical path length and can be used in a wavelength range from 200-800nm (UV) or 350-2000nm (IR).

The distance for the optical path from the probe end is 7 mm, the probe has 2 SMA connectors to conveniently couple to the Avantes line of spectrometers and light sources. The probe has 3 UV/VIS fibers of 400 μ m, 2 for illumination and 1 for detection.



Technical Data

Fibers	2 illumination fibers, 1 detection fiber, all 400 μ m, UV/VIS, standard 1.5 meters
Wavelength Range	200-800 nm (UV/VIS) or 350-2000 nm (VIS/NIR)
Connectors	2 x SMA 905
Probe End	Stainless steel cylinder, 37 mm long x 1.6 mm (1/16") diameter, then 63 x 1.8 mm. The probe end can be delivered with 3 different path lengths: 1 mm physical gap – 2 mm optical path, 2.5 mm physical gap– 5 mm optical path and 5 mm physical gap– 10 mm optical path
Tubing	The optical fibers are protected by a metal reinforced PVC outer tubing. The tubing also gives stress relief. OD: 5.0 mm. Total probe length 1.5 m
Temperature	0 °C to 65 °C.
Bending	Minimum bend radius: Short term (few seconds) 40 mm, long term: 240 mm



ORDERING INFORMATION

FDP-UV-MICRO-1	1/16" Micro Dip Probe, UV/VIS, 1 mm gap (2 mm optical path), 1.5m
FDP-UV-MICRO-2.5	1/16" Micro Dip Probe, UV/VIS, 2.5 mm gap (5 mm optical path), 1.5m
FDP-UV-MICRO-5	1/16" Micro Dip Probe, UV/VIS, 5 mm gap (10 mm optical path), 1.5m
FDP-IR-MICRO-5	1/16" Micro Dip Probe, VIS/NIR, 5 mm physical gap (10 mm optical path), 1.5m

Mini Transmission Dip Probe

The Mini Transmission Dip Probe is a miniature transmission probe for absorption measurements.

The miniaturized tip of only 3.2 mm (1/8") diameter enables sampling in most miniaturized centrifuge tubes available on the market.

The mini Dip Probe has a 10 mm optical path length and can be used in the UV/VIS (200-800 nm) or VIS/NIR wavelength range (350-2000 nm).

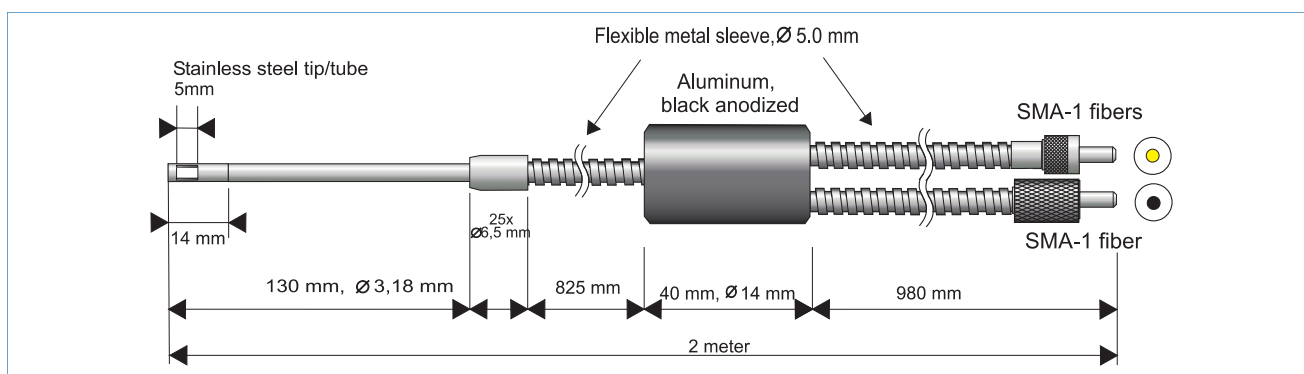
Optionally the probe can be supplied with longer stainless steel or Hastelloy® tube or with a 2.5mm gap (5 mm optical path). Please contact us for special requirements.

The probe has 2 SMA connectors to conveniently couple to the Avantes line of spectrometers and light sources.



Technical Data

Fibers	1 illumination and 1 detection fiber, both 200 µm, standard 2 meters length
Wavelength Range	200-800 nm (UV/VIS) or 350-2000 nm (VIS/NIR)
Connectors	2 x SMA 905
Probe End	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 2.5mm physical gap (5mm optical path). Optionally –HY for Hastelloy® C276
Tubing	The optical fibers are protected by a silicon inner tube and a flexible chrome plated brass outer tubing. The tubing also gives stress relieve. OD: 5.0 mm.
Temperature	-30 °C to 100 °C. (-HT version 200 °C)
Pressure	Probe head 10 bar @ 25 °C
Bending	Minimum bend radius: Short term (few seconds) 20 mm, long term: 120 mm



ORDERING INFORMATION

FDP-2xx200-2-2.5-mini	1/8" Mini Dip Probe, 2.5 mm path length (optical 5mm), 2m length
FDP-2xx200-2-5-mini	1/8" Mini Dip Probe, 5 mm path length (optical 10mm), 2m length
Options	
-HT	High Temperature version (up to 200°C)
-HY	Hastelloy® C276 Probe material replaces Stainless Steel

Transmission Dip Probe

The transmission dip probe is used to obtain online and in-line absorbance measurements in fluids. By dipping or permanently mounting the probe end into the fluid stream, the absorbance is measured.

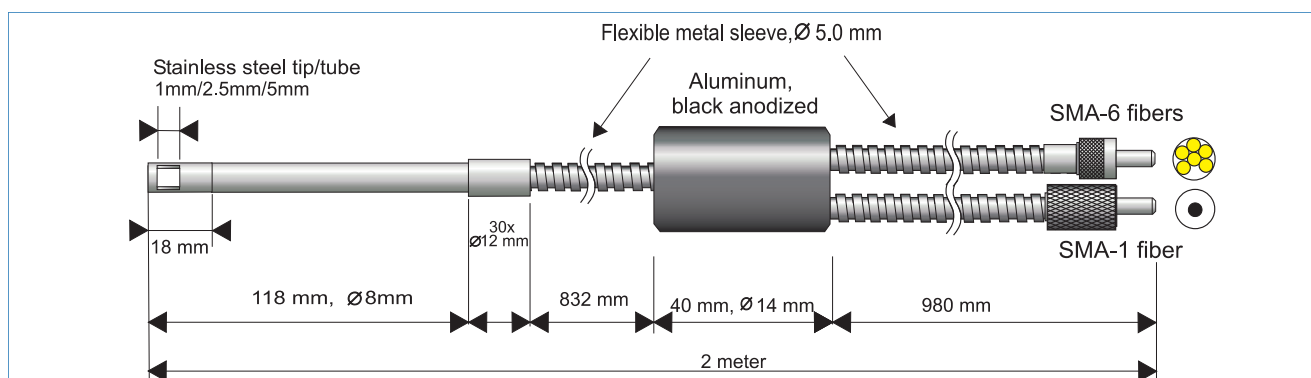
Via a standard SMA905 connector light is coupled into a fiber bundle, consisting of 6 fibers and carried to the probe end, where it crosses a gap of 1, 2.5 or 5 mm and reflects against a diffuse white material. Back reflected light returns into a 7th fiber. This fiber transfers the data to the output SMA905 connector, which can be coupled to a spectrometer.

At the probe end the read fiber is placed in the middle of the lighting fibers for best efficiency of the probe. Both bundles are led through one piece of flexible stainless steel tubing. In a ferrule they are split and run separated for one meter to reach the SMA905 connectors.



Technical Data

Fibers	6 illumination fibers, 1 detection fiber, all 200 µm, standard 2 meters
Wavelength range	200-800 nm (UV/VIS) or 350-2000 (VIS/NIR)
Connectors	SMA905 connectors (2x)
Tips	Replacement tips are available with 1, 2.5 and 5mm 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
Probe end	Stainless steel 316 cylinder, 100 mm long x 8,0 mm diameter. Waterproof, Optionally -HY for Hastelloy® C276
Tubing	The optical fibers are protected by a silicon inner tube and a flexible chrome plated brass outer tubing. The tubing also gives stress relief. OD: 5.0 mm
Temperature	-30°C to 100°C. (-HT version 200 °C)
Pressure	Probe head 10 bar @ 25 °C
Bending	Minimum bend radius: Short term (few seconds) 20 mm, long term: 120 mm



ORDERING INFORMATION

FDP-7xx200-2-yy	Transmission Dip Probe, yy(1, 2.5, 5 mm) gap, 2 m length, SMA term.
FDP-TIP-yy	Replacement tips, 1 mm, 2.5 mm, 5 mm gap for probe (fill in gap length for yy, note optical path = 2*yy)
Options	
-HT	High Temperature version (up to 200°C)
-HY	Hastelloy® C276 Probe material replaces Stainless Steel

Transmission Dip Probe with Variable Path Length

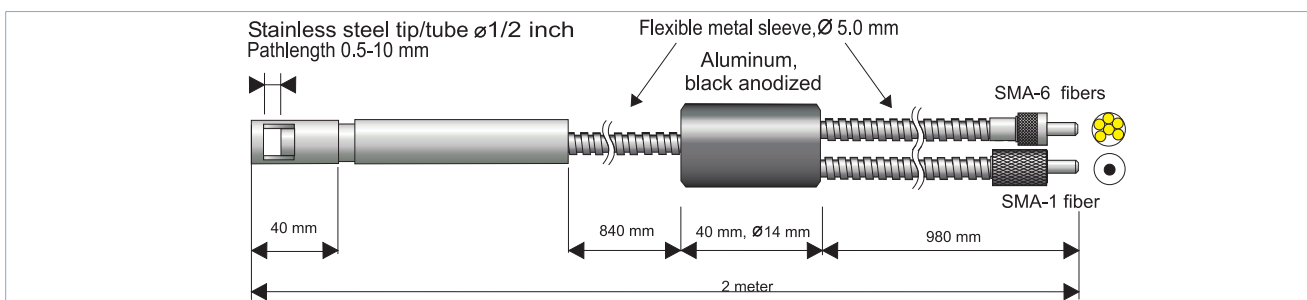
The transmission dip probe with variable path length can be used to obtain online and inline absorbance measurements in fluids. The 1/2" Probe has an optical path length, which can be set by the user in a range from 0.5 mm to 20 mm and is therefore extremely versatile for high- or low-absorption fluids. The probe end is simply dipped into the fluid to do the measurements. Via a standard SMA905 connector light is coupled into a fiber bundle, consisting of 6 fibers and carried to the probe end, where it crosses a user-defined physical gap of 0.25-10 mm and reflects against a diffuse white material. The back reflected light returns into a 7th fiber.

This fiber transfers the data to the output SMA905 connector, which can be coupled to a spectrometer. At the probe end the read fiber is placed in the middle of the lighting fibers for best efficiency of the probe. Both bundles are led through one piece of flexible stainless steel tubing. In a ferrule they are split and run separated for one meter to reach the SMA905 connectors.



Technical Data

Fibers	6 illumination fibers, 1 detection fiber, all 200µm, standard 2 meters
Wavelength range	200-800 nm (UV/VIS) or 350-2000 nm (VIS/NIR)
Connectors	SMA905 connectors (2x)
Optical Path	0.25 - 10 mm physical gap, i.e. an optical path of 0.5-20 mm
Probe end	Stainless steel 316, 140-160 mm long x 12,7 mm (1/2") diameter. Waterproof. Optionally -PK for PEEK or -HY for Hastelloy® C276
Tubing	The optical fibers are protected by a silicon inner tube and a flexible chrome plated brass outer tubing. The tubing also gives stress relief. OD: 5,0 mm. Optionally a waterproof, steel reinforced, silicon tubing can be provided (-MS)
Temperature	-30 °C to 100 °C. (-HT version 200 °C)
Pressure	Probe head 10 bar @ 25 °C
Bending	Minimum bend radius: Short term (few seconds) 20 mm, long term: 120 mm

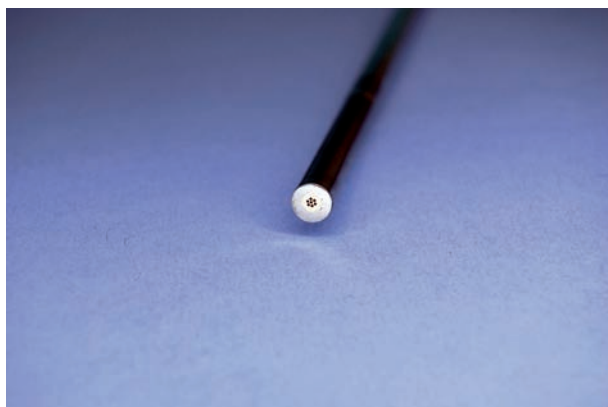
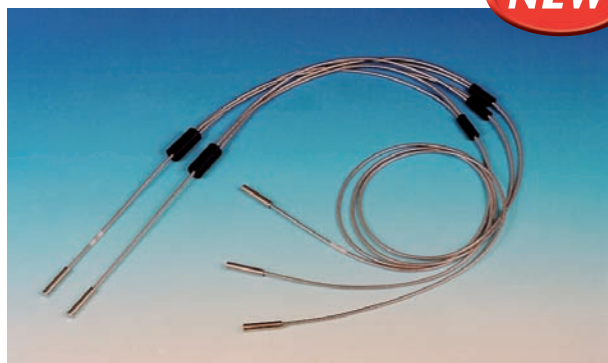


ORDERING INFORMATION	
FDP-7xx200-2-VAR	Transmission Dip Probe in SS with variable tip length, 2 m length, SMA term.
FDP-TIP-VAR	Replacement Stainless Steel tip for Transmission dip probe with variable tip length
Options	
-HT	High Temperature version (up to 200°C)
-PK	PEEK Probe material replaces Stainless Steel
-HY	Hastelloy® C276 Probe material replaces Stainless Steel

Special Fiber Optic Probes

For special applications where a fiber probe needs to be installed in a harsh industrial environment, specific features may be required. Avantes has been constructing many high quality probes for harsh environments over more than 15 years. Special expertise has been built-up in high temperature (HTX), high pressure (HP), vacuum and other specifications. Also the combination of fiber diameters, wavelength range, sleeving material and length as well as connectors, ferrules, etc. enables an unlimited amount of custom specific products. Below are a few examples of our capabilities.

NEW



HTX Extreme High Temperatures

Some special probes for extreme high temperatures are used in catalysis reactors under temperatures up to 500°C. The use of CuBALL fibers and silver soldering technique allows us to design and manufacture –HTX probes.

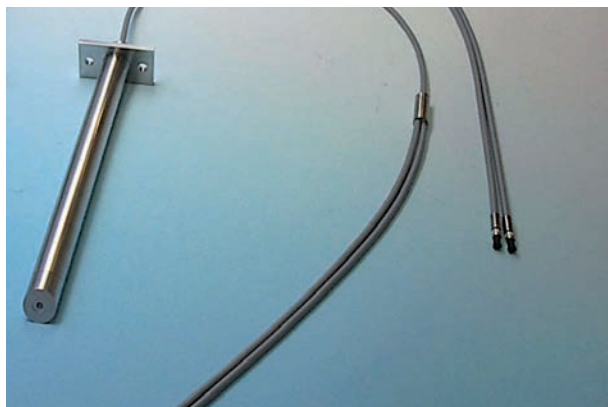
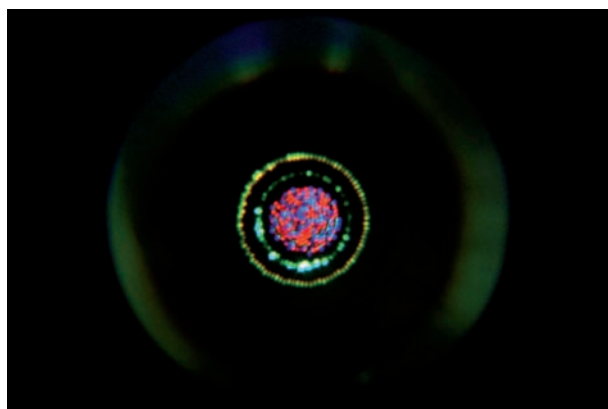
This reflection probe has 7 fibers of 400µm CuBALL, UV/VIS, is 2m long and the probe tip can withstand temperatures up to 500°C. The SMA905 connectors are bonded with an -HT temperature epoxy and can withstand 200°C.

Special configurations

For translucency measurements on the human skin it is necessary to get a reflection signal from different penetration depths.

This is realized in a probe end with many fibers in a bundle and 2 different rings of fibers around the center bundle.

This probe has a total length of 1.5 meters and consist of 350 fibers of 100µm, UV/VIS, 5 legs all terminated with SMA905 connectors



Process Probes

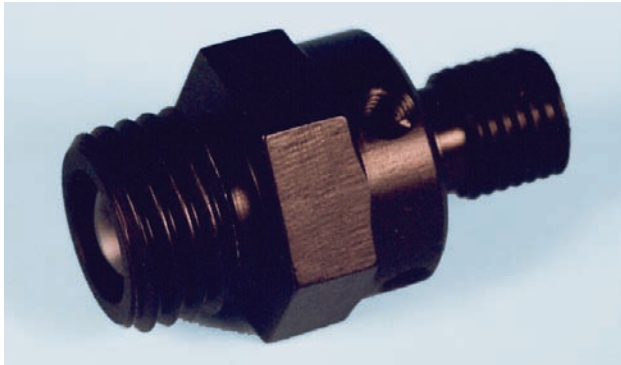
Specially for the paper and pulp industry an NIR Reflection probe has been designed with a laser-welded window under 25 degrees. The probe is used in a refiner in a very abrasive material stream and often gets in contact with acetone and turpentine.

The probe is 3 meters long and consists of 14 fibers of 400µm, VIS/NIR, and has an internal reference in the coupling piece. Temperature range up to 200 °C (-HT) and pressure up to 30 bars. The probe has a metal silicone (-MS) sleeving and is terminated with SMA905 connectors

Contact our sales staff for more special requests

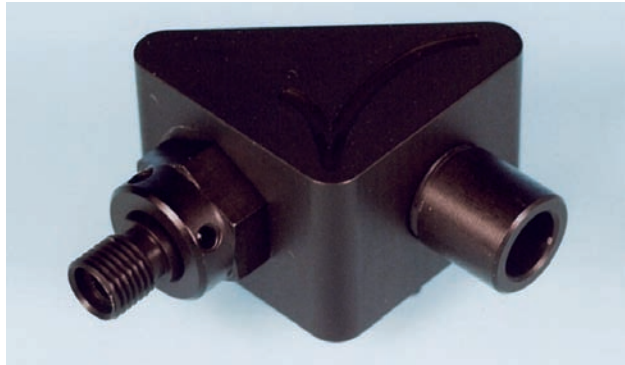
Collimating Lenses

COL-UV/VIS



The collimating lenses convert divergent beams of light into a parallel beam. The lenses are optimized for the UV/VIS/NIR range, are SMA terminated for coupling to optical fiber assemblies and have anodized aluminum housings. The focal point can be adjusted. The COL-90-UV/VIS is used to have the collimated light exit under a 90-degree angle. Optionally an FC/PC connector can be offered as well.

COL-90-UV/VIS



For collimating and focusing light over larger distances the COL-UV/VIS-25 with larger diameter is available.

For reflection probes a special adjustable FCR-COL-UV/VIS is developed to be able to create a small reflection spot on a distance.

Technical Data

	COL-UV/VIS	COL-90-UV/VIS	COL-UV/VIS-25
Lens Diameter	6 mm		25 mm
Lens confocal length	8.7 mm		50 mm
Lens Material	UV grade Fused Silica		
Wavelength range	200-2500nm		
Fiber connection	SMA 905, UNS 1/4" (standard, FC/PC also possible)		
Mirror reflectivity	n.a.	>90% (200-1100nm)	n.a.
Housing Material	Aluminum black anodized		
Thread	UNF 3/8"-24	n.a.	M6 (on the side for OPM mounting)
Temperature range	-30 °C to 100°C (-HT version 200 °C)		-30 °C to 100°C

ORDERING INFORMATION

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

Cosine correctors

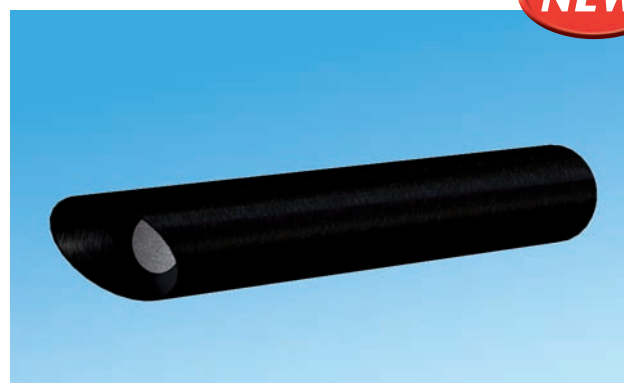
CC-UV/VIS



The cosine correctors are spectro radiometric sampling optics, designed to collect radiation (light) over 180°, thus eliminating optical interface problems associated with the light collection sampling geometry inherent to other sampling devices.

The CC-UV/VIS cosine corrector has an active area of 3.9 mm, has Teflon® diffusing material and is optimized for applications from 200-800 nm. For the UV/VIS/NIR range (200-2500nm) a Radin material is available in the CC-VIS/NIR.

CC-UV/VIS/NIR-5.0



Both cosine correctors screw onto the end of any SMA-terminated optical fiber. When coupled to a miniature fiber optic spectrometer, these cosine correctors can be used to measure UV-A and UV-B solar radiation, environmental light, lamps and other emission sources.

Special cosine correctors are available, such as the 8mm active area (CC-UV/VIS/NIR-8MM) and a cosine corrector with 5° angular field of view for solar measurement applications (CC-UV/VIS/NIR-5.0).

Technical Data

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

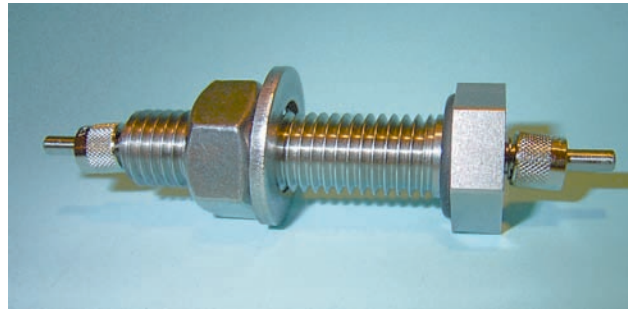
ORDERING INFORMATION

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

Vacuum Feedthrough

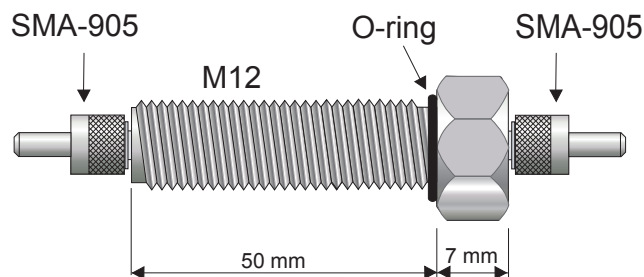
The FC-VFT vacuum feedthroughs are designed for use of fiber optics in vacuum chambers, such as for plasma monitoring. The vacuum feedthrough consists of an M12 housing with Viton® O-ring and 2 SMA fiber optic interconnects to allow easy coupling to fiber optic cables and probes (2 extra SMA fiber interconnects ME-FI-SM-MM need to be ordered separately). The vacuum feedthrough can be delivered for all fiber diameters, such as 50 µm up to 1000 µm for UV/VIS as well as for VIS/NIR.

FC-VFT



Technical Data

Fibers	1 fiber, diameter 50µm/100µm/200µm/400µm /600µm / 800µm or 1000µm
Wavelength range	200-800 nm (UV/VIS) or 350-2000 (VIS/NIR)
Connectors	Standard SMA905 connectors (2x)
Wall thickness of vacuum chamber	5-40 mm
Vacuum	Max. 10 ⁻⁷ mbar
Temperature	-40 °C to 100 °C (-HT version 200 °C)

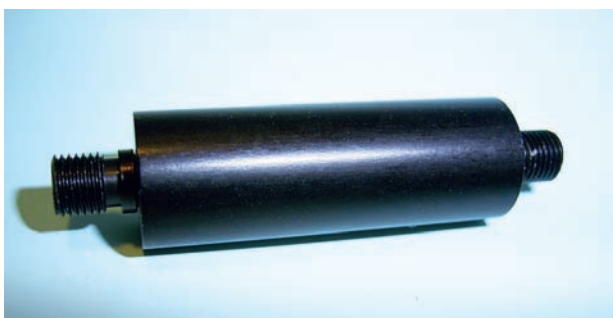


ORDERING INFORMATION (Specify xx = UV for UV/VIS, IR for VIS/NIR)

FC-VFT-xx50	Vacuum feedthrough for 50 µm fibers, incl. SMA adapter, needs 2 extra SMA interconnects
FC-VFT-xx100	Vacuum feedthrough for 100 µm fibers, incl. SMA adapter, needs 2 extra SMA interconnects
FC-VFT-xx200	Vacuum feedthrough for 200 µm fibers, incl. SMA adapter, needs 2 extra SMA interconnects
FC-VFT-xx400	Vacuum feedthrough for 400 µm fibers, incl. SMA adapter, needs 2 extra SMA interconnects
FC-VFT-xx600	Vacuum feedthrough for 600 µm fibers, incl. SMA adapter, needs 2 extra SMA interconnects
FC-VFT-xx800	Vacuum feedthrough for 800 µm fibers, incl. SMA adapter, needs 2 extra SMA interconnects
FC-VFT-xx1000	Vacuum feedthrough for 1000 µm fibers, incl. SMA adapter, needs 2 extra SMA interconnects
ME-FI-SM-MM	SMA fiber interconnect, 2 pieces needed for each vacuum feedthrough
Options	
-HT	High Temperature version (up to 200°C)
-SR	Solarization resistant fibers for DUV <250nm applications (in combination with UV fibers only)

Fiber Optic Mode Mixer

MMA-UV/VIS-SMA Mode mixer



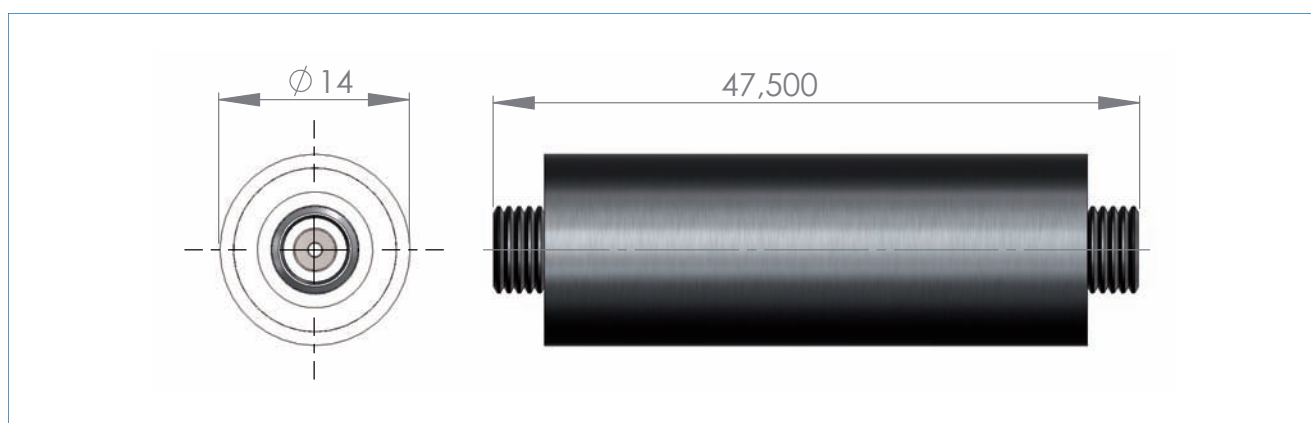
The compact MM-UV/VIS-SMA Modemixer is made of anodized aluminum and allows the connection of two optical fibers with Standard-SMA-Connectors on the two ends of the product.

Key component is a high transmitting Suprasil-Rod with a diameter of 1 or 3 mm diameter. This part transmits the light from one to the other fiber. Afterwards the modes are perfectly mixed. The mode-mixer also works as a mode stripper. Typical applications are found when light from fiber (bundles) must be mixed and coupled into other fiber (bundles).

Different types and fiber diameters are possible.

Technical Data

Wavelength Range	200-2000nm
Optical Rod Diameter	3 mm or 1 mm
Lens Material	Suprasil 1
Housing Material	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	Modemixer / Modestripper 1mm UV/VIS diameter for SMA Connectors
MMA3-UV/VIS-SMA	Modemixer / Modestripper 3mm UV/VIS diameter for SMA Connectors

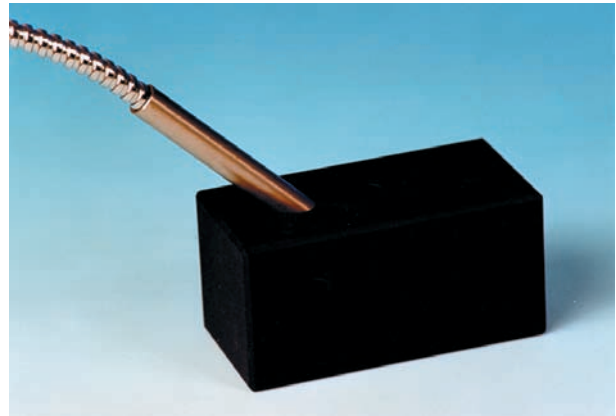
Reflection Probe Holders

The RPH-1 Reflection probe holder is useful to fix an FCR standard reflection probe under an angle of 90 or 45 degrees, as mostly used for color measurements.

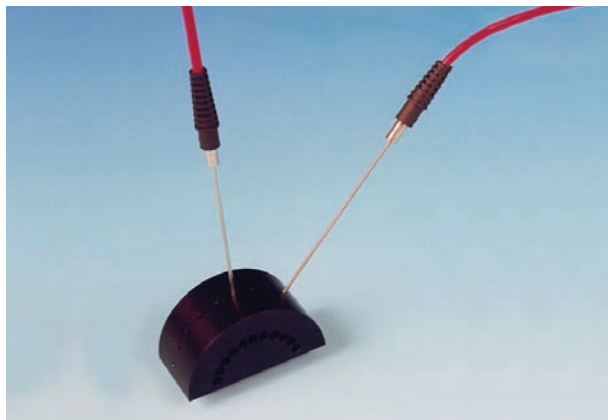
The 45 degrees angle is used for diffuse reflection measurements. The 90 degrees angle is used to measure specular reflection.

The holes have a 6.5 mm diameter and contain a setscrew to fix the probe in its position. The RPH measures 60 x 30 x 30 mm and is made of black anodized aluminum.

RPH-1 Reflection Probe Holder



AFH-15 Angled Fiber Holder



The AFH-15 Angled Fiber Holder holder is useful to fix 1.5 mm diameter ferrule terminated fibers (for example FC-UV200-2-1.5x40) or reflection probes (for example FCR-7UV200-2-1.5x100) under 15°, 30°, 45°, 60°, 75° and 90° angles. In this way different reflection measurement setups can be made with multiple separate fibers for illumination and detection. A total of 11 holes have each a 1.6 mm diameter and contain a setscrew to fix the probe or fiber in its position. At the bottom is a 12 mm hemisphere free to enable reflection in all directions.

The AFH-15 is made of black anodized aluminum.

The AFH-Ocular was developed for reflection color measurements on small spot diameters (<0.5 mm). The ocular enables to precisely monitor the location of the measurement spot.

The holder is used for miniaturized reflection probes with 7 x 100 µm fibers and 1 mm outside diameter stainless steel tip (FCR-7UV100-2-1x25).

A black cover should be used during the measurement to cover the ocular from ambient light.

AFH-Ocular



ORDERING INFORMATION

RPH-1	Reflection probe holder for 45/90 degree mounting of 1/4" reflection probes
AFH-15	Angled fiber probe holder for measuring under different angles, needs 1.5 mm ferrule terminated fibers
FC-UV200-2-1.5x40	Fiber cable, 200µm UV/VIS fiber, 2m long, one end with SMA connector, other end with stainless steel ferrule, OD=1.5 mm x 40 mm length.
AFH-Ocular	Angled fiber probe holder for precise measurements under 45 degrees incl. ocular
FCR-7UV100-2-1x25	Reflection probe with 7x100µm UV/VIS fibers to 1x25 mm stainless steel ferrule, 2 meter long with PVC/Kevlar protection sleeve and 2 SMA connectors

Multipurpose Work Stand for Fiber Optic Accessories

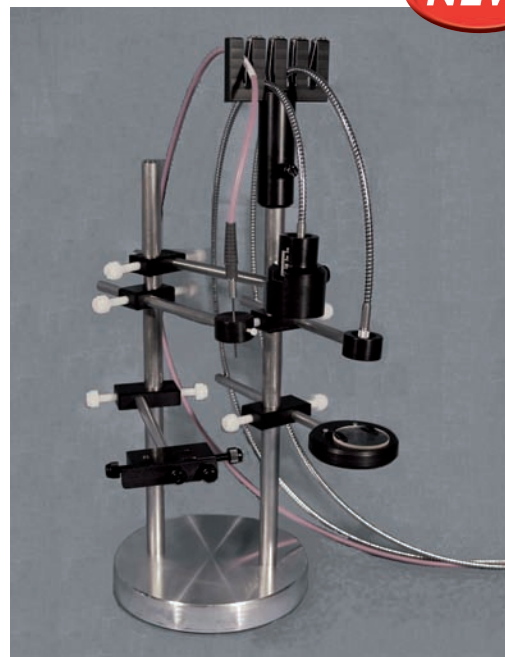
NEW

Over the years a number of multipoint, multidirectional fiber optic holders have been developed, that are depicted on these pages. The base is a multipurpose work stand with 2 vertical support rods. The rods are secured into the base plate with M6 screws. The 300mm long, 14 mm diameter rods can be used on larger breadboards and optical tables.

MWS-CLIP4 Fiber Optic Cable Clip with 4 channels



This cable clip secures fiber optic cables up to 6 mm sleeving diameter to avoid movement of the fiber cable during the measurement.



MWS-AWD-15/30 SMA Fiber holder adjustable working distance 15/30mm

The holder is rod mounted to the work stand, using a lockable coupling MWS-CPL-1. The holder will accept any SMA, ST and FC/PC terminated fiber optic up to 1000µm core diameter. 2 versions are available, one with a scaled 15 mm working distance and the other with a 30 mm scaled working distance. Both types have a 25mm diameter working aperture on the underside.

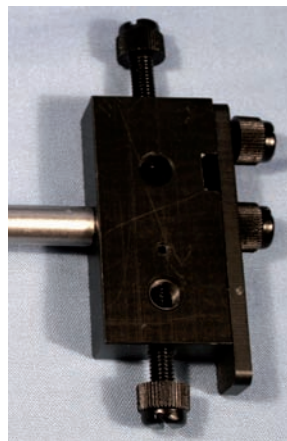


MWS-PBHLD-1.5 Probe holder 1.5mm ferrule terminated fibers



The holder is rod mounted to the work stand, using a lockable coupling MWS-CPL-1. The probe position is lockable. The holder will accept a 1.5mm diameter reflection probes (FCR-7xx200-2-1.5x100) and 1.5mm ferrule terminated fiber optics (FC-xx200-2-1.5x40).

MWS-PBHLD-MULT Multiple Probe holder



The holder is rod mounted to the work stand, using a lockable coupling MWS-CPL-1. Holds 2 different sizes probes (xx and yy, please specify) in 2 positions. Provided with a clamp fitting to hold and position ferrules and probes up to 10 mm diameter.



MWS-PBHL1.5-30 Angular Probe holder 1.5mm ferrule terminated fibers



The holder is rod mounted to the work stand, using a lockable coupling MWS-CPL-1. The holder will accept 1.5mm diameter reflection probes (FCR-7xx200-2-1.5x100) and 1.5mm ferrule terminated fiber optics (FC-xx200-2-1.5x40). The default angle is 30 degrees, for other angles please contact us. The holder can be ordered with 2-7 holes to accept up to 7 probes. Please specify holes location and configuration.

MWS-PBHL6.35 Probe holder for standard reflection probes



The holder is rod mounted to the work stand, using a lockable coupling MWS-CPL-1. The probe position is lockable. The holder will accept all standard 6.35mm diameter reflection probes.

MWS-SAPLCL-10 Rod mounted sample platforms with 10 mm diameter aperture and Clip

The sample platform is rod mounted to the work stand, using a lockable coupling MWS-CPL-1. The sample platform can hold samples, to be measured for transmission, scattering, reflection or fluorescence on a vertical axis.

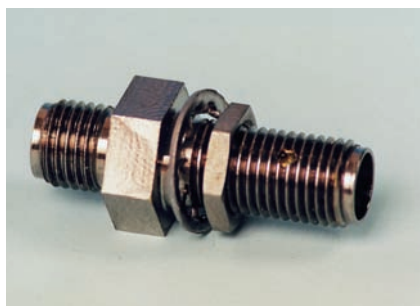


ORDERING INFORMATION

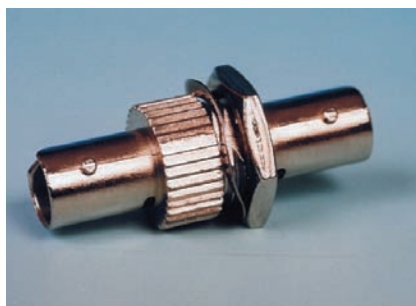
ORDERING INFORMATION	
MWS-1	Multipurpose work stand with 1 rod 300mm long, 14mm diameter
MWS-2	Multipurpose work stand with 2 rods 300mm long, 14mm diameter
MWS-CLIP4	Fiber Optic Cable Clip with 4 channels
MWS-PBHL6.35	Probe holder for standard reflection probes
MWS-PBHL1.5	Probe holder 1.5mm ferrule terminated fibers
MWS-PBHL-MULT	Multiple Probe holder
MWS-PBHL1.5-30	Angular Probe holder 1.5mm ferrule terminated fibers
MWS-AWD-15	SMA Fiber holder adjustable working distance 15mm
MWS-AWD-30	SMA Fiber holder adjustable working distance 30mm
MWS-SAPLCL-10	Rod mounted sample platforms with 10 mm diameter aperture and Clip

Fiber Interconnects

SMA interconnect



ST interconnect



FC/PC interconnect



SMA Bulkhead



ST Bulkhead



FC/PC Bulkhead



The ME-FI-SM-MM SMA fiber interconnect and ME-SM-BC SMA Bulkhead are accessories for SMA-terminated optical fibers. Each connector consists of 1/4"-36 outside-thread female adapter for easy connection to any SMA-terminated optical fiber. For ST and FC/PC-connectors similar accessories are available. The fiber interconnects may 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.

ORDERING INFORMATION	
ME-FI-SM-MM	SMA Fiber interconnect, panel mountable
ME-FI-ST-MM	ST 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-ST-BC	ST Bulkhead adapter
ME-FCPC-BC	FC/PC Bulkhead adapter