

REMOTE SAMPLING ACCESSORIES

Hollow waveguide and fiber optic sampling accessories provide a new dimension of flexibility – expanding the reach of the sample compartment. The probe is flexible and may be taken to the sample; such as an unwieldy object too large to be placed on an accessory or in a chemical reaction vessel. PIKE offers NIR and mid-IR versions of remote sampling probes.

Mid-IR FlexIR™
Mid-IR Hollow Waveguide Accessory
Remote and flexible sampling in the mid-IR spectral region

NIR FlexIR
NIR Fiber Optic Accessory
Remote sampling in the NIR spectral region

INTRODUCTION
AND APPLICATIONS
INCLUDED

Mid-IR FlexIR – Hollow Waveguide Accessory for Remote Infrared Sampling

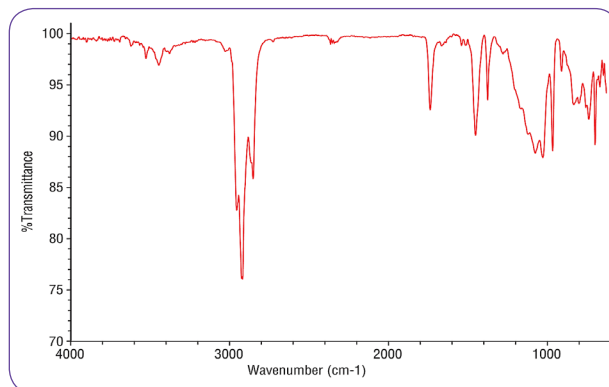


FEATURES

- Fast, easy identification of solids and liquid samples outside of the sample compartment
- 1 or 2 meter, hollow waveguides offer exceptional durability and high throughput
- Full mid-IR spectral range coverage
- ATR, specular and diffuse reflectance probes for a complete array of sampling applications
- Standard and high-temperature/high-pressure probes for reaction monitoring
- Permanent alignment of sampling probe to the hollow waveguide for consistent analysis results
- MCT or DTGS detector choice for maximum sensitivity and convenience
- Compatible with most FTIR spectrometers

The PIKE FlexIR™ Mid-IR Hollow Waveguide Accessory is an excellent tool for remote and specific area analysis of a wide variety of samples. Visible surface contamination, small area material identification and bulky materials too large to fit into the FTIR sample compartment are a few of the many samples and application types for the FlexIR accessory.

The FlexIR is designed for ruggedness and wide spectral range. It utilizes a customized optical design with diamond-turned focus optics providing exceptional IR throughput. The hollow waveguides are very durable and free from the typical fracture problems encountered with polycrystalline core fibers. The highly-reflective hollow waveguides transmit maximum energy through the full mid-IR spectral region – eliminating the need for multiple fibers for complete spectrum coverage when chalcogenide or halide probes are used.



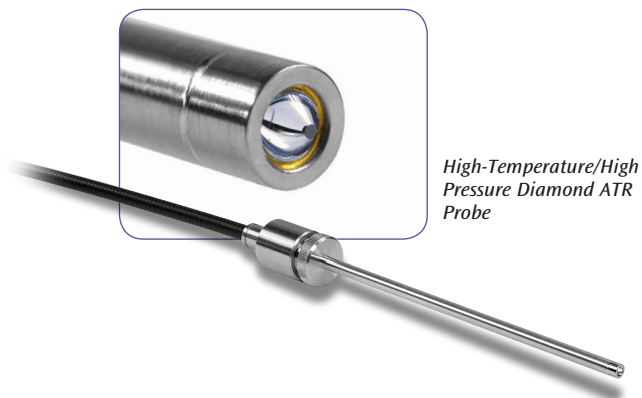
Visible defect on manufactured product – Mid-IR FlexIR accessory with ATR probe.

For maximum configurability two FlexIR bases, with an MCT or DTGS detector, are available. Two detector options serve to optimize the signal-to-noise ratio (SNR) against the required spectral range and the application needs. The mid-band MCT style is the most versatile and common detector offered because of its high sensitivity and fast data collection. A DTGS FlexIR base is available for those applications that do not require a high SNR, and benefit from the flexibility and convenience of a room temperature detector. To optimize its performance, the DTGS detector is integrated into the probe. This probe is equipped with a short handle for ease of positioning and sampling.



FlexIR with DTGS

For reaction monitoring, the accessory can be equipped with a high-temperature/high-pressure probe. The probe is made of Hastelloy and features a two-reflection ATR diamond crystal. The 6.35-mm shaft diameter and 178-mm length make it suitable for use in a wide variety of reaction vessels. The probe maximum temperature is 150 °C, with maximum pressure up to 8.3 MPa.



High-Temperature/High-Pressure Diamond ATR Probe

SPECIFICATIONS

Optical Design	All reflective, diamond-turned focus optics
Accessory Dimensions, MCT Model (W x D x H)	153 x 132 x 150 mm (excludes FTIR baseplate and mount)
Accessory Dimensions, DTGS Model (W x D x H)	60 x 67 x 80 mm (excludes FTIR baseplate and mount)

SPECIFICATIONS

Spectral Range ATR	Mid MCT	DTGS
ZnSe	5000–700 cm ⁻¹	5000–550 cm ⁻¹
Ge	5000–700 cm ⁻¹	5000–700 cm ⁻¹
Diamond	5000–700 cm ⁻¹	5000–550 cm ⁻¹
Spectral Range Specular	5000–700 cm ⁻¹	5000–550 cm ⁻¹

SPECIFICATIONS

Probe Design	Hollow waveguide, full mid-IR reflective
Bend Radius, Minimum	150 mm
HWG Dimensions	1 or 2 m long, 1.6 mm OD, 1.0 mm ID
Diamond ATR Probe	
Probe Body	Hastelloy C-276
ATR Crystal	Monolithic Diamond
ATR Crystal Diameter	4.5 mm
Number of Reflections	2
Maximum Temperature	150 °C (High-Temperature/High-Pressure) 80 °C (Basic)
Maximum Pressure	8.3 MPa (1204 psi)
Shaft Dimensions	178 mm length, 6.35 mm diameter
Standard ATR Probes - MCT Version	
Probe Body	Handle: Aluminum Sampling Tip: Stainless Steel
Maximum Sample Depth	60 mm
ATR Crystal Types	Diamond/ZnSe, ZnSe, and Ge
ATR Crystal Diameter	4.5 mm
Maximum Operating Temperatures - MCT Version	Diamond/ZnSe: Ambient ZnSe: 60 °C Germanium: 60 °C
Maximum Operating Temperatures - DTGS Version	Diamond/ZnSe: Ambient ZnSe: Ambient Germanium: Ambient
Specular Reflectance Probe	Gold-coated, 20 degree AOI
Diffuse Reflectance Probe	Gold-coated, 2.5 mm port
Shaft Dimensions of all Standard Probes, MCT	102 mm length, 22 or 12 mm diameter

ORDERING INFORMATION

MID-IR FLEXIR BASE WITH MCT DETECTOR

PART NUMBER DESCRIPTION

045-30XX Mid-IR FlexIR Base for MCT Version

Notes: Replace XX with your spectrometer's Instrument Code. [Click for List >](#)
 The FlexIR is provided with base optics mounting for the sample compartment of your FTIR spectrometer. An on-board MCT detector must be selected (below). Your FTIR spectrometer must be capable of interfacing with an external detector.

HOLLOW WAVEGUIDE MCT DETECTORS

(must select one)

PART NUMBER DESCRIPTION

045-3200 Mid-band MCT Detector

045-3100 Narrow-band MCT Detector

PROBES FOR MID-IR FLEXIR WITH MCT DETECTOR

(select one or more)

PART NUMBER DESCRIPTION

045-4200 Diamond ATR Probe, basic, 1 m

045-4300 Diamond ATR Probe, High-Temperature/High-Pressure, 1 m

045-4100 Diamond/ZnSe ATR Probe, 1 m length, 22 mm diameter

045-4102 Diamond/ZnSe ATR Probe, 2 m length, 22 mm diameter

045-4010 ZnSe ATR Probe, 1 m length, 22 mm diameter

045-4012 ZnSe ATR Probe, 2 m length, 22 mm diameter

045-4050 Ge ATR Probe, 1 m length, 22 mm diameter

045-4052 Ge ATR Probe, 2 m length, 22 mm diameter

045-4030 Specular Reflectance Probe, 1 m length, 22 mm diameter

045-4032 Specular Reflectance Probe, 2 m length, 22 mm diameter

045-4020 Diffuse Reflectance Probe, 1 m length, 22 mm diameter

045-6000 Diamond/ZnSe Probe, 1 m length, 12 mm diameter

045-6100 ZnSe Probe, 1 m length, 12 mm diameter

045-6200 Ge Probe, 1 m length, 12 mm diameter

Notes: Sampling probes are fixed to the hollow waveguides for maximum sampling reproducibility. Diffuse and specular probes are open-tipped and are not suitable for powder or liquid sampling.

MID-IR FLEXIR BASE WITH DTGS DETECTOR

PART NUMBER DESCRIPTION

045-35XX Mid-IR FlexIR Base for DTGS Version

Notes: Replace XX with your spectrometer's Instrument Code. [Click for List >](#)
 The FlexIR is provided with base optics mounting for the sample compartment of your FTIR spectrometer. Your FTIR spectrometer must be capable of interfacing with an external detector. The DTGS detector is integrated into the probe.

PROBES FOR MID-IR FLEXIR WITH DTGS DETECTOR

(must select one or more)

PART NUMBER DESCRIPTION

045-5100 Diamond/ZnSe ATR Probe, 1 m

045-5010 ZnSe ATR Probe, 1 m

045-5050 Ge ATR Probe, 1 m

045-5030 Specular Reflectance Probe, 1 m

Notes: Sampling probes are fixed to the hollow waveguides for maximum sampling reproducibility. DTGS detector is integrated into the probe. Specular probe is open-tipped and is not suitable for powder or liquid sampling.

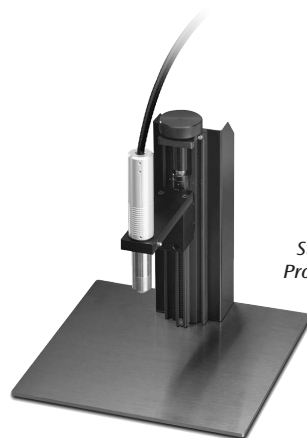
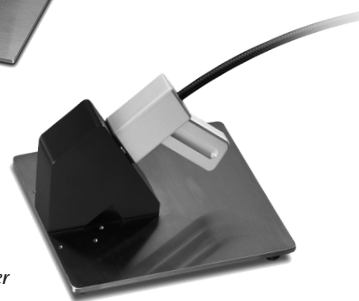
HOLLOW WAVEGUIDE PROBE HOLDERS

PART NUMBER DESCRIPTION

045-3400 Adjustable Probe Holder

045-3410 Standard Probe Holder

Note: Probe holders may be used with all standard hollow waveguide probes.

Standard
Probe HolderAdjustable
Probe Holder

NIR FlexIR – NIR Fiber Optic Accessory for Fast and Remote Sample Identification



FEATURES

- Fast, easy identification of solids and liquid samples in situ
- 2 meter, low-OH fibers providing exceptional throughput and excellent spectral data with short analysis time
- Spectral range from 1.0 to 2.5 microns (10,000 to 4000 cm^{-1})
- Integrated, high-sensitivity, extended range InGaAs detector with electronics connection for your FTIR spectrometer
- Standard SMA connectors providing maximum flexibility with fiber probes
- Standard diffuse reflectance sampling tip with inert sapphire window for solid samples
- Optional transmittance sampling tip for liquid samples
- Compatible with most FTIR spectrometers configured for NIR operation

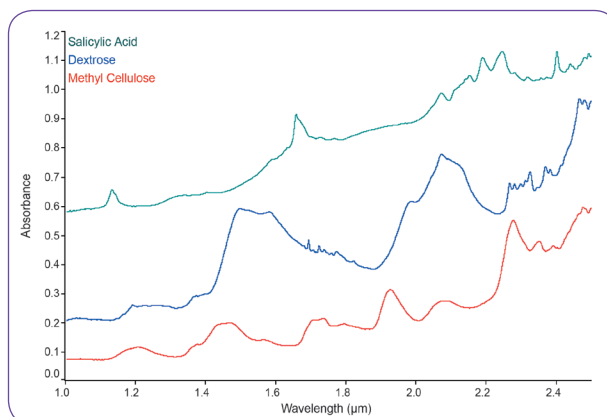
The PIKE Near-IR (NIR) FlexIR™ fiber optic accessory is an excellent tool for remote and speedy analysis of a wide variety of materials. Powders, plastics, coatings, and liquid samples are readily measured – typically within 30 seconds. The NIR FlexIR is ideal for performing incoming QC of materials used in pharmaceutical, polymer, and chemical manufacturing.

NIR sampling is fast and efficient as it eliminates the need for sample preparation. The NIR FlexIR accessory further speeds analysis since the probe tip simply contacts the sample, often in drums, and the spectrum is collected. Powdered samples packaged within a plastic bag can be analyzed without removal from the bag, which further speeds analysis time and eliminates analyst exposure to chemical materials.

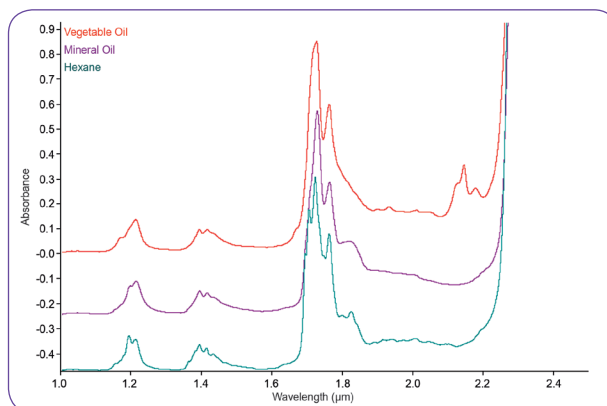
The NIR FlexIR is designed for maximum throughput and performance. The fiber optic cable is directly coupled to the integrated indium gallium arsenide (InGaAs) detector – eliminating energy loss due to additional transfer optics and beam divergence.

With the optional Liquids Sampling Tip, it is easy to identify incoming liquids by inserting the wand tip into the liquid sample and collecting its spectrum.

The NIR FlexIR accessory is built and tested for optimum performance for your FTIR spectrometer.



Spectra of incoming pharmaceutical materials measured and verified with the NIR FlexIR accessory.



Spectra of incoming liquid materials measured and verified with the NIR FlexIR accessory.

ORDERING INFORMATION

PART NUMBER	DESCRIPTION
045-10XX	FlexIR NIR Fiber Optic Accessory Includes base optics mounting for the sample compartment of your FTIR spectrometer, electronic cabling, diffuse reflectance probe and probe stand.

Notes: Replace **XX** with your spectrometer's Instrument Code. [Click for List >](#)
Your FTIR spectrometer must be configured with NIR beamsplitter and NIR source for optimum performance of the FlexIR accessory. Your FTIR spectrometer must be capable of interfacing with an external detector.

SAMPLING OPTIONS

PART NUMBER	DESCRIPTION
045-2001	Liquids Sampling Tip for FlexIR, 1.0 mm pathlength
045-2000	Liquids Sampling Tip for FlexIR, 1.5 mm pathlength
045-2002	Liquids Sampling Tip for FlexIR, 2.0 mm pathlength

Note: The Liquids Sampling Tip is screw-mounted and easily exchanged with the solids sampling tip on the FlexIR sampling probe.

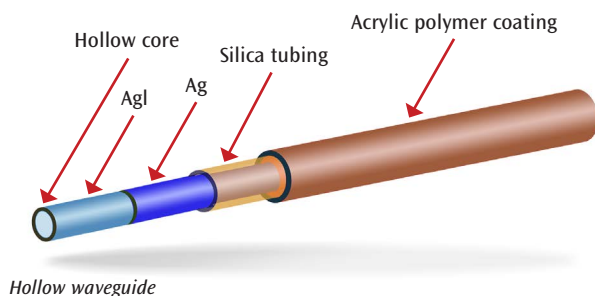
REPLACEMENT PARTS

PART NUMBER	DESCRIPTION
045-2010	Diffuse Reflectance Tip for NIR FlexIR probe
045-7051	NIR FlexIR Probe Stand

Mid-IR Remote Sampling – *Introduction and Applications*

Fourier transform infrared (FTIR) remote sampling offers a viable solution for the analysis of samples which are not conducive to the use of traditional FTIR sampling accessories due to constraints posed by the size of a bench-top instrument's sample compartment or the nature of the sample. Taking an IR probe to a sample is desirable in numerous applications and a necessity in others. Examples of remote IR sampling may be found across many fields. In the fine arts, priceless paintings and artifacts may be analyzed with limited sample handling. Mid-IR analysis of intractable samples such as large painted panels may be conducted. Biomedical applications encompass soft tissue and skin analysis. In chemical production, remote sampling allows for reaction monitoring and the analysis of samples restricted to glove boxes and fume hoods.

PIKE Technologies offers the next generation of commercially-available FTIR remote sampling accessories with the Mid-IR FlexIR. Hollow waveguides (HWGs), the cornerstone of these mid-IR remote sampling accessories, offer enhanced performance characteristics compared to traditional mid-IR optical fibers. The most popular type of HWGs consists of reflective coated silica tubing. The inner portion of silica tubing is coated with Ag followed by converting some of the Ag to AgI to form a dielectric layer, which exhibits a highly reflective and very smooth surface. The exterior of the silica tubing is coated with acrylate polymer to provide additional strength.



HWGs used in the design of the Mid-IR FlexIR accessory address many of the limitations found with the use of traditional chalcogenide glass and silver halide polycrystalline fibers. Chalcogenide fibers exhibit a strong absorption band located near 2170 cm^{-1} due to S-H or Se-H bonds; as a consequence, the signal-to-noise ratio (SNR) in this spectral region is significantly decreased. To address this issue, two different fiber types, chalcogenide and silver halide, are often employed to generate a full spectral range. The chalcogenide fiber generally used in mid-IR spectroscopy covers approximately $6500\text{--}2250\text{ cm}^{-1}$ and $2050\text{--}1000\text{ cm}^{-1}$ while the silver halide fiber covers $2100\text{--}600\text{ cm}^{-1}$. In contrast, HWGs are capable of spanning a wide spectral range from $11,000\text{ to }700\text{ cm}^{-1}$ eliminating the need for a complementary fiber set. The spectral range of the Mid-IR FlexIR accessory is dependent on the probe type and the configured detector.

Durability of traditional fibers has been a concern and a hindrance in past mid-IR remote sampling accessories. Additionally, intrinsic flaws originating during the manufacture of glass fibers significantly increase fiber fragility, and may often result in catastrophic failure under routine application use. Furthermore, the bend radius of traditional fibers are limited. Contrary to these properties, HWGs offer a robust means of delivering and collecting IR radiation and offers a smaller bend radius.

For ultimate flexibility the Mid-IR FlexIR offers a choice of detector, either a liquid nitrogen MCT detector for applications that require high sensitivity or a DTGS detector for applications that require less sensitivity yet desire the convenience of a room temperature detector. Two models of MCT detectors are available (narrow-band and mid-band) to allow the optimization of signal-to-noise ratio and spectral range. The MCT detector is mounted on the base optics while the DTGS detector is nested in the probe tip.

The sample probe is permanently aligned to the HWG for consistent analysis results. A variety of probes are available covering ATR, diffuse reflectance, and specular reflectance sampling techniques. Three ATR crystal offerings are zinc selenide (ZnSe), germanium, and diamond/zinc selenide composite. Fiber length is 1 or 2 m.

To illustrate the diverse capabilities of the newest technology in mid-IR remote sampling – the Mid-IR FlexIR, three application examples will be presented highlighting applications using attenuated total reflectance (ATR), diffuse reflectance and specular reflectance sampling probes.

Biomedical Application: ATR Probe

The simplicity of ATR sampling has led to its use in numerous biomedical applications. Confining the ATR crystal sampling surface to an FTIR sample compartment limits in vivo studies.

Remote ATR sampling, however, expands the flexibility of FTIR studies and applications in this field. For example, remote ATR sampling makes it possible to investigate chemical diffusion through the skin, residual chemicals retained on the skin from body lotions and washes and the investigation of skin aberrations.

The objective of this biomedical application was to investigate residual chemicals found on human skin after the application of a commercially-available sunscreen spray. A spectrum was collected before and after the application of the skin care product using the FlexIR ZnSe ATR probe.

Spectral data of untreated skin clearly shows the IR chemical signature of skin including the amide I and amide II bands at 1650 and 1550 cm^{-1} , respectively. The result from spectral subtraction allows for the investigation of the sunscreen chemicals remaining on the skin (Figure 1). Capabilities of collecting in vivo data allow for the optimization of formulations and the study of time-based efficacy of existing products and those in the product development stage.

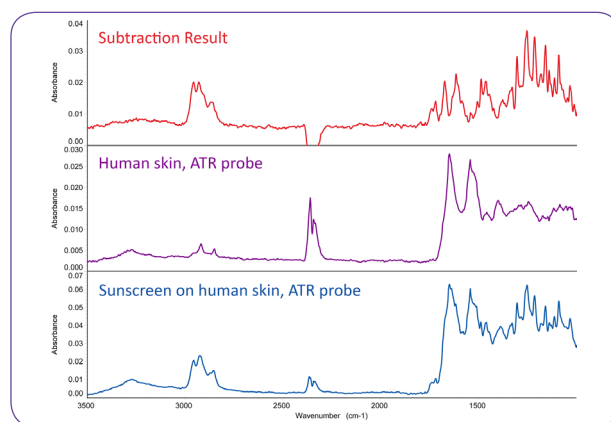


Figure 1. Spectra of untreated and treated skin.

Intractable Panels: Diffuse Reflectance and Specular Reflectance

Reflective-type measurements may be classified as either diffuse or specular. Coatings and thin films on reflective substrates are candidates for specular reflectance measurements. Using this sampling technique, the reflected beam from the sample is collected at an angle of incidence equal to that of the incoming beam as it is delivered to the sample. Diffuse samples scatter the reflected beam across a wide range of angles and in IR sampling must be gathered using a collection optic.

To illustrate non-destructive mid-IR testing using remote sampling, two intractable samples were analyzed. One sample consisted of a coating on a smooth reflective surface, conducive to specular reflectance measurements. The other sample type had a painted diffuse surface. Figure 3 shows the spectrum of a coating on a smooth reflective surface obtained by using the Mid-IR FlexIR configured with a specular reflectance probe, and Figure 4 shows spectra of painted diffuse panels collected with the diffuse reflectance probe. The two diffuse painted panels clearly show differing chemical properties. In each sample the high SNR results in quality spectra. The spot size of both probes is 2.5 mm in diameter allowing for concise measurements of small defects. Remote sampling offers a convenient method of non-destructive analysis.

Conclusions

HWGs bring new technology to mid-IR remote sampling accessories. The diversity of sampling probes covering ATR, diffuse reflectance and specular reflectance used in conjunction with HWGs and high precision optics offers the capability to collect quality spectra of a wide range of samples, which may be prohibited with traditional in-compartment FTIR sampling accessories.

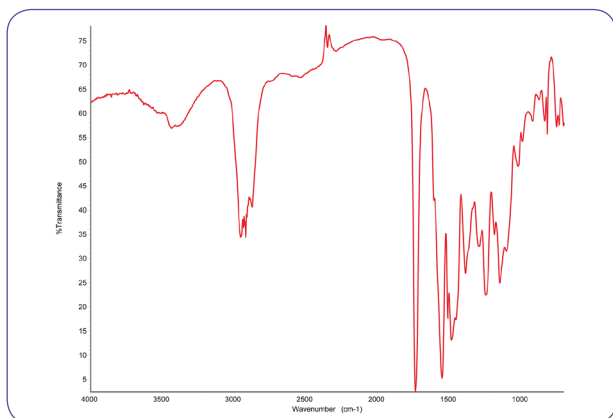


Figure 3. Spectrum of a coating on aluminum.

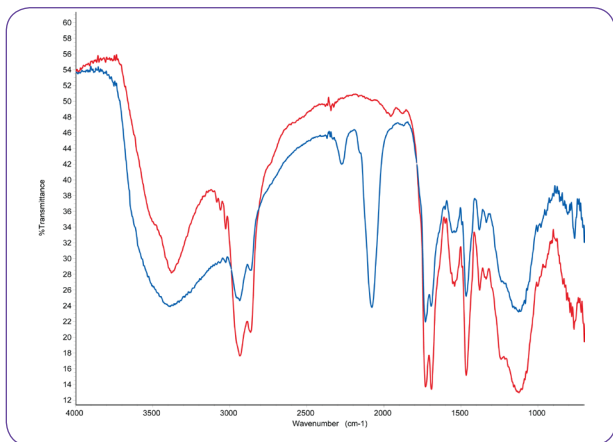


Figure 4. Spectrum of a panel with diffuse finish.

ORDERING TERMS, CONTACT INFORMATION AND GUARANTEE

PART NUMBERS AND PRICE

The PIKE price list includes accessories that may be used with a variety of makes and models of spectrometers. Please specify the part number and description when ordering, including your instrument type and model number. [Click here](#) for a list of spectrometer and spectrophotometer instrument codes. When placing an order, substitute these codes for the final two digits (XX) in the accessory part number.

PIKE Technologies is continually extending the accessory product range. If you are unable to find a required item, please contact us to discuss your needs. We will be glad to assist.

PAYMENT TERMS

Purchase Order Number, cash in advance, MasterCard and Visa are acceptable. Payment is net 30 days, and shipments are FOB Madison, WI USA. Freight charges are prepaid and added to your invoice. If you wish to pay freight charges, please specify this on your order. Prepayment is required for international customers.

INTERNATIONAL HANDLING FEE

For orders placed from outside the United States or Canada, a handling fee of \$40 will apply per order to cover the costs associated with the additional documentation and bank charges required for international shipments.

WAYS TO ORDER

Many products are available for purchase directly through our website. These items are marked on our website with a red shopping cart icon.

Please include the following information when placing an order: your name, phone number, product part number, quantity, ship to address, bill to address, purchase order number and spectrometer model on which the accessory will be used.

Orders may be placed via mail, phone, fax, e-mail or on our website. We accept Visa and Mastercard via phone and direct online purchases. For security purposes, do not send credit card information via e-mail. An electronic order form is available on our website (for P.O. Numbers only – do not use this form for credit card orders). There is no minimum order requirement. Please use the following addresses and phone/fax numbers when placing your orders:

PIKE Technologies, Inc.
6125 Cottonwood Drive
Madison, WI 53719
(608) 274-2721 (TEL)
(608) 274-0103 (FAX)
orders@piketech.com (E-MAIL)
www.piketech.com

DELIVERY

The delivery/shipment date is confirmed upon receipt of an order. Special requirements and custom accessories are subject to different lead times. Please contact us for price quotes and delivery information on these products.

GUARANTEE

All PIKE products are guaranteed to be free from defects in material and workmanship for a period of 12 months from the date of shipment. Should you be dissatisfied, or have any queries, please contact us immediately and we will promptly repair or replace the product at no charge.

PRODUCT RETURNS

Please contact PIKE to receive your Return Material Authorization (RMA) number if you wish to return any of our products. A restocking fee may apply. Customers are responsible for shipping charges for all returned products. For products under warranty, back-to-customer shipping charges will be covered by PIKE. Please do not return any products without obtaining the RMA number first.

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Products and prices are subject to change without notification.

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FTIR AND UV-VIS INSTRUMENT CODES

When ordering a PIKE accessory, replace the **XX** or **XXX** portion of the product's part number with your spectrometer's instrument code below. For assistance, please contact a PIKE customer service representative at (608) 274-2721 or sales@piketech.com.

FTIR INSTRUMENT CODES (XX)

ABB Bomem

FTLA2000-100 (Arid Zone)	80
Michelson 100, MB Series	81
MB 3000	82

Agilent

Excalibur™, Scimitar™, FTS, 600-IR Series	10
Excalibur™, Scimitar™, 600-IR Series with recognition	13

Analect (See Hamilton Sundstrand)

Bio-Rad (See Agilent)

Bruker Optics

IFS™, Vector™, Equinox™ Series.	50
Tensor™, Vertex™ with recognition (Quick-Lock)	51

Buck Scientific

M500	65
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Digilab (See Agilent)

Hamilton Sundstrand AIT

Diamond 20	60
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Horiba

7000 Series	35
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Interspectrum

Interspec 200-X	90
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Jasco

300/600 Series	56
400	57
4000/6000 Series	58

JEOL

Winspec™ Series	46
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Lambda Scientific

Lambda FTIR 7600	66
Lambda FTIR 8600	64

Lumex

INFRALUM FT-02, FT-08	67
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Mattson (See Thermo Electron)

Midac

M Series	30
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Oriel	95
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PerkinElmer

1700 Series	70
Spectrum™ GX, 2000	71
Spectrum BX / RX, 1600, Paragon 1000	73
Frontier, Spectrum One, 65, 100, 400 with recognition	74
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Shimadzu

8300, 8400 Series, IRPrestige™-21, IRAffinity-1s	15
IRPrestige™-21, IRAffinity-1s with recognition (QuickStart)	16
IRTracer™-100	18
IRTracer™-100 with recognition	19

Thermo Electron / Nicolet / Mattson

Infinity, Galaxy, RS Series	20
Genesis™, Satellite, IR 300	21
Impact™ 400, Magna, Protege™, 500 / 700 Series	40
Avatar™, Nexus™, Nicolet™, iS™10, iS™50	40
Model 205/210	41
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Varian (see Agilent)

UV-VIS INSTRUMENT CODES (XXX)

Agilent/Varian

Cary 50	100
Cary 60	111
Cary 100, 300	110
Cary 4000, 5000, 6000i	120

Jasco

600 Series	600
Optical Table	999

PerkinElmer

Lambda 650, 750, 850, 950 and 1050	700
Lambda 25, 35, 45	730

Shimadzu

1600 and 1700	200
1800 Series	210
2600	240
3600	220

Thermo Fisher Scientific

Evolution 300/600	400
Evolution 200	410

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6125 Cottonwood Drive, Madison, WI 53719
(608) 274-2721 (Tel), (608) 274-0103 (Fax)
www.piketech.com · sales@piketech.com