

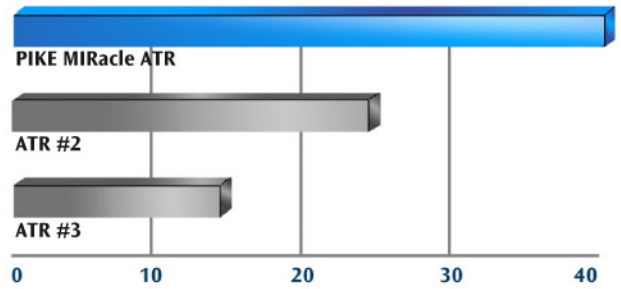
## MIRacle ATR – Fast and Easy IR Sampling



### FEATURES

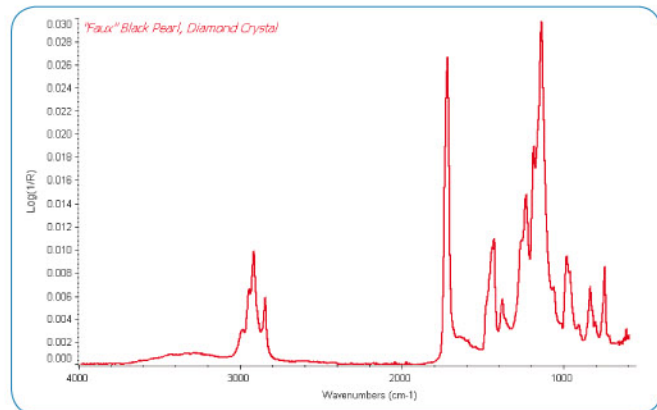
- Highest IR throughput – saving you time and improving your analysis quality
- Complete flexibility – add options to your MIRacle as your sampling needs change
- Highest value – for today’s competitive analytical and research needs
- Fully configurable – diamond, ZnSe, Ge and Si MIRacle crystal plates; single or multiple reflections
- Pinned-in-place, changeable crystal plates – for fast and easy sampling optimization
- Highest purity, type IIa diamond crystal – will not scratch and is chemically inert to acidic or caustic materials
- Optional specular reflectance plate – for measurement of coatings on reflective surfaces
- Choice of pressure clamps – high-pressure, digital high-pressure and micrometric sample clamps
- Sampling options – temperature control, flow-through attachment and sealed clamp

### %Throughput



MIRacle – Highest IR Throughput ATR.

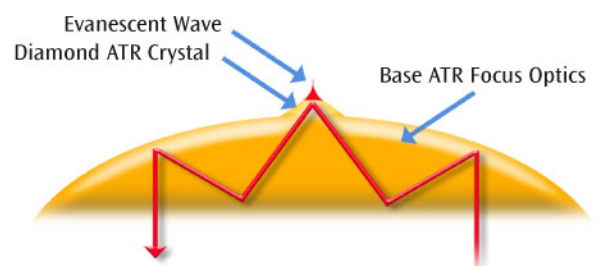
The PIKE MIRacle™ is a universal ATR sampling accessory for analysis of solids, liquids, pastes, gels, and intractable materials. In its most popular configuration it is a single reflection ATR accessory with high IR throughput which makes it ideal for sample identification and QA/QC applications. Easily changeable crystal plate design provides analysis of a broad spectrum of sample types while ensuring constant sampling pathlength. An assortment of crystal materials and single, 3- and 9-reflection ATR crystals are available to optimize general qualitative or quantitative analysis.



Faux black pearl, using MIRacle diamond ATR crystal.

### MIRacle Optical Design

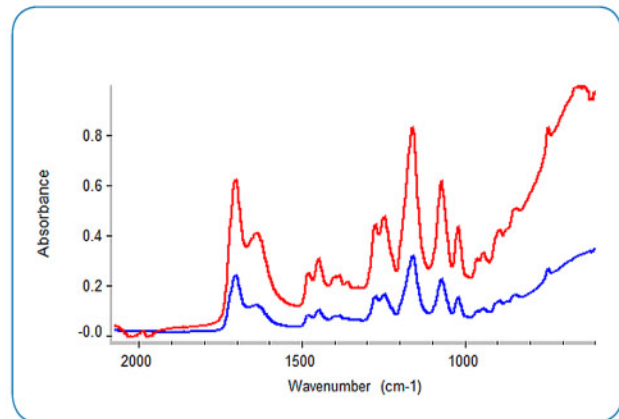
In the patented MIRacle optical design the ATR crystal focuses the IR beam and also provides the ATR sampling interface. This technology delivers greater energy throughput than competitive products, saves considerable time and produces higher quality spectra. For the single reflection, the small sampling surface results in increased force per unit area for improved contact between rigid samples and the ATR crystal.



Beam path through MIRacle crystal optic.



MIRacle crystal plates. Clockwise: diamond/ZnSe, diamond/KRS-5, Ge, ZnSe and Si.

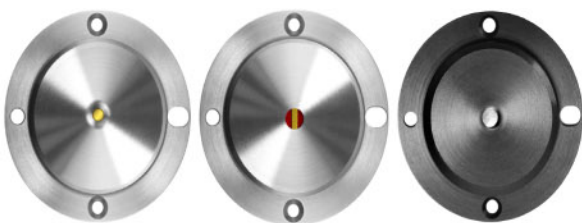


Hydrogel, using 3-reflection diamond/ZnSe crystal (red) and single reflection diamond/ZnSe (blue).

### MIRacle Crystal Options

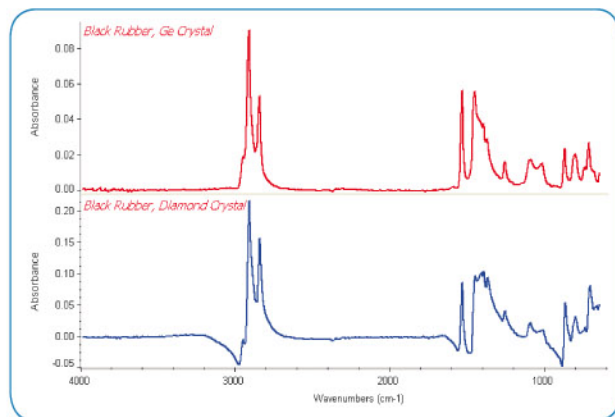
The MIRacle ATR accessory may be configured with five different crystal types: diamond/ZnSe, diamond/KRS-5, ZnSe, Ge and Si. 1-, 3- and 9-reflection styles are available. Trough and flat plate configurations are options for the multiple reflection plates.

Crystal plates are pinned in place and easily changeable within seconds with no alignment required. With this flexibility, you can change the crystal type to exactly match your sampling requirements. For example, diamond is ideal for brittle samples because it will not scratch, whereas Ge is ideal for carbon-filled samples because of its high refractive index and lower depth of penetration. Two single reflection diamond crystal plates are available, diamond/ZnSe and diamond/KRS-5. The latter offers a full spectral range to 250  $\text{cm}^{-1}$ . 3- and 9-reflection crystal plates provide increased sensitivity for minor components in liquid samples. 3-reflection diamond/ZnSe crystal plates are available in flat and trough style, and 9-reflection diamond/ZnSe is offered in trough style only.

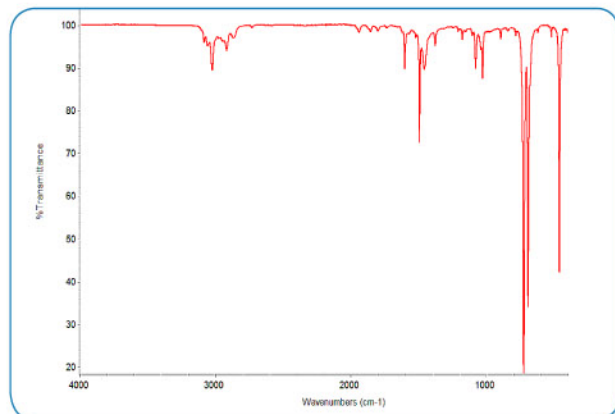


9-reflection trough plate, 3-reflection flat plate, specular reflectance plate.

Table 1 shows MIRacle ATR crystal characteristics including refractive index, spectral range cutoff, pH range and hardness for single reflection ATR crystal plates. Still have questions? Please contact us as we are pleased to discuss your sampling requirements.



Black rubber samples are best run using Ge ATR crystal.



Toluene sample collected using diamond/KRS-5 crystal.

Table 1: MIRacle Crystal Plate Specifications

MIRacle Crystal Plate	Application	Hardness $\text{kg/mm}^2$	Cutoff $\text{cm}^{-1}$ , Spectral Range	Refractive Index @ 1000 $\text{cm}^{-1}$	Depth of Penetration @ 45°, $\mu$	pH Range of Sample
Diamond/ZnSe	Ideal for hard samples, acids or alkaline	5700	525	2.4	2.00	1–14
Diamond/KRS-5	When you need full mid-IR spectral range	5700	250	2.4	2.00	1–14
Ge	General purpose and carbon filled or rubber	550	575	4.0	0.66	1–14
Si	Excellent for far-IR spectral measurement	1150	8900–1500, 475–40	3.4	0.85	1–12
ZnSe	General purpose ATR crystal	120	520	2.4	2.00	5–9

MIRacle crystal plates are covered by PIKE Technologies patent numbers 5,965,889 and 6,128,075 or are manufactured under license of 5,200,609, 5,552,604 and 5,703,366.





MIRacle Digital Clamp – ideal for controlled pressure



MIRacle Confined Space Clamp – for instruments with limited area in sample compartment



MIRacle High-Pressure Clamp – ideal for routine sampling



MIRacle Micrometer Clamp – for low pressure applications

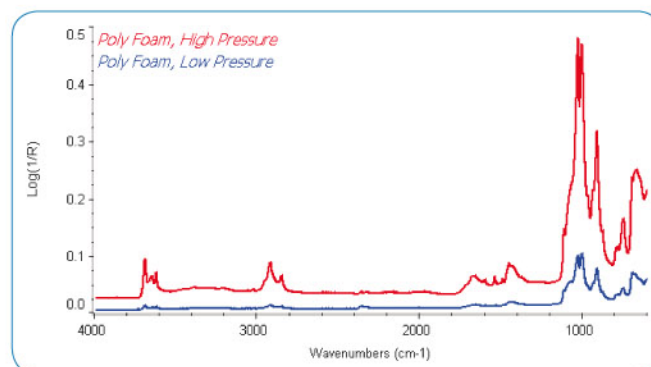
### MIRacle Pressure Clamp Options

MIRacle pressure clamps are pinned in place and easily changeable within seconds. A high-pressure clamp is recommended for most applications and is available in basic and digital configurations. The digital version requires a high-pressure clamp and the Digital Force Adapter (DFA) that attaches directly to the clamping assembly. The DFA's embedded load cell exhibits high linearity, reproducibility, and exceptional accuracy. The magnitude of applied force is displayed on an external easy-to-read LCD readout. The digital clamp is ideal for applications that require controlled and reproducible pressure. All clamps include tips for hard, soft and pellet-shaped samples. High-pressure clamps are calibrated to deliver over 10,000 psi of pressure when used with the single reflection crystal plates, and utilize a slip-clutch mechanism to prevent excessive pressure from being applied to the crystal.

Ability to deliver high pressure is very important for achieving spectral quality. In the example to the right, we demonstrate spectral differences of a porous polymer sample measured with the micrometer clamp and the high-pressure clamp. Clearly the high-pressure clamp is required to obtain a high-quality spectrum.

MIRacle Clamp Pressures	Max Force, lbs	Crystal Diameter, mm	Pressure, psi
High-Pressure Clamps	40	1.8	10,141
		6.0	913
Micrometer Pressure Clamp	8	1.8	2,028
		6.0	183

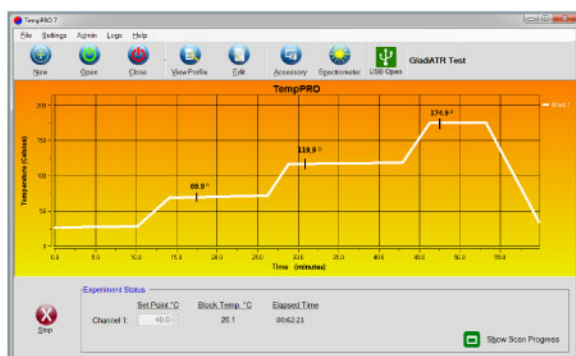
Note: All clamps except Micrometer are high-pressure.



Porous polymer sample measured using high- and low-pressure clamp.

### Temperature Control

The MIRacle can be configured with liquid jacketed and resistively heated crystal plates which require a temperature control module. These PIKE controllers have a touch-panel interface with USB port and are ready for use with PIKE TempPRO software. TempPRO provides a graphical user interface for temperature control and kinetics measurements. The liquid jacketed plates require user-provided liquid circulator.



PIKE TempPRO software for graphical setup and control of kinetic measurements.

### MIRacle ATR Summary

The MIRacle ATR accessory is a high-performance FTIR sampling tool for solid, liquid, or polymer samples. Easily changeable crystal plates provide optimized spectral data for unique sample types. With options for single, three or nine reflection crystal plates, several pressure clamp styles and heating or cooling, the MIRacle is able to address a wide range of FTIR sampling applications.



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## ORDERING INFORMATION

### MIRACLE BASE OPTICS *(must select)*

PART NUMBER	DESCRIPTION
025-18XX	MIRacle ATR Base Optics/Platform Assembly




Notes: Replace **XX** with your spectrometer's Instrument Code listed on page 164. MIRacle Base Optics includes purge tubes, purge kit and spectrometer base mount.

### CRYSTAL PLATES FOR MIRACLE *(must select 1 or more)*

PART NUMBER	DESCRIPTION
025-2108	Diamond/ZnSe Performance Crystal Plate
025-2107	Diamond/ZnSe HS Performance Crystal Plate
025-2028	Diamond/KRS-5 Performance Crystal Plate
025-2027	Diamond/KRS-5 HS Performance Crystal Plate
025-2018	ZnSe Performance Crystal Plate
025-2058	Ge Performance Crystal Plate
025-2098	Si Performance Crystal Plate
025-2118	3-Reflection Diamond/ZnSe Performance Crystal Plate
025-2120	3-Reflection Diamond/ZnSe Performance Crystal Plate, Trough
025-2038	3-Reflection ZnSe Performance Crystal Plate
025-2218	9-Reflection Diamond/ZnSe Performance Crystal Plate, Trough
025-2208	Specular Reflection Performance Plate

Notes: MIRacle crystal plates are pre-aligned and pinned in place. Changing crystal plates is easy and fast to optimize sampling results. Crystal plate housings are manufactured using polished stainless steel for chemical resistance. The diamond/ZnSe and diamond/KRS-5 crystal plate is available with optional Hastelloy® (HS) metal for exceptionally caustic or acidic samples.

## SPECIFICATIONS

<b>ATR Crystal Choices</b>	Diamond/ZnSe, Diamond/KRS-5, Ge, ZnSe, Si
<b>Crystal Plate Mounting</b>	User-changeable plates
<b>Crystal Plate Mount</b>	Stainless steel or Hastelloy
<b>Angle of Incidence</b>	45 degrees, nominal
<b>Crystal Dimensions (surface)</b>	1.8 mm single reflection 6.0 mm 3- and 9-reflection
<b>Pressure Device</b>	Rotating, continuously variable pressure; click-stop at maximum (High-Pressure Clamp)
<b>Digital Force Adapter (option)</b>	Load cell sensor for precise and reproducible pressure control. Attaches directly to High-Pressure MIRacle clamps. Digital readout. Not for use with heated plates.
<b>Maximum Pressure</b>	10,000 psi
<b>Sample Access</b>	55 mm, ATR crystal to pressure mount
<b>Heating Options</b>	Ambient to 60 or 130 °C maximum
Accuracy	+/- 0.5% of set point
Sensor Type	3 wire Pt RTD (low drift, high stability)
<b>Temperature Control</b>	Touch-panel display with USB interface. PIKE TempPRO software (sold separately) for PC control with unlimited ramps and automated data collection.
  	
Input	100–240 VAC, auto setting, external power supply
Output	1.3A/24 VDC 30 W maximum
<b>Specular Reflection Option</b>	Optional, 45 degree nominal angle of incidence
<b>Purge Sealing</b>	Purge tubes and purge line connector included
<b>Accessory Dimensions (W x D x H)</b>	104 x 103 x 210 mm (excludes FTIR baseplate and mount)
<b>FTIR Compatibility</b>	Most, specify model and type

### MIRACLE SAMPLING OPTIONS

PART NUMBER	DESCRIPTION
025-4018	Heated ZnSe Performance Crystal Plate
025-4058	Heated Ge Performance Crystal Plate
025-4108	Heated Diamond/ZnSe Performance Crystal Plate (60 °C max.)
025-2104	Liquid Jacketed Diamond/ZnSe Performance Crystal Plate, (60 °C max.)
025-2014	Liquid Jacketed ZnSe Performance Crystal Plate
025-2054	Liquid Jacketed Ge Performance Crystal Plate
025-2094	Liquid Jacketed Si Performance Crystal Plate
026-5012	Flow-Through Attachment, 100 µL
026-5013	Liquids Retainer and Volatiles Cover Set
026-3051	Volatiles Cover for Performance Plates
026-5010	Liquids Retainer for Performance Plates
076-1610	Digital Temperature Control Module
007-0207	PIKE TempPRO Software

Notes: Flow-Through Attachment, Liquids Retainer and Volatiles Cover are compatible with non-trough crystal plate offerings and require High-Pressure Clamp, P/N 025-3025 or P/N 025-3027, sold separately. Temperature control module selection is required for heated crystal plates. If PC control is desired, TempPRO software must be purchased (sold separately from Temperature Control Module). Liquid jacketed crystal plates require customer-provided circulator. Do not exceed 60 °C when using temperature controlled diamond plates and 130 °C for all others.

### PRESSURE CLAMPS FOR MIRACLE

*(must select clamp for solids or polymer analysis)*

PART NUMBER	DESCRIPTION
025-3025	Performance High-Pressure Clamp
076-6025	Digital Force Adapter for High-Pressure Clamp
025-3029	Performance Micrometric, Low-Pressure Clamp
025-3027	Performance High-Pressure Confined Space Clamp
076-6028	Digital Force Adapter for High-Pressure Confined Space Clamp

Notes: The High-Pressure Clamp is recommended for general applications. Pressure clamps include a flat tip, a swivel tip and a concave tip. The Digital Force Adapter requires High-Pressure Clamp, P/N 025-3025 or 025-3027 (sold separately), and may not be used at temperatures above ambient.

### REPLACEMENT PARTS

PART NUMBER	DESCRIPTION
025-3095	Flat Tip for High-Pressure Clamp
025-3093	Swivel Tip for High-Pressure Clamp
025-3092	Concave Tip for High-Pressure Clamp
025-3052	Flat Tip for Micrometric Clamp
025-3061	Swivel Tip for Micrometric Clamp
025-3054	Concave Tip for Micrometric Clamp
025-3053	MIRacle Micrometer Clamp Tip Assortment
025-3094	7.8 mm ATR Pressure Tip for High-Pressure Clamp
025-3096	7.8 mm ATR Pressure Tip for Micrometer Clamp
025-3099	Tip Assortment for High-Pressure Clamp

Notes: Please contact PIKE Technologies for items not described in this list. Reconditioning service for used MIRacle crystal plates is available.



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## Dedicated MIRacle Sampling Tools and Options

### Sealed Clamp

The Sealed Sample Chamber for the MIRacle Single Reflection ATR accessory attaches to dedicated single reflection diamond, ZnSe or Ge crystal ATR plates allowing the complete assembly to be moved from the spectrometer to a protective environment for sample handling. Once the sample has been loaded onto the ATR crystal, the sealed clamp may be engaged shielding the sample from the external environment. Typical applications include studies of toxic or chemically aggressive solids and powders.

The chamber is made of stainless steel and is sealed against the crystal plate with a chemically resistant O-ring. The chamber contains an internal, spring-loaded anvil that compresses the sample against the ATR crystal at a preset, clutch-controlled setting.



### Liquids Retainer and Volatiles Cover

The Liquids Retainer offers a trough configuration for the MIRacle. The Volatiles Cover reduces the amount of evaporation of a highly volatile liquid sample on the surface of the crystal. The High-Pressure Clamp is required, and serves to apply pressure to the u-bridge thus compressing a sealing PTFE O-ring located underneath the Liquids Retainer.



### Temperature Control Options

The MIRacle can be configured with liquid jacketed plates and resistively heated crystal plates with temperature control module. The PIKE controller has a touch-panel interface with USB port and are ready for use with PIKE TempPRO software. TempPRO provides a graphical user interface for temperature control and kinetics measurements. The liquid jacketed plates require user-provided liquid circulator.



### Digital Force Adapter for High-Pressure Clamp

The Digital Force Adapter attaches directly to the clamping assembly to precisely measure the applied force by using an embedded load cell that exhibits high linearity and exceptional accuracy. The magnitude of applied force is displayed on an external easy-to-read LCD readout. The digital clamp is ideal for applications that require controlled and reproducible pressure. This option may not be used with temperature controlled plates.



### Flow-Through Attachment

The Flow-Through Attachment is used for continuous monitoring or handling samples that pose a hazard or are degraded from ambient exposure. Samples are introduced using the Luer-Lok™ fitting by connecting a syringe or a flow line. Swagelok® fittings are optional. The High-Pressure Clamp is required.



### Specular Reflection Plate

The MIRacle may be converted from an ATR accessory to a specular reflection accessory by using the Specular Reflection Plate. The angle of incidence is 45 degrees, and the plate is easily interchangeable with ATR plates.



### ORDERING INFORMATION

#### SEALED HIGH-PRESSURE CLAMP FOR MIRACLE

*(must select the sealed clamp and at least one crystal ATR plate)*

PART NUMBER DESCRIPTION

025-6020	Sealed High-Pressure Clamp
025-6108	Diamond/ZnSe Sealed Clamp Performance Plate
025-6018	ZnSe Sealed Clamp Performance Plate
025-6058	Ge Sealed Clamp Performance Plate

#### TEMPERATURE CONTROLLED MIRACLE OPTIONS

PART NUMBER DESCRIPTION

025-4018	Heated ZnSe Performance Crystal Plate
025-4058	Heated Ge Performance Crystal Plate
025-4108	Heated Diamond/ZnSe Performance Crystal Plate, (60 °C max.)
025-2104	Liquid Jacketed Diamond/ZnSe Performance Crystal Plate, (60 °C max.)
025-2014	Liquid Jacketed ZnSe Performance Crystal Plate
025-2054	Liquid Jacketed Ge Performance Crystal Plate
025-2094	Liquid Jacketed Si Performance Crystal Plate
076-1610	Digital Temperature Control Module
007-0207	PIKE TempPRO Software

Temperature controller is required for heated crystal plates. If PC control is desired, TempPRO software must be purchased (sold separately from Temperature Control Module). Liquid jacketed crystal plates require customer-provided circulator.

#### MORE MIRACLE SAMPLING OPTIONS

PART NUMBER DESCRIPTION

025-2208	Specular Reflection Performance Plate
025-2028	Diamond/KRS-5 Performance Crystal Plate
026-5013	Liquids Retainer and Volatiles Cover Set
076-6025	Digital Force Adapter for High-Pressure Clamp
026-5012	Flow-Through Attachment, 100 µL