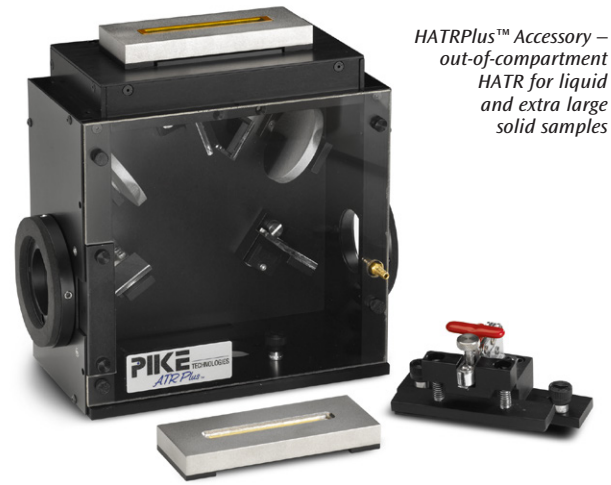
Multiple Reflection HATR –
Maximum Sensitivity and Highly Versatile FTIR Sampling

HATR Accessory – in-compartment HATR for liquid and solid samples



HATRPlus™ Accessory – out-of-compartment HATR for liquid and extra large solid samples

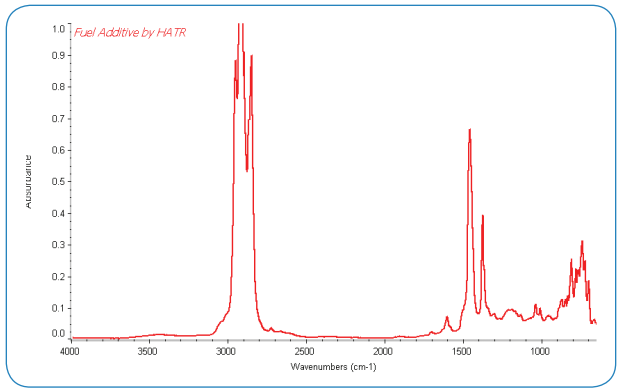
Features

- Excellent energy throughput offering high signal-to-noise ratio and spectral quality
- Up to 20 internal reflections on the sample for maximum sensitivity for low concentration components
- Removable crystal plates with pinned positioning for high precision and quick cleanup
- HATR plates with ZnSe, KRS-5, Ge, AMTIR or Si crystals with selectable face angles to optimize sampling depth
- In-compartment (HATR) and out-of-compartment (HATRPlus) versions for small and extra large sample sizes
- Several temperature controlled and flow-through crystal options

Horizontal Attenuated Total Reflectance (HATR) accessories successfully replace constant path transmission cells, salt plates and KBr pellets used in the analysis of liquid, semi-liquid materials and a number of solids. HATRs feature a constant and reproducible effective pathlength and are well suited for both qualitative and quantitative applications. In general, sampling is achieved by placing the sample onto the HATR crystal – generally eliminating sample preparation.

The PIKE Technologies HATR accessory provides high sensitivity for analysis of low concentration components in liquid, solid, and polymer samples. To optimize spectral measurements a selection of crystal materials, sample formats, and temperature and flow-through configurations are available.

PIKE Technologies HATR products are available in two base optic configurations. The HATR is an **in-compartment** design for samples which fit into the FTIR sample compartment. The HATRPlus is an **out-of-compartment** design for samples which are larger and do not fit into the FTIR sample compartment. The sampling surface of the HATRPlus extends above the FTIR cover, thereby permitting analysis of very large samples. Applications examples include coatings on large manufactured components, layered composition analysis on large objects, and skin analysis in the health and personal care industries.



FTIR spectrum of fuel additive using HATR trough plate with ZnSe crystal.

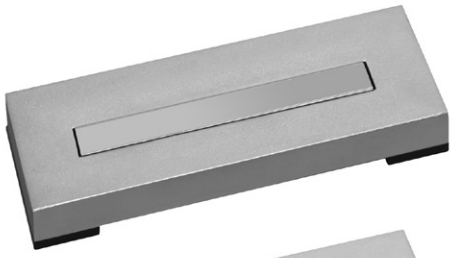
The PIKE Technologies HATRs are high-performance accessories, carefully designed to provide excellent results with minimum effort. Accessories are easily installed in the sample compartment, locking into position on the sample compartment baseplate.

Stable alignment provides excellent analytical precision. Crystal plate changeover is rapid, allowing a wide range of samples to be analyzed with maximum convenience. PIKE Technologies HATRs have been optimized for maximum optical throughput and excellent quality spectra can be obtained from demanding samples. Several high-quality crystal materials covering a full spectrum of applications are available. Trough and sealed flat crystal plates are sealed using metallic gaskets, eliminating premature failure and the risk of cross-contamination associated with inferior, epoxy-bonded systems. Flat crystal plates are designed with positive surface relief to aid in improved sample contact.

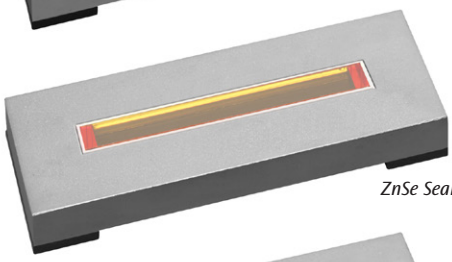
All PIKE HATRs include a purge tube interface for the FTIR spectrometer. This provides full integration of the accessory with the FTIR spectrometer's purging system (sealed and desiccated or purged) for removal of water and carbon dioxide artifacts from the FTIR spectra. Thanks to this, purging is very efficient and the spectrometer can be operated with the sample compartment door open.

HATR Crystal Plate Choices

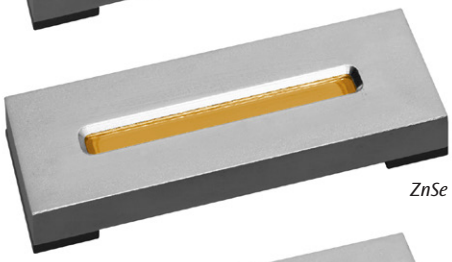
PIKE Technologies HATR crystal plates are available in trough, flat plate and flow cell configurations.



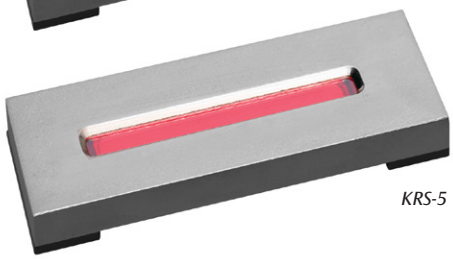
Ge Flat Plate



ZnSe Sealed Flat Plate



ZnSe Trough Plate



KRS-5 Trough Plate

The **flat plate** is used for the analysis of solid materials – including polymer and film samples. It is ideal for solid samples which are too large to fit within the trough plate configuration. The crystal is mounted slightly above the surface of the metal plate, which helps to achieve good crystal/sample contact when the flat plate press is used.

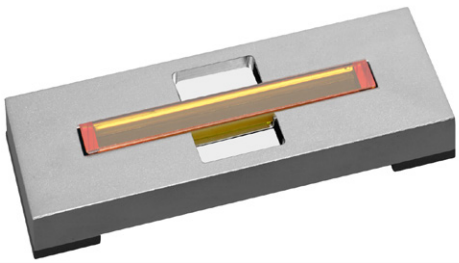
The ZnSe and Ge 45-degree flat plates are available in a sealed version, which is ideal for sampling of oils and other types of low surface tension liquids.

Flat HATR crystal plate – ideal for solids, polymer films and coatings.

The **trough plate** is designed for easy sampling, with a large, recessed crystal to accommodate the sample – generally a liquid, powder, or paste. The trough plate is ideal when samples must be cleaned from the crystal with some type of aqueous or organic solvent.Typically, only a thin layer of the sample needs to be applied onto the crystal surface. For fast evaporating samples, a volatiles cover should be used to cover the sampling area.

Soft powders will often produce good spectra when analyzed by HATR, assuming that they can be put in intimate contact with the crystal. A powder press option is used to achieve this. This device is placed directly on top of the sample filled trough and pressed by hand until the desired result is obtained.

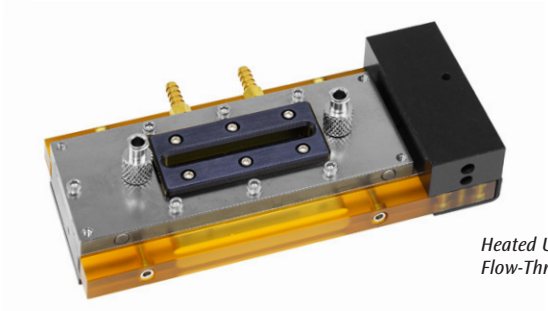
Trough HATR crystal plate – ideal for liquids, powders, pastes and gels.



RCPlate

RCPlate™

For special applications where you need to look at coatings on an HATR crystal, PIKE Technologies offers the RCPlate option. The RCPlate is designed to enable easy removal and reinsertion of the HATR crystal. Applications include analysis of coatings, mono-molecular layers, or bio-films deposited directly upon the HATR crystal. With RCPlates, it is easy to collect the background spectrum on the clean crystal, remove the HATR crystal from the RCPlate, coat the crystal and then reposition it into the RCPlate to collect the sample spectrum.

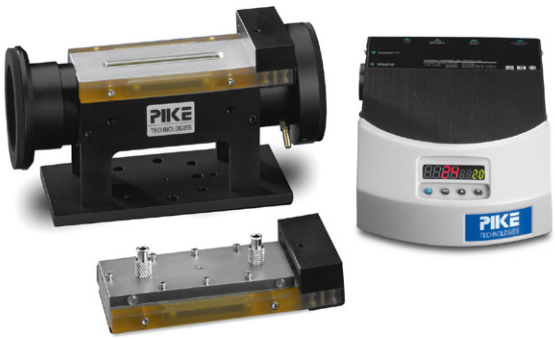


Heated UV HATR Flow-Through Cell

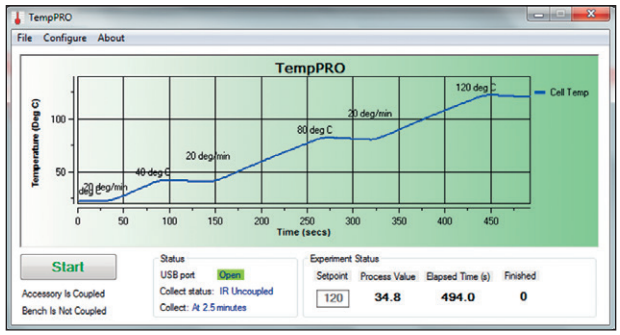
Flow-Through Cell

Flow-through cells are a versatile option for the dynamic laboratory. The ATR crystal is sealed in with O-rings, which allows for user-changeable crystals. The sample may be introduced by syringe or through tubing connected to a 1/16-inch compression fitting. Flow-through cells may be configured for temperature control and with PTFE coating.

In addition to our standard flow-through cells, PIKE offers a flow-through cell with a quartz window for photocatalytic studies. Due to UV-induced degradation of ZnSe caused by the external source probe, we recommend using an AMTIR crystal for these applications.



HATR with Heated Trough Plate and temperature control module – foreground shows Heated Flow-Through Cell.

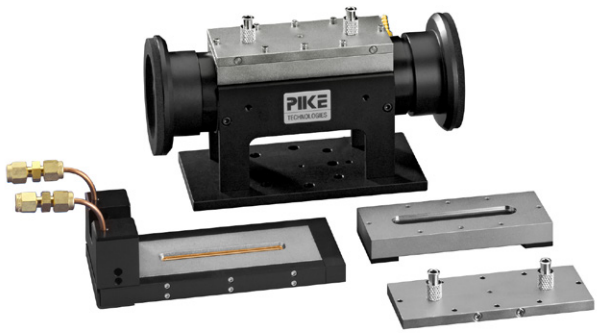


PIKE TempPRO Software for kinetic experiments with our Resistively Heated Crystal Plates.

All resistively heated HATR plates and flow-through cells are controlled by PIKE temperature controllers in digital or digital PC versions. The selection of the digital PC version includes PIKE TempPRO software, which provides a graphical user interface for temperature control and kinetic measurements.

A large number of flat, trough and flow-through sampling plates are available for PIKE Technologies HATRs – all are pin-mounted to the HATR with no alignment required. They are compatible and interchangeable with HATR and HATRPlus products which allows optimizing the accessory's configuration for best spectral results.

Do you need an HATR product or feature not shown here in our catalog? Please contact us to discuss your application.



HATR with Flow-Through Cell (background). Liquid Jacketed Trough Plate is shown in foreground (left).

SPECIFICATIONS

Temperature Range	Ambient to 130 °C
Accuracy	+/- 0.5% of set point
Sensor Type	3 wire Pt RTD (low drift, high stability)
Controllers	
Digital	+/- 0.5% of set point
Digital PC	+/- 0.5% of set point, graphical setup, up to 100 ramps, USB interface
Input Voltage	100–240 VDC, auto setting, external power supply
Output Voltage	24 VDC/50 W maximum
HATR Crystals	ZnSe, Si, Ge, AMTIR and KRS-5
Crystal Dimensions	80 x 10 x 4 mm or 80 x 10 x 2 mm
Number of Reflections on the Sample	10 for 45 degree, 4-mm thick 20 for 45 degree, 2-mm thick 5 for 60 degree, 4-mm thick
Base Dimensions (W x D x H)	115 x 55 x 70-104 mm (excludes baseplate and purge collars; base height depends on the beam height of the spectrometer)

Complete HATR Systems

Bundled HATR Systems (*insert spectrometer model for XX*)

Part Number	Description
022-10XX	HATR Trough Plate System with 45º ZnSe Crystal *Includes Trough Plate, Volatiles Cover and Powder Press*
022-11XX	HATR Flat Plate System with 45º ZnSe Crystal *Includes Flat Plate and HATR Pressure Clamp*
022-12XX	HATR Combined Trough and Flat Plate System with 45º ZnSe Crystals *Includes Trough Plate, Flat Plate, Volatiles Cover, Powder Press and Pressure Clamp*
024-11XX	HATRPlus Flat Plate System with 45º ZnSe Crystal *Includes Flat Plate and HATR Pressure Clamp*

Notes: Replace XX with your spectrometer's Instrument Code. Click for List >
HATR and HATRPlus systems may be purchased with crystal plates other than ZnSe. Just add –Ge for germanium, –KR for KRS-5, –AM for AMTIR, or –Si for silicon to the part number. Additional plates can be added to an order for any system above. Other configurations may be selected from the options below.

Configurable HATR Systems

HATR Base Optics

Part Number	Description
022-19XX	HATR Platform Optics Assembly
024-19XX	HATRPlus Platform Optics Assembly

Notes: Replace XX with your spectrometer's Instrument Code. Click for List >
HATR and HATRPlus Platform Optics Assemblies include volatiles cover, powder press, purge tubes, purge kit and spectrometer base mount.

Pressure Clamp for HATR and HATRPlus

(*must select for solids, films or powder analysis)*

Part Number	Description
022-3050	HATR (pivoting) Pressure Clamp
022-3054	HATR High-Pressure Clamp
024-3050	HATRPlus (pivoting) Pressure Clamp
024-3053	HATRPlus High-Pressure Clamp

Notes: The pressure clamp is required for solids, films, coatings and powdered samples. Maximum force for (pivoting) Pressure Clamp and High-Pressure Clamp is 13 lbs and 30 lbs, respectively.

Crystal Plates for HATR and HATRPlus

(must select 1 or more)

Part Number	Description
022-2010-45	Trough Plate, ZnSe, 45°
022-2020-45	Flat Plate, ZnSe, 45°
022-2024-45	Sealed Flat Plate, ZnSe, 45°
022-2012-45	Trough Plate, ZnSe, 45°, 2 mm
022-2022-45	Flat Plate, ZnSe, 45°, 2 mm
022-2030-45	Trough Plate, KRS-5, 45°
022-2040-45	Flat Plate, KRS-5, 45°
022-2050-45	Trough Plate, Ge, 45°
022-2060-45	Flat Plate, Ge, 45°
022-2064-45	Sealed Flat Plate, Ge, 45°
022-2052-45	Trough Plate, Ge, 45°, 2 mm
022-2062-45	Flat Plate, Ge, 45°, 2 mm
022-2070-45	Trough Plate, AMTIR, 45°
022-2080-45	Flat Plate, AMTIR, 45°
022-2090-45	Trough Plate, Si, 45°
022-2100-45	Flat Plate, Si, 45°

Notes: HATR Crystal Plates are pre-aligned and pinned-in-place. Changing crystal plates is easy and fast to optimize sampling results. For most HATR crystal plates, 60 degree face angle is also available. Where not noted, crystals are 4-mm thick and generate 10 reflections on the sample (45° cut). 2-mm crystals result in 20 reflections (45° cut). If you need a crystal not listed here, please contact us. Reconditioning service is available.

Ordering Information

Heated Crystal Plates for HATR and HATRPlus

Part Number	Description
022-5110	HATR Heated Trough Plate, ZnSe, 45°
022-5120	HATR Heated Trough Plate, AMTIR, 45°
022-5130	HATR Heated Trough Plate, KRS-5, 45°
022-5140	HATR Heated Trough Plate, Si, 45°
022-5150	HATR Heated Trough Plate, Ge, 45°

Part Number	Description
022-5210	HATR Heated Flow-Through Cell, ZnSe, 45°
022-5212	HATR Heated Flow-Through Cell, ZnSe, 45°, 2 mm
022-5220	HATR Heated Flow-Through Cell, AMTIR, 45°
022-5230	HATR Heated Flow-Through Cell, KRS-5, 45°
022-5240	HATR Heated Flow-Through Cell, Si, 45°
022-5250	HATR Heated Flow-Through Cell, Ge, 45°
022-5252	HATR Heated Flow-Through Cell, Ge, 45°, 2 mm
022-5225	HATR Heated Flow-Through Cell with UV Port, AMTIR, 45°

Part Number	Description
076-1420	Digital Temperature Control Module, PC Control
076-1220	Digital Temperature Control Module

Notes: Temperature is adjustable to 130 °C for heated trough plates and flow-through cells. Ge becomes opaque near 100 °C. Resistance heated plates require selection of a PIKE Technologies Temperature Control Module. PC Control Module includes PIKE Technologies TempPRO software. PTFE-coated flow-through cells available – contact us for more information.

Flow-Through Cells for HATR and HATRPlus

Part Number	Description
022-4010	HATR Flow-Through Cell, ZnSe, 45°
022-4012	HATR Flow-Through Cell, ZnSe, 45°, 2 mm
022-4020	HATR Flow-Through Cell, AMTIR, 45°
022-4030	HATR Flow-Through Cell, KRS-5, 45°
022-4040	HATR Flow-Through Cell, Si, 45°
022-4050	HATR Flow-Through Cell, Ge, 45°
022-4052	HATR Flow-Through Cell, Ge, 45°, 2 mm
022-5228	HATR Flow-Through Cell with UV Port, AMTIR, 45°

Notes: HATR flow-through cells include Luer-Lok fittings for easy connection with a syringe. A set of 1/16" Swagelok fittings are also included with each flow-through cell. Flow-through cell volume is 500 µL. PTFE-coated flow-through cells available – contact us for more information.

Liquid Jacketed Crystal Plates for HATR and HATRPlus

Part Number	Description
022-5310	HATR Liquid Jacketed Trough Plate, ZnSe, 45°
022-5320	HATR Liquid Jacketed Trough Plate, AMTIR, 45°
022-5330	HATR Liquid Jacketed Trough Plate, KRS-5, 45°
022-5340	HATR Liquid Jacketed Trough Plate, Si, 45°
022-5350	HATR Liquid Jacketed Trough Plate, Ge, 45°

Notes: Liquid jacketed crystal plates require customer-provided liquid circulator. Liquid jacketed crystal plates enable heating to 130 °C and cooling. Ge becomes opaque near 100 °C.

Liquid Jacketed, Flow-Through Crystal Plates for HATR and HATRPlus

Part Number	Description
022-5410	HATR Liquid Jacketed Flow-Through Plate, ZnSe, 45°
022-5412	HATR Liquid Jacketed Flow-Through Plate, ZnSe, 45°, 2mm
022-5420	HATR Liquid Jacketed Flow-Through Plate, AMTIR, 45°
022-5430	HATR Liquid Jacketed Flow-Through Plate, KRS-5, 45°
022-5440	HATR Liquid Jacketed Flow-Through Plate, Si, 45°
022-5450	HATR Liquid Jacketed Flow-Through Plate, Ge, 45°
022-5452	HATR Liquid Jacketed Flow-Through Plate, Ge, 45°, 2 mm

Notes: Liquid jacketed flow-through crystal plates require customer-provided liquid circulator to enable heating to 130 °C and cooling. HATR flow cells include Luer-Lok fittings for easy connection with a syringe and 1/16" Swagelok® fittings. PTFE-coated flow-through cells available – contact us for more information.

HATR RCPlate

Part Number	Description
022-2300	RCPlate for HATR (for 45° crystals)

Note: Requires a selection of HATR Crystal – see below

HATR and HATRPlus Replacement Parts

Part Number	Description
022-3051	HATR Volatiles Cover
022-3052	HATR Powder Press
160-5554	Crystal, Trap, ZnSe, 45°, 80 x 10 x 4 mm
160-5559	Crystal, Trap, ZnSe, 45°, 80 x 10 x 2 mm
160-5555	Crystal, Trap, KRS-5, 45°, 80 x 10 x 4 mm
160-5556	Crystal, Trap, Ge, 45°, 80 x 10 x 4 mm
160-5560	Crystal, Trap, Ge, 45°, 80 x 10 x 2 mm
160-5557	Crystal, Trap, AMTIR, 45°, 80 x 10 x 4 mm
160-5558	Crystal, Trap, Si, 45°, 80 x 10 x 4 mm
160-5561	Crystal, Trap, ZnSe, 60°, 80 x 10 x 4 mm
160-5562	Crystal, Trap, Ge, 60°, 80 x 10 x 4 mm
022-3032	Spacer for HATR Flow Cell, 2 mm
022-3040	Viton O-Ring for HATR Flow-Through Cell, upper (6 ea.)
022-3045	Viton O-Ring for HATR Flow-Through Cell, lower (6 ea.)
022-3041	Perfluoroelastomer O-Ring for HATR Flow-Through Cell, upper (1 ea.)
022-3046	Perfluoroelastomer O-Ring for HATR Flow-Through Cell, lower (1 ea.)

Notes: Reconditioning service for used HATR crystal plates is available. Contact PIKE Technologies for items not described in this list.