Smart Accessories

Sampling Tools for Nicolet FT-IR Systems

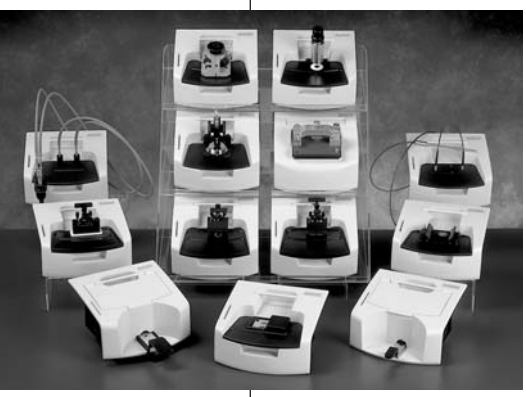
Smart Accessories™

Speed Sample Preparation and Improve the Results in your Laboratory

An Accessory For Every Need

Thermo Electron Corporation offers Smart Accessories, an extensive line of sampling choices for Nicolet™ 380 and Nicolet x700 series FT-IR spectrometers to address a variety of sample types and laboratory needs, from routine to advanced.

- The basic Smart Accessories, such as the Smart Multi-bounce HATR and the Smart Diffuse Reflectance, are ideal for the routine measurements done in quality control or teaching laboratories. These accessories provide affordable tools that offer sampling speed and ease of use.



- Most Smart Accessories are in the analytical range and are optimized for ease of use and universal sample compatibility.
- The research Smart Accessories, such as the Smart ARK, Smart Orbit and Smart SAGA, are geared toward the research environment to provide the highest quality data and the greatest degree of flexibility.

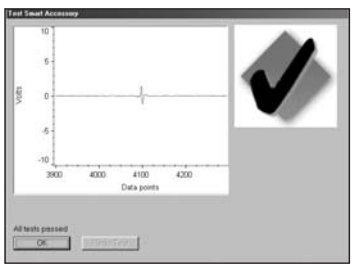
All Smart Accessories are compatible with Nicolet 380 and Nicolet x700 series spectrometers.

Designed For Ease

The most dramatic feature of a Smart Accessory is its integration with the software and the spectrometer, bringing an unprecedented level of convenience and speed. When you place a Smart Accessory in the instrument, you are instantly ready to collect spectra. There is no need for manual or mechanical alignment of accessories and no need to constantly adjust data collection parameter files. The integrated design complements your lab.

Automated Experiment Set-up

Like every smart component on a Nicolet FT-IR spectrometer, Smart Accessories are recognized by the system as soon as they are installed. When a Smart Accessory is placed in the spectrometer, an Experiment file containing the software and hardware parameters for that measurement is automatically loaded. The FT-IR system will set everything for you, so you are free to concentrate on your work.



Optimal, Reliable Performance

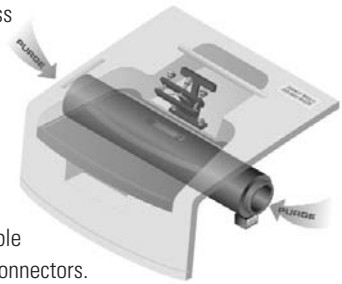
Smart Accessories are the only FT-IR accessories that use permanently aligned optical systems pioneered by Thermo Electron. Permanent alignment means there are no time consuming adjustments necessary before you can collect spectra. With a Smart Accessory you can be confident that everything is positioned properly, making your results more reproducible and reliable.

Confidence Through Diagnostics

Once the experiment parameters are set, the system will run diagnostic tests to validate the performance of your spectrometer, giving you maximum confidence in your results. These tests save time and improve results by identifying common user errors such as improperly cleaning a previous sample from a transmission cell. They also proactively help in addressing problems to maximize productivity.

Automatic Purge

Smart Accessories are constructed around a central-sealed optics tube. If your bench is purged, the accessory will automatically be purged when it is inserted. Because the purged volume of a Smart Accessory is small, purge is achieved quickly. Over time, the small purge volume will also show less fluctuation than the relatively large volumes of a full-sized sample compartment – your results are much more reproducible.



In addition, the design eliminates the need for adjustable purge seals or separate purge connectors. Traditional accessories either do not have purge seals or require adjustments to seal the accessory.

Expertise When You Need It

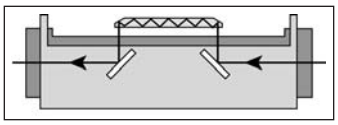
Multimedia on-line tutorials in Thermo Electron's OMNIC™ software help you choose the right accessory for your application, show you how to use and care for your accessory, and how to prepare a sample. OMNIC software can monitor your spectra as you collect them using spectral quality checks to look for common sampling mistakes, then prompt you with situation specific tips and tutorials that can sharpen your skills and improve your results.

How does it work?

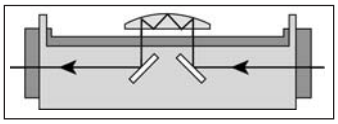
An Overview of Basic FT-IR Sampling Techniques

Attenuated Total Refection (ATR)

An attenuated total reflection accessory operates by measuring the changes that occur in a totally internally reflected infrared beam when the beam comes into contact with a sample. An infrared beam is directed onto an optically dense crystal with a high refractive index at a certain angle greater than the critical incident angle. The resulting internal reflectance creates an evanescent wave that extends beyond the surface of the crystal into the sample held in contact with the crystal. In regions of the infrared spectrum where the sample absorbs energy, the evanescent wave will be attenuated. The altered (attenuated) energy from each evanescent wave is passed back to the IR beam, which then exits the opposite end of the crystal and is directed at the detector in the IR spectrometer. The detector records the attenuated IR beam as an interferogram signal, which can then be used to generate an infrared spectrum.



Beam path for a multi-bounce ATR

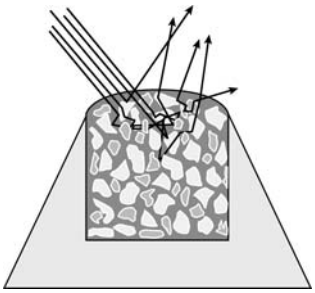


Beam path for a single-bounce ATR

Diffuse Reflectance (DR)

When an infrared beam is focused onto a particulate material, the incident beam can react with the particle in one of several ways. The radiation can be reflected off the top surface of a single particle or multiple particles without penetrating the particle, a process called specular reflectance. Diffuse reflectance results from the penetration of the incident radiation into one or more sample particles and subsequent scatter from the sample matrix.

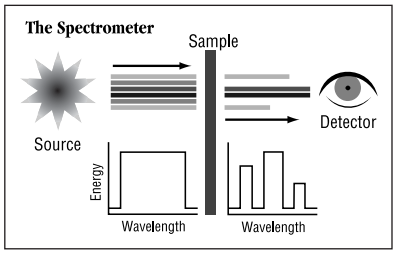
A diffuse reflectance accessory operates by directing the infrared energy into a sample cup filled with the neat solid powder or a mixture of the sample and an infrared transparent matrix (such as KBr). The infrared radiation then interacts with the particles causing the light to "diffuse" or scatter as it moves throughout the sample. The output mirror collects the diffusely scattered energy, which is directed to the detector in the spectrometer. The detector records the altered IR beam as an interferogram signal, which can then be used to generate a spectrum. Typically, a background is collected with the diffuse reflectance accessory in place and the cup filled with just the IR transparent matrix. Excellent quantitative data can be collected with proper sample preparation.



The IR beam interacting with a sample in a diffuse reflectance experiment

Transmission

The transmission technique does not require a separate accessory. The user simply places a sample within the sample compartment of an infrared spectrometer. The infrared beam passes through the sample and the energy that comes through the sample is measured to generate a spectrum. However, often sample preparation is necessary to ensure a thin uniform sample.



Conceptual diagram of a beam path

Specular Reflectance/Reflection-Absorption

Specular reflectance is a surface measurement technique that works on the principle of reflective efficiencies. This principle states that every sample has a refractive index that varies with the frequency of light to which it is exposed. Instead of examining the energy that passes through the sample, specular reflectance measures the energy that is reflected off the surface of a sample. By examining the frequency bands in which the rate of change in the refractive index is high, users can make assumptions regarding the absorbency of the sample. The specular reflectance technique provides excellent quantitative and qualitative data. Reflection-Absorption works on the same principle, but due to sample properties, some of the energy passes through the surface layer, is absorbed into the bulk of the sample and then reflects off of a substrate below the surface layer. A combination of specular reflectance and reflection-absorption can occur when criteria for both techniques are met. If a qualitative comparison of specular reflectance to transmission spectra is desired, users can apply the Kramers-Kronig correction to the data to remove the effects of dispersion.

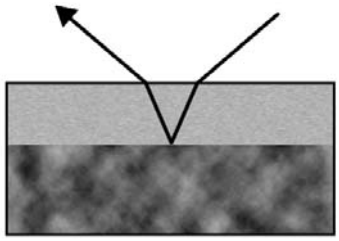


Diagram of Reflection-Absorption

How to Choose the Right Accessory

Samples marked with "▲" are well suited for the indicated Smart Accessory.

Type	Accessory	Page	Distinguishing Features/Applications	Hard Polymers	Soft Polymers	Rubbers	Fibers	Soft Powders	Hard Powders	Pastes	Gels	Surface Coatings	Films on Metals	Brittle/Grindable Solids	Acidic Liquids	Aqueous Liquids	Caustic Liquids	Biologicals	Depth Profiling	Catalysts	Reaction Studies
Multi-Bounce HATR	**Smart ARK™**	pg.6	Research and analytical test laboratory environment High energy throughput/high level quantitative and qualitative analyses 12 reflection ZnSe crystal Over 20 interchangeable crystal plate options (to change angle of incidence and material without optical realignment)		▲	▲		▲		▲	▲	▲				▲	▲	▲	▲		▲
	Smart Multi-Bounce HATR	pg.7	10 reflection ZnSe crystal; optional Ge crystal, and Si crystal		▲	▲		▲		▲	▲	▲				▲		▲			
Single Bounce HATR	**Smart Orbit**	pg.8	Rugged, versatile accessory that stands up to highly corrosive, caustic, intractable or abrasive samples Real Type IIa Single-reflection Diamond ATR crystal Optimal germanium, silicon, or 45° specular sampling	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲			
	Smart OMNI-Sampler™	pg.9	Resilient crystal allows for measuring of acids and bases from pH 1 to 14 Capable of measuring a spot on a sample of 2 mm diameter or less Single reflection Germanium crystal	▲	▲	▲		▲		▲	▲	▲			▲	▲	▲	▲			
	Smart Performer	pg.10	Small crystal area (2mm) in flat and trough formats Single reflection with 4 crystal configurations: ZnSe, Ge, AMTIR, Si		▲	▲	▲	▲		▲	▲	▲			▲	▲	▲	▲			
	Smart MIRacle™	pg.11	Small round crystal allowing reliable analysis of sample volumes 5 µl and higher Single reflection with 5 crystal options: ZnSe, Ge, AMTIR, Si, diamond		▲	▲	▲	▲		▲	▲	▲			▲	▲	▲	▲			
	Smart DuraSamplIR™	pg.12	1, 3 and 9 reflection diamond element options, heating and hastelloy (for corrosive samples) options available	▲	▲		▲	▲	▲	▲	▲	▲		▲	▲	▲	▲	▲			▲
	Smart DuraScope™	pg.12	Video – enhanced diamond ATR with integrated camera design allowing magnification of sample up to 100x 1 and 3 reflection diamond element options	▲	▲		▲	▲	▲	▲	▲	▲		▲	▲	▲	▲	▲			▲
	Smart Golden Gate	pg.13	Industrial strength ATR with diamond crystal with up to 200 lbs of force available to achieve good sample-to-crystal contact of even the hardest sample Single reflection type IIA diamond crystal	▲	▲		▲	▲	▲	▲	▲	▲		▲	▲	▲	▲	▲			▲
	Smart SplitPea™	pg.14	Extremely small ATR sampling with visible magnification capability; calibrated, repeatable pressure device; diamond ATR, silicon ATR, and specular reflectance	▲	▲	▲	▲	▲	▲	▲	▲			▲	▲	▲	▲				
HATR & Specular Reflectance	**Smart SpeculATR™**	pg.15	Dual purpose accessory offers great laboratory flexibility – both ATR and specular reflectance sampling; low cost Fresnel crystal are simple to add or replace		▲	▲		▲		▲	▲	▲	▲						▲		

Samples marked with "▲" are well suited for the indicated Smart Accessory.

Type	Accessory	Page	Distinguishing Features/Applications	Hard Polymers	Soft Polymers	Rubbers	Fibers	Soft Powders	Hard Powders	Pastes	Gels	Surface Coatings	Films on Metals	Brittle/Grindable Solids	Acidic Liquids	Aqueous Liquids	Caustic Liquids	Biologicals	Depth Profiling	Catalysts	Reaction Studies
			Sample Type																		
Specular Reflectance	**Smart Refractor™**	pg.16	High throughout grazing angle accessory with all refractive optics; internal silicon polarization; monolayer sensitivity									▲	▲								
Specular Reflectance	**Smart SAGA™**	pg.17	All gold reflecting optics; unique internal dual masking easily set with a calibrated thumb wheel; germanium polarizer allowing monolayer sensitivity									▲	▲								
Diffuse	**Smart Collector™**	pg.18	Research laboratory environment/nanogram levels of sensitivity																		
			Optional Environmental Chamber for performing at elevated temperatures/high pressure/vacuum conditions	▲	▲			▲	▲				▲	▲						▲	▲
			Maximizes diffusely scattered radiation while minimizing specular reflected radiation																		
	Smart Diffuse Reflectance	pg.19	Convenient sample slides with storage space in the accessory cover																		
			Includes Si-Carb™ sampling tool, for analyzing solid materials such as paint chips	▲	▲			▲	▲				▲	▲							
	Smart NIR UpDRIFT™	pg.20	Near-infrared spectral range																		
			Analyze directly from plastic bags, plastic, and glass bottles	▲	▲	▲		▲	▲	▲	▲			▲							
			Maximizes diffusely scattered radiation while minimizing specular reflected radiation																		
Transmission	**Smart OMNI-Transmission™**	pg.21	Enclosed design provides excellent purge and is chemically resistant, protecting the spectrometer from contamination and spillage																		
			Four sample positions to accommodate KBr Pellet holders, Precision Pathlength liquid cells, film holders and gas cells	▲	▲			▲	▲	▲	▲		▲	▲	▲	▲	▲	▲			
Fiber Optics	**Smart NIR FiberPort™**	pg.22	Near-infrared spectral range																		
			Ability to bring the sampling accessory to the sample – useful for samples in remote locations or of non-standard shape and size	▲	▲	▲		▲	▲				▲		▲	▲	▲				

Smart ARK

For Research Grade, Multiple-Reflection ATR Analysis

The Smart ARK is a stable, rugged, high energy throughput HATR available. For analyzing liquids, solids, semi-solids and soft powders the Smart ARK is the ideal choice for both research and analytical test laboratories. It is well suited for high level accurate quantitative and qualitative analyses because sample preparation is not necessary. The Smart ARK's high performance is a result of high optical collection efficiency and unique patented crystal design. This crystal design allows the user to change crystal angles and materials without optical realignment. The multi-reflection crystal design is extremely well-suited for analyzing lower concentration samples and where high sensitivity is necessary. It is good for samples that require consistent, precise analysis or when different pathlengths are required to analyze a sampling system.

Example Applications

- Liquids
- Solids
- Semi-solids
- Powders
- Quantitative and qualitative measurements

Unique Features

To change crystal angles or material (and subsequently the depth of penetration into a sample or effective pathlength) Thermo Electron's patented crystal design ensures high energy throughput without the need for mechanical or manual optical alignment of the accessory. It is extremely easy to change crystal plates and angles; there is no need to worry about moving mirrors and mechanical parts failing. The crystal design ensures reproducibility and reliability with every measurement, which is especially critical when transferring analytical methods between laboratories with multiple spectrometers. The Smart ARK is available with the widest variety of crystal plates in different materials and angles including 30, 40, 50, 55, 60, and 70 degrees (dependent on material). There is a crystal material for almost any pH sample and a suitable crystal angle that results in a pathlength from 0.6 to 45 micrometers.

The following table shows the angle of incidence (q), number of reflections, the refractive index of the crystal (R.I.), the calculated depth of penetration (dp), the calculated effective pathlength (EPL) in micrometers for three common materials (other materials available upon request). The experimental sampling depth is 2 to 3 times the calculated depth of penetration.

Θ	# of Refl.	ZnSE (R.I. = 2.4)		Ge (R.I. = 4)		AMTIR (R.I. = 2.5)	
		dp	EPL(µm)	dp	EPL(µm)	dp	EPL(µm)
30	21	NA	NA	1.2	17.68	NA	NA
40	14	4.4	45.64	0.763	4.24	2.76	38.75
45	12	2.0	12.12	0.664	2.59	1.70	9.68
50	10	1.5	5.82	0.596	1.62	1.34	4.93
55	8	1.25	3.11	0.547	.992	1.14	2.71
60	7	1.11	1.94	0.510	.672	1.02	1.72
Critical Angle			38.68	22.02		36.87	

Both trough and flat plate style crystal plates are available to suit the specific sample analysis. The trough plate version is optimized for use with liquids, pastes, and gels. The flat plate version is optimized for use with solid films. All crystal plates are Teflon® coated to improve chemical resistivity and prevent discoloration of the plate surface. The pressure device has been optimized to reduce breakage of the crystals that can be caused by too much or uneven pressure.

Specifications

Crystal Material: Zinc Selenide (standard), Germanium (optional), Silicon (optional), Zinc Sulfide (optional), AMTIR (optional)

Angle of Incidence: 45 degree (standard), optional 30, 40, 50, 55, 60, 70-depending on material

Number of Reflections: 12 (standard) see chart above for additional information

Pathlength: Approximately 12 micrometers

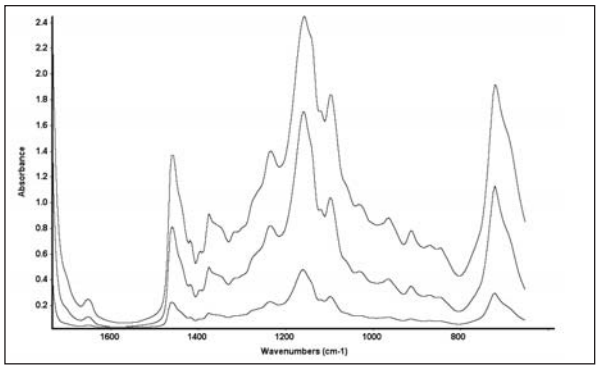
Sample Volume (trough): 1.0 milliliters

Heated Option: Allows thermal studies from ambient to 100°C

Ordering Information

ACCESSORY	PART NUMBER
Smart ARK Trough Plate Kit	0031-3XXT
Smart ARK Flat Plate Kit	0031-3XX
Smart ARK Combination Kit	0031-2XX
Smart ARK Heated Trough Plate Kit	0031-4XXT
Smart ARK Heated Flat Plate Kit	0031-4XX

XX = 97 for Nicolet 380 XX = 99 for Nicolet x700 series



Spectra of vegetable oil using 40° (top), 45° (middle) and 60° (bottom) ZnSe crystals on the Smart ARK

Manufactured by:

Thermo Electron Corportation

Smart Multi-Bounce HATR

For Multiple-Reflection ATR Analysis

The Smart Multi-Bounce HATR crystal has a pathlength of 10.1 micrometers, while the smallest pathlength of a typical transmission cell is 15 micrometers. This short pathlength makes the Smart Multi-Bounce HATR suitable for samples that absorb strongly and yields better results than transmission. In addition, the Smart Multi-Bounce HATR is well suited for providing information about the surface properties of a material.

Example Applications

- Aqueous solutions
- Solvents
- Flexible films
- Gels
- Soft powders

Unique Features

The horizontal sampling surface is ideally suited for obtaining high-quality infrared spectra – without the need for sample preparation. There are convenient storage spaces within the cover of the accessory which accommodate the accessory's sampling tools, such as a powder press and volatile liquid cover.

The Smart Multi-Bounce HATR uses crystals mounted in plates that are pinned in place on the accessory. This allows you to change plates by simply lifting one off and placing another on. All of the Smart Multi-Bounce plates are Teflon coated to improve chemical resistivity and prevent discoloration. Once measurements have been made, the crystal may be wiped clean or if necessary the whole plate can be simply lifted off and removed for rapid cleaning.

Plate and Crystal Choices

Multi-Bounce HATR Trough Plate Kit

The trough plate kit is useful for analyzing liquids, powders, pastes, and gels. The ATR crystal is recessed and mounted into a trough shaped, leak-proof sampling plate. The ATR crystal sample plate restricts catastrophic liquid spills from damaging the accessory in any way. Also included is a volatile liquid cover that eliminates solvent evaporation and a powder press to ensure good contact between powdered samples and the crystal.

Multi-Bounce HATR Flat Plate Kit

The flat plate kit is useful for analyzing films and coatings on flat samples. Flat plates are configured with the crystal 'flush' with the surface of the plate. The pressure device included with the flat plate kit ensures reproducible pressure and uniform optical contact between the sample and crystal.

Smart Multi-Bounce HATR Combination Plate Kit

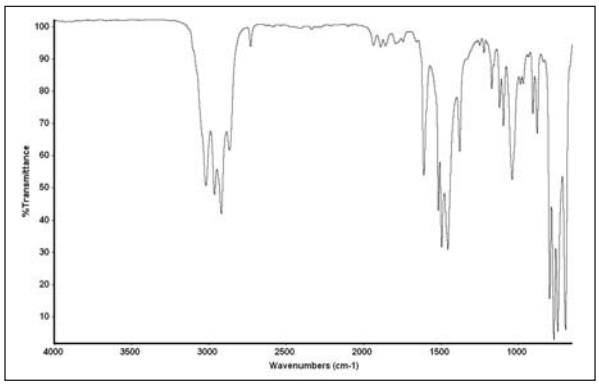
The combination plate kit is ideal when a variety of liquid and solid samples are analyzed. This kit includes both trough and flat plates, and the following sampling tools:

- Volatile liquid cover
- Powder press
- Pressure device

Crystal Materials

The standard crystal material is zinc selenide (ZnSe), with a 45 degree angle of incidence. This material is well suited for almost all routine sampling. Zinc selenide is fairly hard, and is utilized for neutral pH solutions.

The optional Germanium crystal has a high refractive index with a shallow depth of penetration into the sample, making it well suited for measuring samples with a high refractive index, such as carbon-filled polymers. Although germanium has a limited spectral range, it offers good chemical resistivity to both acids and bases.



Xylene mixture with 45° ZnSe trough with Smart Multi-Bounce HATR

Specifications

Crystal Material: Zinc Selenide, standard; (4000 – 650 cm^{-1})
Germanium, optional; (4000 – 800 cm^{-1})
Silicon, optional; (4000 – 1500 cm^{-1})

Number of Reflections: 10

Crystal Angle: 45°

Pathlength: Approximately 10 micrometers

Sample Volume (trough): 0.5 milliliters

Ordering Information

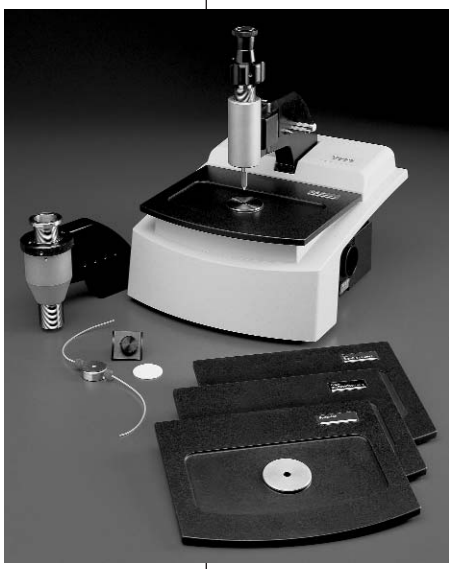
ACCESSORY	PART NUMBER
Smart Multi-Bounce for Solids	0028-3XX
Smart Multi-Bounce for Liquids	0028-3XXT
Smart Multi-Bounce Combination Kit I (for Liquids & Solids)	0028-2XX

XX = 97 for Nicolet 380 XX = 99 for Nicolet x700 series

Manufactured by:
Thermo Electron Corportation

Smart Orbit

For Single-Reflection, Diamond ATR Analysis



The Smart Orbit is a high-performance diamond single bounce ATR accessory. Diamond ATR is ideal for analysis of hard, abrasive, reactive, caustic or corrosive materials because it is both inert and extremely strong. Diamond also has a wide spectral range and good depth of penetration, which makes it a great choice for more common samples. The Smart Orbit offers additional sampling flexibility by offering optional germanium and silicon crystal plates and a 45 degree specular reflectance option. A flow cell can be added to facilitate the introduction of liquid samples to the ATR crystal element.

Four different sample tips are included with the adjustable pressure tower: one short and one long pointed tip to apply high pressure to solid samples; a concave tip – for spherical solid samples; and a Teflon coated tip for powders and delicate samples such as combinatorial beads. The Lightning Viewer provides an 8X magnified view of the sample, ideal for ensuring sample placement upon the ATR crystal.

Example Applications

- Liquids ranging from pH 1 to 14
- Fibers
- Hard or oddly shaped samples
- Abrasive, caustic or corrosive materials
- Large or small samples
- Acidic or alkaline materials

Unique Features

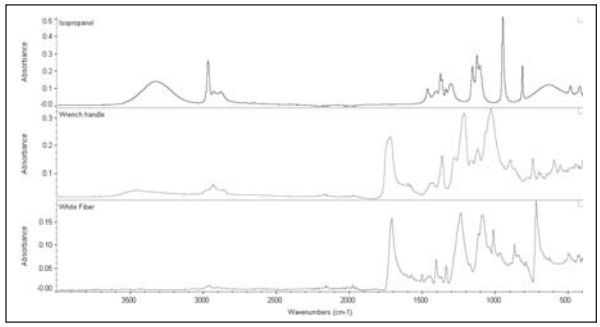
The Smart Orbit utilizes all reflective optics design with no spectral energy loss due to beam focusing crystals or lenses such as ZnSe or KRS-5. This allows the investigator to use ATR sampling over the entire spectral range of the FTIR spectrometer, from near to far infrared – the widest spectral range of any diamond ATR sampling accessory.

The Smart Orbit uses a real type IIa diamond that is braised into its stainless-steel plate using tungsten carbide. This preparation enables the diamond plate to withstand high pressure for excellent IR sensitivity. In addition, the entire sample plate is resistant to acidic, alkaline, caustic and corrosive chemicals and can withstand harsh cleaning materials such as steel wool or razor blades.

The Smart Orbit sample plates can be quickly removed and are coated with a robust Teflon coating that makes clean up a breeze. Replacing the sample plate is just as easy because alignment pins assure proper placement every time.

The Smart Orbit accessory is also the only fully validated diamond accessory for use in a regulated pharmaceutical environment.

The sampling plate of the Smart Orbit is large – a full 7 inches (17.8 cm) deep and 8.5 inches (21.6 cm) wide. In addition the sampling plate is situated above the sample compartment of the spectrometer, providing additional access for larger samples. Clearance between the sample and the pressure device accommodates samples up to 1.3 inches (3.5 cm) with the adjustable pressure tower and 0.78 inches (2.1 cm) with the Lightning Viewer. Both devices swivel 90 degrees from the center point to allow unobstructed access to the sample area from the front and sides. These features combine to allow very large samples to be analyzed. However, the small 1.5 mm active crystal area ensures that small samples and specific areas of interest can be isolated.



Smart Orbit provides spectral results from a variety of samples such as small fibers, hard polymers and more

Specifications

Crystal Material: Type IIa Diamond tungsten carbide mounted in stainless steel

Active Sample Area: 1.5 mm

Spectral Range: 10000 to 55 cm^{-1}

Depth of Penetration: 2.03 micrometers at 1000 cm^{-1}

Refractive Index: 2.4

Useful pH Range: 1 – 14

Sample Plate Options: Germanium, Silicon, 45° Specular Reflection

Pressure Device Options: the adjustable slip-clutch pressure tower or the Lightning Viewer

Ordering Information

ACCESSORY	PART NUMBER
Smart Orbit for Nicolet 380	840-145200
Smart Orbit for Nicolet x700 series	840-145300
Smart Orbit with Lightning Viewer for Nicolet 380	840-145400
Smart Orbit with Lightning Viewer for Nicolet x700 series	840-145500
ValPro Qualified Smart Orbit for Nicolet 380	840-168200
ValPro Qualified Smart Orbit for Nicolet x700 series	840-168300
ValPro Qualified Smart Orbit with Lightning Viewer for Nicolet 380	840-168400
ValPro Qualified Smart Orbit with Lightning Viewer for Nicolet x700 series	840-168500

Manufactured by:

Thermo Electron Corportation

Smart OMNI-Sampler

For Single-Reflection ATR Analysis

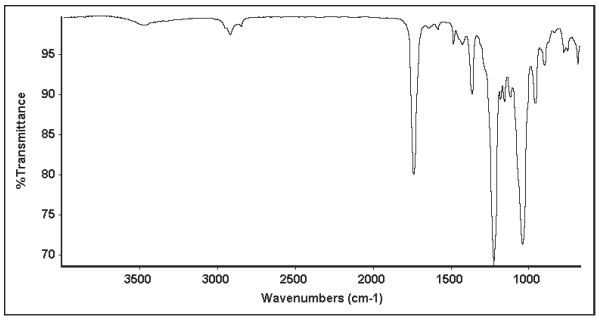
The Smart OMNI-Sampler is a good choice when you need to make fast and simple measurements but face a wide range of different sample types – solids or liquids. It is a universal single reflection HATR sampling accessory that fulfills almost all application needs. In addition to routine solids and liquids, the Smart OMNI-Sampler will facilitate the analysis of difficult samples, such as dark carbon-filled samples, single polymer beads, hard rigid polymers, and coatings on glass substrates. For tough to analyze samples, the Smart OMNI-Sampler is a cost effective alternative to diamond sampling accessories. It is as easy to use as "position, click, and scan".

The Smart OMNI-Sampler utilizes a spherical ATR crystal as the sampling surface. This crystal design in combination with the tilt back pressure tower provides "point-to-point" contact between the sample and crystal when analyzing solid samples. This point-to-point contact is useful for analyzing hard, rigid, unyielding, and difficult-to-analyze samples. It is ideal for making quantitative measurements because the tilt back pressure tower operates with a slip-clutch mechanism to ensure that the correct pressure is applied every time, independent of the sample's size or shape. Operation could not be any easier – simply position the sample on the crystal and turn the knob. When the correct pressure is applied, an audible click lets you know that you are ready to make your measurements. The tilt back pressure tower also tilts back at a 45° angle for easy access to crystal for cleaning and sample positioning.

The optional Lightning Viewer allows precise positioning of very small samples on the germanium surface. The Lightning Viewer features a sapphire surface and allows application of the same "turn and click" slip clutch pressure as the standard pressure device.

Example Applications

- Single polymer beads
- Single filaments
- Formed, rigid polymers
- Paint chips
- Printed circuit board
- Paper/contaminants
- Carbon-filled materials (o-rings)
- Liquid, including aqueous solutions, corrosive, and caustics



Rigid polymers may be measured without sample preparation using the Smart OMNI-Sampler

Unique Features

The Smart OMNI-Sampler integrates several unique features to make sample measurements simple and error-free. The spherical crystal design produces a nominal 2x reduction in the beam diameter. This provides enhanced sensitivity, the ability to run smaller samples, and the ability to exert more pressure on the sample, ensuring optimal contact. The pressure device tip is 2 mm, essentially defining the practical sample size.

The Smart OMNI-Sampler utilizes an extremely rugged germanium ATR crystal that has a spectral range of 4000 – 675 cm^{-1}. The germanium crystal gives a shallow depth of penetration that is ideal for highly absorbing carbon filled samples, and thin surface analyses. Compared to other ATR accessories with flat sampling surfaces, the spectral quality is greatly enhanced due to the point-to-point contact between the crystal and the tilt back pressure tower pressure device. The crystal material and shape makes the Smart OMNI-Sampler a good general purpose IR accessory.

The liquid holder extends the usefulness of the Smart OMNI-Sampler. It can be attached easily, requiring no modifications to the accessory. The "swimming pool" design is optimized for small volumes and ease of cleaning.

Specifications

Crystal Material: Germanium; spectral data down to 675 cm^{-1}

Sampling Area: 2 millimeters diameter

Crystal Angle: 45° (single reflection)

Depth of Penetration: Approximately 0.67 micrometers at 2000 cm^{-1}

Useful pH Range: 1 – 14

Sample Volume: 1.86 milliliters

Pressure Device: Tilt back pressure tower or Lightning Viewer, both with fail-safe mechanism to prevent crystal damage

Ordering Information

ACCESSORY	PART NUMBER
Smart OMNI-Sampler	0028-8XX
Smart OMNI-Sampler with Lightning Viewer	0029-8XX

XX = 97 for Nicolet 380 XX = 99 for Nicolet x700 series

Manufactured by:

Thermo Electron Corportation

Smart Performer

For Single-Reflection ATR Analysis

The Smart Performer is a single-reflection ATR accessory designed with the everyday user in mind. Its economical price and sampling flexibility make it a superior choice. The wide selection of crystal choices available (ZnSe, Ge, Si and AMTIR) permits analysis of all types of samples ranging in size, shape, texture, and pH. The small spot size of 2 mm makes sample positioning and experimental analysis easy. Its calibrated, micrometric pressure device allows the user to apply consistent pressure to the sample.

The Smart Performer has a unique design that makes changing from one crystal to another quick and hassle free. In addition, a specially designed trough plate protects the accessory optics from coming in contact with the sample. This feature makes the Smart Performer a good choice for liquid analysis, particularly samples with high viscosity or that can harm optical components.

Example Applications

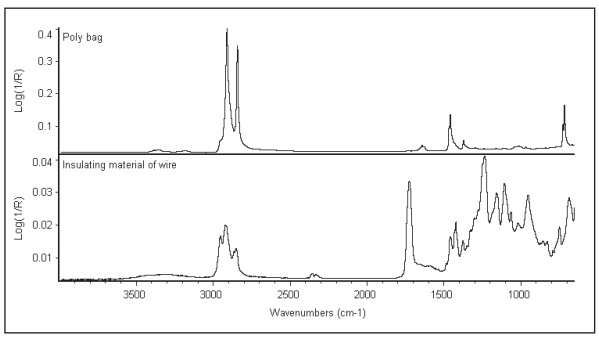
- Single polymer beads
- Pastes and gels
- Powders
- Solids
- Polymer films
- Liquids
- Fibers

Unique Features

The Smart Performer is a rugged, and versatile single bounce HATR that combines functionality with economy. The Smart Performer offers several crystal options to accommodate almost any sample type.

The unique design of the crystal plates allows them to be quickly replaced. The Smart Performer is available with the traditional, flat crystal plate design and also a trough plate which is ideal if liquid or powder analysis is common. The trough design holds the sample in place, ensuring that it will not seep into the accessory optics as is possible with simple screw-on trough attachments.

The Smart Performer offers an optional micrometric pressure device which provides precise control of the pressure applied to the sample by spring-loaded plunger. In addition, an optional flow cell kit can be ordered with the Smart Performer.



Quality spectra are easily collected from materials without destructive or tedious sample preparation

Specifications

MATERIAL	ATR SPECTRAL RANGE (CM^{-1})	REFRACTIVE INDEX	DEPTH OF PENETRATION (μ) (AT 45° & 1000 CM^{-1})
ZnSe	20000 – 650	2.4	2.03
Ge	5500 – 675	4	0.66
Si	8900 – 1500	3.4	0.85
AMTIR	11000 – 725	2.5	1.77

Chart 1

MATERIAL	USES
ZnSe	General use
Ge	Good for most samples. Strong absorbing samples, such as dark polymers
Si	Resistant to basic solutions
AMTIR	Resistant to acidic solutions

Chart 2

Crystal Materials: ZnSe, Ge, Si, AMTIR
Sampling Area: 2 mm
Spectral Range: 20000 to 650 cm^{-1} (ZnSe)
Depth of Penetration: 2.03 micrometers at 1000 cm^{-1} (ZnSe)
Refractive Index: 2.4 (ZnSe)
Useful pH: 5 – 9 (ZnSe)
Optional Pressure Device: Metered manual pressure device, swiveling slip clutch pressure tower, or swiveling Lightning Viewer

Ordering Information

ACCESSORY	PART NUMBER
Smart Performer	0039-1XX
ValPro Qualified Smart Performer for Nicolet 380	840-168600
ValPro Qualified Smart Performer for Nicolet x700 series	840-168700
Select one of the following crystals:	
ZnSe trough plate	0039-603
ZnSe flat plate	0039-703
Ge trough plate	0039-613
Ge flat plate	0039-713
Si trough plate	0039-653
Si flat plate	0039-753
AMTIR trough plate	0039-643
AMTIR flat plate	0039-743
Select one of the following pressure applicators:	
Micrometric Pressure Device	0039-550
Swivel Slip Clutch Pressure Tower	0039-555
Swivel Lightning Viewer	0039-560

XX = 97 for Nicolet 380 XX = 99 for Nicolet x700 series

Manufactured by:
Thermo Electron Corportation

Smart MIRacle

For Micro-HATR Sampling

The Smart MIRacle is a single-reflection HATR accessory ideal for laboratories with a variety of samples and a limited budget. Single-reflection technology greatly simplifies sample preparation, making mixing Nujol smears and pressing KBr pellets obsolete in many cases.

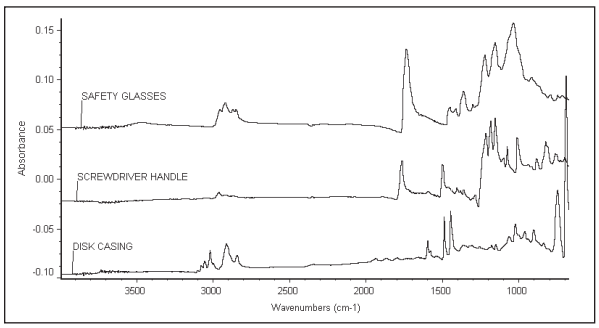
The Smart MIRacle plate configuration has a small round crystal allowing reliable analysis of small sample volumes (5 µl and higher). Solid materials can placed in close physical contact with the crystal, yielding high quality, reproducible spectra.

Example Applications

- Solids, semi-liquids, and liquids
- Awkward solid material
- Soft and hard powders
- Combinatorial chemistry beads and crowns
- Fibers and fiber bundles
- Abrasive and chemically active samples (diamond)
- Acidic and alkaline materials (diamond)

Unique Features

In addition to the advantages it shares with all Thermo Electron Smart Accessories, the Smart MIRacle accessory also offers several unique benefits. The Smart MIRacle combines the functionality of hardened HATRs with economy and flexibility. The accessory features a unique patented* optical design which offers exceptional energy throughput, resulting in increased sensitivity. Other unique features include choice of crystal materials – important for experiments requiring different spectral ranges.



Spectra of several polymers – a screwdriver handle, floppy disk casing, and hard plastic lens – collected using the Smart MIRacle. No sample preparation was required

Crystal Options

The Smart MIRacle offers five crystal configurations. The diamond version features a double reflection, gem quality diamond, sealed into a PTFE-coated stainless steel mount with an idium gasket.

- ZnSe – with mid-IR range of 8400 cm^{-1} to 650 cm^{-1}, good mechanical strength, not suitable for samples with very low or very high pH values
- AMTIR – a chalcogenide glass, covering 8400 cm^{-1} to 650 cm^{-1}. Excellent for acidic samples
- Germanium – with the range of 5500 cm^{-1} to 670 cm^{-1}, hard, chemically resistant and good for strongly absorbing samples
- Silicon – covering 8300 cm^{-1} to 1500 cm^{-1} and 350 cm^{-1} to 70 cm^{-1}. Scratch resistant and non-reactive
- Diamond – covers the entire mid-IR range with the exception of 2300 cm^{-1} to 1800 cm^{-1}. Extremely hard and chemically resistant. Withstands forces up to 6,000 psi (4 Kbar)

The Smart MIRacle HATR accessory uses a "building-block" principle, starting with the universal optical base. Crystal plates kinematically mount to the base, eliminating the need for alignment and allowing them to be exchanged quickly. The side of the plate has a mounting ring that accepts a wide range of sampling attachments. The micrometer controlled clamp, used for analysis of solid samples and some powders, mounts in the back of the base module and allows precise control of the pressure applied to the sample by a spring loaded plunger. The clamp can be easily removed when the Smart MIRacle is used for liquid sampling.

Specifications

Crystal Materials: Zinc Selenide, AMTIR, Silicon, Germanium or Diamond

Crystal Geometry: 1.6 mm

Sample Volume: 5 microliters or more

Standard Attachments: Trough plate with Teflon insert, micrometer controlled compression clamp, compression tip assortment and volatiles cover

Ordering Information

ACCESSORY	PART NUMBER
Smart MIRacle, ZnSe Crystal	869-083500
Smart MIRacle, Ge Crystal	869-083600
Smart MIRacle, AMTIR Crystal	869-083700
Smart MIRacle, Si Crystal	869-083800
Smart MIRacle, Diamond Crystal	869-114700

** Covered under US Patent #5,965,889*

Manufactured by:
PIKE Technologies

Smart DuraSamplIR and Smart DuraScope

For Single-Reflection, Diamond ATR Analysis

The Smart DuraSamplIR HATR Accessory has all the advantages of traditional ATR sampling with the added benefit of a diamond crystal. It uses Horizontal Attenuated Total Reflectance (HATR) technology to greatly simplify sample preparation. In addition, the hardness, strength, and chemical resistance of the diamond sensing element enable a high pressure device to be used, assuring intimate contact between the sample and the ATR element.

The Smart DuraScope has all of the features of the Smart DuraSamplIR plus DuraVision™, a system to simultaneously image and analyze your sample. DuraVision takes advantage of the diamond's clarity and transparency. The Smart DuraScope is a good choice for small samples.

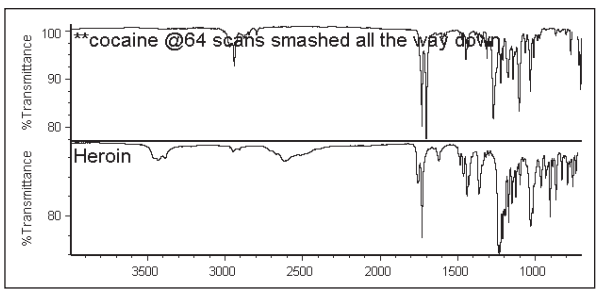
Example Applications

- Liquids ranging in pH from 1 to 14
- Hard, intractable materials
- Abrasive powders
- Painted metal panels
- Fibers
- Inclusions and contaminants down to 200 microns (DuraScope only)

Unique Features

The Smart DuraSamplIR sensing element, called a DuraDisk, is available with a 1, 3 or 9 reflection diamond element (1, 2 and 4 mm in size respectively). The ability to change DuraDisks gives access to a wide range of samples. The 1 and 3 reflection DuraDisks are ideal for samples requiring a high degree of compression such as polymer pellets as well as all liquids and powders. The 9 reflection DuraDisk is suitable for liquids.

Standard DuraDisk sampling heads are made from stainless steel; Hastelloy is available as an option for very corrosive samples. Heating is also available as an option on all DuraDisks.



Top: a single crystal of cocaine using the Smart DuraSamplIR
Bottom: a single crystal of heroin using the Smart DuraSamplIR

The diamond has a very low coefficient of friction, so most samples will not adhere to the surface. A wipe with a tissue is usually enough to clean the surface although any solvent may be used. Sandpaper, razors, and steel wool are also acceptable cleaning tools.

The sample compression device for the 1 and 3 bounce DuraDisk is a torque-limited device which applies sufficient force to compress even the hardest samples against the diamond element. In addition, it is open on three sides for the analysis of large samples. The tips are interchangeable for different sample shapes and are removable for easy cleaning.

The Smart DuraScope integrates video enhancement to create an analysis tool that is versatile, functional, and easy to use. The integrated camera design allows magnification up to 100X, depending on the size of the computer display. The integrated monitor allows the user to visually manipulate samples and observe the diamond-sample interface as the sample is compressed against the diamond.

The Smart DuraScope pressure device applies pressure but also serves as a light conduit to deliver room light to the back of the sample. This illuminates the sample sufficiently for image capture. For opaque samples that do not allow any light through, the Smart DuraScope is equipped with variable dual illumination capability which irradiate the sample through the diamond.

Specifications

Crystal Material: Diamond or Silicon

Spectral Range: Standard to 650 cm^{-1}; Optional to 230 cm^{-1}

Sampling Area: 1 reflection: 500 micrometers
3 reflection: 1.5 millimeters
9 reflection: 3 millimeters (DuraSamplIR only)

Depth of Penetration: 2 µm at 1000 cm^{-1}

Useful pH Range: 1 – 14

Sample Volume: 1 reflection: 1 microliters
3 reflection: 2 microliters
9 reflection: 5 microliters (DuraSamplIR only)

Ordering Information

ACCESSORY	PART NUMBER
Smart DuraSamplIR, 1 bounce	840-091600
Smart DuraSamplIR, 3 bounce	840-091500
Smart DuraSamplIR, 9 bounce	840-091400
Smart DuraScope, 1 bounce	869-091700
Smart DuraScope, 3 bounce	869-091800

Manufactured by:
Smiths Detection

Smart Golden Gate

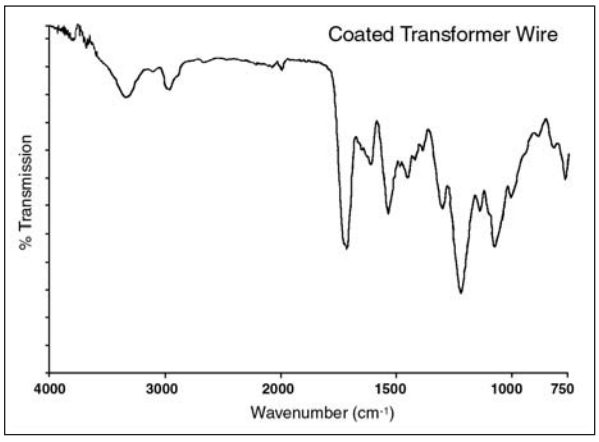
For Single-Reflection, Diamond ATR Analysis

The Smart Golden Gate Single Reflection Diamond ATR analyzes sample types from hard solids to corrosive liquids. This versatile infrared sampling instrument is fast, sensitive, and robust. Outstanding sensitivity is achieved using high pressure contact against a Type IIa diamond, selected for its unparalleled sensitivity as a single-reflection ATR element together with its unique physical and chemical stability. The accessory can be used to analyze a range of samples from single particles and fibers to corrosive liquids, and the large working area sample platform is ideal for macro sampling. The diamond is high temperature bonded into its tungsten carbide mount giving performance and strength to withstand the high pressures required for maximum optical contact with hard samples.

Because of the robust design of the Smart Golden Gate and the ability to apply very high pressures to the sample, this accessory can be used for almost any sample type in any research or QA environment. Little or no sample preparation is needed, the only requirement is that the sample is in optical contact with the diamond. With up to 200 pounds* available to achieve this, good spectra can be run from even the hardest rocks and powders. Special anvils are available to hold polymer pellets, to seal in and run air/moisture sensitive samples and analyze coatings on wires. The Smart Golden Gate is particularly suitable for samples which may polymerize or set on the crystal since they can be cleaned off with a knife or abrasive pads without causing any damage to the unit.

Example Applications

- Polymer pellets
- Intractable or opaque solids
- Single fibers
- Corrosive liquids
- Geochemical samples
- Powders
- Coated wires
- Air sensitive samples



Spectrum of coated wire collected using the Smart Golden Gate

Unique Features

Several features unique to the Smart Golden Gate relate to the mounting of the natural Type IIa diamond. This is brazed into a solid tungsten carbide disc at 1,200°C with a special metal solder. This imparts enormous strength and inertness to the ATR crystal assembly. A standard self leveling sapphire anvil is used to apply high pressure to the sample. A high efficiency refracting optical system gives very high optical throughput resulting in excellent signal-to-noise spectra with the standard DTGS detector.

- 45° single reflection type IIa diamond
- Brazed tungsten carbide diamond mount
- Fully enclosed beam condensing lens system
- Sapphire anvil for high pressure contact
- Reproducible pressure control to 200 pounds

Specifications

Crystal Material: Type IIa diamond

Maximum Supplied Load: 200 pounds

Spectral Wavelength Range: 5000 to 600 cm^{-1} ZnSe optics
5000 to 400 cm^{-1} KRS-5 optics

Ordering Information

ACCESSORY	PART NUMBER
Smart Golden Gate – ZnSe/Diamond	840-081500
Smart Golden Gate – KRS-5/Diamond	840-081600

** Applied load across the diamond surface.*

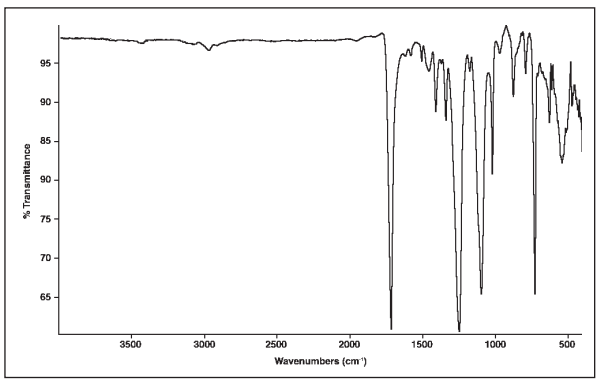
Manufactured by:
Smiths Detection

Smart SplitPea

Micro ATR Sampling for a Broad Range of Sample Types

The Smart SplitPea is a novel horizontal internal reflection (ATR) accessory with a sampling area less than 250 µm in diameter. The element is a unique, hemispherical silicon crystal that focuses the beam to the small spot size, maximizing sensitivity and allowing excellent surface data (ATR is a surface technique) from very small samples. It is configured to apply localized, known pressure that produces superior contact between the sample and the internal reflection element. Samples include: hard samples such as paint chips and combinatorial chemistry crowns; small samples, such as individual fibers and nanoliters of liquids; large samples, such as transparency film and defects. For positioning samples on the small sampling area, a 50X viewing microscope is available; the microscope viewer is also the pressure applicator so you can see your sample make contact with the crystal. For very small samples that are extremely hard, the Smart SplitPea is also available with a diamond element.

In addition to ATR sampling, the Smart SplitPea is well-suited to small spot size specular reflectance. The crystal plate is exchanged for an open-faced plate; the internal optics are already optimized.



20 micron PET fiber measured using Smart SplitPea configured with Silicon crystal

Example Applications

- Optically thick, hard samples
- Slightly curved samples
- Fibers
- Paint chips
- Nanoliters of liquids and pastes
- Defects on large panels
- Droplets of corrosive liquids
- Forensic samples
- Combinatorial chemistry beads

Unique Features

- Internal and external reflection capabilities provide application versatility
- High sample throughput due to little or no sample preparation
- Small sampling area – less than 250 micrometers in diameter for internal reflectance with a silicon crystal
- Inert internal reflection elements available for use from the Near-IR to the Far-IR
- The only micro-ATR with energy between 650 – 400 cm^{-1}
- Calibrated pressure applicator for reproducible ATR measurements. Designed to achieve optimal contact between the internal reflection element and hard surface solids
- Flip-up, streamlined pressure applicator for easy access to sampling area
- Spill-resistant cover

Specifications

Crystal Materials: Silicon or diamond

Sampling Area: Less than 250 micrometers

Two internal reflection holders with mounted Si hemispheres or one holder with mounted diamond prism

Sample holder adapter for studying powders by internal reflectance

External reflection sample holder and alignment mirror

Ordering Information

ACCESSORY	PART NUMBER
Smart SplitPea/Silicon	869-105100
Smart SplitPea/Silicon with ViewThru Press	869-105200
Smart SplitPea/Diamond	869-105300
Smart SplitPea/Diamond with ViewThru Press	869-105400

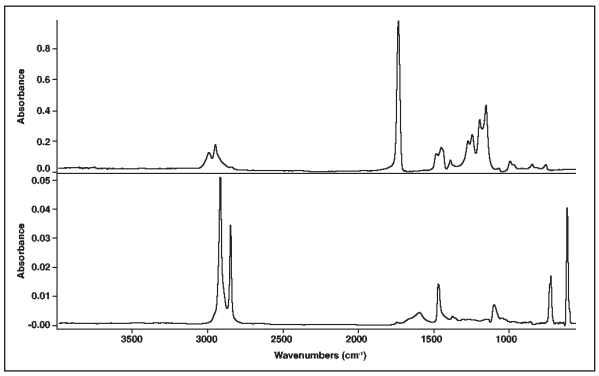
Manufactured by:
Harrick

Smart SpeculATR

Dual Technique Accessory for Economical Sampling Flexibility

The Smart SpeculATR is a dual technique Smart Accessory combining the almost universal sampling power of Attenuated Total Reflectance with the specialized sampling of specular reflectance. In ATR mode, the Smart SpeculATR is a single reflection Fresnel ATR accessory. When the ATR crystal disk is removed, the Smart SpeculATR becomes a 45° incidence specular reflectance accessory with multiple sampling area capabilities. The Smart SpeculATR is recommended for strongly absorbing samples especially when spectral subtraction is important for your analysis, and for those laboratories or samples that benefit from a multi-technique approach to sampling. The Smart SpeculATR comes with a choice of multiple crystal materials which can be quickly changed to adapt to different sample types or for variable depth sampling. The flexibility of the Smart SpeculATR combined with its extreme ease of use make this accessory an ideal choice for laboratories looking to increase productivity.

ATR is primarily a surface technique, and the depth of analysis into a sample is controlled by changing internal reflection elements. Specular reflectance provides sample data to a depth where the infrared beam is totally reflected. By coupling the two techniques, one strengthens the ability to generate a fairly detailed picture of a particular sample's profile. The Smart SpeculATR brings all of this capability into a single, low-cost package. The value of the accessory is even greater for laboratories analyzing some materials that work well with one technique and others that require a different sampling approach. And with the Smart SpeculATR, sample preparation is minimized or even eliminated.



Top spectrum: PMMA by Smart SpeculATR in specular reflectance mode. Bottom spectrum: polyethylene plus unknown additive in failed packaging material by Smart SpeculATR in ATR mode with silicon crystal

Example Applications

- Strongly absorbing liquids
- Pastes and gels
- Soft polymers
- Thin films

Specular Reflection is commonly used for measurement of thin films of greater than 1 micron, as well as diffusely scattering surfaces:

- Thin films on metals
- Resin coatings
- Painted surfaces on metals
- Polymer Coatings on metals

Unique Features

Fresnel ATR crystals are very inexpensive to replace or to add additional crystal materials to the accessory: roughly 25% of the cost of traditional ATR prisms. Crystals can be exchanged or replaced quickly with a snap-in ring plate crystal design and an elegant lock mechanism. This implementation of ATR also features extremely high throughout for enhanced sensitivity and signal-to-noise performance. The horizontal sampling surface is ideally suited for obtaining high quality infrared spectra – without the need for sample preparation. Additionally, the large crystal surface is ideal for high-sensitivity sampling of large surfaces or heterogeneous samples.

- Pinned in place mounting – allows you to change plates by simply lifting one off and snapping another in place
- Pressure device – ensures reproducible pressure and uniform optical contact between solid and powder samples and the crystal

Specifications

ATR Mode

Crystal Materials: three different user-changeable Fresnel ATR crystal materials: Zinc Selenide, Germanium, or Silicon

Crystal Angle: 45° angle of incidence

Specular Reflectance Mode

Angle of Incidence: 45°

Sampling Area: Masks of either 7 or 13 millimeters are available for the analysis of smaller samples

Ordering Information

ACCESSORY	PART NUMBER
Smart SpeculATR	0035-1XX

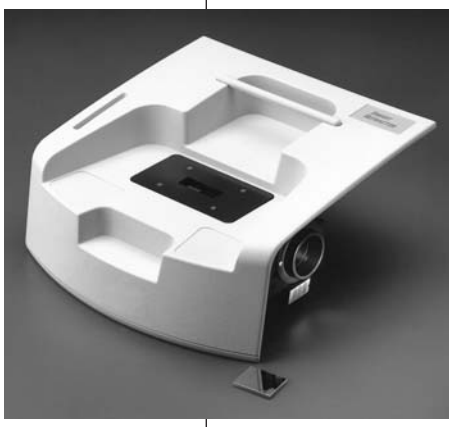
XX = 97 for Nicolet 380 XX = 99 for Nicolet x700 series

Manufactured by:

Thermo Electron Corportation

Smart Refractor

High Sensitivity Accessory for Grazing Angle Reflectance Studies

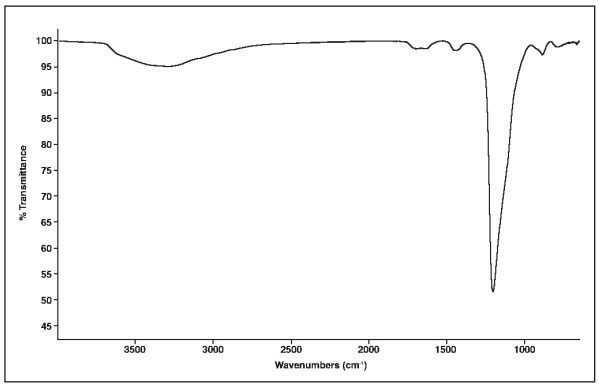


The Smart Refractor is a specular reflectance accessory for grazing angle studies. The Smart Refractor incorporates two wedged ZnSe windows to refract the beam to and from your sample. It also includes a pre-mounted, internal polarizing plate. This enhances spectral contrast by rejecting the 'S' polarized component of the infrared beam, which does not contribute to spectral data. This unique design uses no mirrors. It is recommended for very thin layers or coatings on reflective substrates. Its high angle of incidence and built-in polarization provide high sensitivity for extremely thin layers.

Due to the use of solely refracting optics, the Smart Refractor is capable of extremely high signal-to-noise performance and sensitivity for a grazing angle accessory. The horizontal, teflon-coated sample stage is ideal for flat samples that typically benefit from a grazing angle analysis. Simply lay the sample flat and collect data.

Example Applications

- Thin films on metal and semiconductor substrates
- Ultra-thin coatings
- Lubricants
- Residues
- Molecular monolayers



SiO_2 coating on aluminum surface measured with Smart Refractor

Unique Features

- Horizontal sampling surface for high sample throughput
- Fixed 75° incident angle and built-in, removable polarizer
- Two wedged ZnSe windows to refract the beam to and from the sample

Specifications

Angle of Incidence: 75° fixed

Sample Size: Minimum of 1.5 inches by .5 inches

Optics: All refractive, ZnSe windows standard

Polarizer: Silicon

Sampling Stage: Teflon-coated horizontal sampling surface

Ordering Information

ACCESSORY	PART NUMBER
Smart Refractor	869-105000

Manufactured by:
Harrick

Smart SAGA

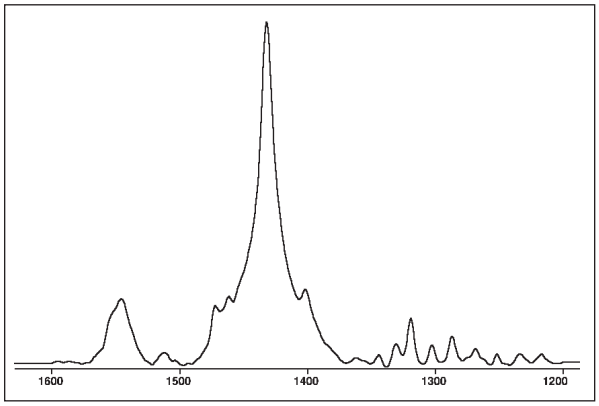
For Research Performance Grazing Angle Reflectance Studies

The Smart SAGA (Specular Apertured Grazing Angle) is ideal for grazing incidence analysis of sub-micron films on metallic substrates. Grazing angle reflectance is the technique of choice for analyzing thin coatings or deposits because the high angle of incidence increases pathlength of the infrared beam through the material of interest, significantly enhancing sensitivity. This accessory samples an average angle of 80 degrees from the normal. Analysis of films from 10 Angstroms to 0.5 microns is possible. A permanently mounted polarizer minimizes the 'S' polarized light which does not contribute to spectral data at the surface, increasing sensitivity and sampling speed. Samples are analyzed conveniently by placing them on a horizontal sampling surface and masked using a unique sliding aperture assembly.

This is an extremely easy accessory to use for grazing angle studies, yet it delivers superior performance and great sample area discrimination. Simply lay the sample flat on the horizontal sampling serve, position it using the laser-engraved grid if desired, turn the wheel to set the aperture size, and scan. Monolayer sensitivity is achievable due to the high angle of incidence and selective polarization.

Example Applications

- Ultra-thin coatings
- Adsorbed species on metal substrates
- Lubricants
- Surface contaminants
- Residues
- Molecular monolayers



Cadmium arachidate monolayer on a gold substrate analyzed with a Smart SAGA

Unique Features

In addition to the all of the advantages of Thermo Electron Smart Accessories, the Smart SAGA features a unique internal sliding aperture assembly to quickly provide sampling areas of different sizes. The aperture is set by simply rotating a calibrated thumb wheel on the front of the assembly. It defines the infrared beam area both before and after reaching the sample surface, using a revolutionary double-pass beam path. The design eliminates the need to soot apertures to reduce unwanted reflections, and allows accurate sample definition localized studies. The integrated polarizer allows the best possible sensitivity and signal-to-noise ratio.

The sample stage features a laser-engraved linear measurement grid that allows reproducible sample positioning for localized studies of larger samples. These markings provide spatial information about where data was collected on a sample that can be recorded for future reference.

- 80 degree fixed angle of incidence
- All gold reflecting optics
- Unique internal aperture sliding assembly providing four different shapes and sizes of sample definition. No need to soot the apertures
- Integrated polarizer to eliminate the 'S' polarized light and enhance the "P" polarized light component. The integrated design also protects the polarizer from contamination
- A laser engraved grid on the sampling plate to facilitate reproducible sample positioning and masking when performing quantitative analysis

Specifications

Angle of Incidence: Average 80° fixed

Sampling Area: Two circular active areas: 5mm, and 8mm; one oval active area of 16mm x 8mm, and open beam

Optics: Gold reflective

Sample Positioning: Laser-engraved measurement grid on sample stage

Polarizer: Germanium

Ordering Information

ACCESSORY	PART NUMBER
Smart SAGA	0033-1XX

XX = 97 for Nicolet 380 XX = 99 for Nicolet x700 series

Manufactured by:
Thermo Electron Corporation

Smart Collector

For Research Grade Diffuse Analysis

The Smart Collector, designed for the infrared analysis of solid samples, especially powdered materials, is one of the most advanced and versatile accessories for Diffuse Reflectance Infrared Fourier Transform Spectroscopy (DRIFTS). Diffuse reflection greatly simplifies the preparation of samples compared to traditional techniques such as KBr pellets and mulls. For the research laboratory environment, the Smart Collector utilizes a unique optical design that increases the percentage of diffuse reflection required to obtain nanogram levels of sensitivity. Combined with the environmental chamber option, the Smart Collector can perform a wide variety of diffuse reflectance experiments quickly and easily at elevated temperatures, high pressure, and vacuum conditions with minimal sample preparation.

Example Applications

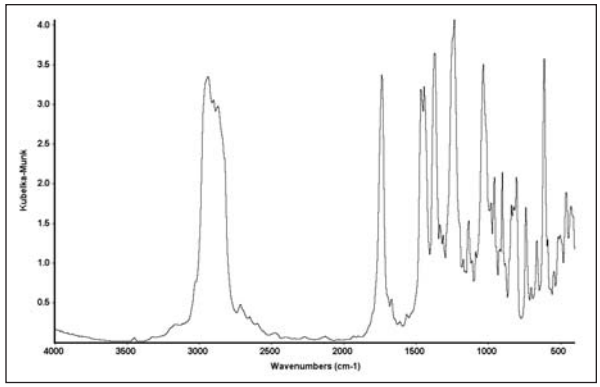
- Solids
- Powders
- Organic and inorganic samples

Unique Features

An infrared spectrum collected from other diffuse reflection accessories can be distorted by the presence of unwanted specular radiation from the front surface of the sample. This spectral distortion is typically observed with undiluted inorganic samples, and higher concentrations of strong infrared absorbers. This distortion can be observed as band inversion (Restrahlen bands) or derivative shaped bands. To eliminate this distortion, the Smart Collector incorporates unique collection optics that inherently maximize diffuse reflected radiation while minimizing the specular reflected component. This optical design also eliminates the need for any manual or automatic sample height adjustments because it is always at the optimum position and optical focus.

The Smart Collector is the only research diffuse reflectance accessory that has the optional, easy to use and install environmental chambers. These chambers can be quickly installed with minimal effort and with no realignment of the accessory. The ability to perform in-situ measurements of solid materials can provide invaluable information. Studies such as heterogeneous catalytic mechanisms, thermal degradation studies, and zeolite analyses can be monitored with any one of the temperature/pressure or vacuum chambers. Samples sensitive to oxygen or the atmosphere can be handled with the ambient chamber in a standard glove box.

The Smart Collector has been designed for high energy throughput and ease of use. The Smart Collector comes complete with two sample holders. One holder has two integral sample cups within it. Typically, one of the positions is loaded with the sample, and the other is loaded with a reference material such as potassium bromide (KBr). The integral sample cups eliminate the need to worry about small parts that can be easily lost and makes it easy to load



Cholesteryl acetate 1% in KBr collected using the Smart Collector

samples without the risk of dropping small sample cups. The second holder has an integral mirror mounted in it that can be used for performance testing, and a slot for a Si-Carb platen. The Si-Carb Sampling Kit is used to obtain spectra of hard, intractable samples, such as coatings, paints, and hard polymers. The Si-Carb kit includes the adhesive-backed silicon carbide paper that is used to abrade the surface to be analyzed, and a handle and platen to hold the paper. This technique transfers a small amount of sample to the disk. An infrared spectrum is obtained of the material clinging to the surface of the silicon carbide disk. If KBr is needed to dilute a sample for analysis, the convenient KBr Powder Packets can be used. Each of the KBr Powder Packets contains a convenient, pre-measured quantity of dry KBr for dispersing a sample.

Specifications

Sample Cup Volume: Approximately 0.25 gram

Environmental Chambers: Temperature, pressure and vacuum

KBr Powder Packets: Qty. of 25, (0.5 gram each)

Silicon Carbide Disks: 100 each Si-Carb adhesive backed disks, with 320 grit and 400 grit

Ordering Information

ACCESSORY	PART NUMBER
Smart Collector	0031-9XX
Smart Collector HT/HP/Vacuum Chamber	0031-901
Smart Collector Dual HT/HP/Vacuum Chamber	0031-902
Temperature Controller	0019-037

XX = 97 for Nicolet 380 XX = 99 for Nicolet x700 series

Manufactured by:
Thermo Electron Corportation

Smart Diffuse Reflectance

For Mid-infrared Diffuse Analysis

The Smart Diffuse Reflectance accessory is highly effective at maximizing diffusely scattered radiation while minimizing specular reflected radiation which is a source of spectral interference. Samples can be analyzed as is, with a slight amount of grinding or by grinding and mixing with potassium bromide (KBr). A wide variety of samples can be analyzed non-destructively.

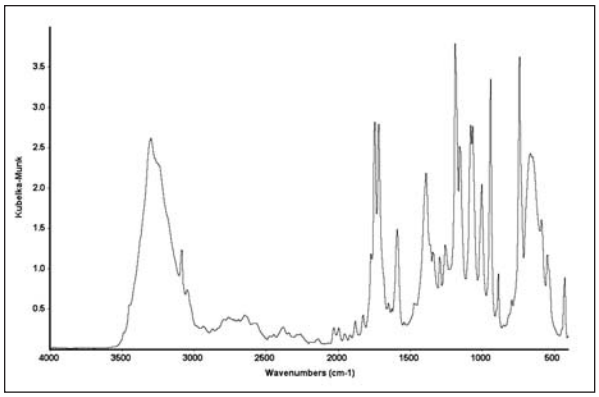
Example Applications

- Hard and soft powders
- Organic and inorganic materials
- Paint chips
- Inflexible sample that can be abraded with silicon carbide paper

Unique Features

The Smart Diffuse Reflectance accessory comes complete with two sample slides. One holder has two integral sample cups within it. Typically, one of the positions is loaded with the sample and the other is loaded with a reference material, such as KBr. The integral sample cups eliminate the need to worry about easily lost small parts, and are easy to load without the inconvenience of handling small sample cups. If KBr is needed to dilute a sample for analysis, the convenient KBr Powder Packets can be used. Each of the KBr Powder Packets contains a convenient, pre-measured quantity of dry KBr for dispersing a sample.

The Smart Diffuse Reflectance accessory is the only fully validated DRIFTS accessory for use in a regulated pharmaceutical environment.



Ninhydrin 1% in KBr collected using the Smart Diffuse Reflectance

The second holder is intended for use with the Si-Carb measuring system and has an integral gold mirror that can be used as a background reference. This sample slide also has a slot that holds the Si-Carb disk. The Si-Carb kit includes the adhesive-backed silicon carbide paper that is used to abrade the surface to be analyzed, plus a handle and sample plate to hold the paper. This technique transfers a small amount of sample to the disk. An infrared spectrum is obtained of the material clinging to the surface of the silicon carbide disk.

Specifications

Sample Cup Volume: 0.25 gram

Dual Sample Slide Holders: Si-Carb holder and powder sampler holder

KBr Packets: 0.5 gram packets (25)

Silicon Carbide Disks: 320 grit Si-Carb disks (100); 400 grit Si-Carb disks (100)

Ordering Information

ACCESSORY	PART NUMBER
Smart Diffuse Reflectance	0028-4XX
ValPro Qualified Smart Diffuse Reflectance for Nicolet 380	840-168800
ValPro Qualified Smart Diffuse Reflectance for Nicolet x700 series	840-168900

XX = 97 for Nicolet 380 XX = 99 for Nicolet x700 series

Manufactured by:

Thermo Electron Corporation

Smart NIR UpDRIFT

For Near-infrared Diffuse Analysis

The Smart NIR UpDRIFT is an innovative top-loading diffuse reflectance accessory for Thermo Electron's near-infrared series of spectrometers. The UpDRIFT utilizes a unique optical focusing system (a CPC, compound parabolic concentrator) that virtually eliminates the specular reflected component, which can distort spectral results. The UpDRIFT is designed for fast, easy analyses of solids and powders using the standard diffuse reflectance technique. Samples can be analyzed directly from plastic bags and most plastic and glass bottles, ranging in size from microvials to 6-inch diameter bulk sample carboys. This accessory can be used to either quantitatively or qualitatively measure a variety of sample morphologies.

Example Applications

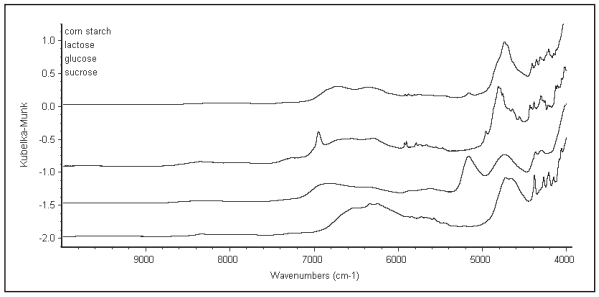
- Solids
- Powders
- Samples in either glass or plastic containers
- Quantitative and qualitative analysis

Unique Features

This accessory provides non-invasive sampling in the near-infrared spectral region. There is no need to remove your sample from its original container to obtain meaningful results. The UpDRIFT is well suited for routine measurements of powders, solids, and samples in either glass or plastic bottles. The sapphire window sampling surface is extremely rugged and scratch resistant making it an ideal choice in a demanding sample environment. The accessory provides three ways to analyze samples; solids and bottles can be positioned upright; bottles can be held horizontally; and loose powders can be analyzed directly on the sapphire window sample stage. The combination of the magnetic support block and the slide-mounted sample holders allow samples in a variety of bottle sizes to be analyzed easily.

The UpDRIFT accessory has an optical design that meets a wide range of near-infrared application needs and will exceed the user's performance expectations. The compound parabolic concentrator (CPC) is a highly efficient imaging system that collects the maximum amount of diffuse reflected radiation while minimizing the specular reflected radiation that can make spectra either difficult to interpret or not accurately fit a quantitative sample model. This optical design also eliminates the need for fine-tuning and tedious setups required by other optical configurations.

The UpDRIFT comes with a standard reference material, Spectralon®, in an easy-to-position holder. The UpDRIFT uses the reference to test the accessory's performance and can be used as a background material. Spectralon is useful for testing the performance because it diffusely scatters 99% of the energy applied to it while only 1% or less contributes to specular reflectance.



Samples measured in their glass vials using the Smart NIR UpDRIFT

Specifications

Spectral Range: 10000 to 4200 cm^{-1}
Optics: Polished Aluminum Compound Parabolic Concentrator (CPC)
Sample Surface Window Material: Sapphire
Sampling Area: 6 mm
Reference Material: Spectralon in Holder
Maximum Bottle Size: 6-inch diameter

Ordering Information

ACCESSORY	PART NUMBER
Smart NIR UpDRIFT	0027-0XX

XX = 97 for Nicolet 380 XX = 99 for Nicolet x700 series

Manufactured by:
Thermo Electron Corportation

Smart OMNI-Transmission

For Transmission Analysis

The Smart OMNI-Transmission is ideal when you need to make fast and accurate measurements of liquids, solids, or gases that are mounted in cells or cell holders and mounts. The Smart OMNI-Transmission optimizes the ease and speed with which basic transmission measurements are made. The accessory features one step, snap-in-place installation and automatically seals the sample compartment with its Quick-Purge™ feature. This capability drastically reduces the length of time between sample analyses and is extremely advantageous when analyzing a large number of samples in succession. Purging the sample environment during infrared analysis eliminates atmospheric water vapor and carbon dioxide that can obscure peaks of interest and complicated spectral subtractions. Typically, purging the main instrument sample compartment without a Smart Accessory can take up to five times longer to reach environmental equilibrium than with the Smart OMNI-Transmission accessory. The accessory has an enclosed design which is chemically resistant and will protect the instrument from contamination and spillage.

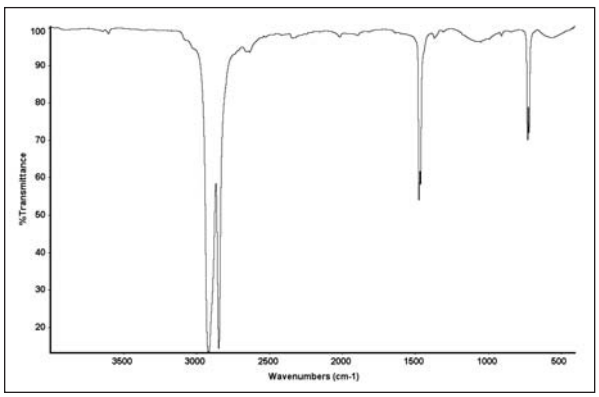
Example Applications

- Liquids, solids, or gases that are mounted in cells or cell holders and mounts
- Corrosive and caustic samples

Unique Features

The Smart OMNI-Transmission integrates several optimized features to make transmission measurements easier and even more precise. The sturdy construction of the enclosed system protects the user and spectrometer from chemical and environmental damage. When using corrosive or caustic materials, the Smart OMNI-Transmission accessory protects the spectrometer from potential accidental spillage.

To obtain faster results and higher quality spectral information, the Smart OMNI-Transmission accessory should be used to enhance transmission infrared analyses. The Quick-Purge feature dramatically decreases the time necessary between samples. With the Smart OMNI-Transmission accessory it takes two minutes or less to reach environmental equilibrium, while with the standard sample compartment holder it can take up to 11 minutes. The Quick-Purge feature eliminates atmospheric water vapor and carbon dioxide that can obscure peaks of interest and complicate spectral subtractions. Once a cell has been placed in the sample card/cell holder tray, a plastic insert can be installed to complete the purge features.



25 micrometer polyethylene film collected using the Smart OMNI-Transmission

Three inserts are included with the accessory – one is for the EZ-Flow Transmission cell and the other two can be customized for all other cells.

The Smart OMNI-Transmission accessory has four sample positions to accommodate KBr Pellet holders, Precision Pathlength liquid cells, infrared cards, film holders, gas cells and many other transmission tools. Each position is for optimizing the IR beam focus through different cells. The entire sample card/cell holder tray can be removed for easy cleaning with running tap water or by wiping with the appropriate solvent.

Specifications

Time to Reach Environmental Equilibrium: Two minutes or less

Purge Volume: Approximately 24 cubic inches

Sample Positions: 1 – 4 from left to right for optimizing the beam focus through transmission cards and cells

Maximum Cell Size: 50 millimeters

Ordering Information

ACCESSORY	PART NUMBER
Smart OMNI-Transmission	0028-1XX
Smart OMNI-Transmission Liquid/Mull Starter Kit	0029-1XX
Smart OMNI-Transmission Solid Starter Kit	0029-0XX

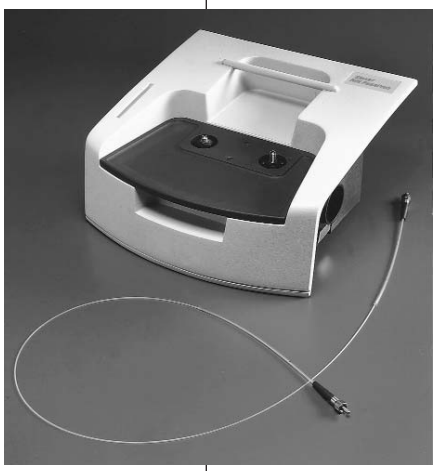
XX = 97 for Nicolet 380 XX = 99 for Nicolet x700 series

Manufactured by:

Thermo Electron Corporation

Smart NIR FiberPort

For Near Infrared Fiber Optic Analysis



A Near-IR Fiber Optics interface and a probe give the user the unique ability to bring the sampling accessory to the sample. This is extremely useful for analyzing samples that are at a remote location or for analyzing samples that are not the optimum shape or size to fit into a standard spectrometer sample compartment. Sampling can be as easy as touching the tip of the fiber optic probe to the sample. Polymers, pharmaceutical powders and tablets, foods, fabrics, and chemicals can all be analyzed easily with the NIR FiberPort interface and a probe such as the SabIR™. High quality, library-searchable spectra are obtained within seconds using the combined performance of the Smart NIR FiberPort and a Near-IR spectrometer.

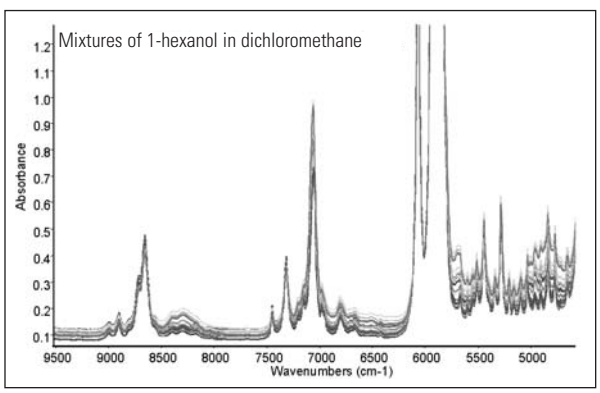
Example Applications

- Samples in remote locations
- Samples not conducive to being placed on a mounted crystal plate
- Polymers
- Pharmaceutical powders and tablets
- Foods
- Fabrics

Unique Features

The Smart NIR FiberPort is a unique transfer optic accessory that efficiently transfers near-IR energy to and from the spectrometer to the fiber optic cables and probe. The Smart NIR FiberPort is an innovative interface that employs a two mirror, two lens design. It utilizes the spectrometer's detector and eliminates the need for a specialized, dedicated detector. The system is designed to accept optical fibers and probes with a numerical aperture approximately equal to 0.22. The Smart NIR FiberPort utilizes industry standard SMA 905 connectors and assemblies.

The Smart NIR FiberPort comes complete with a test fiber that can be used to verify the performance of the accessory. It is a coated silica/silica fiber with a 365 µm core, and can transmit from 10000 – 4200 cm^{-1}.



Spectra from an incoming quality control check on bulk 1-hexanol are identified as dichloromethane using the Smart NIR FiberPort configured with a liquid dip probe

Any near-IR cables can be used to transmit the near-IR energy between the FiberPort and the probes. While almost any near-IR probe can be used, the typical probe that is used to analyze solids is the SabIR.

The SabIR includes a sampling probe that has stainless steel shaft construction and an embedded sapphire window at the sampling surface. The integrated cables are a bundle of high throughput, low -OH silica fiber, approximately 2 meters in length. The probe comes complete with a probe mount and reference material.

Dip probes of varying pathlength are also available for liquid analysis with the Smart NIR FiberPort.

Specifications

Useful Spectral Range:
10000 – 4200 cm^{-1} (1 to 2.5 µ)

Typical Fiber Material:
Low -OH silica glass

Integrated Launch and Detector Optics: Optimized refractive optics

Accepted Numerical Aperture: Approximately 0.2

Connectors: High-power SMA 905 assemblies

Ordering Information

ACCESSORY	PART NUMBER
Smart NIR FiberPort*	0027-8XX
SabIR**	840-072200

XX = 97 for Nicolet 380 XX = 99 for Nicolet x700 series

** Requires a Near-IR fiber optic probe*

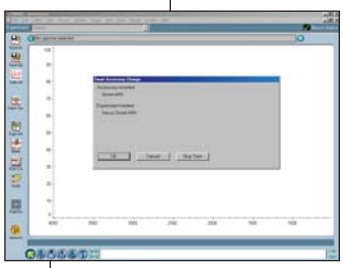
*** Requires the NIR FiberPort*

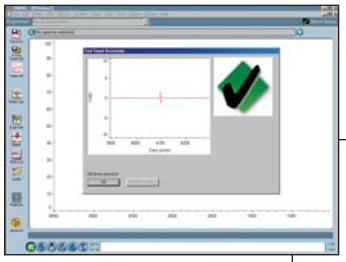
Manufactured by:
Thermo Electron Corportation

Success

The key to success in today's fast paced labs is having the correct accessory with the best suited spectrometer. Thermo Electron's Smart systems automate setup, testing, and operation. This makes sample preparation easy and ensures complete, reliable sampling performance. Installing a Smart Accessory turns a Nicolet 380 or x700 series spectrometer into a versatile analysis tool, enabling you to acquire high-quality spectra every time with complete confidence.

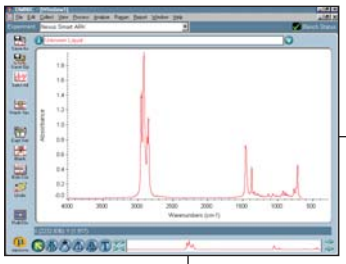
SET UP





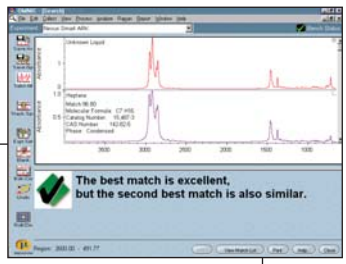
TEST

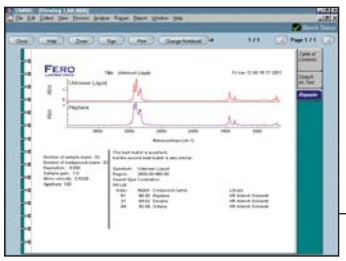
SAMPLE



ANALYZE

COMPARE





REPORT

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