

## Introduction

### Evolution in Infrared...



At Specac, we are justifiably proud of our pedigree in providing accurate and reliable infrared sampling accessories to academic, industrial and research institutions worldwide. Spectroscopists around the globe have depended continually upon Specac for innovative products that keep pace with the changing needs of their applications.

The driving force behind our expansion and change over the years has been our commitment to achieving total customer satisfaction. Our leading edge solutions for infrared spectroscopy have continued to deliver results in the fast changing environments of both the laboratory and process plant.



### Satisfying the expectations of our customers...

Specac delivers quality products engineered to meet your needs. Our accessories are easy-to-use and built to last. From polymer film preparation accessories, used for routine quality checks, to sophisticated, fiber-optic-coupled, remote sampling systems for reaction monitoring, Specac has the experience to provide the ideal sampling solution. Even if your application is not standard, you can draw upon the resources of our optical and mechanical engineering experts, as well as our specialist team of spectroscopists. Together we can satisfy your sampling requirements.



Our service to you does not stop there. We back our products with technical support and expertise. Whether you need advice in determining the best accessory for your application, or assistance with alignment or operation, a network of customer support representatives is on hand, worldwide.

## Introduction

Specac continually seeks to improve the quality of its products and services, and to maintain competitive prices, through cost engineering and investment in the latest technology. Cost effectiveness and durability are built-in to every product. This maximizes sampling flexibility by allowing you to expand your accessories as your sampling needs change.

If you use FTIR analysis Specac can deliver quality accessories, giving you genuine value for money. Join our many loyal and satisfied customers who choose Specac to deliver...

### ***Innovative Solutions for Infrared Spectroscopy™***



***Specify Specac™... Tomorrow's sampling today...***

### **Copyright Information**

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Benchmark ATR, Benchmark baseplate, DC-2, Diabrase, FIRst Aid Kit, Golden Gate, Minidiff Plus, Omni-Cell, Professional Sampling Kit, Selector, Silver Gate, Sirocco, Specacabinet, Specacard, Specadie, Specamill, "Innovative Solutions for Infrared Spectroscopy", "Specify Specac" and "Tomorrow's sampling, today" are trademarks of Specac Ltd. All other trademarks are the property of their respective companies.

Note: Due to the continual update of our products, some illustrations in this catalog may vary in detail to the actual products supplied.

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## Applications Index

This applications index has been constructed to help you identify the best accessory for your sampling application.

For any virtually any sample type there is an accessory for the transmission or reflection technique. The table below shows which accessories can be used for various sample types under various conditions. You can then find further information about each accessory in this table by clicking on the link.

	Accessory	Link	Solids	Liquids	Gases	Temp	Pressure	Flow
<b>Transmission</b>	Omni-Cell	<a href="#">GO!</a>	✓	✓				
	Variable Pathlength Cell	<a href="#">GO!</a>		✓				
	Variable Temperature Cell	<a href="#">GO!</a>	✓	✓		✓	✓	✓
	Heating Jackets	<a href="#">GO!</a>	✓	✓	✓	✓	✓	✓
	DC-2	<a href="#">GO!</a>	✓					
	Micro Samplers & Beam Condenser	<a href="#">GO!</a>	✓	✓				
	10cm Gas Cells	<a href="#">GO!</a>			✓		✓	✓
	Heated Gas Cell	<a href="#">GO!</a>			✓	✓		✓
	Sirocco Gas Cells	<a href="#">GO!</a>			✓	✓	✓	✓
	High Temperature/High Pressure Cell	<a href="#">GO!</a>	✓		✓	✓	✓	✓
	Accessory	Link	Solids	Liquids	Gases	Temp	Pressure	Flow
<b>Reflectance</b>	Golden Gate ATR	<a href="#">GO!</a>	✓	✓		✓	✓	✓
	Benchmark ATR	<a href="#">GO!</a>	✓	✓		✓	✓	✓
	Silver Gate Single Reflection ATR	<a href="#">GO!</a>	✓	✓		✓		✓
	25 Reflection ATR	<a href="#">GO!</a>	✓	✓				
	Selector (Diffuse)	<a href="#">GO!</a>	✓	✓		✓	✓	✓
	Environmental Chamber	<a href="#">GO!</a>	✓			✓	✓	✓
	Minidiff Plus (Diffuse)	<a href="#">GO!</a>	✓					
	Monolayer (Specular)	<a href="#">GO!</a>	✓	✓				
	Variable Angle (Specular)	<a href="#">GO!</a>	✓					
	Fixed Angle (Specular)	<a href="#">GO!</a>	✓					

## Transmission Spectroscopy

Transmission spectroscopy is the oldest and simplest technique for analyzing samples in the infrared. This method of analysis is based upon the absorption of the infrared beam by a sample at specific wavelengths. Different compounds each display a unique infrared spectrum allowing them to be identified. The extent of absorption 'A' is defined by the Beer-Lambert

Law:  $A=abc$  where 'A' is the absorptivity coefficient, 'b' is the pathlength, and 'c' is the concentration. This law enables scientists to use infrared data to determine quantitative information.

Small amounts of sample can be analyzed by using an appropriate microsample holder in conjunction with a beam condenser.

### Liquids

In transmission spectroscopy, liquids are analyzed as a thin film sandwiched between two windows in a liquid cell. The type of cell, choice of window material, and pathlength is determined by the sample. Samples can be analyzed neat, or diluted with an appropriate solvent. In order to perform quantitative analysis, the sample should be analyzed in a cell with a

known pathlength. A guide to pathlength selection for different concentrations in the mid infrared is shown here.

Analytical Concentration	Typical Pathlength
> 10 %	0.05 mm
10 % – 1 %	0.1 mm
1 % – 0.1 %	0.2 mm
< 0.1 %	> 0.5 mm

### Solids

A variety of methods exist for analyzing solid samples by transmission spectroscopy. Thin polymer films can be analyzed directly by using a film holder. Transmission spectra of solids can also be obtained by grinding the sample together with an infrared transparent matrix, such as KBr, and pressing the resulting powder into a thin disk. Another method of

analyzing solids is to make a mull by combining the sample with a liquid paraffin, such as Nujol, and placing it between two infrared transparent windows.

A diamond compression cell is available for transmission studies of single fibers and other micro samples.

### Gases

Gases have densities several orders of magnitude lower than liquids and solids at standard temperature and pressure. Therefore, transmission spectroscopy of gases requires cells with a longer pathlength than those used for liquid or solid analyses, usually 10 cm or longer.

Low concentrations of gases require a pathlength of several meters. This is achieved in a short space by using a multi-pass cell, where the infrared beam is bounced through the sample several times in order to obtain the desired pathlength.

**The Omni-Cell System**

***A Universal Transmission Cell for the analysis of liquids and mulls in FTIR or Dispersive Spectroscopy***



**Omni-Cell Body 01800**

The Omni-Cell System is a novel approach to the analysis of liquid samples in transmission spectroscopy - one cell is suitable for all applications.

The cells are compatible with all FTIR Spectrometers, as well as older dispersive systems. They can be configured easily for use as demountable liquid cells, permanently sealed liquid cells, or as mull cells.

Transmission is well established as a technique for analyzing samples in the infrared. The choice of window material, pathlength, and window configuration are determined by the sample and wavelength range of interest.

Samples can be analyzed neat or diluted with an appropriate solvent. For quantitative analysis, the sample is often analyzed in a cell with a known pathlength. A guide to the selection of the correct pathlength for various concentrations is shown opposite.

Solid samples can be analyzed using the mull technique. The solid is mixed with a mulling agent, such as Nujol, to form a mull. The mull is then analyzed between circular windows.

- Product Highlights**
- Quick to assemble and change windows
  - Windows and Spacers compatible with older cells
  - FTIR and Dispersive compatibility
  - Quick release clamping mechanism
  - Low cost and reliable
  - Wide choice of window materials

Analytical Concentration	Typical Pathlength
> 10 %	0.05 mm
10 % – 1 %	0.1 mm
1 % – 0.1 %	0.2 mm
< 0.1 %	> 0.5 mm



## The Omni-Cell System

These cells are shipped as a kit of parts, and require assembly.

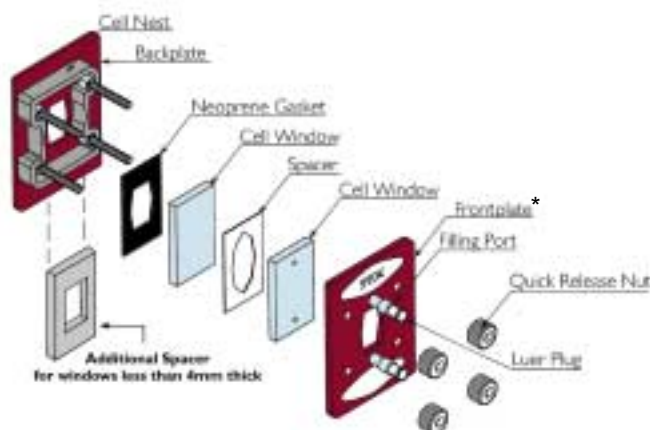
### **Demountable Cell**

This is a general-purpose cell for all liquids. It has the advantage of being easy to dismantle for cleaning, and for changing windows and spacers.

#### **Applications**

- General Purpose
- All liquids
- Quantitative analysis

### **Demountable Omni-Cell 01800 Windows (01810) and Spacer (01850)**



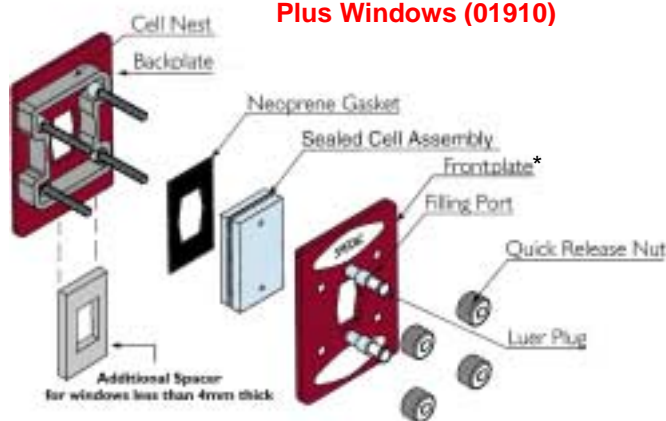
### **Sealed Cell**

The window pair and spacer are amalgamated as an assembly. The advantages of this cell are a constant pathlength for quantitative analysis and suitability for use with volatile liquids.

#### **Applications**

- Volatile liquids
- Quantitative applications
- Low viscosity liquids

### **Sealed Omni-Cell 01800 Plus Windows (01910)**



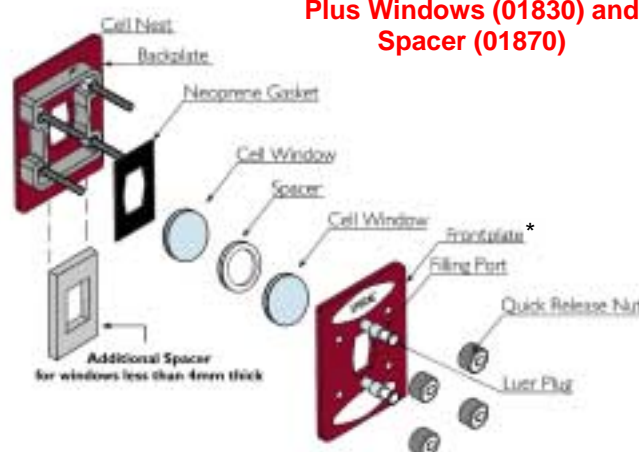
### **Mull Cell**

The Mull Cell does not use the standard liquid filling ports. The sample is placed directly onto one of the circular windows and the other window is then placed on top. The advantage is that very viscous liquids, gels, and pastes can all be analyzed easily.

#### **Applications**

- High viscosity liquids
- Gels and pastes
- Oils and greases
- Solids suspended as mulls

### **Mull Omni-Cell 01800 Plus Windows (01830) and Spacer (01870)**



\*The Front Teflon gasket is bonded to the front plate for ease of assembly

### Ordering Information Omni-Cell

Ordering an Omni-Cell is easy. Just order the Universal Omni-Cell Body, then the windows and the spacers to suit your application.

#### ***Universal Omni-Cell Body***

**01800** Omni-Cell Body.

*Includes front and back plates, cell nest, 4 quick release nuts, bonded front Teflon gasket, rear neoprene gasket and 2 Teflon Luer plugs.*

Requires, but does not include, windows and spacers.

#### ***Demountable Liquid Omni-Cell Window Pairs (Rectangular)***

- 01810** NaCl Liquid Omni Windows
- 01811** KBr Liquid Omni Windows
- 01812** CaF<sub>2</sub> Liquid Omni Windows
- 01813** BaF<sub>2</sub> Liquid Omni Windows
- 01814** \*ZnSe Liquid Omni Windows
- 01815** KRS-5 Liquid Omni Windows
- 01816** CsI Liquid Omni Windows
- 01817** CsBr Liquid Omni Windows
- 01818** \*Silica (IR) Liquid Omni Windows
- 01819** \*AgBr Liquid Omni Windows
- 01820** \*Silicon Liquid Omni Windows
- 01821** \*Polythene Liquid Omni Windows

#### ***Liquid Omni-Cell Spacers (Rectangular)***

- 01850** 0.05 mm Teflon Spacers (5)
- 01851** 0.10 mm Teflon Spacers (5)
- 01852** 0.20 mm Teflon Spacers (5)
- 01853** 0.50 mm Teflon Spacers (5)
- 01854** 1.00 mm Teflon Spacers (5)
- 01855** 0.025 mm Lead Spacers (5)
- 01856** 0.05 mm Lead Spacers (5)
- 01857** 0.10 mm Lead Spacers (5)
- 01858** 0.20 mm Lead Spacers (5)
- 01859** 0.50 mm Lead Spacers (5)
- 01860** 1.00 mm Lead Spacers (5)
- 01861** 0.006 mm Mylar Spacers (5)
- 01862** 0.012 mm Mylar Spacers (5)
- 01863** 0.025 mm Mylar Spacers (5)

#### ***Mull Omni-Cell Window Pairs (Circular)***

- 01830** NaCl Mull Omni Windows
- 01831** KBr Mull Omni Windows
- 01832** CaF<sub>2</sub> Mull Omni Windows
- 01833** BaF<sub>2</sub> Mull Omni Windows
- 01834** \*ZnSe Mull Omni Windows
- 01835** KRS-5 Mull Omni Windows
- 01836** CsI Mull Omni Windows
- 01837** CsBr Mull Omni Windows
- 01838** \*Silica (IR) Mull Omni Windows
- 01839** \*AgBr Mull Omni Windows
- 01840** \*Silicon Mull Omni Windows
- 1841** \*Polythene Mull Omni Windows

#### ***Mull Omni-Cell Spacers (Circular)***

- 01870** 0.05 mm Teflon Spacers (5)
- 01871** 0.10 mm Teflon Spacers (5)
- 01872** 0.20mm Teflon Spacers (5)
- 01873** 0.50 mm Teflon Spacers (5)
- 01874** 1.00 mm Teflon Spacers (5)
- 01875** 0.025 mm Lead Spacers (5)
- 01876** 0.05 mm Lead Spacers (5)
- 01877** 0.10 mm Lead Spacers (5)
- 01878** 0.20 mm Lead Spacers (5)
- 01879** 0.50 mm Lead Spacers (5)
- 01880** 1.00 mm Lead Spacers (5)
- 01881** 0.006 mm Mylar Spacers (5)
- 01882** 0.012 mm Mylar Spacers (5)
- 01883** 0.025 mm Mylar Spacers (5)

\*These windows require additional rear spacer for thin windows (01893)

**Permanently Sealed Omni-Cell Window Units (Rectangular With Lead Spacer)**

The table below gives the part numbers of the Sealed Cell Assemblies.

These assemblies require, but do not include, the Omni-Cell Body (01800)

<b>Material</b>	<b>0.025 mm</b>	<b>0.05 mm</b>	<b>0.10 mm</b>	<b>0.20 mm</b>	<b>0.50 mm</b>	<b>1.00 mm</b>
<b>NaCl</b>	01910	01920	01930	01940	01950	01960
<b>KBr</b>	01911	01921	01931	01941	01951	01961
<b>CaF<sub>2</sub></b>	01912	01922	01932	01942	01952	01962
<b>BaF<sub>2</sub></b>	01913	01923	01933	01943	01953	01963
<b>ZnSe*</b>	01914	01924	01934	01944	01954	01964
<b>KRS-5</b>	01915	01925	01935	01945	01955	01965
<b>CsI</b>	01916	01926	01936	01946	01956	01966
<b>CsBr</b>	01917	01927	01937	01947	01957	01967
<b>Silica (IR)*</b>	01918	01928	01938	01948	01958	01968

Silicon, AgBr and Polythene are not offered as permanently sealed cell units.

All rectangular window pairs and assemblies consist of one drilled and one undrilled window.

\*All windows are 4 mm thick except ZnSe, Silica (IR), AgBr and Si, which are 2 mm thick, and Polythene which are 3 mm thick. These windows require the additional rear spacer for thin windows (01893).

**Omni-Cell Spares And Consumables**

**01110** Luer Syringe (2 ml)  
**01890** Rear Neoprene Gaskets (2)  
**01891** Quick Release Nuts (4)  
**01892** Luer Plugs for Omni-Cell (2)

**01893** Spacer for thin windows (1)  
**03620** Bottle of Nujol (25 ml)  
**03621** Bottle of Fluorolube (25 ml)

## Window Polishing Kit

### Window Polishing Kit

#### Keep windows in top condition with the Specac Window Polishing Kit

This kit contains all the essential materials required to clean and repolish windows to a flatness of within a few fringes. Repolishing can be achieved efficiently and

economically with a minimum degree of skill. Full instructions are included and all consumable parts are replaceable.

#### Ordering Information Window Polishing Kit

##### 04000 Window Polishing Kit

*The Window Polishing Kit includes the following items. Each item can be ordered separately as spares:*

- 04030** Optical flat (glass plate)
- 04070** Glass polishing lap plate with polishing Selvyt
- 04010** (5) spare Polishing Selvyts (self adhesive pads for Glass polishing lap)
- 04020** Smoothing lap with lapping paper
- 04090** (5) spare lapping papers (for smoothing lap)

- 04040** Polyethylene bottle (2)
- 04050** Cleaning sponge
- 04060** Bottle of polishing rouge (approx. 75 g net)
- 04080** non adhesive Plain Selvyt strips (2)
- 04095** Brushes (2)



**Window Polishing Kit 04000**

## Variable Pathlength Cell

*A Cell that allows adjustment of sample pathlength in situ*



**Variable Pathlength Cell 07500**

### Applications

- Liquid analysis without dilution
- Determination of absorption coefficient

The Variable Pathlength Cell allows for a range of pathlengths to be studied in one cell. Rotation of the main body alters the pathlength of the cell over a range of 0 mm to 6 mm. The windows do not rotate in relation to the body movement and hence maintain parallelism throughout the pathlength range.

### Product Highlights

- Continuous adjustment of sample pathlength
- Micrometer and vernier scales for accurate pathlength setting and readability
- Standard slide mounting
- Non-rotating windows
- Pathlength variation: 0-6 mm
- Scale division: 5  $\mu$ m
- Volume at maximum pathlength: 4.5 ml

### Ordering Information Variable Pathlength Cell

- 07500** Variable Pathlength Cell with NaCl non rotating windows
- 07501** As 07500, but KBr windows
- 07502** As 07500, but CaF<sub>2</sub> windows
- 07503** As 07500, but BaF<sub>2</sub> windows
- 07504** As 07500, but CsI windows
- 07505** As 07500, but CsBr windows
- 07506** As 07500, but KRS-5 windows
- 07507** As 07500, but Fused Silica (IR) windows
- 07508** As 07500, but AgBr windows
- 07509** As 07500, but ZnSe windows

### Replacement Windows for Variable Pathlength Cell

- 07020** Set of NaCl windows
- 07021** Set of KBr windows
- 07022** Set of CaF<sub>2</sub> windows
- 07023** Set of BaF<sub>2</sub> windows
- 07024** Set of CsI windows
- 07025** Set of CsBr windows
- 07026** Set of KRS-5 windows
- 07027** Set of Fused Silica (IR) windows
- 07028** Set of AgBr windows
- 07095** Set of Polyethylene windows
- 07096** Set of ZnSe windows
- 07097** Set of Si windows

### Variable Pathlength Cell Spares and Consumables

- 01110** Luer syringe (2 ml)
- 07130** Neoprene gaskets for Variable Pathlength Cell (10)
- 07135** Luer plug and reservoir cap for Variable Pathlength Cell
- 07140** Teflon gaskets (0.1 mm) for Variable Pathlength Cell (10)
- 07150** Key for Variable Pathlength Cell

### Liquid, Solid, and Solid Gas Exchange Cells for the Variable Temperature Cell and Heating Jackets

The following cells are designed specifically for use with the Variable Temperature Cell (21525), and the Electrical and Water Heating Jackets (20730 and 20710). However, they can also be used at ambient temperatures with

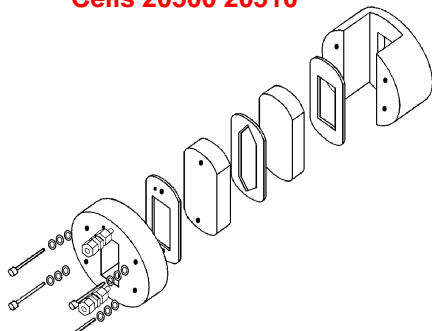
a special holder using a 3" x 2" mounting plate (20740).

The sealed liquid cells are shipped factory assembled.

### Sealed and Demountable Liquid Cells (20500 and 20510)



Sealed and Demountable Liquid Cells 20500 20510



Schematic of Liquid Cell

#### Product Highlights

- Choice of pathlength
- Sealed or demountable cells
- Variety of window materials
- Static or flow versions
- Luer fittings and stainless steel plugs

These liquid cells can be ordered in a variety of configurations. The choices include window material, pathlength, and static or flow configuration. If ordered as a flow cell, they will be configured as a flow cell for the Variable Temperature Cell. Flow cells for the Heating Jackets (20730 and 20710) have their own part numbers.

### Sealed and Demountable Liquid Cells Flow Kit for the Variable Temperature Cell

If you have a Sealed and Demountable Cell ordered as a static version it can be upgraded to a flow cell using this kit. The kit is designed to provide suitable connections for use in the Variable Temperature Cell.

The kit includes a cell front plate with 1/16" stainless steel tubing and appropriate tubing to make the necessary flow connections within the Variable Temperature Cell.



Liquid Cell Flow Kit (20800) for Variable Temperature Cell

### Sealed and Demountable Liquid Flow Cells for the Heating Jackets

Flow versions of the Sealed and Demountable Liquid Cells are available for use specifically with Heating Jackets (20730 and 20710). These cells consist of a standard liquid cell with a modified front plate with Swagelok connections. Tubing of 1/16" o.d. can be directly connected to these cells.

When fitting these cells into Electrical Heating Jacket a special version front retaining plate (20590) must be ordered to accommodate the Swagelok fittings.

#### Solid Cells (20600 and 20610)

##### Product Highlights

- Choice of sample sizes from 12 mm to 30 mm diameter and 0.1mm to 8 mm thick

Note that these flow cells do not fit the Variable Temperature Cell because of the Swagelok fittings.

#### Flow Cell (20570) for Heating Jackets



#### Solid/Gas Exchange Cells (20620)

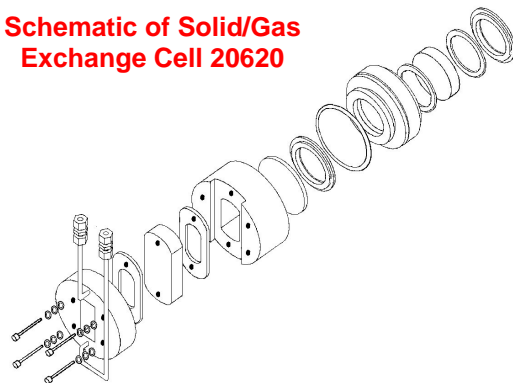
##### Product Highlights

- Surface Studies
- Rapid gas exchange
- Gold plated cell interior

#### Solid Cell (20600) for Heating Jackets



#### Schematic of Solid/Gas Exchange Cell 20620



#### Solid Cell (20610) For Variable Temperature Cell



#### Solid/Gas Exchange Cell 20620



## Ordering Information Liquid, Solid, and Solid Gas Exchange Cells for the Variable Temperature Cell and Heating Jackets

### Liquid Cells

#### Sealed Liquid Cells (Static)

*Includes a complete cell with front plate, top lead gasket, top window, lead spacer (choice of pathlength) and bottom window all sealed together.*

When ordering please specify:

1. Pathlength, 0.025, 0.05, 0.1, 0.2, 0.5 or 1.0 mm

**20500** Sealed Liquid Cell NaCl windows (static)

**20501** Sealed Liquid Cell KBr windows (static)

**20502** Sealed Liquid Cell CaF<sub>2</sub> windows (static)

**20503** Sealed Liquid Cell BaF<sub>2</sub> windows (static)

**20504** Sealed Liquid Cell CsI windows (static)

**20505** Sealed Liquid Cell CsBr windows (static)

**20506** Sealed Liquid Cell KRS-5 windows (static)

**20507** Sealed Liquid Cell Fused Silica (IR) windows

**20508** Sealed Liquid Cell ZnSe windows (static)

**20509** Sealed Liquid Cell Si windows (static)

#### Sealed Liquid Flow Cells for the Variable Temperature Cell

*Includes a complete cell with front plate, top lead gasket, top window, lead spacer (choice of pathlength) and bottom window all sealed together.*

When ordering please specify:

1. Pathlength, 0.025, 0.05, 0.1, 0.2, 0.5 or 1.0 mm

**20560** Sealed Liquid Flow Cell with NaCl Windows

**20561** Sealed Liquid Flow Cell with KBr Windows

**20562** Sealed Liquid Flow Cell with CaF<sub>2</sub> Windows

**20563** Sealed Liquid Flow Cell with BaF<sub>2</sub> Windows

**20566** Sealed Liquid Flow Cell with ZnSe Windows

Sealed Cells can be returned to your local Specac representative for refurbishment.





***Demountable Liquid Cells  
(Static)***

*Includes a complete cell with front plate, top Teflon gasket, top window, Teflon spacer (choice of pathlength) and bottom window all assembled together.*

When ordering please specify:

1. Pathlength, 0.05, 0.1, 0.2, 0.5 or 1.0 mm

- 20510** Demountable Liquid Cell NaCl windows (static)
- 20511** Demountable Liquid Cell KBr windows (static)
- 20512** Demountable Liquid Cell CaF<sub>2</sub> windows (static)
- 20513** Demountable Liquid Cell BaF<sub>2</sub> windows (static)
- 20514** Demountable Liquid Cell CsI windows (static)
- 20515** Demountable Liquid Cell CsBr windows (static)
- 20516** Demountable Liquid Cell KRS-5 windows (static)
- 20517** Demountable Liquid Cell Fused Silica (IR) windows (static)
- 20518** Demountable Liquid Cell AgBr (static)
- 20519** Demountable Liquid Cell ZnSe windows (static)
- 20531** Demountable Liquid Cell Si windows (static)
- 20532** Demountable Liquid Cell Spectrocil B windows (static)

***Demountable Liquid Flow Cells  
for the Variable Temperature Cell***

*Includes a complete cell with front plate, top Teflon gasket, top window, Teflon spacer (choice of pathlength) and bottom window all assembled together.*

When ordering please specify:

1. Pathlength, 0.05, 0.1, 0.2, 0.5 or 1.0 mm

- 20580** Demountable Liquid Flow Cell NaCl Windows
- 20581** Demountable Liquid Flow Cell KBr Windows
- 20582** Demountable Liquid Flow Cell CaF<sub>2</sub> Windows
- 20583** Demountable Liquid Flow Cell BaF<sub>2</sub> Windows
- 20586** Demountable Liquid Flow Cell ZnSe Windows
- 20587** Demountable Liquid Flow Cell Fused Silica (IR) Windows

***Sealed and Demountable Liquid Cells Flow Kit for the Variable Temperature Cell***

- 20080** Kit for converting static liquid cell to flow cell.

Includes a cell front plate with 1/16" stainless steel tubing and appropriate tubing to make the necessary flow connections within the Variable Temperature Cell.

## **Flow Cells for Heating Jackets**

### **Sealed Flow Cells**

*Includes a complete cell with front flow plate, top lead gasket, top window, lead spacer and bottom window all sealed together.*

When ordering please specify:

1. Pathlength, 0.025, 0.05, 0.1, 0.2, 0.5 or 1.0 mm

When used with the Electrical Heating Jacket requires, but does not include, Front Plate (20590).

**20570** Sealed Liquid Flow Cell with 1/16" Swagelok fittings, NaCl Windows

**20571** Sealed Liquid Flow Cell with 1/16" Swagelok fittings, KBr Windows

**20572** Sealed Liquid Flow Cell with 1/16" Swagelok fittings, CaF<sub>2</sub> Windows

**20573** Sealed Liquid Flow Cell with 1/16" Swagelok fittings, BaF<sub>2</sub> Windows

**20576** Sealed Liquid Flow Cell with 1/16" Swagelok fittings, ZnSe Windows

**20577** Sealed Liquid Flow Cell with 1/16" Swagelok fittings, Fused Silica (IR) Windows

Sealed Cells can be returned to your local Specac representative for refurbishment.



### **Demountable Liquid Flow Cells**

*Includes a complete cell with front flow plate, top Teflon gasket, top window, Teflon spacer and bottom window all assembled together.*

When ordering please specify:

1. Pathlength, 0.05, 0.1, 0.2, 0.5 or 1.0 mm

When used with the Electrical Heating Jacket requires, but does not include, Front Plate (20590).

**20580** Demountable Liquid Flow Cell with 1/16" Swagelok fittings, NaCl Windows

**20581** Demountable Liquid Flow Cell with 1/16" Swagelok fittings, KBr Windows

**20582** Demountable Liquid Flow Cell with 1/16" Swagelok fittings, CaF<sub>2</sub> Windows

**20583** Demountable Liquid Flow Cell with 1/16" Swagelok fittings, BaF<sub>2</sub> Windows

**20586** Demountable Liquid Flow Cell with 1/16" Swagelok fittings, NaCl Windows

**20587** Demountable Liquid Flow Cell with 1/16" Swagelok fittings, Fused Silica (IR) Windows

### **Front Plate for Flow Cells**

**20590** Special front retaining plate required if using Heating Jacket Flow Cells with Electrical Heating Jacket.

**Note that these flow cells do not fit the Variable Temperature Cell because of the Swagelock fittings.**

**Windows for Static Liquid Cells  
and Flow Cells**

- 20520** Pair of NaCl windows
- 20521** Pair of KBr windows
- 20522** Pair of CaF<sub>2</sub> windows
- 20523** Pair of BaF<sub>2</sub> windows
- 20524** Pair of CsI windows
- 20525** Pair of CsBr windows
- 20526** Pair of KRS-5 windows
- 20527** Pair of Fused Silica (IR)  
windows
- 20528** Pair of AgBr windows
- 20596** Pair of ZnSe windows
- 20597** Pair of Si windows
- 20598** Pair of Spectrosil B windows

**Liquid Cell Spares and  
Consumables**

- 20530** Lead Gaskets
- 20535** Tin Spacers
- When ordering please specify:  
1. Thickness, 6 or 12  $\mu\text{m}$
  
- 20540** Lead Spacers
- When ordering please specify:  
1. Thickness, 6 or 12  $\mu\text{m}$
  
- 20040** Front Teflon Gaskets (10)
- 20060** Rear Teflon Gaskets (10)
- 20050** Assorted Teflon Spacers (2  
each of 0.05, 0.1, 0.2, 0.5  
and 1.0 mm)
- 20070** Teflon Spacers (10)
- When ordering please specify:  
1. Thickness, 0.05, 0.1, 0.2, 0.5 or  
1.0 mm
  
- 10030** Flushing Tube Kit
- 10040** Threaded Luer Fitting
- 10050** Syringe Needles (10)
- 10060** Stainless Steel Plugs (2)
- 10070** Teflon Sealing Washers (10)

**Solids Holders**

- 20600** Solids Holder for Heating  
Jackets
- 20610** Solids Holder for Variable  
Temperature Cell

**Solid/Gas Exchange Cells**

*Includes complete cell with front  
plate, Teflon gaskets and windows  
of choice ready assembled. The  
Flow Kit for the Variable  
Temperature Cell (20080) is also  
supplied for fitting if desired.*

- 20620** Solid/Gas Exchange Cell,  
NaCl windows
- 20621** Solid/Gas Exchange Cell,  
KBr windows
- 20622** Solid/Gas Exchange Cell,  
CaF<sub>2</sub> windows
- 20623** Solid/Gas Exchange Cell,  
BaF<sub>2</sub> windows
- 20624** Solid/Gas Exchange Cell,  
CsI windows
- 20625** Solid/Gas Exchange Cell,  
CsBr windows
- 20626** Solid/Gas Exchange Cell,  
KRS-5 windows
- 20627** Solid/Gas Exchange Cell,  
Fused Silica (IR) windows
- 20628** Solid/Gas Exchange Cell,  
AgBr windows
- 20629** Solid/Gas Exchange Cell,  
ZnSe windows
- 20630** Solid/Gas Exchange Cell, Si  
windows
- 20631** Solid/Gas Exchange Cell,  
Spectrosil B windows

**Windows for Solid/Gas Exchange Cells**

- 20633** Pair of NaCl windows
- 20634** Pair of KBr windows
- 20635** Pair of CaF<sub>2</sub> windows
- 20636** Pair of BaF<sub>2</sub> windows
- 20637** Pair of CsI windows
- 20638** Pair of CsBr windows
- 20639** Pair of KRS-5 windows
- 20640** Pair of Fused Silica (IR) windows
- 20641** Pair of AgBr windows
- 20642** Pair of ZnSe windows
- 20643** Pair of Si windows
- 20644** Pair of Spectrocil B windows

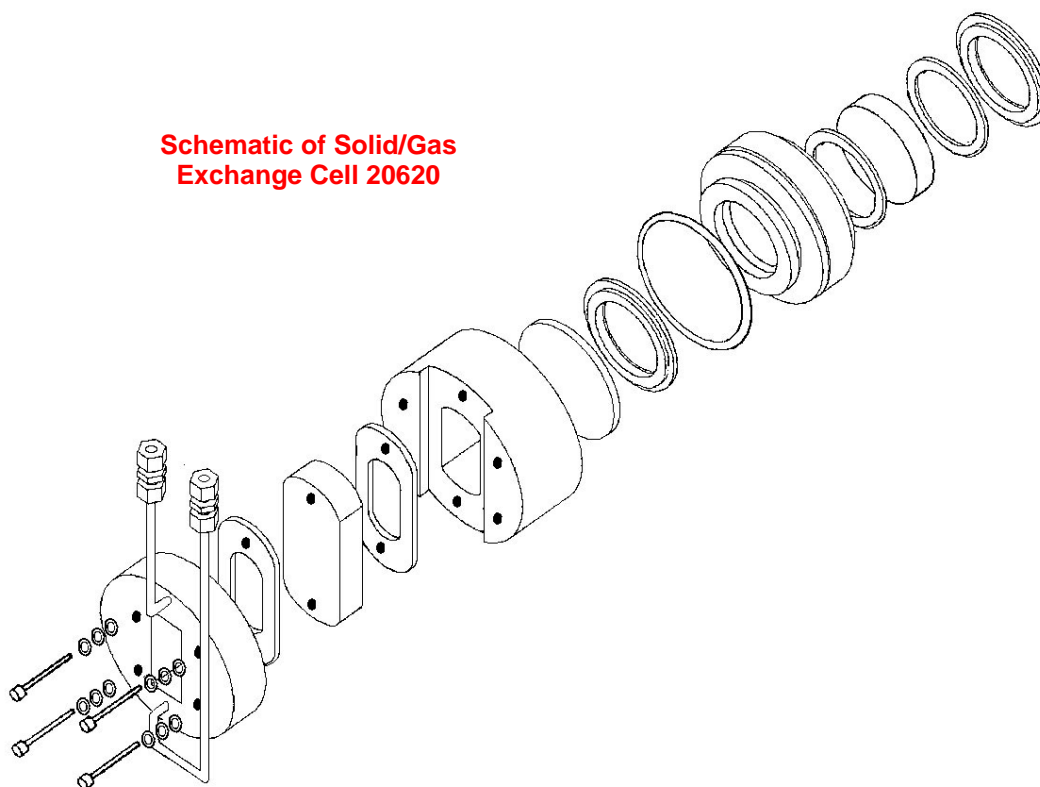
**Spares and Consumables for Solid/Gas Exchange Cells**

- 01871** Teflon Spacers 0.10 mm (5)
- 02090** Rear Neoprene Gaskets (10)
- 20040** Front Teflon Gaskets (10)

**Ambient Temperature Holder**

- 20740** 3" x 2" mount holder for all sample cells

**Schematic of Solid/Gas Exchange Cell 20620**



## The Variable Temperature Cell

### The Variable Temperature Cell

*For the analysis of liquids or solids between -190°C and 250°C*

#### Applications

- Analysis under extreme temperature conditions
- Absorption band study at low temperatures
- Polymerization studies
- Phase transition studies
- Reaction kinetics
- Polymorphism
- Catalysis
- Oxidation studies

#### Product Highlights

- Programmable controlled temperatures from -190 °C to 250 °C (Stability  $\pm 0.1^\circ\text{C}$ )
- Dewar cooling system
- Heated external windows prevent condensation
- Flow mode for liquids
- Solid sample gas exchange capability
- Baseplate or 3" x 2" mounts



**Variable Temperature Cell 21525**

The Variable Temperature Cell is the ideal accessory for the transmission study of liquid or solid samples at temperatures ranging from -190 °C to 250 °C.

The Variable Temperature Cell consists of a vacuum jacket with NaCl windows. Inside the cell is a refrigerant dewar and cell holder assembly. The cell holder assembly has a built-in heating block for high temperatures. Sample cells are inserted into the cell holder assembly and the whole is operated within a vacuum environment maintained by the outer jacket. Using a combination of refrigerant and control from the cell block heaters any temperature from -190 °C to 250 °C can be achieved. Choice of window materials allows for use of this accessory in the UV, visible and IR regions.

The Variable Temperature Cell is supplied with a high stability controller with an RS232 interface for optional independent control using a PC.

Special versions of this cell have been designed for use in Raman and Fluorescence applications. These cells use four ports and the samples are contained in cuvettes or bulbs. Please contact your local Specac representative for details

## The Variable Temperature Cell

### Ordering Information Variable Temperature Cell

#### **21525** The Variable Temperature Cell

*Includes refrigerant dewar/cell holder, Vacuum jacket with NaCl windows, Fixed thermocouple (copper-constantan) Low voltage supply cables, and High Stability Temperature Controller with RS232 interface.*

When ordering please specify:

1. 3" x 2" Slide Mount, or spectrometer make and model for Baseplate version
2. 220V or 110V and country of final destination.

Requires, but does not include, a liquid, solid, or solid/gas exchange sample holder.

#### **Variable Temperature Cell Windows (Jacket)**

- 20800** Pair of NaCl windows
- 20801** Pair of KBr windows
- 20802** Pair of CaF<sub>2</sub> windows
- 20803** Pair of BaF<sub>2</sub> windows
- 20804** Pair of CsI windows
- 20805** Pair of CsBr windows
- 20806** Pair of KRS-5 windows
- 20807** Pair of Fused Silica (IR) windows
- 20808** Pair of AgBr windows
- 20812** Pair of polyethylene windows
- 20896** Pair of ZnSe windows
- 20897** Pair of Si windows
- 20898** Pair of Spectrocil B windows

#### **Variable Temperature Cell Spares**

- 20200** Thermocouple (copper-constantan)
- 20810** Replacement set of O-rings
- 20650** 13 mm Disk Holder



## Heating Jackets

### Electrical Heating Jacket

***For liquid and solid sampling in transmission to 250 °C***

For transmission studies of liquids or solids up to 250 °C the Electrical Heating Jacket, used with a range of liquid, solid or gas exchange sample holders, is ideal. The sample cells are held in the jacket by a stainless steel retaining plate and quick release nuts.

The heating jacket system uses a low voltage heater integrated into the metal cell holder. The water-cooling, necessary for thermostatic control, acts as a thermal insulator and prevents heat transfer to the spectrometer via the standard 3" x 2" mount.

The Electrical Heating Jacket is supplied with a high stability power controller with RS232 interface for optional independent control using a PC.

#### Product Highlights

- Programmable controlled temperatures up to 250 °C
- Static or flow sampling capabilities
- Fully CE Safety compliant
- Protective water cooling system
- Standard 3" x 2" slide mount

**Electric Heating Jacket 20730**



### Water Heating Jacket

***For liquid and solid sampling in transmission to 90 °C***

The Water Heating Jacket is similar to the Electrical Heating Jacket, but it uses circulating water to heat the sample cell. A jacket around the circular aperture is filled with a solution, for example water, heated by a thermocirculating system. Temperature control of the sample holder is reliant upon this thermocirculating system.

The sample cell holders used with Electrical Heating Jacket can also be used in this accessory.

**Water Heating Jacket 20710**



## Heating Jackets

### Ordering Information Heating Jackets

#### **20730** The Electrical Heating Jacket

*Includes, low voltage heated jacket with water cooling system, NiCr/NiAl thermocouple, High Stability Temperature Controller with RS232 interface.*

When ordering please specify:

1. 220V or 110V and country of final destination.

Requires, but does not include, a liquid, solid, or solid/gas exchange sample holder.

#### **20710** The Water Heating Jacket

*Includes, Water Heating Jacket on a 3" x 2" mount*

Requires, but does not include:

1. A liquid, solid, or solid/gas exchange sample holder.
2. Thermocirculating system



**Electric Heating Jacket 20730**



**Water Heating Jacket 20710**



### Special Transmission Cells

Specac produces a large range of transmission cells to suit special requirements from the ultraviolet to mid infrared regions of the spectrum. These cells may be mounted directly into sample compartments, or coupled to Spectrometers with fiber optic systems.

Pressure capabilities up to 5000 p.s.i. are available, with pathlengths from sub-millimeter to several centimeters for liquids, and even longer for vapor phase cells. Short path cells and flow cells can be supplied with wedged spacers. This removes problematic interference fringes from the spectra. Specac short path flow cells use a unique system to ensure a smooth flow pattern, even with viscous samples. Extra ports to improve purging can also be specified. Body construction and seal materials can be specified to suit your requirements. O-rings and gaskets are used for the vast majority of seals, but in extreme cases Specac can supply both quartz and sapphire, diffusion bonded directly into stainless steel substrates.

Specac has a range of liquid and vapor phase high-pressure cells for remote sensing in the chemical industry. Using water-free quartz fibers it is possible to monitor a process in the near infrared several hundred meters away. Multiplexers allow the possibility of looking at several processes with a single spectrometer. Again, the choice of materials can be specified, together with the type of fittings required. Heating jackets are also available for these cells.

There are also special versions of the more standard Specac Cells. In addition to our standard Liquid Cells for the Variable Temperature Cell, Specac can provide special high pressure liquid cells. These cells fit in the Variable temperature cell and Heating Jackets, and, when fitted with sapphire windows, can withstand pressures of up to 5000 p.s.i.. Also, special long pathlength versions of the Omni-Cell System can be provided. Standard Omni-Cell bodies will accommodate pathlength spacers of up to 10mm, but for 10 mm pathlengths and above the Omni-Cell body can be adapted.

For modifications to meet specialist requirements, please contact your local Specac representative.



## DC-2 Diamond Compression Cell

***A Universal Diamond Compression Cell specially designed for FTIR microscopes and the Specac Microfocus Beam Condenser***

### Product Highlights

- Flat type Ila diamond windows
- High temperature diamond-to-metal bonding into tungsten carbide
- Large clear aperture 1.5 mm
- Hastelloy body construction
- Universal use with FTIR microscopes and Microfocus Beam Condenser
- High working pressure, high throughput

The DC-2 is a unique diamond compression cell, using proven high temperature diamond-to-metal bonding technology for maximum strength and durability.

The cell consists of two Hastelloy plates containing a pair of diamond windows. This enables samples to be compressed to an ideal thickness for transmission measurements. This means that sample preparation is minimal, and the samples are ready for direct analysis on an FTIR microscope stage.

No tools are required, making sample loading both quick and simple. The screw down compression system gives non-rotating uniform pressure across the sample and the large clear aperture is ideal for multiple sample loading.

Our unique diamond mount. Provided a significant strength advantage. Because of this strength we can minimize the thickness of the diamond, allowing us to achieve the highest optical throughput for this type of micro transmission cell.

### Applications

- Compression to optimum transmission thickness of polymers, rubbers and minerals
- Microanalysis of brittle, elastic, semi-rigid fibers, particles and fragments



**DC-2 Diamond Compression Cell 02550**

## Microfocus Beam Condenser

***A rugged, high performance 4x Beam Condenser specially designed for use with the DC-2 Diamond Compression Cell***

In combination with the DC-2 Diamond Compression Cell, this system can be used for the analysis of virtually all solid samples by transmission. The beam condenser uses lens focussing requiring minimal adjustment for maximum ease-of-use. The compact design ensures minimum pathlength through the accessory.

The system is compatible with all FTIR spectrometers. Snap-in location ensures the compression cell is easily and reproducibly installed in the Microfocus Beam Condenser. The Microfocus Beam Condenser is baseplate mounted for optimal support and stability using a standard Specac Benchmark baseplate.

ZnSe lenses are standard, but KRS-5 lenses are available as an option for extended wavelength work.



**Microfocus Beam Condenser 02560**

**Ordering Information Diamond Compression Cell and Microfocus**

***Diamond Compression Cell***

**02550** DC-2 Diamond Compression Cell



***Microfocus Beam Condenser***

**02560** Microfocus Beam Condenser with ZnSe lenses

When ordering please specify:

1. Spectrometer make and model

**02561** Microfocus Beam Condenser with KRS-5 lenses

When ordering please specify:

1. Spectrometer make and model

***Microfocus Beam Condenser and Diamond Compression Cell Kits***

**02551** DC-2 kit

*Includes, DC-2 Diamond Compression Cell, Microfocus Beam Condenser with ZnSe lenses, Forceps, Stainless steel sample needle, Sample preparation knife, Blades (10), Blade remover (2),*

When ordering please specify:

1. Spectrometer make and model,

**02552** DC-2 Kit. As per 02551, but with KRS-5 lenses.

When ordering please specify:

1. Spectrometer make and model

***Microfocus Options***

**02570** KRS-5 lens kit for use with Microfocus Beam Condenser

**20571** ZnSe lens kit for use with Microfocus Beam Condenser

***Microfocus Spares and Consumables***

**02508** Sample forceps

**02509** Stainless steel sample needle

**02510** Sample preparation knife with blades (10) and blade remover



## 10 cm Gas Cells



**10 cm Stainless Steel Gas Cell 05800**

### Product Highlights

- Demountable for ease of cleaning and window replacement
- Choice of cell material: stainless steel or Pyrex
- Choice of window materials
- Window diameter : 47 mm
- Clear aperture: 39 mm
- Two ports for static or flow experiments
- Slide mounted cell holder (optional)

### Applications

- Qualitative gas analysis
- Residual solvent vapor analysis
- Liquid head-space analysis



**10 cm Pyrex Gas Cell 05000**

These gas cells are ideal for analyzing gases and vapors at room temperature and low pressures. Gases and gaseous mixtures can be examined in static or flow modes.

The cells consist of threaded cylindrical vessels with end caps, and window seals, removable windows are supplied separately. The cell bodies are available in Pyrex and stainless steel.

Stopcock valves are used for introducing samples into these cells.

## 10cm Heated Gas Cell

The 10 cm Heated Gas Cell analyzes gaseous samples and vapors from room temperature to 250 °C. The cell is an evacuable stainless steel chamber with an injection septum sample introduction port. It is heated by a low voltage heater surrounding the body. The temperature can be measured with a thermocouple passing through a vacuum tight seal into the gas cavity.



**10 cm Heated Gas Cell 05660**

The cell is supplied with a High Stability Temperature Controller with RS232 interface for optional independent control using a PC.

### Product Highlights

- Stainless steel construction
- Stainless steel vacuum stopcock
- Chemically resistant window seals
- Choice of window materials
- 10 cm pathlength/38 mm clear aperture
- Low voltage heater system for operator safety
- Programmable controlled temperature with RS232 interface
- Slide mounted
- Flow mode (optional)
- Window size 47 mm diameter

### Applications

- Gases and vapors at elevated temperatures
- Vapors generated by solids and liquids at elevated temperatures
- Decomposition studies

## Ordering Information 10 cm Gas Cell

### 10 cm Gas Cells

**05000** 10 cm Pyrex Gas Cell  
Requires, but does not include:

1. Cell Windows
2. Cell Mount (05030)



**05800** 10 cm Stainless Steel Gas Cell

Requires, but does not include:

1. Cell Windows
2. Cell Mount (05030)

### 10 cm Gas Cell Windows

The following windows can be used for the 10 cm Pyrex, Stainless Steel, and Heated Gas cells.

Please note that the windows are included when ordering the 10 cm Heated Cell.

**05020** Pair of NaCl windows

**05021** Pair of KBr windows

**05022** Pair of CaF<sub>2</sub> windows

**05023** Pair of BaF<sub>2</sub> windows

**05096** Pair of ZnSe windows

**05024** Pair of CsI windows

**05025** Pair of CsBr windows

**05026** Pair or KRS-5 windows

**05027** Pair of Fused Silica (IR) windows

**05028** Pair of AgBr windows

**05095** Pair of Polyethylene windows

**05097** Pair of Si windows

**05098** Pair of Spectrosil B windows

### 10 cm Pyrex and Stainless Steel Gas Cells Cell Mounts

**05030** Cell Mount for Pyrex and Stainless Steel Gas Cell

### 10 cm Heated Gas Cells

**05660** 10 cm Heated Gas Cell with NaCl windows

*Includes: High Stability*

*Temperature Controller with RS232 interface, windows, Cell Mount.*

When ordering please specify:

1. 220V or 110V and country of final destination.

**05661** 10 cm Heated Gas Cell with KBr windows, as per 05660.

**05663** 10 cm Heated Gas Cell with BaF<sub>2</sub> windows, as per 05660.

**05664** 10 cm Heated Gas Cell with CaF<sub>2</sub> windows, as per 05660.

**05666** 10 cm Heated Gas Cell with ZnSe windows, as per 05660.

### Pyrex and Stainless Steel Gas Cells Spares and Consumables

**05040** Complete seal kit for Pyrex Gas Cell

**05803** Vacuum valve for Stainless Steel Gas Cell

**05804** Complete seal kit for Stainless Steel Gas

### Heated 10 cm Gas Cell Spares and Consumables

**05662** Stainless steel flow tubes(10)

**05665** Injection Septa (10)

**05667** Complete seal kit

## Sirocco Heatable Long Path Gas Cells

*Long pathlength cells for the detection of gases at ppm levels.*

### Product Highlights

- Borosilicate glass bodywork
- Silver or gold mirrors (protected)
- Benchmark series baseplate mounting
- Nickel plated aluminum internal bodywork
- Vacuum gas inlet / outlet taps
- Adhesive free construction
- Removable mirror carriages
- Standard pressure range  $\pm 15$  p.s.i.
- Pathlength calibration
- Purgeable transfer optics
- KBr windows

### Advanced Product Options

- ZnSe windows
- Nickel plated aluminum bodywork for pressures up to 125 p.s.i.
- Variable pathlength mirror carriages
- Fixed to variable pathlength upgrade
- Heating to 200 °C with electronic control
- Laser alignment facility
- Desiccator storage caps
- Purge bellows
- Pressure gauge kit

The Sirocco series is a range of fixed and variable long pathlength gas cells. They have a comprehensive range of standard features, and many advanced, optional features, such as Heating Jackets.

The standard borosilicate glass bodied cells are available in 3 sizes: 2 m, 5 m and 10 m. The 5 m and 10 m cells may be ordered as

variable pathlength cells for maximum flexibility, or as fixed pathlength cells for routine applications. For optimum versatility there is are many options including choices of nickel coated aluminum or glass body, window material, mirror coatings, and seal materials. The cells have a variety of interfacing optics to allow use on all FTIR spectrometers.

**Glass Bodied Sirocco Gas Cell**

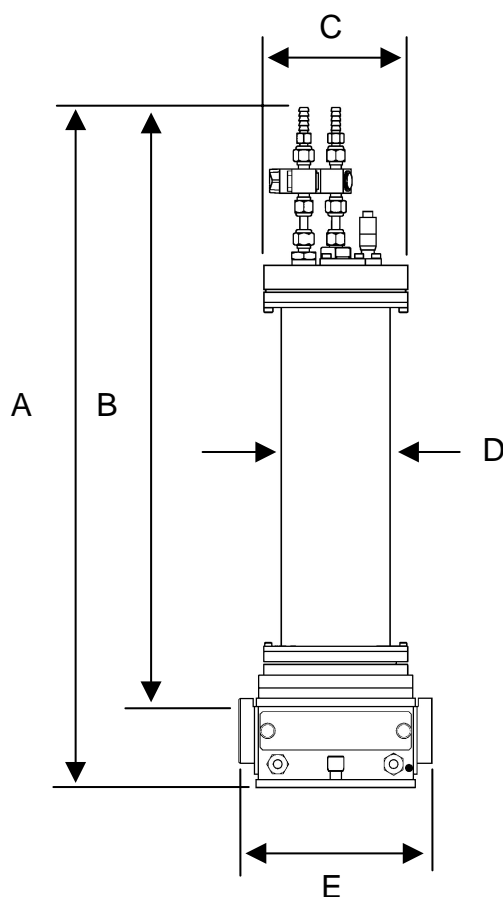




## Sirocco Heatable Long Path Gas Cells

All of the cells are equipped with the basic standard features and can be configured to best suit a specific application. The cell specification can be changed to meet different experimental requirements. All cells are pre-tested to  $10^{-3}$  Torr as a safety check. The optional Heated Jacket and Controller both comply with European CE safety regulations and can therefore be used with absolute confidence.

To ensure perfect operation and freedom from unwanted impurities a number of features have been built in to the design and manufacture of the Sirocco cells. The cells are completely free from adhesive and all the Viton o-ring seals are pre-baked to eliminate any contamination from solvents or outgassing. Internal screws have small bleed holes drilled into them to prevent any trapped pockets of gas causing sample cross contamination.



### ***Specifications of the Sirocco Cells***

Cell	A	B	C	D	E
2m	384	314	73	46.5	153
5m	536	466	114	86.5	153
10m	540	470	142.5	113.2	153

(All dimensions in mm)

## Sirocco Heatable Long Path Gas Cells

P/N	Cell Type	Base Pathlength	Volume	Pathlength Available
24102	2 m	12.5 cm	0.19 liters	0.5 to 2.5m*(in 0.5m steps)
24105	5 m	25.0 cm	1.33 liters	1 to 8m (in 1m steps)
24110	10 m	26.4 cm	2.60 liters	2.1 to 10.6m (in 1.056m steps)

\*The 2 m cells have these pathlengths fixed only (factory set). The variable pathlength option is offered only for 5 m and 10 m cells. This allows for adjustment between the range of pathlengths specified.

All of the cells have been rated to a vacuum of  $3 \times 10^{-3}$  Torr ( $4 \times 10^{-3}$  mbar).

In order to see beam passes in a cell and for alignment purposes we recommend the Laser Alignment Accessory (24500).

### Options for Sirocco Gas Cells

#### Heating Jacket

All of the Sirocco Cells (glass and metal bodied versions) can be upgraded to heated gas cells with an appropriate heating jacket and electronic temperature controller.

The heating jacket simply slides over the Sirocco Gas Cell and can be operated from ambient up to 200 °C using the electronic controller. The controller also has RS232 interface allowing independent control with a PC. Temperature stability is  $\pm 1$  °C.

A key feature of the heating jacket design is the uniformity of the temperature achievable throughout the entire gas cell. This prevents localized "hot spots" within the cell.



Heating Jacket for Sirocco Gas Cell

### **Benchmark Series Laser Alignment Accessory**

This accessory allows visual verification of the optical pathlength through a Sirocco Cell. The pathlength is determined by counting the array of spots on the field mirror. The accessory is based on a low power (0.8 mW) visible continuous wave LED, secured in a fixed position in a Benchmark accessory alignment housing. The gas cell is simply installed into the alignment accessory. The 635 nm Class II laser can be powered from a battery unit or the special mains transformer supplied.



**Laser Alignment Accessory 24500**

### **Desiccant Storage Caps**

These caps are designed to fit over the inlet and outlet ports of the transfer optics box to seal the cell unit when not in use. One of the caps contains a desiccant material to maintain a dry atmosphere within the transfer optics box, extending the life of the windows in the cell.



**Desiccant Storage Caps 24150**

### **Pressure Gauge Kit**

A Pressure Gauge Kit is available to fit all metal bodied cells. Specac recommend the use of a pressure gauge when using the gas cells at elevated pressures.

Metal bodied cells are not available with KBr windows due to upper pressure limits of 125psi obtainable with these cells.

### QA Soft Database and Quantitative Analysis Programs

QA Soft is an automated quantitative analysis program enabling quantitative measurement of all infrared active gases to ppm sensitivity. The program will even work with complex mixtures where the bands in the spectra are overlapping.

The software is formatted for Grams 32 or Grams 386 and can be provided on 3 1/2 " disks or in CD-ROM format. The database contains 254 spectra of common gases at a resolution of 0.5  $\text{cm}^{-1}$ .

The data is digitized at 0.25  $\text{cm}^{-1}$ , 0.5  $\text{cm}^{-1}$ , 1.0  $\text{cm}^{-1}$  and 2.0  $\text{cm}^{-1}$ . Spectra carry full header information relating experimental parameters. Quantitative information is extracted using special integration and subtraction algorithms. These are more powerful than the classical least-squares technique, particularly when data consists of overlapping spectra with unidentified contributors.

## Ordering Information Sirocco Gas Cells

### **Sirocco Gas Cells**

**24102** Two meter fixed pathlength Sirocco Cell.

When ordering please specify:

1. Silver or Gold mirrors
2. Fixed pathlength, 0.5, 1.0, 1.5, 2.0 or 2.5 m
3. Window material, KBr or ZnSe
4. Body material, Glass or metal
5. Spectrometer make and model.

**24105** Five meter Sirocco Cell

When ordering please specify:

1. Silver or Gold mirrors
2. Fixed pathlength, 1, 2, 3, 4, 5, 6, 7, or 8 m, or variable pathlength
3. Window material, KBr or ZnSe
4. Body material, Glass or metal
5. Spectrometer make and model.
6. If pressure gauge is required

**24110** Ten meter Sirocco Cell

When ordering please specify:

1. Silver or Gold mirrors
2. Fixed pathlength, 2.1, 3.2, 4.2, 5.3, 6.3, 7.4, 8.5, 9.5, or 10.6 m, or variable pathlength
3. Window material, KBr or ZnSe
4. Body material, Glass or metal
5. Spectrometer make and model.
6. If pressure gauge is required

### **Heating Jacket and Controller**

**24302** Heating Jacket and Controller for 2 m cells

When ordering please specify:

1. 220V or 1 110V and country of final destination

**24305** Heating Jacket and Controller for 5 m cells

When ordering please specify:

1. 220V or 1 110V and country of final destination

**24310** Heating Jacket and Controller for 10 m cells

When ordering please specify:

1. 220V or 1 110V and country of final destination

### **Sirocco Gas Cell Spares and Consumables**

**10707** Purge Bellows

**24150** Desiccator storage caps to fit all Sirocco Cells

**24153** KBr windows for Sirocco Cells.

When ordering please specify:

1. Two, Five or Ten Meter pathlength cell

**24154** ZnSe windows for Sirocco Cells

When ordering please specify:

1. Two, Five or Ten Meter pathlength cell

## Sirocco Heatable Long Path Gas Cells

**24151** Silver Mirrors on mirror carriage frame. (The carriage frames are complete mirror assemblies that can be interchanged to provide additional fixed pathlengths.)

When ordering please specify:

1. Two, Five or Ten Meter pathlength cell
2. Fixed pathlength required

**24152** Gold Mirrors on mirror carriage frame. (The carriage frames are complete mirror assemblies that can be interchanged to provide additional fixed pathlengths.)

When ordering please specify:

1. Two, Five or Ten Meter pathlength cell
2. Fixed pathlength required

### ***Laser Alignment Accessory***

**24500** Laser Alignment accessory for all Benchmark compatible accessories.

### ***Database and Analysis Programs***

#### **QA Soft 98**

Please contact your local Specac representative to discuss the software configuration for your product.



## High Temperature/High Pressure Cell

***Enables transmission or reflection studies of solids and decomposition vapors under extreme conditions***

The High Temperature/High Pressure Cell is a water cooled, stainless steel chamber that can operate at up to 800 °C and 1000 p.s.i.. The cell supports a 13 mm disk for transmission analysis. It also allows the study of vapors generated by the thermal decomposition of a sample, and an optional specular reflectance mode is available.

The unit incorporates several safety features including external fuse protection to prevent overheating and a burst disk to prevent over pressurization. The ZnSe cell windows are heated separately to reduce condensation. Three gas ports are provided for gas analysis and purging.

### Applications

- Catalysis studies
- Oxidation studies
- Polymorphism
- High pressure gas studies
- Combustion studies
- Oxidation state chemistry
- Solid fuels
- High temperature transmission and reflection properties



**High Temperature High Pressure Cell 05850**

### Product Highlights

- Programmable controlled temperature up to 800 °C
- Pressure up to 66 bar (1000 p.s.i.)
- Vacuum down to  $10^{-4}$  bar ( $10^{-1}$  Torr)
- Easy interchange between analysis modes (transmission - decomposition)
- Reflection mode (optional)
- Heated windows
- Dual temperature safety features
- Low voltage heater system for operator safety
- Pressure burst disk
- Safety certified window units
- Pathlength: 30 mm
- Cell volume: 80 cm<sup>3</sup>
- Sample loading: 13 mm disk or approx. 0.4 cm<sup>3</sup> sample

## Ordering Information High Temperature/High Pressure Cell

### **High Temperature/High Pressure Cells**

#### **05850** High Temperature/High Pressure Cell

*Includes: Optical unit with baseplate, Transmission - decomposition holder, ZnSe window assembly, High Stability Temperature Controller (stability 0.1 °C RMS, low voltage (30 V)), and RS232 interface.*

1. When ordering please specify:  
220V or 110V and country of final destination
2. Spectrometer make and model

#### **05855** Advanced High Temperature/High Pressure Cell system

*Includes: Optical unit with baseplate, Transmission - decomposition holder, Reflectance mode optical assembly, ZnSe window assembly, High Stability Temperature Controller (stability 0.1 °C RMS, low voltage (30 V)), and RS232 interface.*

1. When ordering please specify:  
220V or 110V and country of final destination
2. Spectrometer make and model

### **High Temperature/High Pressure Cell Options**

#### **05860** Reflectance mode upgrade kit

When ordering please specify:

1. Spectrometer make and model

### **Spares and Consumables**

#### **05865** Replacement seal kit

#### **05868** Decomposition boats (2)

#### **05867** Replacement ZnSe window assembly (tested and certified)

#### **05869** Replacement burst disk





## Infrared Polarizers

*Enables samples to be studied using polarized light*



**Polarizer Kit 12501**

Specac polarizers are manufactured using a holographic/photolithographic technique. This technique deposits an array of parallel aluminum conductors on a substrate at a spacing of up to 4000 lines per inch. A choice of substrates is available. Specac polarizers are mounted into metal support rings. A rotating holder is available as an option.

Other sizes and specifications are available on request, please contact your local Specac representative for details.

### Applications

- Molecular orientation studies of crystal or polymer film
- Thin film layer studies
- Semiconductors
- Langmuir-Blodgett films

### Product Highlights

- Wavelength range from NIR to Far IR
- Holographically produced aluminum grid deposited on substrate
- Clear aperture diameter 25 mm
- Polarizer size: 34.9 mm O.D., 7.9 mm thick (polyester 54 mm O.D., 6.36 mm thick)
- Standard slide mounting, Polarizer Mount (optional) with 0 - 180° rotation

## Infrared Polarizers

<b>INFRARED POLARIZER PERFORMANCE SPECIFICATIONS</b>							
Substrate	Thickness (mm)	Wavelength Range ( $\mu\text{m}$ )	Transmission Efficiency $K_1$	Transmission of unwanted Polarization $K_2$	Degree of Polarization $(K_1-K_2)/(K_1+K_2)$	Extinction Ratio $K_1/2K_2$	Grid Spacing ( $\mu\text{m}$ )
KRS-5	2	2-35	74% @ 10 $\mu\text{m}$ 70% @ 3 $\mu\text{m}$	0.25% @ 10 $\mu\text{m}$ 1.5% @ 3 $\mu\text{m}$	99% @ 10 $\mu\text{m}$ 95% @ 3 $\mu\text{m}$	148:1 @ 10 $\mu\text{m}$ 23:1 @ 3 $\mu\text{m}$	0.25
Polyethylene	~0.5	20-1000	80%	4%	>93%	10:1	4
Polyester	0.0025	50-1000	90%	3% Max.	>93%	15:1	10
Germanium	2	8-14	90% @ 10 $\mu\text{m}$	0.25% @ 10 $\mu\text{m}$	99% @ 10 $\mu\text{m}$	180:1 @ 10 $\mu\text{m}$	0.4
Calcium Fluoride	2	1-9	85%	1% @ 3 $\mu\text{m}$ 3% @ 1.5 $\mu\text{m}$	98% @ 3 $\mu\text{m}$ 93% @ 1.5 $\mu\text{m}$	30:1 @ 2.5 $\mu\text{m}$ 170:1 @ 7 $\mu\text{m}$	0.25
Barium Fluoride	2	1-12	85%	1% @ 3 $\mu\text{m}$ 3% @ 1.5 $\mu\text{m}$	98% @ 3 $\mu\text{m}$ 93% @ 1.5 $\mu\text{m}$	42:1 @ 3 $\mu\text{m}$ 200:1 @ 10 $\mu\text{m}$	0.25
Zinc Selenide	2	2-14	70% @ 10 $\mu\text{m}$ 75% @ 2.5 $\mu\text{m}$	1.0% @ 10 $\mu\text{m}$ 2.8% @ 2.5 $\mu\text{m}$	97% @ 10 $\mu\text{m}$ 93% @ 2.5 $\mu\text{m}$	140:1 @ 10 $\mu\text{m}$ 17:1 @ 2.5 $\mu\text{m}$	0.25

Special Technical Note: Higher Extinction Ratios are possible with KRS-5, CaF<sub>2</sub> and BaF<sub>2</sub> Polarizers. There is a sacrifice in  $K_1$  value to achieve ratios as high as 180:1 @ 3  $\mu\text{m}$  and >350:1 @ 10  $\mu\text{m}$

## Ordering Information Infrared Polarizers

### ***Polarizers***

- 12000** KRS-5 Polarizer
- 12200** Polythene Polarizer
- 12400** Polyester Polarizer
- 12700** Ge Polarizer
- 12800** CaF<sub>2</sub> Polarizer
- 12900** BaF<sub>2</sub> Polarizer
- 12950** ZnSe Polarizer

### ***Polarizer Mount and Holder***

- 12500** Polarizer Mount with slide mounted plate and rotating ring
- 12600** Rotatable Cell with graduated rotating window holder (slides into Polarizer Mount)
- 12650** Rotatable Film Holder with graduated scale and magnetic holder (slides into Polarizer Mount)

### ***Polarizer Kit***

- 12501** Polarizer Kit  
*Includes: Polarizer (please specify part number), Polarizer mount (12500), and Storage case*
- When ordering please specify:
1. Part number of Polarizer required

### ***Polarizer Spares and Consumables***

- 01830** Pair of NaCl windows for Rotatable Cell
- 01831** Pair of KBr windows for Rotatable Cell



## Infrared Reflectance Spectroscopy

Reflectance Spectroscopy is used for samples that are difficult to analyze by transmission. An advantage of many reflectance techniques is that the samples can usually be analyzed without any preparation.

Reflectance measurements are divided into two categories:

1. Internal reflectance measurements: made using an ATR element in contact with the sample.

2. External reflectance measurements: made by collecting the infrared beam reflected from the sample surface.

In external reflectance, incident radiation is focused directly on to the surface of a sample. The light reflected from the sample may be scattered in different directions or reflected directly, depending upon the physical form of the sample. When reflected light is scattered by the sample it is called diffuse reflection. When it is reflected directly, it is called specular reflection.

### ***Attenuated Total Reflectance (ATR)***



Internal reflection occurs when infrared radiation enters an ATR crystal made of a highly refractive infrared transmitting material. ATR crystals are designed to enable total internal reflection creating an evanescent wave at the crystal surface. This wave extends into a sample held in intimate contact with the crystal and absorption spectra can be recorded as a result. The depth of penetration of the

evanescent wave into the sample is a function of the crystal material and the angle of incidence. Deeper penetration is achieved with either a smaller incidence angle or a lower refractive index crystal. The depth of penetration also increases with the wavelength.

## **Diffuse Reflectance**

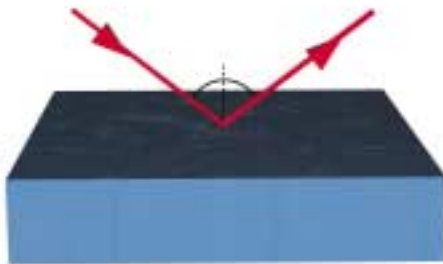


In diffuse reflection infrared spectroscopy (DRIFTS) diffusely scattered light can be collected either directly from a sample, or from an abrasive sampling pad previously abraded against an intractable sample. Many samples

will give diffuse reflectance spectra. These include powders, fibers or matt surfaced samples such as textiles.

Where samples have a rough surface, such as a powder, specularly reflected light is a minor contributor to the overall signal. Specac diffuse reflection accessories are optimized to increase collection of the diffuse reflectance and decrease the specular component, as the specular component may adversely affect the spectrum.

## **Specular Reflectance**



Specular reflectance is a non-destructive method for surface measurements using the mirror-like reflection from the shiny surface of a sample. Specular reflectance occurs when the reflected angle of infrared radiation equals the angle of incidence. The amount of light reflected depends on the angle of incidence, and the refractive index, surface roughness, and absorption properties of the sample.

Specular reflection accessories for infrared spectroscopy are used typically to measure coatings on reflective surfaces. This type of

measurement is actually a transmission measurement of the coating, rather than a specular reflection measurement from the front surface. Typical applications include the study of surface coatings on surface treated, painted, or polymer coated metals.

Increased pathlengths through thin coatings can be achieved by increasing the angle of incidence. The maximum sensitivity is achieved at the grazing angle (80-85°). Monolayer films at a liquid-air interface can be studied using a grazing angle of incidence. Thicker coatings, in the micrometer thickness range, are studied typically using angles of 30°. Band intensities of the spectra also depend on the type and degree of polarization as well as the effective pathlength. The Specac range of reflectance accessories includes both fixed and variable incidence angle accessories.

## Golden Gate Single Reflection Diamond ATR System

***The Golden Gate is the World's most versatile Infrared sampling system. It analyzes all types of samples, from hard solids to corrosive liquids, and it is easy to use, sensitive, and robust***



### **Golden Gate Diamond ATR 10500**

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 diamond is high temperature bonded into its tungsten carbide mount, giving the performance and strength to withstand the high pressures required for maximum optical contact with hard samples. The quick lock and release bridge allows for fast sample turnaround. The built-in pressure control mechanism means reproducible results are obtainable without the need for a torque tool.

The Golden Gate 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.

### **Applications**

- QA on powders, for example pharmaceuticals
- Analysis of hard and soft polymer pellets
- Forensic sampling, paint chips and single fibers
- Hard samples, for example rocks and geochemicals
- Corrosive liquids
- Coated wires
- Air sensitive samples

### **Product Highlights**

- No sample preparation - easy to use
- Rugged, type IIa diamond metal-bonded into a tungsten carbide mount
- Hard, inert, sapphire self-leveling pressure anvil
- Pressure bridge for highest sensitivity
- A wide choice of accessory configurations
- Quick release bridge with safety interlock - high sample throughput
- Built-in pressure control for reproducible results

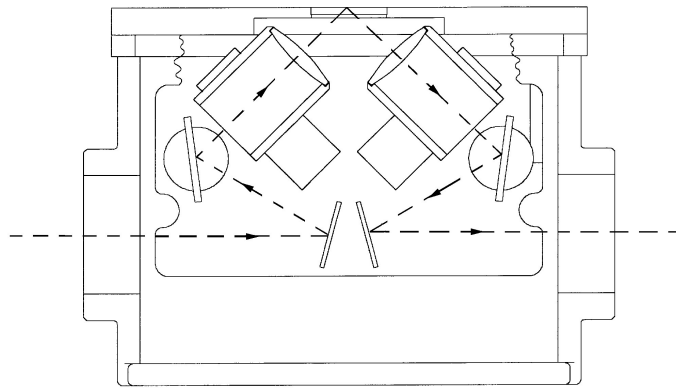


**Golden Gate with Wire Holder Top-plate 10565**

**Schematic of the Golden Gate Single Reflection Diamond ATR Systems**

The Top-plates of the Golden Gate Single Reflection ATR Series are supplied on an optical unit, containing mirrors and a choice of beam condensing optics (ZnSe or KRS-5). All Top-plates are interchangeable with the optical unit.

A schematic is shown here of the beam path through the Golden Gate optical system. The schematic is shown with a left-to-right beam path. The symmetrical arrangement means that a Golden Gate ATR can also be used with a right-to-left beam system.

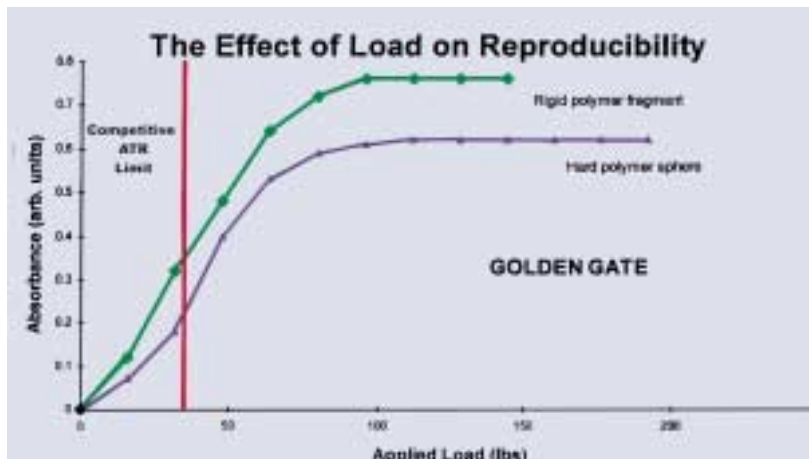


**Reproducibility and Sensitivity of the Golden Gate Single Reflection Diamond ATR System**

A key feature of the Golden Gate Single Reflection ATR System is the outstanding contact achievable between solid samples and the diamond crystal.

diamond and the sample increases, there is a critical load at which the optimum optical contact is achieved. Thereafter, no increase in absorbance intensity is possible and maximum sensitivity of the measurement is achieved.

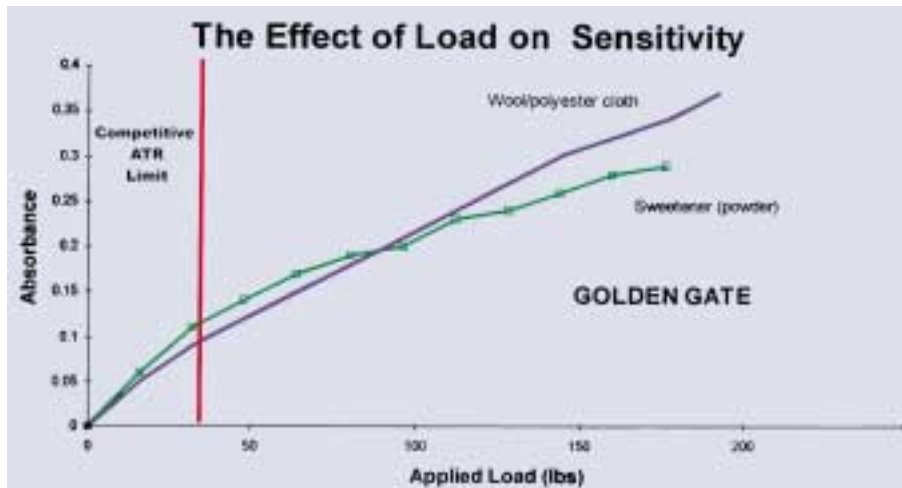
As the load is increased via the bridge clamping mechanism and optical contact between the



## Golden Gate Single Reflection Diamond ATR System

With accessories capable of applying only small loads there is uncertainty as to whether the maximum optical contact has been achieved. Therefore, sensitivity for the technique is also compromised. In addition, until optimum contact is achieved, there is no control over experimental reproducibility.

Low load measuring devices on low load ATR units are not sensitive to changes in the sample properties under applied load. The unique high load capability of the Golden Gate Diamond ATR ensures that maximum sensitivity is achieved reproducibly.



### Golden Gate Anvil Options

A variety of special anvils exist for use with the Golden Gate Top-plates. The use of an appropriate anvil improves the sample handling capabilities of the Golden Gate Single Reflection ATR System.



Golden Gate Anvil Options

#### 1 Reactive Sample Anvil

Samples sensitive to air or moisture can be loaded and pressed in a dry box. The anvil has a seal that compresses as the sample is pressed, keeping the sample in an inert environment during analysis.

#### 2 & 5 Grooved Anvils (Narrow and Wide)

For coatings on wires the grooved anvils hold the wire exactly in the middle of the diamond.

#### 3 Sapphire Anvil

This is the standard anvil and is used for most sample types. It has the advantage of being very hard, and easy to clean to prevent sample carry-over. It is also self-leveling to accommodate irregular samples.



## Golden Gate Single Reflection Diamond ATR System

### Golden Gate Anvil Options



#### **4 Stainless Steel Flat Anvil**

This is used for fibers or fine wires. It is not self-leveling, which is an advantage with irregular samples.

#### **6 Pellet Anvil**

Polymer pellets are held firmly in position with this concave anvil.

#### **7 Volatiles Cover**

This cover is Essential to minimize evaporation losses from volatile samples

#### **8 View-Thru Anvil**

The View-Thru Anvil allows the sample to be viewed through a 4X lens system with a built-in reflective illuminator. The lower window of the anvil acts as a viewing window so the sample may be positioned accurately, then observed as pressure is applied. The anvil does not rotate as it presses on the sample, preventing movement of the sample and also minimizing heating effects due to friction.

#### **9 Flow-Thru Anvil**

This micro flow cell anvil seals around the diamond under pressure. It has a volume of 28 microliters and it can operate up to 1000 p.s.i.. The pipe flow fittings are 1/16" O.D. stainless steel. This anvil can be used as a flow cell or as a micro reaction chamber in conjunction with the heated Golden Gate. It has also been used for the study of polymers in the presence of a supercritical fluid.

## Golden Gate Top-Plate Options

### Germanium Top-Plate

Traditionally difficult samples, such as those containing high concentrations of carbon black, require controlled penetration of the infrared beam. The high refractive index of germanium makes this ATR material an ideal choice for these samples. Optimum sensitivity is achieved using a 4x4 mm germanium crystal cemented into a rugged stainless steel disk for maximum strength and support.

#### Product Highlights

- 45° single reflection Germanium crystal
- 4x4 mm cement bonded stainless steel mount
- Working range 5000-550  $\text{cm}^{-1}$
- Pressures up to 2 kbar (29,000 p.s.i., 720 lb load)
- High throughput
- Good chemical resistance
- Suitable for use with DTGS detectors

The shallow depth of penetration with no band distortion overcomes difficult quantitative analysis of strongly infrared absorbing materials. Similarly, corrosive samples, thin films and surface coatings can also be analyzed.



Golden Gate Germanium Top-plate  
10566

#### Applications

- Very strongly absorbing polymers, rubbers and dyestuffs
- Surface coatings
- Forensic Science
- Macro and micro samples

### Low Temperature Top-Plate

The Golden Gate low temperature diamond ATR system is the first ATR accessory to provide high performance ATR measurements down to near liquid nitrogen temperature. The system uses a thermally insulated copper and stainless steel dewar in conjunction with an integral heater to provide continuous temperature control across the working range.



Low Temperature Golden Gate  
Diamond ATR 10592

## Heated Diamond Top-Plate

### Applications

- Polymerization studies
- Thermochemical studies
- Curing reactions
- Degradation / decomposition

Many reactions and processes occur at high temperatures. The Heated Diamond Top-plate includes all the normal features of the Golden Gate sampling technique, but it has the added capability of heating samples up to 200 °C.

Diamond has a uniquely high thermal conductivity. The Top-plate has a low thermal mass and there are high power heaters in close proximity to the diamond. This achieves both rapid and efficient heating and gives a high degree of temperature control. A rapid sample turn around is therefore possible.

The Top-plate can be used with a computer controlled temperature controller with digital readout to 1°C.

With safety in mind, low voltage (30 V) heaters are used. For additional protection thermal fuses are fitted as standard. The controller complies with European CE regulations.



Heated Golden Gate Top-plate 10540

### Product Highlights

- Heatable to 200 °C
- Diamond in tungsten carbide mount
- Low voltage heaters
- Thermal safety fuses
- Programmable temperature control with RS232 compatibility
- Complies with CE regulations
- Low thermal mass

## Micro Specular Reflectance Top-Plate

A 45° angle Micro Specular Reflection Top-plate is for flat samples of greater than 2mm x 2mm, or powders that can be pressed into a self-supporting wafer.

A scribed reference grid allows accurate repeat positioning of samples.

### Applications

- Micro reflectance samples
- Very highly absorbing samples
- Carbon black containing polymers

Golden Gate Micro Specular Top-plate 10514



## Golden Gate Reaction Cell

### Applications

- Chemical reaction analysis at high temperatures and pressures
- Caustic solutions
- Slurries with abrasive particulates
- Acidic reactions
- Optimization of process parameters

The Reaction Cell allows in-compartment reaction monitoring over a broad range of extreme conditions.

The diamond is metal bonded into a tungsten carbide mount and this is contained within a high pressure reaction vessel.

The unique strength and durability of the diamond element makes it ideal for withstanding combinations of aggressive chemical contact at high temperatures and pressures.



Golden Gate Reaction Cell

### Product Highlights

- Controlled temperatures to 200 °C
- Low voltage (30 V)
- Cell volume 28 ml
- Pressures up to 3000 p.s.i.
- Water jacket to prevent overheating
- Stainless steel construction with a choice of other materials
- Stirring option
- Flow through configuration option

## Supercritical Fluids Top-Plate

The supercritical fluids Top-Plate is a special version of the Golden Gate diamond ATR system designed to withstand extremes of

temperature and pressure. Samples are measured in a specially constructed low volume stainless steel sample chamber.

## Wire Holder Diamond Top-Plate

For the study of coated wires and single fibers, the Wire Holder Diamond Top-plate ensures precision positioning of the sample over the middle of the diamond.

This top-plate comes complete with two dedicated grooved anvils, one narrow and one wide.

## Ordering Information Golden Gate

### **Golden Gate ATR Mk II**

A Complete Golden Gate ATR Mk II System consists of an Optics Unit, Lenses, Top-plate, Baseplate and Purge Bellows.

#### **10500** Golden Gate ATR Mk II

When ordering please specify:

1. Top-plate: Diamond, Germanium, Wire Holder, or Micro Specular Reflectance.
2. Spectrometer make and model
3. Lens Configurations: ZnSe (5000 - 650  $\text{cm}^{-1}$ ), or KRS-5 (5000 - 300  $\text{cm}^{-1}$ )

#### **10542** Heated Golden Gate ATR Mk II

*Includes: Automatic Temperature Controller with RS232 control.*

When ordering please specify:

1. Spectrometer make and model
2. Lens Configurations: ZnSe (5000 - 650  $\text{cm}^{-1}$ ), or KRS-5 (5000 - 300  $\text{cm}^{-1}$ )
3. 220 V or 110 V and country of final destination.

#### **10592** Low Temperature Golden Gate ATR Mk II

*Includes: Automatic Temperature Controller with RS232 control.*

When ordering please specify:

1. Spectrometer make and model
2. Lens Configurations: ZnSe (5000 - 650  $\text{cm}^{-1}$ ), or KRS-5 (5000 - 300  $\text{cm}^{-1}$ )
3. 220 V or 110 V and country of final destination.

#### **10586** Super Critical Fluids Golden Gate ATR Mk II

*Includes: Automatic Temperature Controller with RS232 control.*

When ordering please specify:

1. Spectrometer make and model
2. Lens Configurations: ZnSe (5000 - 650  $\text{cm}^{-1}$ ), or KRS-5 (5000 - 300  $\text{cm}^{-1}$ )
3. 220 V or 110 V and country of final destination.

### **Golden Gate MK II Top-Plates**

#### **10563** Diamond ATR Top-plate

*Includes: sapphire and pellet anvils, volatiles cover*

#### **10566** Germanium ATR Top-plate

*Includes: large stainless steel anvil and volatiles cover*

#### **10565** Wire Holder Diamond ATR Top-plate

*Includes: narrow and wide gauge grooved anvils and stainless steel flat anvil*

#### **10514** Micro Specular Reflectance Top-plate

*Includes: reference mirror*

#### **10591** Golden Gate Low Temperature ATR Top-plate

*Includes: Automatic Temperature Controller with RS232 control.*

When ordering please specify:

1. Lens Configurations: ZnSe (5000 - 650  $\text{cm}^{-1}$ ), or KRS-5 (5000 - 300  $\text{cm}^{-1}$ )
2. 220 V or 110 V and country of final destination.

**Golden Gate MK II Top-Plates  
(continued)**

**10585** Golden Gate Super Critical  
Fluids ATR Top-plate

*Includes: Automatic Temperature  
Controller with RS232 control.*

When ordering please specify:

1. Lens Configurations: ZnSe  
(5000 - 650  $\text{cm}^{-1}$ ), or KRS-5  
(5000 - 300  $\text{cm}^{-1}$ )
2. 220 V or 110 V and country of  
final destination.

**10540** Heated Diamond ATR Top-  
plate

*Includes: Automatic Temperature  
Controller with RS232 control.*

When ordering please specify:

1. Lens Configurations: ZnSe  
(5000 - 650  $\text{cm}^{-1}$ ), or KRS-5  
(5000 - 300  $\text{cm}^{-1}$ )
2. 220 V or 110 V and country of  
final destination.

**Golden Gate Reaction Cell**

This version of the Golden Gate  
ATR Mk II System is available in a  
number of configurations - contact  
your local Specac representative to  
discuss your requirements.

**Golden Gate Mk II Upgrade –  
Lenses**

**10552** ZnSe lens upgrade kit 5000  
– 650  $\text{cm}^{-1}$

**10508** KRS-5 lens upgrade kit 5000  
– 300  $\text{cm}^{-1}$

**Golden Gate Mk II Anvil Options**

**10503** Volatiles cover

**10522** Forensic Sapphire anvil

**10531** Sapphire anvil

**10532** Pellet anvil

**10536** Reactive sample anvil

**10547** Grooved anvil - narrow  
gauge

**10548** Grooved anvil - wide gauge

**10549** Stainless steel flat anvil

**10567** Stainless steel large anvil for  
Germanium Top-plate

**10568** Micro Reaction/Flow Cell  
anvil

**10569** View-Thru Anvil/Bridge  
assembly

**Golden Gate MK II Options and  
Spares**

**10707** Purge bellows

**10504** Torque wrench

**10505** Torx Adapter

**Anvil Options for MK I Golden  
Gate Top-plates, without Quick  
Lock Bridge (Pre Oct 1999)**

**10501** Sapphire anvil

**10502** Pellet anvil

**10506** Reactive sample anvil

**10517** Grooved anvil - narrow  
gauge

**10518** Grooved anvil - wide gauge

**10519** Stainless steel flat anvil

**10521** Forensic Sapphire anvil

**10557** Stainless steel large anvil for  
Germanium Top-plate

**10558** Micro Reaction/Flow Cell  
anvil

**10504** Torque wrench

**10505** Torx Adapter

**Mk I to Mk II Top-plate Upgrade**

Specac can upgrade a Mk I Golden  
Gate (Pre Oct 1999) Top-plate to a  
Mk II version with a quick lock and  
release bridge and in-built pressure  
mechanism.

**10564** Mk I to Mk II Top-plate  
Upgrade.

*Includes: sapphire anvil and pellet  
Anvil.*

Return your Mk I Top-plate to your  
local Specac representative for the  
upgrade.

## Benchmark ATR

***An advanced multi-reflection ATR system with an extensive range of top-plate options***

### Applications

- Liquids (static or flowing)
- Gels/Pastes
- Films and fine powders
- Temperature dependent samples

### Product Highlights

- Choice of In or Out-of-Compartment base units
- High optical throughput
- Easy alignment
- Purgeable optics
- Extensive range of top-plates
- Polarizer mount facility
- Crystal interchangeability (trough top-plate version)

The Benchmark System of Horizontal ATR Accessories offers a comprehensive range of advanced top-plate options and is compatible with all FTIR spectrometers.

Two optical systems are available; In-Compartment and Out-of-Compartment. Both systems accept all of the top-plate options, and both include purge ports, bellows, and polarizer mounts. A unique feature on the Out-of-Compartment system is a



**Benchmark In-Compartment ATR with Trough Top-plate**



**Benchmark Out-Of-Compartment ATR with Trough Top-plate**

purge-seal option allowing the top-plate to be removed without breaking the purge.

High performance transfer optics ensure high optical throughput is achieved with all top-plates. Liquids, pastes, solids and films are analyzed by simple pouring, spreading or clamping actions. Static, flow and heatable top-plates provide further flexibility, versatility and expandability in sampling.

### **Benchmark ATR Top-plate Options**

#### **Trough Top-plate**

- For liquids, pastes and gels
- Shallow or deep trough options (volumes 12.9 ml and 20.9 ml respectively)
- Removable crystal for easy cleaning
- Variety of crystals available
- Adhesive free construction

**Benchmark Trough Top-plate 11130**



#### **Flat Top-plate**

- Films, pastes and fine powders
- Bonded crystal for added strength
- Variety of crystals available

**Benchmark Flat Top-plate 11133**



#### **Flow Thru Top-plate**

- On-line process control
- 550 µl volume
- Removable crystal
- Variety of crystals available

**Benchmark Flow Thru Top-plate 11116**



#### **Thermostabilized Top-plate**

- For reaction kinetics or quality control
- Liquid Flow ATR
- 550 µl volume
- Removable crystal
- Stainless steel top-plate and Kalrez spacer
- Heatable to 90 °C
- Adhesive free construction

**Benchmark Thermostabilized Top-plate 11118**





## Benchmark ATR Top-plate Options

### Heated Trough Top-plate

Two versions of the Benchmark Heated Trough Top-plates are available. The ATR crystal is removable with each top-plate.

- The Water Heated version is for sub-ambient to 90 °C and is heated or cooled by thermocirculating liquid.
- The electrically heated version has power provided by a dedicated temperature controller with RS232 interface. This top-plate is heatable to 200 °C.

### *Benchmark ATR Options*

#### Volatiles Cover

- Prevents evaporation of volatile samples from trough top-plates



**Benchmark Volatiles Cover 11132**

#### Clamp Kit

- For films, solids and powders
- Ensures reproducible contact between the sample and the ATR crystal
- For use with flat or trough top-plates
- Pressures up to 60 p.s.i.



**Benchmark Clamp Kit 11136**

## Ordering Information Benchmark ATR

### ***Benchmark ATR Base Units***

#### **11160** Benchmark In-Compartment ATR

When ordering please specify:

1. Spectrometer make and model

#### **11180** Benchmark Out-of-Compartment ATR with fully sealed optics and uninterrupted purge facility

When ordering please specify:

1. Spectrometer make and model

### ***Benchmark ATR Top-plates***

#### **11116** Benchmark ATR 550 µl Flow Through Top-plate with ZnSe 45°

#### **11118** Benchmark ATR 550 µl Water Thermostabilized Flow Through Top-plate with ZnSe 45°

#### **11130** Benchmark ATR Trough Top-plate with ZnSe 45°

#### **11133** ZnSe Benchmark ATR Flat Top-plate with 45° crystal.

#### **11134** Si Benchmark ATR Flat Top-plate with 45° crystal.

#### **11135** Ge Benchmark ATR Flat Top-plate with 45° crystal.

#### **11139** Benchmark ATR Water Heated/Cooled Trough Top-plate with ZnSe 45° (90 °C max)

#### **11155** Benchmark ATR Electrically Heated Trough Top-plate with ZnSe 45° and Automatic Temperature Controller (200 °C max) with RS232 interface

When ordering please specify

1. 220 V or 110 V and country of final destination

### ***Benchmark ATR Options***

#### **11125** Liquid Sample Pump

#### **11126** 6 Liter Thermocirculator for water thermostabilized Top-plates

#### **11132** Volatiles Cover

#### **11136** Clamp Kit for Benchmark Flat Top-plates (All spectrometers except PE 1600, Paragon, Spectrum 1000 and Spectrum RX and BX)

#### **11138** Clamp Kit for Benchmark Flat Top-plates for PE 1600, Paragon, Spectrum 1000 and Spectrum RX and BX

#### **11200** Torque Wrench for consistent crystal mounting

### ***Benchmark ATR Spares and Consumables***

#### **10707** Purge Bellows

#### **11145** ZnSe 45° Crystal for Benchmark Trough and Flow Through Top-plates

#### **11146** Si 45° Crystal for Benchmark Trough and Flow Through Top-plates

#### **11147** Ge 45° Crystal for Benchmark Trough and Flow Through Top-plates

#### **11150** Kalrez Gaskets for 550µl Top-plates

#### **11129** Gasket Replacement Kit for Thermostabilized and heated Benchmark Top-plates

#### **11152** Silicone Tubing for Benchmark Flow version Top-plates (5 m)

#### **11176** Paralene Coated KBr Window Kit for Out-of-Compartment Benchmark ATR

## The Silver Gate Single Reflection ATR

***A high throughput single reflection ATR accessory for the FTIR analysis of solids, liquids, gels and pastes***



**Silver Gate Single Reflection ATR  
(ZnSe) 10581**

### Applications

- Highly absorbing samples
- Small samples
- Liquids, semi-solids, films and finely milled powders

### Product Highlights

- Rapid analysis of solids, liquids and pastes with little or no sample preparation.
- High optical throughput provides fast and efficient sample measurement.
- Proven, strong clamping device, based on the Golden Gate diamond ATR, allows rapid, reproducible sample throughput.
- Flat crystal surface provides optimum sample contact and prevents point loading.
- Rugged, fixed configuration design makes the Silver Gate ATR accessory ideal for quality assurance.
- Open top-plate architecture for easy sample access

The Silver Gate single reflection ATR system is a new, high throughput FTIR accessory capable of analyzing solids, liquids, and pastes with little or no sample preparation. The quick lock and release bridge, based on the proven Golden Gate diamond ATR system, allows for rapid sample throughput and reproducible solid sampling. It also has a built-in torque limiter to control the loads applied to the ATR crystal.

The standard configuration uses a germanium crystal bonded into a hard-anodized top-plate for maximum resistance to chemical attack. The sampling surface is flat to ensure the best possible contact with any sample, avoiding point loading as well as the stray light and non-linearity found with domed crystals. The Silver Gate single reflection ATR is extremely robust and it has factory pre-aligned optics. This ensures that it can be installed easily and rapidly with little or no alignment. The Silver Gate optics are fully enclosed and can be purged very quickly due to the small internal volume. The Benchmark base-plate mounting system allows the accessory to be rapidly and reproducibly replaced in your spectrometer and provides the stability needed for a high sample throughput. The Silver Gate single reflection ATR accessory is a fixed configuration accessory, ideal for use in quality assurance. The simple, efficient optical design of the Silver Gate single reflection ATR accessory makes it ideal for polarization studies as well as extremely robust.

**Ordering Information Silver Gate Single Reflection ATR**

**Silver Gate ATR**

**10580** Silver Gate single reflection ATR with germanium crystal.

*Includes: optics, anodized top-plate, Golden Gate type clamping device with integral torque limiter and flat anvil, volatiles cover, Benchmark baseplate, and purge bellows.*

When ordering please specify:

1. spectrometer make and model

**10581** Silver Gate Single Reflection ATR with zinc selenide crystal. As 10580 except with zinc selenide crystal.

When ordering please specify:

1. spectrometer make and model

**Silver Gate Spares**

**10582** Stainless steel large anvil for Silver Gate single reflection ATR

**10503** Volatiles cover

**10707** Purge bellows



## 25 Reflection ATR

### ***For high sensitivity ATR measurements with FTIR or dispersive instruments***

The large number of reflections and the availability of different incidence angles make this accessory ideally suited for the enhancement of small bands in weakly absorbing samples. To vary the depth of penetration, any angle between 30° to 60° can be selected by moving the sample holder platform.

#### Applications

- Solids
- Liquids
- Pastes
- Variable depth studies for coatings and films

#### Product Highlights

- Variable angle of incidence (30° - 60°)
- Very high sensitivity
- Suitable for both FT-IR and dispersive instruments
- Two pin sample location on sample mount
- Standard slide mounting
- Choice of crystal materials; KRS-5 as standard
- Interchangeable sample holders (solids, liquids and pastes)



**25 Reflection ATR 11000**

#### **Ordering Information 25 Reflection ATR**

#### ***25 Reflection Variable Incidence Angle ATR***

**11000** 25 Reflection ATR  
*Includes: solids holder and KRS-5 crystal (45°)*

#### ***25 Reflection ATR Options***

**11001** Solids holder

#### ***25 Reflection ATR Spares and Consumables***

**11004** KRS-5 crystal (45°)\*

**11006** Ge crystal (45°)\*

**11009** Si crystal (45°)\*

\* 30° and 60° crystals available on request

## Selector

***An expandable diffuse reflectance sampling system that can change with your applications***

Diffuse reflectance is based upon the collection of radiation that has been diffusely scattered from the sample. The Specac Selector uses an optimized off-axis optics configuration which selectively collects the diffusely reflected components, whilst minimizing the specular component.

Various sampling cups are offered including a standard 11 mm diameter cup, a micro 4 mm diameter cup, and tilted cups. The tilted cups allow for collection of total reflectance, diffuse and specular components. In addition, an abrasive sampler, 12 mm diameter, can be used with Diabrase pads to allow quick and easy sample preparation of intractable solids. The abrasive pad is simply rubbed against the sample of interest and mounted in the Selector accessory.

The Selector is mounted on its own baseplate. The off-axis design allows room for the use of specialist alternative configurations. The Environmental Chamber option extends the sampling capabilities of the Selector.

### Applications

- Powders
- Intractable solids
- Liquid samples as a dispersion over KBr matrix

### Product Highlights

- Diffuse or total reflectance capabilities
- Minimal alignment
- Easy sample handling
- Macro, micro and tilted cups
- Diabrase synthetic diamond abrasive pads



**Selector Diffuse Reflectance System  
1990**

## ***The Environmental Chamber***

### **Product Highlights**

- Programmable controlled temperatures to 500 °C
- Operates from vacuum ( $10^{-3}$  Torr) to high pressure (500 p.s.i.)
- Provides controlled atmosphere (gas inlet and outlet)
- Extensive safety features

This accessory allows for the study of diffusely reflecting solid samples in a controlled atmosphere ranging from ambient temperature to 500 °C, and vacuum ( $10^{-3}$  Torr) to 500 p.s.i. pressure. The standard chamber window is ZnSe, which gives a good balance between IR transmission and mechanical strength. Other optical transmitting windows are available on request.

The body is constructed from 316 stainless steel for ruggedness and chemical resistance. Safety features include a low voltage automatic power supply and an automatic shut-down feature, should the temperature sensor detect an overheating fault. A water cooling jacket keeps the outside of the chamber cool when operating at high temperatures and a safety “burst disk” activates whenever the pressure exceeds the recommended safety limit.

The Environmental Chamber, in conjunction with the Selector, is ideal for use in chemical research such as kinetics, catalysis, surface analysis, polymerization and coordination chemistry.



**Selector Environmental Chamber 19930**

## Ordering Information Selector

### ***The Selector Diffuse Reflectance System***

**19900** The Selector Diffuse Reflectance System

*Includes: optical unit with dedicated baseplate, Micro sample cup (4 mm diameter), 2 Standard cups (11 mm diameter), Diabrase abrasive sample pads (2 mm diameter)(20), 2 mounts for abrasive sample pads, tilted cup for total reflectance measurements*

When ordering please specify:

1. Spectrometer make and model

### ***Selector Environmental Chamber***

**19930** Environmental Chamber  
Includes High Stability Controller with RS232 interface.

When ordering please specify:

1. Spectrometer make and model.
2. 220 V or 110 V and country of final destination.

### Selector Spares and Consumables

**03610** KBr powder (50 g)

**19915** 4 mm diameter micro cup for Selector

**19916** 11 mm diameter standard cup for Selector

**19917** Tilted cup for total reflectance measurements

**19918** Abrasive pad sample mount for Selector

**19919** Diabrase abrasive sample pads 12 mm diameter for Selector (100)

**19934** Spare ZnSe Window housing for the Environmental Chamber





## Minidiff Plus

### *A diffuse reflectance accessory for routine analysis*

For routine diffuse reflectance sampling, the Minidiff Plus is the ideal accessory. High performance solids analysis is made simple through a minimal alignment optical system. Solid sampling versatility is maintained through the use of standard sampling cups and Diabrase abrasive sampling pads. The sample introduction system reduces the risk of sample spillage, with up to 3 samples being loaded at the same time. The Benchmark baseplate mounting provides consistent, stable and reliable positioning of the accessory in the spectrometer.

#### Applications

- Powders
- Intractable solids
- Liquid samples as a dispersion over a KBr matrix

#### Product Highlights

- Pre-aligned mirrors
- Easy sample handling
- Diabrase sampling
- Baseplate mounted
- Micrometer focusing adjustment



**Minidiff Plus Diffuse Reflectance  
04510**

## Ordering Information Minidiff Plus

### ***Minidiff Plus Diffuse Reflectance Accessory***

**04510** Minidiff Plus Diffuse Reflectance Accessory  
Includes: optical unit and baseplate, abrasive sample holders with 3 mounts (2), sample cup holders with 3 cups (2), Diabrase abrasive pads (9 mm diameter) (20) KBr powder (50 g), pestle and mortar

When ordering please specify:

1. Spectrometer make and model

### ***Minidiff Spares and Consumables***

- 03610** KBr powder (50 g)  
**04505** Sample cup holders with 3 cups (2)  
**04506** Diabrase abrasive pads (9 mm diameter) for Minidiff Plus (100)  
**04508** Abrasive sample holders with 3 mounts (2)

## Monolayer/Grazing Angle Specular Reflectance

***Uses variable angle capabilities for interface analysis by specular reflectance***

### Applications

- Reflection-absorption spectra of solids
- Langmuir-Blodgett films
- Surfactant studies
- Liquids in biological membranes
- Semi-conductors
- Paints
- Resins
- Polymer coatings
- Matt surfaced samples
- Molecular orientation of surfaces

### Product Highlights

- Grazing angle capability
- Monolayer analysis
- Continuously variable incidence angles from 8° - 85° (dependant on spectrometer)
- Volume of trough 8.9 ml
- Sample size 50x20 mm
- Built-in polarizer mount
- Aperture stop facility for controlling the sampled area
- Liquid film compression/expansion capability
- Inert Teflon sample trough (liquids)

The Monolayer/Grazing Angle accessory allows reflectance measurements to be made on a variety of samples over a wide range of angles of incidence. Solid samples can be placed on the flat stage or liquid samples can be poured into the Teflon Monolayer trough. This has a moveable liquid surface tensioning boom to allow the study of orientated mono-molecular films on a liquid surface.



**Monolayer Grazing Angle Specular Reflectance 19650**

### Ordering Information Monolayer

#### ***Monolayer/Grazing Angle Accessory***

**19650** Monolayer Grazing Angle accessory, suitable for most  
*Includes: optical unit with baseplate, horizontal sample stage, aperture stops, polarizer mount, Teflon sample trough*

When ordering please specify:

1. Spectrometer make and model

#### ***Monolayer Spares and Consumables***

**19662** Teflon trough for monolayer mode samples

**19663** Aperture stops and holder for the Monolayer/Grazing Angle accessory

## Fixed Angle Specular Reflectance

***For analysis of solids by specular reflectance 30° fixed angle permits precise repeatable surface measurements***

### Applications

- Analysis of surface coatings (polymer, optical)
- Local analysis of defects and inclusions
- Fragile samples

### Product Highlights

- 30° fixed angle
- Convenient horizontal sample position (20.8 mm diameter full aperture)
- Accommodates powder samples
- Suitable for dispersive and large beam FT -IR
- Minimal alignment



**Fixed Angle Specular Reflectance  
19820**

## Ordering Information Fixed Angle Specular Reflectance

### ***Fixed Angle Specular Reflectance for FT -IR Spectrometers***

**19820** Fixed Angle Specular  
Reflectance Accessory  
*Includes: optical unit, reference  
mirror, sample aperture masks  
(5 mm and 10 mm diameter)*

When ordering please specify:

1. Spectrometer make and model

## Accessories for Sample Preparation

This section of the catalogue is concerned with accessories that are used for the preparation of samples prior to transmission or reflectance spectroscopy measurements.

Classically, hydraulic presses and dies are used to make pellet disks from a pre-ground mixture of KBr and sample. However, the hydraulic presses can be adapted for use in other applications. For instance, they can be used in conjunction with heated platens and film making systems for the production of a wide range of solid/film type samples.

Specac produces a wide range of sample mounts from simple cards to X-Y stages. In addition, Specac offers comprehensive sampling kits that combine all the vital parts and accessories you need to analyze virtually any sample by IR Spectroscopy.

**Constant Thickness Film Maker  
15620**



**Evacuatable Pellet Dies**

**Manual Hydraulic Press**



## 15 and 25 Ton Manual Hydraulic Presses

***Easy to use, rugged, and durable, Hydraulic Presses suitable for a wide range of applications***

The Specac 15 and 25 Ton Manual Hydraulic Presses have been designed to handle a wide variety of pressing applications. They are specifically suited to the preparation of KBr disks using the Specac Evacuatable Pellet Die assembly.

The Presses can also be used with Specac Heated Platens for applications such as the preparation of thin polymer films.



**Manual Hydraulic Press**

### Product Highlights

- Polycarbonate safety guards
- Adjustable upper bolster
- Adjustable pressure control valve
- Vacuum Ports
- Pressure release valve
- Optional gauges for low pressure applications (0-1, 0-2, 0-5 Tons)

### Specification

- Max Height (at handle) 610 mm
- Max Width 310 mm
- Max Depth 190 mm
- Weight 50 kg
- Lower Piston Stroke 25.4 mm
- Upper Bolster Screw Travel 89 mm
- Minimum Distance Between Pressing Faces 38 mm
- Maximum Distance Between Pressing Faces 152 mm
- Lower Pressing Face Diameter 86 mm
- Upper Pressing Face Diameter 32 mm
- Max Width of Sampling Area (side-to-side) 134 mm
- Max Depth of Sampling Area (back-to-front) 141 mm

## 40 Ton Automatic Hydraulic Press

### *A Microprocessor controlled press for high tonnage applications*

The Specac 40 Ton Automatic Press has been designed for sophisticated pressing applications requiring a high degree of automation and reproducibility.

The automated control system ensures ease-of-use, rapid and flexible sample preparation, and requires minimum maintenance. Fail-safe cut out switches and high impact safety guards ensure safe operation, even for occasional operators. A large access area allows the use of heated platens, dies, and specialized sample holders up to 200 mm in diameter.

The piston has a fast approach facility, greatly reducing the pressing time, and the pressure is re-applied until the set load is reached. Functions such as Lock, Pressing Time/Rate, and Diagnostics are all controlled via the microprocessor. An additional feature for unattended operation, such as press cycling, is available and an RS232 interface enables control via a PC.



**40 Ton Automatic Press**

#### Specification

- Max Load on Ram (Piston) 40 Tons (40,639 kg)
- Load Applied (Displayed To) 0.1 Ton
- Digital Display Setting (To 1 Ton) 4 to 40 Tons
- Top Bolster Diameter 32 mm
- Top Lead Screw Vertical Travel 35 mm
- Ram (Piston) Diameter 100 mm
- Ram (Piston) Stroke 38 mm
- Maximum/Minimum Distance between Pressing Faces 135 mm/35 mm
- Sample Area Size (W , D, H) 210, 240, 210 mm
- Baseplate (Width x Depth) 400 mm x 580 mm
- Height (with control box) 570 mm
- Weight 145 kg

#### Product Highlights

- 40 Ton capacity. Other ranges available on request
- Optimized for XRF and IR sampling
- CE Safety Approved
- Full programming facility for unattended operation
- Controlled application and release of pressure
- Accommodates samples up to 200 mm in diameter

## Automatic Air Press

### *A low tonnage press for accurate and reproducible pressing*

In addition to the Hydraulic Presses Specac also produces a low tonnage Automatic Air Press.



**Automatic Air Press**

Pressures up to 1.5 Tons can be applied in a smooth and efficient manner. The operation allows a consistent load to be applied even when a sample begins to yield on compression. For samples requiring repetitive low tonnage pressing the Specac Air Press is ideal.

#### **Product Highlights**

- Smooth operation
- Adjustable pressure limits
- Timed operation
- CE Safety Approved
- Load reproducibility

## Ordering Information Presses

### **15 and 25 Ton Manual Hydraulic Presses**

**15011** Manual Hydraulic Press

When ordering please specify:

1. 15 or 25 Ton Press

### **15 and 25 Ton Manual Hydraulic Press Options**

**15051** Gauge Conversion Kit 0-1 Ton

**15052** Gauge Conversion Kit 0-2 Ton

**15053** Gauge Conversion Kit 0-5 Ton

### **15 and 25 Ton Manual Hydraulic Press Spares and Consumables**

**15100** Seals and Gaskets Kit

**15101** Hydraulic (1 liter)

### **40 Ton Automatic Hydraulic Press**

**25600** T40 Auto Press 220 V UK

**25601** T40 Auto Press 110 V US

**25602** T40 Auto Press 220 V EUR

### **Alternative Pressure Ranges**

The 40 Ton Automatic Press can be supplied for different pressure ranges if more accuracy at low tonnage is required, for example a version is available with a pressure range of 0.4 – 4 Tons. Other ranges are available. Please contact your local Specac representative for a quotation.

### **Automatic Air Press**

Many configurations are possible for a diversity of applications.

Please contact your local Specac representative for a quotation.

## Evacuatable Pellet Dies

### *Production of high quality sample pellets*

#### Product Highlights

- Hardened Stainless Steel
- Highly polished pellets
- Evacuatable for sample pellet clarity and quality
- Vacuum pump kit for moisture free pressing (optional)

Specac produces a wide range of 440C hardened stainless steel Evacuatable Pellet Dies, used for compacting powdered samples into disks or briquettes.

The dies are designed for use with the Specac Hydraulic Presses. Halide disks for infrared analysis are usually produced with the smaller size dies. The larger size dies are commonly used in briquetting samples for XRF and XRD analysis and many other industrial applications. All of the dies are equipped with nitrile O-ring seals and an evacuation port to allow for the removal of moisture, if desired, during the pressing process.

Non-standard size dies are available. Contact your local Specac representative for details.



**Evacuatable Pellet Dies**



## Evacuatable Pellet Dies

### ***Evacuatable Pellet Die Specifications***

#### **Recommended load limits for Dies**

5 mm: 2.0 Tons, 13 mm: 10 Tons, 20 mm: 24 Tons,  
 32 mm: 50 Tons, 45 mm: 80 Tons

#### **Die Dimensions**

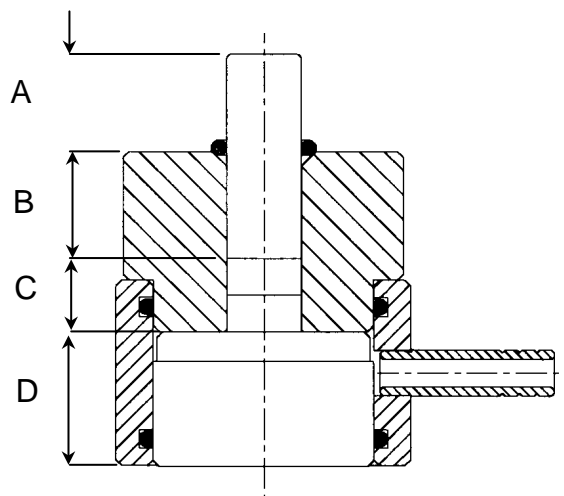
A+B= Plunger Height

C= Stainless Steel Pellet Height (only 1 pellet in 3 mm die).

D= Base Height

E= Diameter

A+B+C+D= Total Height of Die



Die Size	5 mm	10 mm	13 mm	20 mm	32 mm	40 mm	45 mm
<b>P/N</b>	03060	03100	03000	03165	03300	03290	03845
<b>A</b>	13.7	16.0	16.0	21.4	21.4	21.4	21.4
<b>B</b>	38.8	19.1	19.1	35.8	35.8	35.8	35.8
<b>C</b>	12.7	12.7	12.7	19.1	19.1	19.1	19.1
<b>D</b>	22.2	22.2	22.2	27.8	27.8	27.8	27.8
<b>E</b>	50.8	50.8	50.8	68.3	68.3	95.3	95.3



**Evacuatable Pellet Dies**

**Ordering Information Evacuable Pellet Die**

<b>Evacuable Pellet Dies Complete</b>		<b>Options</b>
Die Size (dia)		Sample Pellet Holder
5 mm	03060	03400
10 mm	03100	03404
13 mm	03000	03410
20 mm	03165	03193*
32 mm	03300	03520*
40 mm	03290	03298*
45 mm	03845	03542*
* These pellet holders are sample retaining rings only and do not have a rectangular mounting plate .		

**Vacuum Pump and Spares**

**03640** Vacuum Pump Kit - For producing clear, moisture free sample pellets with the Evacuable Pellet Dies.

*Includes: vacuum pump (1x10<sup>-1</sup> mbar), gauge, connector tube.*

When ordering please state:

1. 220 V or 110 V and country of final destination

**03641** Seal kit for Vacuum Pump

**03642** Mist filters for Vacuum Pump

**03643** Oil for Vacuum Pump

**Evacuable Pellet Die Spares and Consumables**

**03600** Agate Pestle and Mortar (Mortar Bowl diameter 4cm)

**03610** KBr powder (50 g)

**03460** Paper rings for 13 mm die (11 mm diameter aperture) (100)

**03470** Micro frames for 13 mm die (11 mm x 2 mm aperture) (100)

**03475** Ultra Micro frames for 13 mm die (4 x 1 mm aperture) (100)

<b>Die Spares</b>						
<b>Diameter</b>	<b>Set of Pellets</b>	<b>Plunger</b>	<b>Body</b>	<b>Base</b>	<b>Extractor Ring</b>	<b>O Ring Kit</b>
<b>5 mm</b>	03061	03063	03064	03050	03069	03062
<b>10 mm</b>	03101	03103	03104	03050	03025	03102
<b>13 mm</b>	03010	03030	03040	03050	03025	03020
<b>20 mm</b>	03166	03168	03169	03191	03521	03167
<b>32 mm</b>	03310	03330	03340	03230	03521	03320
<b>40 mm</b>	03291	03293	03294	03295	03297	03292
<b>45 mm</b>	03846	03847	03848	03849	03543	03871

## Specamill

***Provides efficient grinding and blending of solid materials***

### Applications

- Grinding and blending a wide variety of materials
- Sample preparation for KBr pellets
- Sample preparation for diffuse reflectance spectroscopy



**Specamill**

### Product Highlights

- Rapid grinding
- Choice of capsule and sphere materials
- Adjustable vibration
- Timer with manual override

The Specamill is used for the production of the uniformly small and consistent particle size necessary for successful preparation of KBr sample pellets. It can also be used in preparing samples for diffuse reflectance spectroscopy.

The Specamill grinds samples using rapid vibration of three spheres inside the sample capsule.

The capacity of each capsule is 3 ml and the recommended filling volume is 30 % (excluding spheres).

## Ordering Information Specamill

### ***Specamill***

**06000** Specamill (220 V, 50 Hz) UK

**06001** Specamill (220 V, 50 Hz) EU

**06800** Specamill (110 V, 60 Hz) US

The Specamill requires but does not include a capsule set

### ***Specamill Capsule Sets***

**06100** Stainless steel capsule set  
*Includes: stainless steel stopper, stainless steel spheres (3)*

**06200** Agate capsule set  
*Includes: agate stopper, agate spheres (3)*

### ***Specamill Spares and consumables***

**06300** Agate spheres (3)

**06500** Blade for Specamill

**06600** Clip for Specamill

**06700** Spare capsule holder

**06400** Stainless steel spheres (3)

## Specadie

*Produces KBr pellets without using a press*

### Applications

- Halide pellets for IR analysis

### Product Highlights

- No press or pellet holder required
- Rapid sample preparation
- Evacuatable for sample clarity and quality

The evacuatable die produces an 8.5 mm diameter pellet between two highly polished bolt ends.

The die body, which acts as a pellet holder, is mounted on a special Specadie holder



**Specadie Kit 03700**

## Ordering Information Specadie

### Specadie

**03550** Specadie with bolts and seals only

**03700** Specadie Kit  
Includes: Specadie, Specadie Holder, bench mounted wrench, open ended wrench, spare set of bolts, spare set of seals, bottle of KBr powder (50 g)

### Spares and consumables

**03560** Circular Specadie holder

**03570** Set of bolts

**03590** Set of two open ended wrenches, 9/16" (14.3 mm) and 1/2" (12.7 mm) AF

**03595** Bench mounted wrench

**03580** Set of seals

**03610** KBr powder

## Specacabinet

### Specacabinet

***Allows storage of hygroscopic infrared materials under controlled conditions***

#### Product Highlights

- Thermostatically controlled up to 80 °C (stability  $\pm 0.5$  °C)
- Sliding doors
- Size (LxWxH):  
Internal: 737x331x432 mm  
External: 762x356x508 mm
- Can be wall mounted

#### Ordering Information

##### Specacabinet

##### ***Specacabinet***

**19100** Specacabinet (220 V, 50Hz)  
UK

**19101** Specacabinet (110 V, 60 Hz)  
US

**19102** Specacabinet (220 V, 50 Hz)  
EU



**Specacabinet**

## Heated Platens

***A quick and simple accessory for converting standard Hydraulic Presses to heatable versions***

### Product Highlights

- Digital temperature display
- Controlled temperature to 300 °C with water cooling
- 15 Ton load bearing capacity
- CE Safety Approved
- 100 mm diameter pressing surface
- Compatible with all Specac Hydraulic Presses

The Heated Platens have been designed to provide heatable pressing surfaces compatible with all Specac Hydraulic Presses.

The platens are easily installed by replacing the bolster fixing of the press with the top-platen and placing the bottom platen over the lower pressing face of the press.

The platens have a large surface area, are rugged, durable and have full CE safety approval. They are fitted with a permanent thermocouple to monitor the temperature close to the pressing surface. The press connection ports are water-cooled, providing an efficient heating and cooling cycle. The platens are controlled by a digital automatic temperature controller with a stability of  $\pm 1.0$  °C.



**Heated Platens 15515**

## Ordering Information Heated Platens

### ***Heated Platens***

**15515** Water Cooled Heated Platens and Automatic Temperature Controller with Digital Display.  
Includes 2 meters of 6mm I.D. PVC tubing and flow connectors.  
When ordering please specify:  
1. 220 V or 110 V and country of final destination.

### ***Heated Platens Spares and Consumables***

- 15601** Teflon sheets 0.25 mm thick for Water Cooled Heated Platens (10)  
**15512** Replacement heater set for Platens (220 V)  
**15522** Replacement heater set for Platens (110 V)  
**15513** Pair of insulating pads

## Constant Thickness Film Maker Systems

### ***Film Making systems to produce high quality, reproducible polymer films***

Two versions of Constant Thickness Film Maker System are offered for the preparation of reproducible thickness polymer films.:

1. The High Temperature version is used to 400 °C for high melting point polymers.
2. The standard version is used with heated platens up to 300 °C

Both film maker systems are compatible with all Specac presses. The high temperature system is a compact unit combining the film maker device, heated platens, and cooling chamber as an integral unit. Further features of this system include a sample cup making device, non-drip water connections, low voltage operation and a high stability temperature controller.

## Constant Thickness Film Maker System

### **Product Highlights**

- Up to 300 °C operation
- 15 minute cycle time
- 4 Ton load limit
- 0.015, 0.025, 0.050, 0.100, 0.250, 0.500 mm films of 29 mm diameter
- Easy film release
- Operates with Heated Platens

**Constant Thickness Film Maker 15620**



## High Temperature Constant Thickness Film Maker System

### **Product Highlights**

- Up to 400 °C operation
- 10 minute cycle time
- CE Safety Approved
- Integral heating and cooling
- 2 Ton load limit
- 0.015, 0.025, 0.050, 0.100, 0.250, 0.500 mm films of 29 mm diameter
- Easy film release

**High Temperature Constant Thickness Film Maker 15800**



## Ordering Information Film Maker Systems

### **Film Maker Systems**

#### **15620** Constant Thickness Film Maker

*Includes: 0.015, 0.025, 0.050, 0.100, 0.250, and 0.500 mm spacer rings, aluminum foil disks 40 mm diameter (200), Specacards 10 mm diameter clear aperture (20), stainless steel forceps.*

Requires but does not include:

1. Manual Hydraulic Press
2. Heated Platens (15115)

#### **15800** Series High Temperature Constant Thickness Film Maker

*Includes: 0.015, 0.025, 0.050, 0.100, 0.250, and 0.500 mm spacer rings, aluminum disk foils 40 mm diameter (200), tool for making aluminum foil sample cup, Specacards 10 mm diameter clear aperture (20), stainless steel forceps, high stability digital temperature controller (400 °C), Non-drip water connectors*

When ordering please specify  
1. 220 V or 110 V and country of final destination

Requires but does not include:

1. Manual Hydraulic Press

### **Film Maker Kits**

#### **15630** Series Constant Thickness Film Maker Kit I

*Includes: Constant Thickness Film Maker, Heated Platens, and Digital Automatic Temperature Controller (300 °C)*

When ordering please specify:  
1. 220 V or 110 V and country of final destination

#### **15632** Series Constant Thickness Film Maker Kit II

*Includes: Constant Thickness Film Maker System, Heated Platens, and Digital Controller (300 °C), 15 Ton Manual Hydraulic Press*

When ordering please specify:  
1. 220 V or 110 V and country of final destination

#### **15810** Series High Temperature Constant Thickness Film Maker Kit

*Includes: High Temperature Constant Thickness Film Maker System, 15 Ton Manual Hydraulic Press*

When ordering please specify:  
1. 220 V or 110 V and country

### **Film Maker Spares and Consumables**

**03800** 10 mm diameter aperture Specacards (100)

**03805** Teflon retaining rings for supporting elastic film samples (20)

**03810** 10x25 mm aperture Specacards (100)

**03815** Filing rack for Specacards (holds 36 cards)

**03820** Magnetic film holder

**15627** 40 mm diameter aluminum foil disks (200)

**15623** 15 and 25 µm spacers (1 of each)

**15624** 50 and 100 µm spacers (1 of each)

**15625** 250 µm spacer

**15626** 500 µm spacer

**15628** Stainless steel forceps



## Specacards, Magnetic Holders and Cuvette Holders

*Enable the mounting of thin polymer films and KBr pellets for analysis and storage*

### Specacards

#### Product Highlights

- Self sealing adhesive coating
- Indexing space
- Clear aperture: 10 mm diameter or 25x10 mm
- Slide mounted
- Filing rack available

### Magnetic Film Holder

#### Product Highlights

- Magnetic ring
- Clear aperture: 10 mm diameter
- Slide mounted



**Specacards 03800**



**Magnetic Film Holder 03820**

### Ordering Information Specacard, and Film Holder

**03800** Specacards 10 mm diameter aperture (100)

**03810** Specacards 25x10 mm aperture (100)

**03815** Filing rack for Specacards

**03820** Magnetic Film Holder

## FTIR Starter Kit

***Provides a cost-effective package for routine transmission analysis of solids, liquids and gases***

The FTIR Starter Kit is the perfect combination of transmission accessories, for use with solids, liquids and gases. The items are packaged in a hard shell carrying case for storage and transportation.

### Product Highlights

- Omni Liquid Cell
- Omni Mull Cell
- 10 cm Gas Cell
- Film holder
- Specadie
- Carrying case



**FT-IR Starter Kit 01135**

## Ordering Information FTIR Starter Kit

### 01135 FTIR Starter Kit

*The FTIR Starter Kit includes the following items. Each item can be ordered separately as spares:*

- 01110** Luer syringe
- 01800** Omni Cell assembly (2)
- 01811** Pair of KBr windows for Omni Liquid Cell
- 01812** Pair of CaF<sub>2</sub> windows for Omni Liquid Cell
- 01831** Pair of KBr windows for Omni Mull Cell

- 01851** Teflon spacers 0.1 mm for Omni Liquid Cell (5)
- 01864** Assorted Teflon spacers for Omni Liquid Cell (10)
- 01871** Teflon spacers 0.1 mm for Omni Mull Cell (5)
- 02303** Microspatula
- 03600** Agate pestle and mortar
- 03610** Bottle of KBr powder (50 g)
- 03620** Bottle of Nujol (25 ml)
- 03700** Specadie disk pressing kit
- 03820** Magnetic film holder
- 05000** 10 cm Pyrex gas cell with KBr windows
- 05030** Circular cell mount for Pyrex gas cell (slide mounted)

## Professional Sampling Kit

### *The cost-effective way to obtain reflectance sampling versatility*

The Professional Sampling Kit offers an economic package of three high performance accessories, giving coverage of the most popular techniques in reflectance sampling.

The kit consists of Attenuated Total Reflectance (ATR), Diffuse Reflectance (DRIFTS) and Specular Reflectance units. Also included in the kit are all the ancillary consumables, such as KBr powder, spatula, pestle and mortar, and Diabrase abrasive pads, necessary to tackle most samples in the infrared spectroscopy laboratory. All of the accessories are compatible with the standard

Benchmark baseplate mounting and can therefore be quickly and easily interchanged. The units in the Professional Sampling Kit require minimal alignment thereby reducing operator learning and set-up time.

#### Product Highlights

- Benchmark ATR for solids, liquids, gels, and powders
- Minidiff Plus for powders and intractable solids
- Fixed Angle Specular Reflectance Accessory for coatings

## Ordering Information Professional Sampling Kit

### **04540** Professional Sampling Kit

When ordering please specify:

1. Spectrometer make and model

*The Professional Sampling Kit includes the following items. Each item can be ordered separately as spares:*

**11160** Benchmark In-Compartment ATR Unit

**11130** Benchmark ATR Trough Top-plate with ZnSe 45° crystal

**11133** Benchmark ATR Flat Top-plate with ZnSe 45° crystal

**11136** Benchmark Clamp Kit

**19820** Fixed Angle 30° Specular Reflectance Unit

**04510** Minidiff Plus Diffuse Reflectance Accessory

**04505** Sample cup holders (2)

**04508** Abrasive sample holders (2)

**03600** Agate Pestle and Mortar

**02303** Microspatula

**03610** Bottle of KBr powder (50 g)

## Oil in Water Analysis Kit

### *For analysis of low concentrations of hydrocarbons in water*

The Oil in Water Analysis Kit contains three matched pairs of infrared grade quartz cells. The cells conform to the USA Environmental Protection Agency (EPA) procedure for the analysis of total recoverable oil, grease or petroleum hydrocarbons in water.

The cells are supplied in three different pathlengths. They are all stoppered to ensure retention of volatiles in the samples. The cells have large filling ports to ensure quick and efficient sample introduction and removal. Cell matching ensures precise repeat measurements.

#### Product Highlights

- Matched transmission cell pairs
- Large aperture to avoid scattering of IR beam
- Stoppered
- Three different pathlengths: (10 mm, 50 mm, 100 mm)
- Transmission range approximately 40,000  $\text{cm}^{-1}$  to 2,700  $\text{cm}^{-1}$
- Slide mounted holder



**Oil in Water Analysis Kit 08900**

### Ordering Information Oil-in Water Analysis Kit

**08900** Oil-in-Water Analysis Kit with EPA instruction method

*The Oil-in-Water Analysis Kit includes the following items. Each item can be ordered separately as spares:*

**08904** Slide mounted holder

**08901** Matched pair of 10 mm pathlength rectangular infrared quartz cells

**08902** Matched pair of 50 mm pathlength cylindrical infrared quartz cells

**08903** Matched pair of 100 mm pathlength cylindrical infrared quartz cells

## Spectroscopist's Notes

The following hints and tips on Infrared Sampling may help you achieve better spectra with greater ease.

### Hints and Tips - Sample Preparation

For the preparation of halide disks, pestles, mortars and KBr powder should be stored in a dry environment such as the Specacabinet. The equipment should be used while still warm to minimize water contamination of the disk.

A good approximation for "first time right" halide disks is to choose a weight-to-weight ratio of 1% sample to 99% KBr. This approximation is good for most organic materials.

Don't take shortcuts by insufficient grinding of halide disk constituents. The target particle size is 0.025 mm, to coincide with the wavelength of light in the classical mid-infrared region.

Fold a sheet of paper in half to make a simple funnel for swift and easy transfer of the ground-up halide disk constituents into the pellet dies.

Take the time to use a vacuum pump with evacuable pellet dies when producing halide disks. The resulting higher quality disks produce improved spectra.

If a finished halide disk absorbs too strongly, there is no need to start again completely. Simply break off a small piece and regrind with additional KBr.

Don't forget to contact your local Specac representative if you need any help with your application. Contact details are listed at the back of this catalogue.

When using diamond compression cells it is worth checking to see if the sample has preferentially adhered to just one of the windows. If so, use the one window only for improved spectral quality. Always run background data for both one and two windows in anticipation of this.

When using liquid transmission cells in quantitative measurements it is useful to check the pathlength before and after an experiment. This is especially helpful with demountable cells.

Try using two syringes, one in each cell port, when filling and emptying liquid transmission cells. This helps to prevent air bubbles in the liquid film, and is especially useful when using very thin spacers.

Whilst doing a series of concentration solutions it is advisable to change the sample via the filling ports rather than dismantling the cell. Concentration contamination effects are avoided in quantitative work by analyzing the sample set in increasing order of concentration.

Typical transmission pathlengths for organic solvent based solutions are as follows: -

>10 %	0.05 mm
10 % - 1 %	0.1 mm
1 % - 0.1 %	0.2 mm
<0.1 %	>0.5 mm

## Hints and Tips - Reflection Measurements

Two ways of reducing the ATR penetration depth into a strongly absorbing sample are choosing an ATR crystal with a higher refractive index (see the list of optical material properties at the back of this catalogue), and selecting a larger angle of incidence.

When analyzing powdered samples using ATR, pre-grinding the sample will improve the homogeneity of the sample particles, and yield better spectra.

Aerosol spray samples can be conveniently analyzed using the ATR technique. Spray the contents onto a flat or trough top-plate, in a fume cupboard, away from the spectrometer compartment.

Lacquers and coatings can be analyzed for specular reflectance in the following way. Wrap aluminum

foil (shiny side out) around the reference mirror and apply the coating. Allow to dry and record spectra of the resulting film.

When using diffuse reflectance the sample heights are not always uniform. Each time the sample is changed it is desirable to reach the optimum height and peak energy as quickly as possible. A rolling micrometer on the Specac Minidiff Plus accessory adjusts the height in seconds, without using tools.

Level the surface of a sample for diffuse reflectance measurement by gently tamping down the surface, using a glass slide resting on the surface under its own weight. Do not press the surface hard, and risk compacting the sample. The surface can be seen through the glass slide.

## Hints and Tips - Transmission Measurements

Always wear gloves when handling all infrared windows to avoid contamination. This is good practice even for non-hygroscopic windows.

For accessories that are, or may be, out of alignment, a small beam white light source is ideal for recreating the beam path. Once rough alignment has been recovered, use the energy level output on the spectrometer in order to fine-tune the signal.

Test the identity of an unknown window or crystal by measuring the transmission characteristics in the spectrometer. Be aware that the cut-off values quoted in transmission characteristics tables are typically for short pathlengths of a few millimeters. Longer paths through ATR crystals will reduce the absorption cut-off back towards shorter wavelengths.

When using a temperature-controlled accessory, always remember to set the temperature to 20 °C after use. This will remove the risk of accidentally heating the accessory the next time it is switched on.

Always check the chemical compatibility of a window or crystal material by using scrap fragments. If in doubt, contact your local Specac representative for assistance.

When cleaning accessory optics it is advisable to remove the accessory from the spectrometer. If this is undesirable, be economical with the amount of solvent used, as large amounts of solvent vapor can have an effect on subsequent spectra. It is also advisable to purge the accessory before use.

Choosing Fluorolube as a mulling agent allows the study of all CH stretching bands in an infrared spectrum using the mull technique. These are masked by paraffin absorptions when using Nujol.

The use of an O-ring on the plunger body of an evacuable pellet die prevents the plunger falling onto the newly pressed disk when removing the disk from the body of the die.

Fingerprints can be removed from mirrors by slowly dragging a methanol soaked lens tissue over the surface of the mirror. Use a stream of dry air to remove excess solvent.

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## A - Z of IR

### **100% Line**

Ratio of two background spectra under identical conditions. Determines condition of spectrometer, or accessory, and quality of spectra. An ideal 100% Line would be a horizontal line at 100%.

## **A**

### **Absorbance**

The amount of Infrared radiation absorbed by a sample. It is proportional to concentration, and is defined by Beer's Law, so it can be used for Quantitative Analysis. Often the Y-axis unit in Infrared spectra, absorbance is related to transmittance by  $A = \log_{10} (1/T)$ , where A is the absorbance and T is the transmittance.

### **Attenuated Total Reflectance (ATR)**

A reflectance sampling technique, used in such accessories as the Golden Gate and the Benchmark 6 Reflection ATR System. A beam of Infrared radiation is passed through a prism of material which is Infrared transparent, and has a high refractive index, at least higher than the sample being analyzed. Due to internal reflectance, the light reflects off the surface of the crystal at least once, setting up an evanescent wave, which extends into the sample by typically a few microns. The sample must be held in intimate contact with the crystal.

## **B**

### **Background Spectrum**

A single beam spectrum produced without a sample in the Infrared beam. It is used to record the contributions that the instrument and the environment make to the measurement. The sample spectrum can be ratioed against the background spectrum to remove these contributions.

### **Baseline correction**

The manipulation of a spectrum to correct a sloped or curving baseline. The spectroscopist draws a function parallel to the baseline which is then subtracted from the spectrum.

### **Beamsplitter**

An optical device which reflects half the radiation striking it, and transmits half.

### **Benchmark**

Specac's universal compatibility baseplate system, adapting Specac accessories to all spectrometer models. Also Specac's 6 Reflection ATR System, capable of analyzing almost any sample.

## C

### **Calibration**

In Quantitative Analysis, the correlation of peak heights and areas in a spectrum with the concentrations of standard analytes. After calibration, unknown analyte concentrations can be calculated.

### **Calibration curve**

An Absorbance vs. Concentration plot used in calibration. If the sample obeys Beer's Law, the plot will be linear and unknown concentrations can be calculated.

### **Condenser**

The optical element that condenses light on a sample.

### **Critical Angle**

Defined as being:

$$\theta_c = \arcsin (n_1/n_2)$$

where  $\theta_c$  is the critical angle for an interface between two specific media,  $n_1$  and  $n_2$  are the refractive indices of the two media and  $n_2$  has the higher refractive index; the critical angle is the smallest angle of incidence at which total internal reflection occurs.

## D

### **Depth of Penetration**

When a sample is analyzed using ATR, the depth of penetration is the depth at which the evanescent wave has decreased to  $1/e$  (or 36.788%) of its original value after penetrating the sample. The depth of penetration is dependent on many factors, including the angle of incidence, the refractive index of the ATR crystal, and the wavelength of the Infrared radiation.

### **Diffraction**

The bending of light around the edge of an opaque body, or through a narrow slit, resulting in a series of alternately high and low intensities in the shadow of the obstacle.

### **Diffuse reflection**

The random reflection resulting when a beam of light reflects off a rough, matt surface e.g. powder or fiber.

### **Dispersive Instruments**

Infrared spectrometers that use a grating or prism to disperse Infrared radiation into its component wavelengths before detecting them. This type of instrument is less widespread since the arrival of FTIR spectrometers.

### **DRIFTS (Diffuse Reflectance Infrared Fourier Transform Spectroscopy)**

A reflection sampling technique making use of the phenomenon of diffuse reflectance.

## E

### **Evanescent wave**

A standing wave of radiation set up in an ATR crystal at the interface with the sample. The wave penetrates into the sample and an Infrared spectrum can be obtained.

## F

### **Far IR**

Infrared radiation between 400 and 10  $\text{cm}^{-1}$

### **Fluorolube**

Polymer of trifluorovinyl chloride  $(-\text{CF}_2-\text{CFCl}-)_x$  used for the preparation of mulls. Unlike Nujol, it doesn't mask CH stretch bands.

### **Fourier Transform**

The integration performed upon an interferogram to produce an Infrared spectrum.

### **Fourier Transform Infrared (FTIR) Spectrometer**

The instrument used for FTIR spectroscopy.

### **FTIR Spectroscopy**

A method of obtaining an Infrared spectrum by measuring the interferogram of a sample using an interferometer, then performing a Fourier Transform upon the interferogram to obtain the spectrum.

## G

### **Germanium**

Element, atomic number 32, atomic weight 72.6: a gray-white metallic semiconductor. Its high refractive index (4.01) makes it an important material for ATR crystals, used to analyze highly absorbing samples.

### **Golden Gate**

Specac's world-famous single reflection ATR accessory, analyzing almost all sample types: hard solids, to powders, to corrosive liquids, to fibers. The Golden Gate is the world's most versatile sampling system. The

standard Diamond Golden Gate uses a type IIa diamond as the ATR element for unparalleled optical sensitivity, while diamond's unique physical strength makes it ideal for excellent contact with the hardest of solids. Its tremendous chemical stability allows it to withstand corrosive liquids. Other Golden Gate versions available, to accommodate various types of sample, include a Germanium Golden Gate, whose high refractive index is useful for highly absorbing samples, and a heatable version for high temperature analysis.

### **Grazing angle reflection**

An optical phenomenon occurring when the incident Infrared radiation strikes a sample, deposited on a reflective material, at an angle of around  $80^\circ$  to the normal. Useful for the analysis of thin coatings, e.g. paints on metallic surfaces.

## I

### **Index of refraction**

A property of a material describing the behavior of electromagnetic radiation when travelling through it (not all EM radiation can travel through all materials). It is defined as being the ratio of the speed of light in a vacuum to the speed of light in the material concerned. Also called refractive index.

### **Infrared (IR) radiation**

The region of the electromagnetic spectrum from 14,000 to  $10 \text{ cm}^{-1}$ .

### **Infrared Spectroscopy**

The study of the characteristic Infrared spectra of matter.

***Infrared spectrum***

A plot of Intensity of Infrared radiation vs. Wavenumber. A spectrum can be interpreted to determine the molecular structure of the sample from which it has been obtained, because different functional groups in a molecule will each produce a unique feature, or fingerprint, in the spectrum.

***Interferogram***

A plot of Infrared detector response vs. Optical path difference. This is what an FTIR spectrometer measures, to be Fourier Transformed to obtain a spectrum.

***Interferometer***

An optical device causing two beams of light to travel different distances to produce an optical path difference. This allows constructive and destructive interference to occur, and changing the optical path difference allows the measurement of an interferogram.

***Internal reflection***

The effect where electromagnetic radiation passing through a material reflects off the surface of the material at the interface with another medium, which has a lower refractive index, instead of leaving the material to enter the new medium. If the angle of incidence is larger than the critical angle, then none of the light will be transmitted to the new medium, it will all be reflected. This phenomenon is called total internal reflection.

**K**

***KBr pellet***

A pellet produced for use in transmission analysis. This technique is used for powders and other solids. The sample is ground, then "diluted" with KBr powder, before being pressed into a pellet. The pellet is then mounted on a Specacard before being placed directly in the Infrared beam for analysis.

***Kramers-Kronig Transform***

A mathematical calculation performed upon specular reflectance spectra to eliminate the effect of variations in the refractive index of the sample. It results in a k-spectrum and an n-spectrum, which are the true absorbance spectrum and a plot of Refractive index vs. Wavenumber respectively.

***KRS-5***

Trade name for thallium iodide bromide, a common ATR crystal material (Refractive index 2.38) with Near IR and Mid IR transmission characteristics.

***Kubelka-Munk units***

Unit of intensity of diffuse reflected light. The Kubelka-Munk equation relates this intensity to the concentration and scattering factor of a sample. The scattering factor is determined by the particle size, shape and packing density, but can be difficult to quantify.

## M

### **Micrometer**

A gauge for accurately measuring small distances, thicknesses etc..

### **Mid IR**

Infrared radiation between 4,000 and 400  $\text{cm}^{-1}$ .

### **Mull**

A Transmission sampling technique. A solid sample is ground, then dispersed in a mulling agent (e.g. Nujol). The mull mixture is then sandwiched between two windows (e.g. KBr) in an Omni-Cell body before being placed directly in the Infrared beam.

### **Mulling agent**

(Usually) an oil added to a ground sample in the preparation of a mull.

## N

### **Near IR**

Infrared radiation between 14,000 and 4,000  $\text{cm}^{-1}$ .

### **Nujol**

A liquid paraffin used for the preparation of mulls. Nujol is not always the best mulling agent as it masks any CH stretch bands that would otherwise be seen in the sample spectrum.

## O

### **Omni-Cell**

With over 400 window and pathlength combinations available as standard, to cater for every sample and wavelength of interest, Specac's Omni-Cell is the simplest and most versatile Infrared transmission cell system available anywhere. The Omni-Cell can be configured as a sealed liquid cell, a demountable liquid cell, or a mull cell. Easily assembled, or disassembled, in a few seconds, it is designed for fast sample turn-around. With a known pathlength, the spectrum from an Omni-Cell is suitable for Quantitative Analysis.

## P

### **Peak-to-Peak Noise**

A noise measurement often made on a 100% Line to determine spectrum quality and instrument performance when obtained under controlled conditions. It is measured as the difference between the lowest and highest transmittance value in a specific wavenumber range.

### **Polarizer**

A device for converting light into polarized light. Typically, polarizers are a ZnSe substrate with thin parallel gold wires on the surface to form a grid.

### **Polymer film**

A thin film, of precise thickness, pressed at an elevated temperature using a Specac Constant Thickness Film Maker Kit. The film can then be mounted in a magnetic film holder before being placed directly in the Infrared beam for transmission analysis.

## Q

### **Quantitative Analysis**

Calculation of sample concentration using measurements from a spectrum, such as band ratios and peak areas and heights. This technique requires a calibration before unknown concentrations can be determined.

## R

### **Raman effect**

When monochromatic light is scattered by molecules, a small fraction of the scattered light is observed to have a different frequency from that of the incident beam; this is the Raman effect. Raman spectroscopy can reveal vibrations that may be inactive under Infrared analysis, and therefore can provide complementary information about the molecular structure of the sample under examination. The Specac Variable Temperature Cell is suitable for the Raman Technique.

### **Reflection Absorption**

Also known as "Double-transmission", reflection absorption is a sampling technique used on thin coatings on metal. The Infrared beam passes through the coating again after reflecting off the metal surface, before reaching the detector.

### **Refractive Index**

See Index of Refraction.

### **Resolution**

Measure of the ability of a spectrometer to distinguish features of a spectrum which are very close together.

## S

### **Scan**

The measuring of an interferogram in FTIR. Usually involves cycling the mirror in the interferometer once.

### **Sealed Liquid Cells**

Basic accessories used to obtain transmission spectra of liquids. Consists of two IR transparent windows (e.g. NaCl), held apart by a spacer, filled with the liquid under consideration. The cell is then put directly into the beam. Specac's advanced Omni-Cell system can be configured for use as a sealed liquid cell, with 9 options for windows and 6 options for pathlength to give 54 standard combinations.

### **Selector**

Specac's versatile diffuse reflectance accessory, featuring unique off-axis optics to fully minimize unwanted specular reflectance, offers rapid FTIR analysis of solids with minimal sample preparation. The Selector can include an Environmental Chamber, for extreme temperature and pressure analyses, an Autosampler, to automatically analyze up to 32 samples, and an X-Y stage, for sample mapping of large or inhomogeneous samples.

### **Signal-to-Noise Ratio (SNR)**

To determine the quality of a spectrum, or spectrometer, the SNR is the ratio of the signal, or intensity, of the spectrum to the noise at a nearby point on the baseline.

### **Silicon**

Element, atomic number 14, atomic weight 28.09, grayish metallic semiconductor. A very hard, inert crystal with a refractive index of 3.42, Silicon is very useful for Far IR in the range 400 to 30cm<sup>-1</sup>.

### **Single Beam Spectrum**

The spectrum obtained after Fourier Transforming an interferogram. The single beam spectrum is a combination of the spectra of the sample (if applicable), the instrument and the environment.

### **Sirocco Gas Cell**

Specac's advanced transmission gas analysis cell is a new concept in gas cell specification. With an extensive array of standard features on the base unit, personalized modifications can be made from a range of precision engineered options. A range of pathlength options allows analysis at low pressures to be performed in the longer cells, and pathlengths can be verified with a laser alignment accessory.

### **Specacard**

Mount for the transmission analysis, and storage, of KBr pellets. Specacards can also be used, with a magnetic film holder, for polymer films.

### **Specular Reflectance**

The reflectance occurring when a beam of light strikes a smooth, shiny surface, e.g. a mirror, such that the angle of incidence equals the angle of reflection. Specular reflectance can be used to obtain Infrared spectra.

## **T**

### **Transmission**

A physical phenomenon where radiation passes through a body. When producing a transmission spectrum a proportion of the energy is absorbed by the sample, while the remainder travels on to the detector.

### **Transmission Sampling**

The method of sampling whereby the Infrared beam passes directly through the sample before being detected, used in such accessories as the Variable Temperature Cell, the Omni-Cell and the Sirocco Series Gas Cell. An appropriate pathlength must be selected so as to avoid total absorption of the Infrared.

### **Transmittance**

Unit of measurement of the amount of radiation transmitted by a sample. It is often the Y-axis of Infrared spectra. Transmittance is not linearly proportional to the concentration of the sample, therefore spectra plotted with these units cannot be used for Quantitative Analysis.

## **V**

### **Variable Temperature Cell**

Specac's most advanced accessory for the transmission analysis of liquids and solids at temperatures from -190°C to 250°C. Choice of window material allows this accessory to be used in UV, Visible and Infrared regions. This accessory can also be used for Fluorescence and the Raman Technique.



## **W**

### ***Wavelength***

One wavelength is the distance between two identical points on two adjacent identical waves in a beam.

### ***Wavenumber***

Wavenumber is defined as the reciprocal of the wavelength expressed in cm. Units are  $\text{cm}^{-1}$ . Wavenumbers are normally the units along the X-axis in Infrared spectra.

**Optical Materials for Spectroscopy (normally held in stock)**

Window Material	*Useful Range $\text{cm}^{-1}$	Refractive Index at $2000 \text{ cm}^{-1}$	General Properties
$\text{MgF}_2$	91,000-1100	1.37	Slightly more soluble in water than $\text{CaF}_2$ . Used from vacuum UV to IR region: IR and UV polarizers. Birefringent.
$\text{LiF}$	83,000-1400	1.33	Slightly soluble in water, suitable for vacuum UV and near IR.
$\text{CaF}_2$	77,000-900	1.40	Insoluble in water, resists most acids and alkalis. Its high mechanical strength makes it particularly useful for high pressure work. Does not fog. Soluble in ammonium salts.
$\text{BaF}_2$	66,666-800	1.45	Insoluble in water, soluble in acids and $\text{NH}_4\text{Cl}$ . Very sensitive to mechanical and thermal shock. Good resistance to fluorine and fluorides. Does not fog.
$\text{NaCl}$	40,000-600	1.52	Soluble in water and glycerin, slightly soluble in alcohol. Most common IR material due to low cost. Fair resistance to mechanical and thermal shock and can easily be polished.
AMTIR	11,000-725	2.5	Hard, brittle insoluble in water, only attacked by alkalis. A good ATR material.
$\text{AgBr}$	22,000-300	2.30	Insoluble in water, soluble in acids and $\text{NH}_4\text{Cl}$ . Very sensitive to mechanical shock and is malleable. Will cold form. Corrosive to metals and alloys. Good resistance to thermal shock. Sensitive to strong UV radiation, will darken with prolonged exposure.
$\text{KCl}$	33,000-400	1.47	Hygroscopic, similar to $\text{NaCl}$ but with extended transmission. Less soluble and lower reflection losses.
$\text{KBr}$	43,500-400	1.54	Soluble in water, alcohol and glycerin, slightly soluble in ether. Hygroscopic. Fairly good resistance to mechanical and thermal shock.

Optical Materials for Spectroscopy (normally held in stock)

Window Material	*Useful Range $\text{cm}^{-1}$	Refractive Index at $2000 \text{ cm}^{-1}$	General Properties
KRS-5	17,000-250	2.38	Slightly soluble in water, soluble in bases, not soluble in acids. Not hygroscopic. Good transmission range, ideal for ATR work. Soft hence easily deformed. Highly toxic.
CsBr	42,000-250	1.66	Soluble in water and acids, soft and hygroscopic.
CsI	42,000-200	1.74	Soluble in water and alcohol, soft and extremely hygroscopic. Very useful because of wide transmission range. Mildly toxic.
Fused Silica			
UV Grade	59,000-3700	both $\sim 1.46$ at $20,000 \text{ cm}^{-1}$	Unaffected by most solvents, transmission at $50,000 \text{ cm}^{-1}$ ; 98% for UV grade. 40% for IR grade.
IR Grade	40,000-3000		
ZnS (Cleartran)	50,000-770	2.25	Insoluble in water, normal acids and bases, and virtually all organic solvents. Reacts to strong oxidizing agents. Good resistance to thermal and mechanical shock. Suitable for work in temperature range $-200^{\circ}\text{C}$ to $800^{\circ}\text{C}$ .
ZnSe	20,000-500	2.43	Insoluble in water. High resistance to chemical attack. Organic solvents, dilute acids and bases have no effect. Because of its low absorption in IR, ideal for ATR work. Low absorption at $10.6 \mu\text{m}$ hence popular window material for $\text{CO}_2$ Lasers. Toxic hazard.
Ge	5000-550	4.01	Insoluble in water, soluble in hot sulfuric acid and aqua regia. Suitable for ATR work where high pressure contact not required. Very brittle.
Diamond	40,000-less than 100	2.40	Excellent chemical resistance. Unique mechanical strength and thermal conductivity.
Si	8,333-33 not continuous	3.42	Very hard and inert crystal. Useful for far infrared spectroscopy in the region. $400\text{-}30 \text{ cm}^{-1}$ .

Optical Materials for Spectroscopy (normally held in stock)

Window Material	*Useful Range $\text{cm}^{-1}$	Refractive Index at $2000 \text{ cm}^{-1}$	General Properties
Polyethylene	625-less than 4	1.52	Inexpensive far infrared window material. Insoluble in water, tends to swell and become contaminated with some organic solvents. Cannot be used for high temperature work (mp $110^{\circ}\text{C}$ ).
TPX	50-less than 4	1.43	Similar to polyethylene for far infrared but has the advantage of being transparent in the visible region.

\*Dependent on sample thickness.

In the interest of the environment the above windows can be returned to Specac for safe disposal.