SUPER-SEALED LIQUID FLOW CELLS

OPERATION AND USER MANUAL

Spectral Systems

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Optimized Design for Continuous Flow Applications

- Rugged, heavy duty design compatible with continuous use
- Large IR port diameter to accommodate high flow rates
- Proprietary seal technology for leak free operation
- Designed for optimized flow
- Rectangular plate design to fit your FT IR spectrometer standard slide mount
- Proprietary coating applied to high refractive index windows to maximize IR throughput and minimize undesirable fringing
- Individually serialized to aid in record keeping
- Optional factory calibration for your convenience and method certainty

Introduction

The Spectral Systems Super-Sealed™ Liquid Flow Cells are designed and manufactured for continuous flow infrared transmission sampling applications. The large port diameter permits higher flow rates to speed feedback of component concentration. Spectral Systems Super-Sealed Liquid Flow Cells are designed for optimized laminar flow allowing the sample to flow with minimized lateral mixing. The proprietary seal technology used in our Super-Sealed Liquid Flow Cells provides for leak free operation, exceptional durability and maximum sample compatibility. The cell mount for the Super-Sealed Liquid Flow Cell is the standard 2.0" × 3.0" side mount to fit your FT-IR spectrometer. All Super-Sealed Liquid Flow Cells are manufactured with Luer Lock fill ports for covenient coonection with flow tubing and peristaltic pumping systems. The Super-Sealed Liquid Flow Cells are available with your selection of sampling pathlength and window materials. Window materials used in the Super-Sealed Liquid Flow Cells are of the highest quality composition and maximum flatness for precision quantitative analysis. To increase IR throughput and minimize spectral fringing of high refractive index window materials we utilize our Spectral Systems XP-BBAR™ coating on our Super-Sealed Liquid Flow Cells. Please contact us for additional performance features.

For your convenience we offer factory calibration of any of our Super-Sealed Liquid Flow Cells.

Unpacking Your Product

The Super-Sealed Liquid Flow Cell will be packaged in a sealed plastic bag with desiccant. When the Super-Sealed Liquid Flow Cell is not in use it should be stored in a low humidity environment such as a desiccator to prevent fogging of hygroscopic IR windows.

What's included?

- Super-Sealed Liquid Flow Cell
- 2 Teflon® stoppers for cell

Please examine the contents and let us know if there has been a problem with shipping.

SPECIFICATIONS

Plate Geometry	Rectangular
Plate Dimensions	2.0" W × 3.0" H
IR Beam Port Geometry	Oblong
IR Beam Port	18mm W x 25mm H
Nominal Pathlength	±10% guaranteed
Calibrated Pathlength	Optional
Seal Type	Proprietary, leak free
Fill Port Type	Luer Lock
Window Flatness	λ/5 at 10.6 micron

Determining Cell Pathlength

Your Super-Sealed Liquid Flow Cell has been factory tested for pathlength prior to shipping to ensure that it is within ±10% of its nominal pathlength. You can determine its precise pathlength by using the following procedure.

1. Collect an open beam background spectrum on your FT-IR.
2. Collect the spectrum of the empty cell. The resulting spectrum will exhibit a fringing pattern resulting from the reflection of the IR beam between the opposing surfaces of the open cell.
3. Select a region of the spectrum where the fringing pattern is distinct – free of interference (water bands, etc.) and note beginning and ending point values in cm^{-1} for a significant number of fringes. Figure 1 shows the spectrum of a 0.1 mm Super-Sealed Cell.

Notes: High spectral resolution is required for calculating the pathlength of the longer pathlength cells in order to provide sufficient data points for the measurement. Table 1 shows minimum spectral resolution settings required. For all shorter pathlength cells a spectral resolution setting of 4 cm^{-1} is adequate.

4. The pathlength of the cell can be calculated from the following equation[1]:

$$\text{Pathlength} = 10\ N/2(\lambda_1 - \lambda_2)$$

Where;

Pathlength = value in mm

N = number of fringes between λ_1 and λ_2

λ_1 = starting value in cm^{-1} for measurement

λ_2 = ending value in cm^{-1} for measurement

In the example shown in Figure 1, λ_1 = 2534.38 cm^{-1}, λ_2 = 1138.93 cm^{-1} and N = 29. From this we calculate the actual pathlength to be 0.104 mm.

Spectral Systems offers an optional cell calibration for their Super-Sealed Liquid Flow cells. This factory calibration provides you with verification of cell pathlength especially useful in regulated laboratory environments. With selection of the Calibration of Liquid Flow Cell option, you will receive a label on the cell and a certificate stating the factory calibrated cell pathlength. It is important to remember that cell pathlength could change with use, i.e. solubility or abrasion of window material with use.

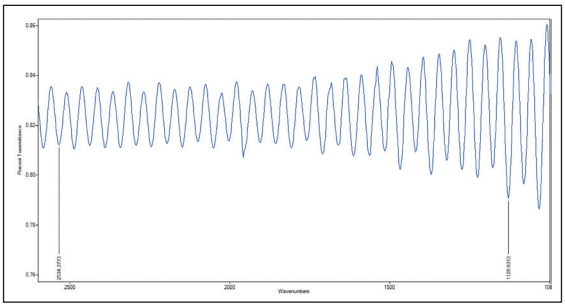


Figure 1. Spectrum of 0.1 mm pathlength Super-Sealed Cell

Minimum Spectral Resolution Required

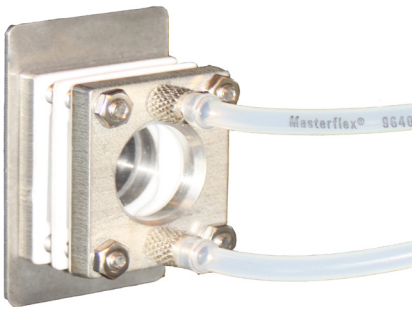
CELL PATHLENGTH (mm)	MINIMUM SPECTRAL RESOLUTION (cm^{-1})
10	0.25
5	0.5
1	2.5
0.5	5.0

Table 1

Sampling Procedures

Samples measured in sealed liquid flow cells are generally a component in a base liquid, for example an additive in fuel for a combustion engine. Generally the pathlength of the liquid cell is chosen to optimize the absorbance of the component which needs to be measured. Often the components of interest are at low concentrations within the base liquid; parts per million (ppm) and low percentage levels are typical. Therefore, we generally need to choose longer pathlength cells to "see" and measure these low concentration levels.

The primary absorbance bands from the base liquid generally are out of the linear range of the spectrometer and therefore cannot be used to internally calibrate the pathlength of the measurement. In these cases the use of a fixed and reproducible pathlength cell is essential. In some sample measurements weakly absorbing bands of the base liquid can be used as a measure of the liquid cell pathlength. In these cases the absorbance of the component of interest can be ratioed to an absorbance band of the base liquid to determine concentration and a fixed pathlength cell aids in the precision of the quantitative measurements.



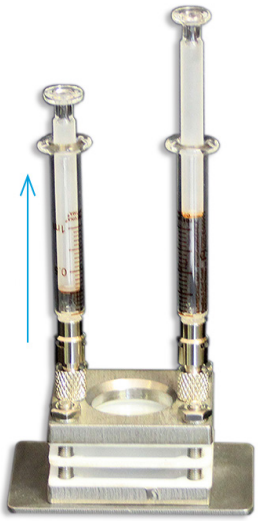
Using the Liquid Flow Cell

The Super-Sealed Liquid Flow Cell is configured with two Luer Lock ports for connection with liquid flow tubing. It is very important to use proper procedure for flowing liquid through the cell. Flow through the cell is engaged by using a peristalic pump.

- Gently connect flow tubing inserted into the sample reservoir and fitted with Luer Lock connectors onto the bottom port one of the flow cell.
- Gently connect the flow tubing connected to the peristaltic pump onto the upper Luer Lock fitting of the flow cell..
- Flow through the cell must be pull via the peristaltic pump to prevent damage.
- Slowly increase the setting of the peristaltic pump to pull the flow to the desired rate. Do not set excessive flow rates which may cause bubbles to form in the cell or may cause damage to the flow cell.
- Examine the flow cell to ensure liquid maintains fill of the cell and that no bubbles are present.
- Collect IR spectra of the liquid as it flows through the cell
- To remove sample from the flow cell, remove the tubing attached to the Luer Lock fittings and install an empty glass syringe onto the lower port and slowly pull the plunger in the out direction to remove the sample.

Cleaning and Storing the Liquid Cell

Before storing the liquid flow cell after use it is important to remove all sample residue to prevent long-term damage to the cell.



Pull a suitable solvent through the cell using the following method:

- Install a Luer Lock glass syringe with solvent onto the lower port of the flow cell. Install an empty glass syringe onto the upper port of the flow cell. Gently pull the plunger of the upper syringe out to draw the solvent into the flow cell. It is recommended this be done three times using three times the volume (each time) of the liquid cell to completely remove sample residue.
- Store the Super-Sealed Liquid Flow Cell in a desiccator to prevent damage to hygroscopic IR transparent windows.

Product Configurations

The Super-Sealed Liquid Flow Cell is available with your selection of sampling pathlength and window materials. Table 2 shows a complete list of Spectral Systems part numbers for these configurations. Each of the window materials have of course unique properties and capabilities relative to spectral range and water solubility. We coat the outer surface of the ZnSe Super-Sealed Liquid Flow cell with our XP-BBAR to increase IR throughput and reduce fringing effects. For your convenience we have listed these properties for each of the materials in Table 3.

Safety Precautions

It is essential to utilize safe laboratory procedures when using the Super-Sealed Liquid Flow Cells. Safety protective eyeglasses and laboratory gloves are required.

Follow proper cell filling and emptying procedures as outlined in Sampling Procedures. Failure to do this may cause liquid cell damage and or exposure to the liquid sample.

Make sure your sample is compatible with the window material of the sealed cell. Failure to do this may cause liquid cell damage and or exposure to the liquid sample.

If any damage to the cell is detected, please contact Spectral Systems for assistance. If the cell leaks it cannot be repaired in the field.

References:

1. *Conley, Robert T., Infrared Spectroscopy (Allyn & Bacon, 1966).*

Part Numbers List for Super-Sealed Liquid Flow Cells

PATHLENGTH (MM) VOLUME (ML)	1.00 0.47	2.00 0.94	4.00 1.88
CaF_2	097-76-001	097-76-002	097-76-003
ZnSe, XP BBar	097-72-001	097-72-002	097-72-003

Table 2. Super-Sealed Liquid Flow Cells include Teflon stoppers for storing the cell when not in use. Special versions of these cells are also available from Spectral Systems. Versions with specialized coatings to increase IR throughput and versions with window wedging to improve performance for high-resolution measurements are available. Please contact us for more nformation for your requirements..

Spectral Range and Water Solubility for Super-Sealed Liquid Flow Cells

WINDOW MATERIAL	CaF_2	ZnSe
Short Wavelength, cm^{-1}	79,500	5,000
Long Wavelength, cm^{-1}	1025	508
Solubility, g/100g	0.0017	0

Table 3. Where SWL = highest wavenumber, LWL = lowest wavenumber and solubility is the value at room temperature

Replacement Parts

DESCRIPTION	PART NO.
Teflon Stoppers (12 each)	097-3711
Glass Syringe, 1 mL	097-3801
Glass Syringe, 5 mL	097-3805
Glass Syringe, 10 mL	097-3810

Super-Sealed Liquid Cells Calibration

DESCRIPTION	PART NO.
Calibration of Liquid Cell	097-00-000

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