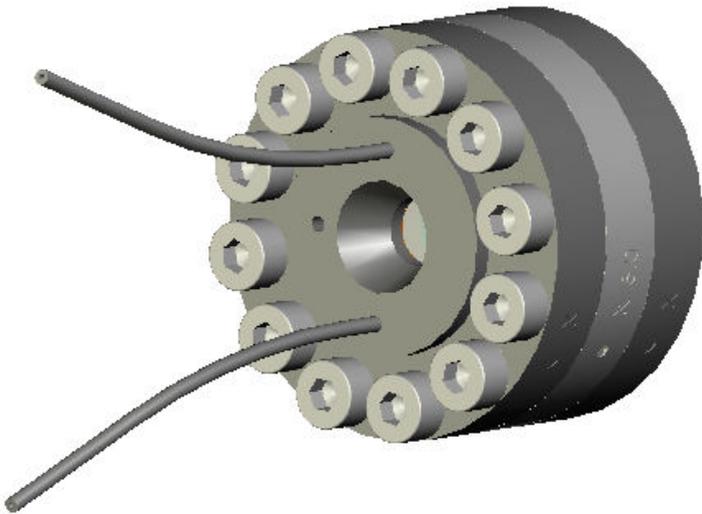




Variable Pathlength  
Very High Pressure Liquid Cell  

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*User Manual*





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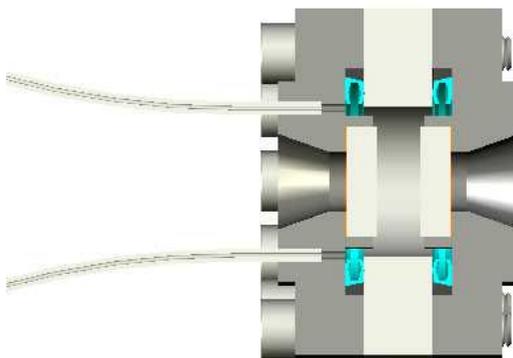
## 1. Introduction

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The Variable Pathlength Very High Pressure (VPVHP) Liquid Cell has been designed for use at pressures up to 10000psi (680bars) and temperatures from ambient to 150C.

The cell consists of two stainless steel metal window housings each containing a sapphire window that are fusion bonded into the window housing. The clear aperture for the cell is 7mm diameter. Between the window housings different stainless steel metal bodied spacers can be inserted to provide a different pathlength for the cell. The spacers provided with the cell allow for pathlengths of 0.1, 0.2, 0.5, 1.0, 2.0, 5.0 and 10mm. Twelve M4 high tensile plated socket cap screws hold the window housings and specific pathlength body spacers together to form the complete cell. The spacer seals to the cell bodies using special PTFE face seals or O-rings.

**Note:** *The cells are demountable by an end user for change of pathlength without compromise to the overall sealing integrity of the cell.*



**Figure 1.** Cutaway side view of VPVHP Liquid Cell

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A pressurised fluid is introduced into the central chamber of the cell created by the pathlength spacer, through 1/16" O.D. x 0.020" wall thickness stainless steel tubing, or through 1/4" O.D. elbow welded outlets. These tubing connections pass through the front window housing assembly only.

The twelve M4 high tensile plated socket cap screws also pass through the front window housing assembly with their socket heads accessible for tightening from this end of the cell. Different length sets of the M4 screws supplied are used with their appropriate pathlength body spacer.

20mm long screws are used with the 0.1, 0.2, 0.5 and 1.0mm spacers.  
25mm long screws are used with the 2.0 and 5.0mm spacers.  
30mm long screws are used with the 10mm spacer.

The cell is mounted for heating within the Specac Electrical Heated Jacket P/N 20730 (for temperatures from 25C to 150C). Please refer to the Electrical Heating Jackets own instruction manual for its use.

## 2. Unpacking and Checklist

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The VPVHP Liquid Cell has been supplied in a carry case with the following parts:

- Complete Cell Assemblies with a “dot and letter” identification including flow tubes and sapphire windows. They will be assembled with their appropriate 5.0mm spacer. The 1/16” flow tubes on the “dot and A letter” cell and the ¼” outlets/elbows on the “dot and B letter” cell will be welded to their respective front plates.
- Set of specific “dot and letter” spacers for cell assemblies, consisting of 0.1, 0.2, 0.5, 1.0, 2.0, 5.0 and 10.0mm pathlengths. (5.0mm spacers are already used on the supplied cell assembly).
- Set of 12 each of M4 screws at 20mm, 25mm and 30mm lengths. (The 25mmscrews are already used on the supplied cell assembly).
- A selection of PTFE face seals and O-rings for use between spacer and cell bodies.
- 1 Special Front Cover Plate (for use with Electrical Heating Jacket P/N 20730). (See Figure 2.)
- 1 torque wrench and M4 hexagonal head adapter piece.
- 1 Certificate of Conformity.

Please check that all the parts are present.



**Figure 2.** Special Cover Plate for Electrical Heating Jacket

## 3. Safety

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### Warnings

- 1) Do not operate the cell at temperatures below ambient or above 150C. Temperatures beyond this range may cause permanent damage to the seals and render the cell dangerous. Ensure that the solvent/sample used is compatible with the seal and window material fitted.
- 2) Do not operate the cell above the rated pressure: 10000psi (680 bars).
- 3) The tubing for liquid introduction is welded into the cell body. Take extra care not to over-bend the stainless steel tubing. This will avoid damaging the weld.
- 4) Ensure that when connecting the flow tubes to the sample stream two spanners are used, one to hold still the tube to the body and the other to screw and unscrew the Swagelok nut to make or break the connection. This will ensure that the welded tubes are not damaged at the joints.
- 5) When using the cell in heating applications, do not set the heating rate too high. High rates may cause thermal shock to some windows and may cause breakage. A heating rate of 10C per minute or less is generally recommended.
- 6) Visually inspect the cell for damage each time before use.

**Note:** *If there is any sign of damage to the windows, tubes or body, **DO NOT USE**. Contact Specac or your local representative for the cell to be returned for repair.*

- 7) All seals and seal surfaces must be handled with care. The slightest scratch or damage will cause leakage of the cell.

## **Variable Pathlength Very High Pressure Liquid Cell**

- 8) It is very important that the outside diameters of the three main components of the cell (the two window housings and the pathlength spacer) are properly aligned when the cell has been constructed. Misalignment will prevent the cell from being properly positioned within the Electrical Heating Jacket P/N 20730.

## 4. Using The Cell

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Before use of the VPVHP Liquid Cell familiarise yourself with the safety warnings. (Section 3 of this manual).

The VPVHP Liquid Cell is supplied with the 5.0mm pathlength spacer already in position specifically for safe transportation and protection of the sapphire window surfaces in their window housing assemblies. Before the cell can be used the seal between the window housings and the spacers must be inserted.

Also at this stage, if you wish to change the pathlength of the cell, the 5.0mm pathlength spacer can be exchanged for the appropriate pathlength spacer.

### Changing The Pathlength Spacer

To remove the 5.0mm pathlength spacer after initial transportation and supply, take the cell and undo the twelve M4 screws that tighten the cell components together. When these screws are removed the spacer can be separated from the front and rear window housing assemblies of the cell.

### PTFE Seals

The PTFE seals that can be used between the spacer and cell window housings are of a special design. They are a two part device with an outer black wedged ring and inner blue colored ring with a wedged outer surface that contains the seal. The two rings **MUST** fit together with the appropriate wedged surfaces in contact with each other, such that the overall seal forms a flat ring. (See Figure 3.)

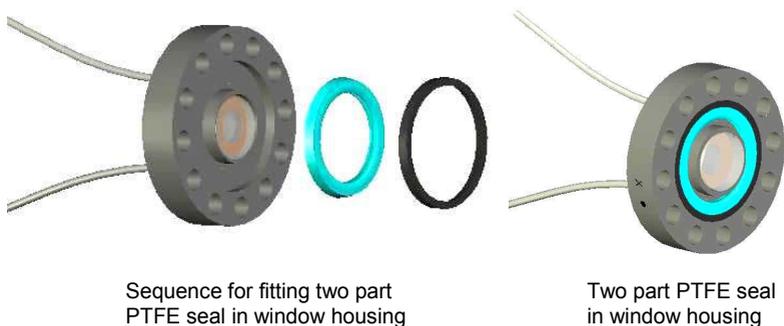
When the two part PTFE seal has been put together correctly, one complete PTFE seal assembly is placed into the inner recess of both the front and rear body assemblies holding the sapphire windows. (See Figure 4.)

## Variable Pathlength Very High Pressure Liquid Cell



**Figure 3.** Two part PTFE seal assemblies.

**Very Important:** The PTFE seal assemblies **MUST** be placed into the recess of the cell window bodies with the **wider** edged face of the turquoise blue inner seal ring in contact with the window housing assembly. The **wider** edged face of the black outer seal ring **MUST** be in contact with the face of the appropriate pathlength spacer to be used. Only in this way will the cell seal sufficiently for operation at high pressures.

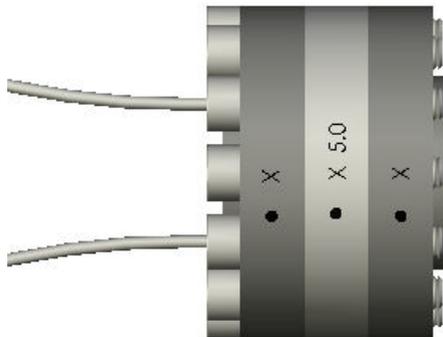


**Figure 4.** Insertion of PTFE seal into window housing

## Fitting The Pathlength Spacer

The window housings and the pathlength spacers of the cell are identified using a “dot and letter” stamped onto the outer surface of the metal. In addition to the “dot and letter” the spacer will also be stamped with the pathlength value of the spacer e.g. 5.0 (for 5.0mm.)

When the PTFE seals have been correctly positioned in the window housings of the cell, it is re-assembled by placing the pathlength spacer between the window housings such that all the “dot and letter” markings are in alignment. e.g. •A next to •A 5.0 next to •A. (See Figure.5 – the letter X is an example letter that may be stamped on the cell components).



**Figure 5.** Cell constructed showing “dot and letter” alignment of components.

Depending upon the pathlength spacer chosen, take the appropriate set of twelve M4 screws and use them to tighten the window housings and spacer together. Loosely tighten (finger tight) all twelve screws and then use the torque wrench and M4 hexagonal head adapter piece supplied to tighten to a torque of 60cNm. It is advisable to tighten the screws correctly for their torque setting in a sequence of diagonally opposite pairs.

**Note:** *This procedure for fitting the PTFE seals and change of the pathlength spacer is from receipt of the cell for the first time. If changing the pathlength spacer after the Cell has been used, this same procedure can be used, but you **MUST** first ensure that the Cell has been disconnected and isolated from the pressurised sample stream and is empty.*

## Operation Of The Cell

### Heated Applications in the Electrical Heating Jacket P/N 20730

When the VPVHP Liquid Cell has been assembled with the appropriate pathlength spacer connect it to the sample flow stream supply via the 1/16" O.D or 1/4" welded tubes on your particular Cell.

**Tip:** *It is better to use what will be the lower of the two flow ports as the inlet port to allow the cell cavity to fill from bottom to top.*

1. Insert the VPVHP Liquid Cell into the Electrical Heating Jacket. (Please refer to the instruction manual for the Electrical Heating Jacket P/N 20730)
2. Replace the standard front coverplate of the Electrical Heating Jacket with the modified coverplate supplied with the VPVHP Liquid Cell and secure using the quick release thumb nuts supplied with the Heating Jacket.

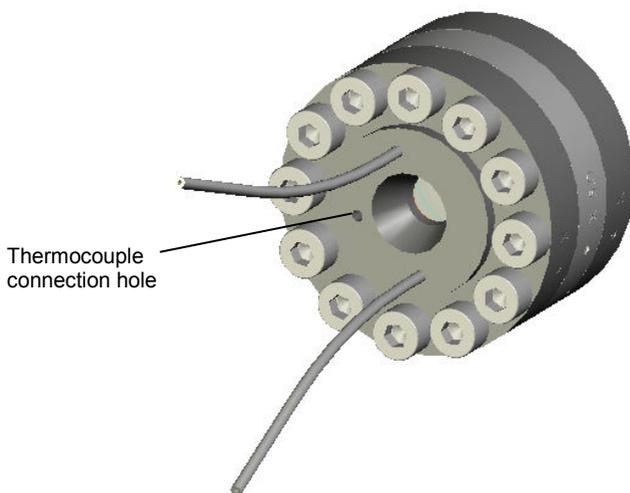
**Note:** *When fitting the 1/4" outlet elbow tubing Cell into the Electrical Heating Jacket, the modified cover plate must be hooked under the supply tubes and fitted to the Jacket at the same time as insertion of the Cell.*

3. Insert the Electrical Heating Jacket together with the VPVHP Liquid Cell in the spectrometer 3" x 2" mount and secure.
4. Insert the thermocouple from the temperature controller to the thermocouple hole in the front window housing of the VPVHP

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Liquid Cell. (See Figure 6). This enables the temperature of the cell to be monitored very close to the liquid sample.

5. Connect the Electrical Heating Jacket to its temperature controller.



**Figure 6.** Thermocouple hole on front window housing

6. Ensure that heating rate (ramp) does not exceed 10C per minute.
7. Start your experimentation.

## 5. Cleaning and Storage

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**Important:** *The VPVHP Liquid Cell must be thoroughly cleaned after use.*

1. Flush the cell through with several milliliters of a suitable solvent in which the sample is soluble.
2. Record the spectrum of the solvent to ensure that all traces of the sample have been flushed out of the cell.
3. Flush the cell through with a volatile solvent (e.g. acetone) and dry by blowing through with clean, dry, compressed air.
4. Store the cell in the carry case or a warm dry cabinet.

## *6. Specifications for the VPVHP Liquid Cell*

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The VPVHP Liquid Cell has the following specification:

Pressure Rating: 10000psi (680 bars).

Cell Body Material: Stainless steel. (Other materials available).

Flow tube: Stainless steel 1/16". O.D. x 0.020" wall thickness or 1/4" O.D. outlets/elbows.

Window Material: Sapphire.

Clear Aperture: 7mm diameter.

Seal Materials: PTFE, (Viton and Isolast also available).

Temperature Range: Ambient to 150C.

Fixed Pathlengths: 0.1mm +/- 10%, 0.2mm +/- 10%, 0.5mm +/- 10%, 1.0mm +/-10%, 2.0mm +/- 10%, 5.0mm +/- 2%, 10.0mm +/- 1%.





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