Performance PerSPECtives

Waters® 2487 Dual λ Absorbance Detector

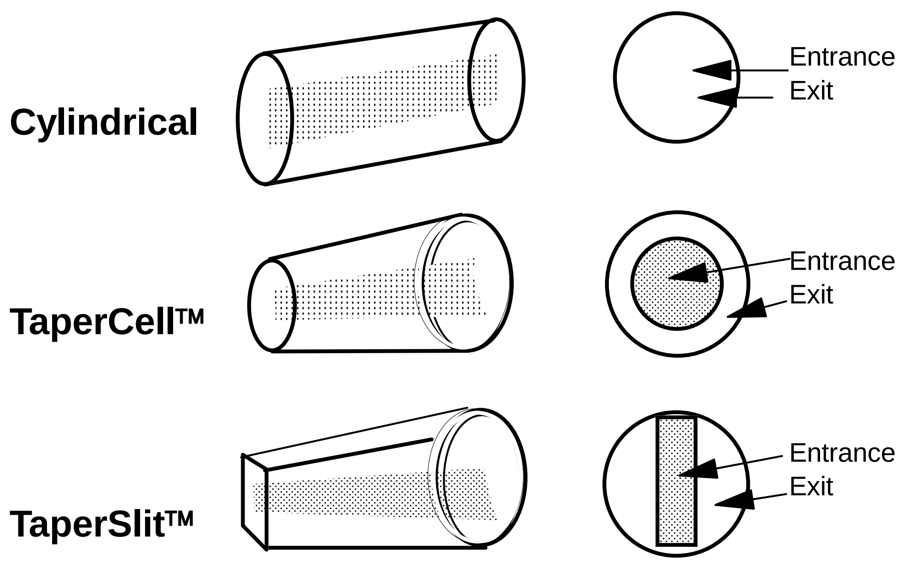
TaperSlit™ Flow Cell Advantages - 1

Today's analytical HPLC methods require more sensitivity to detect small peaks and greater linear range to quantitate large and small peaks in the same injection. HPLC detector flow cell design will affect the quality of the final chromatographic data.

Traditionally, changes in the flow cell design to increase sensitivity reduced the linear range. (See the back page for more details.) Achieving both higher sensitivity and greater linear range requires an innovative flow cell design. The Waters TaperSlit™ flow cell has been developed (patent applied for) for this purpose.

Flow cell designs - sequential designs

Cell Side View 10 mm Length | **End View Entrance and Exit cross-section**



A typical cylindrical flow cell transmits the light inefficiently because some light hits the flow cell walls and causes refractive index (RI) effects. The **TaperCell™** technology increases the transmittance of light and reduce the RI effects by making the cell exit larger than the entrance, reducing the detector noise. The entrance of the cell allows for an eight nm bandwidth.

Waters **new TaperSlit™** design, decreases the bandwidth to 5 nm, but maintains a larger entrance area with a full height slit. The width of the slit determines the 5 nm bandwidth, while the height increases the light transmitted, reducing noise and increasing sensitivity. The decrease to 5 nm bandwidth increases detector linear range.

Waters

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Background Information

Parameters Affecting Sensitivity and Linearity

The compromise between sensitivity and linearity is caused the amount of light transmitted through the cell versus the spectral bandwidth. The more light that is transmitted through the flow cell, the lower the baseline noise resulting in increased sensitivity. A larger circular aperture decreases baseline noise, but also reduces the linear range because of increased spectral bandwidth entering the cell. These relationships are shown in the table (below).

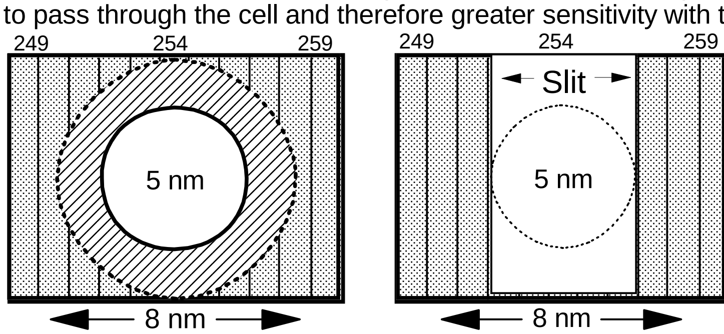
Parameter		Light Energy Transmitted	Noise Baseline Noise	Sensitivity Signal to Noise	Linear Range	Waters 2487 Specification
Spectral bandwidth	↓	↓	↑	↓	↑	**5 nm**
Cell entrance Circular entrance diameter	↑	↑	↓	↑	↓	
TaperSlit cell entrance Width Height	 ↓ ↑	 ↓ ↑↑	 ↑ ↓↓	↑	 ↑ —	

Sensitivity is defined as signal-to-noise ratio or peak height to baseline noise. The TaperSlit flow cell volume of 10 µL is small. This increases sensitivity by decreasing peak bandspreading for increased peak height. The flow cell volume can also be reduced by decreasing the pathlength. However, the absorbance, peak height, will also decrease causing a net loss in sensitivity (Beer's Law: $A = \varepsilon CL$, where L=pathlength). This is typically what happens when a microbore flow cell is used.

Spectral Bandwidth or Spectral Resolution

A spectrum is a continuous band of wavelengths. The Waters 2487 can monitor the wavelengths from 190 to 700 nm. The spectral bandwidth or resolution is a smaller, selective band of wavelengths that go through the flow cell. For example, when 254 nm is programmed as the monitoring wavelength. In the Waters 2487, wavelengths from 252 to 256 nm will strike the analytes, a bandwidth of 5 nm. The bandwidth is determined by slits and/or the flow cell entrance. A narrow bandwidth provides better linearity. However, decreasing the bandwidth will increase baseline noise because the amount of light passing through the flow cell decreases. **The TaperSlit flow cell can achieve both greater linear range and higher sensitivity by a slit shaped entrance hole opening to a larger circular exit.   This is an example of performance by design.**

Bandwidth of 8 and 5 nm with circular or TaperSlit cell entrances. TaperSlit provides more area for light to pass through the cell and therefore greater sensitivity with the same bandwidth.



(For more information on sensitivity and linearity see WPP01, WPP 23 and WPP07.)