

## ISSUES SURROUNDING THE GC INJECTION PORT

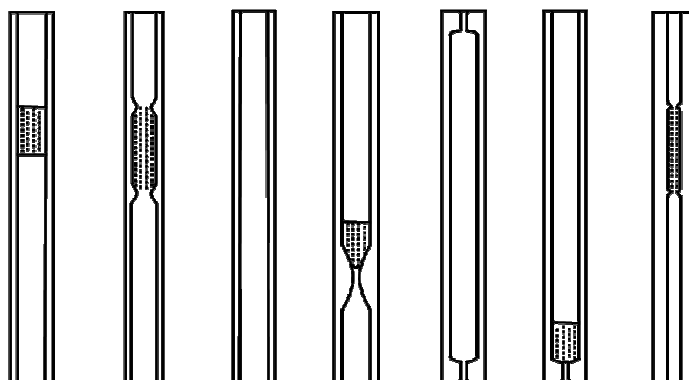
The injection port of a gas chromatograph is where the liquid sample is vaporized and transported onto the column by the carrier gas. A disposable glass liner is used in the injection port to limit sample degradation and enhance vaporization. The glass liner, in its simplest form, is a straight piece of cylindrical glass but can be more complex. An unsuitable liner can be a source of errors in the analytical results and is an important part of the whole chromatography process which should be understood fully to optimize separations.

Factors to be taken into account include the temperature of the injection port, carrier gas flow, injection technique, sample size, split ratio and the design of liner used. The incorrect choice of liner can result in inaccurate quantification, sample flashback, peak tailing and mass discrimination. Choosing the correct liner design very important for both precise and accurate results.

### FIVE ATTRIBUTES OF AN EFFICIENT INLET LINER:

1. The liner design should minimize mass discrimination by ensuring complete vaporization of the sample before it reaches the column entrance.
2. The volume of the inlet liner must be larger than the volume of vaporized sample and solvent.
3. The liner must not react with the sample. This is especially important for polar solutes where the liner should be deactivated.
4. The addition of quartz wool increases the vaporization surface area for the sample and promotes efficient mixing of the sample and carrier gas.
5. The position of the quartz wool should be optimized corresponding to the needle depth in the liner.

### DIFFERENT LINER DESIGNS

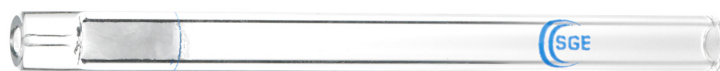


#### Quartz wool or no Quartz wool

The use of quartz wool in a liner has been a subject of much debate and there are many advantages to using wool. The quartz wool acts as a crude filter for the analytical column and minimizes the chances of any particulate or non-volatile material from reaching the column. If the quartz wool is positioned so that the needle tip is in the centre of the wool mass, the wool's large surface area helps in the efficient vaporization of the sample. The wool also promotes mixing in the liner. The needle tip is wiped on the wool as the needle is withdrawn, enabling the entire sample to be vaporized. To reduce sample degradation the wool in the liner should be deactivated. The quartz wool used in SGE liners is fully deactivated after it has been placed in the liner. This eliminates active surfaces being exposed during the process of inserting the wool into the liner, which inevitably involves breaking the strands of the wool. The use of wool is not recommended when analyzing low level pesticides such as DDT or Endrin.

### Taper at the bottom

A taper at the bottom of the liner acts as a feed-in for the capillary column and reduces the amount of dispensed liquid hitting the bottom of the injector. If the quartz wool is packed loosely, then the taper prevents the wool moving out of the liner which might happen when making high pressure injections (e.g. pulsed injections).



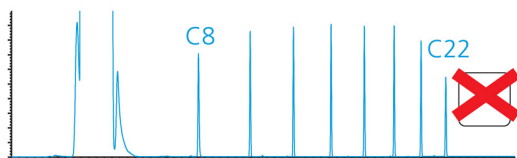
### Restrictions, baffles, cups, complex forms, etc. in the liner without quartz wool

Complex forms of liner can promote vaporization and mixing of the formed vapours which will minimize mass discrimination. One of the functions of the inlet liner is to allow the transfer of a representative sample from the syringe into the capillary column. If a reduced quantity of high molecular weight components is transferred then this is known as high molecular weight mass discrimination. Liner design and quartz wool can both promote mixing and minimize mass discrimination.

### Discrimination – Liner Type

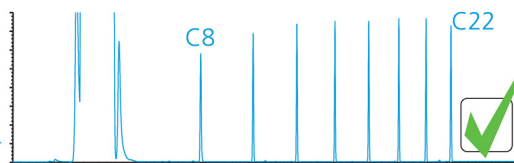
#### Straight-through Liner

Splitless Time 1 min.



#### Tapered Liner

Splitless Time 1 min.



### Taper at the top

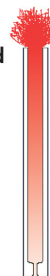
The taper at the top of the liner minimizes the effect known as flashback. This occurs when an excessive amount of liquid is injected into the liner and the volume of the vaporized gas is larger than the volume of the liner. The gas can then escape back out of the liner into the inlet lines and cause contamination. The taper at the top reduces this effect by acting as a partial lid on the liner.

Methylene Chloride at 250°C and 10psi inlet pressure will expand to:

1  $\mu$ L Liquid



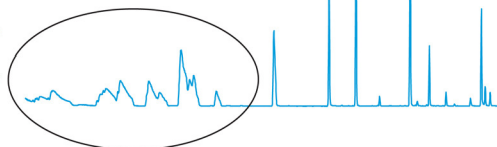
3  $\mu$ L Liquid



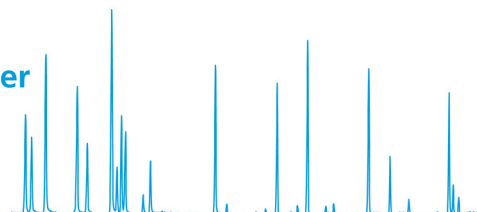
### Inner diameter

The inner diameter will determine the volume capacity of the liner. For a liquid volume greater than 2  $\mu$ L, the liner inner diameter should be as large as possible. When the internal diameter of the liner is halved, the liner volume is reduced to one quarter of the original. Another important effect of the internal diameter of the liner is the velocity of the carrier gas through the liner. A smaller internal diameter will result in a higher velocity of gas, giving faster analyte transfer and therefore sharper peaks, especially for early eluting components. The transfer rate is more critical in splitless injection because the gas flow through the liner is low. A smaller internal diameter can have a dramatic effect of peak shape as shown below.

#### 4mm ID liner



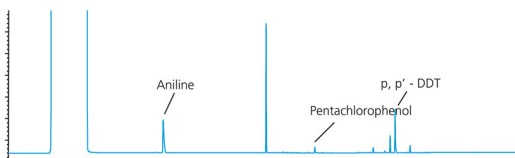
#### 2mm ID liner



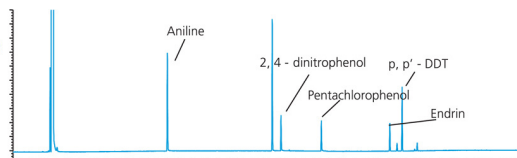
## Deactivation

Deactivation of the liner is more important when using splitless injection techniques. During splitless injection the split vent is usually closed for about 1 minute, resulting in a low liner gas flow. A low gas flow will result in slow transfer and the residence time of analytes within the liner is increased. For thermally labile and heat sensitive compounds, the interaction time of the analyte with the inner surface of the glass liner is increased and this enhances breakdown. The effect is not nearly as pronounced in split injection because the residence time in the liner is shorter.

**Splitless  
Residence Time  
= 1 minute**



**Split  
Residence Time  
= 3 seconds**

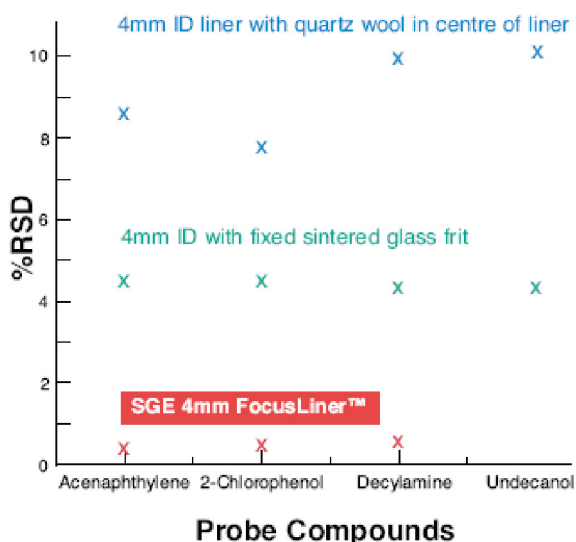


## SGE'S EFFECTIVE LINER SOLUTION



The SGE FocusLiner™ performs as an effective liner by using a simple but effective design whereby the quartz wool is held in the correct position by means of two tapered sections in the liner. The tapered sections are located to ensure the needle tip penetrates the quartz wool at the optimum position every time allowing the needle tip to be wiped consistently.

As seen below the %RSD values for active compounds have been determined when injecting into liners with the quartz wool in different positions. From this it can be demonstrated that the FocusLiner™ provides the most accurate and reproducible results when compared with a glass frit liner and a liner with quartz wool located in the middle.



For more information on SGE Focusliners™ please contact us and remember that no matter how good the deactivation of the liner, its design, or the number of samples injections, it will need to be changed on a regular basis to achieve optimum chromatography.