

# Liner Anatomy

By the Chromatographers at **RESTEK**

## LET'S BEGIN

To correctly diagnose which inlet liner is right for your application, let's first consider method of sample introduction. Different liner characteristics are required to optimize analytical results for each technique, and these will also be addressed.

### SPLIT INJECTIONS

Split injections are a fast, efficient way to transfer a portion of the sample onto the column for analysis. Split injection is often used for dirty samples or highly concentrated samples.

### SPLITLESS INJECTIONS

Splitless injection involves an initial hold time where the split vent flow is turned off and the incoming sample flow is forced onto the column. It is an excellent technique for low concentration samples and commonly is used in drug screening and pesticide residue methods.

### DIRECT INJECTIONS

Direct injection is an alternative to splitless injection. It is an excellent technique for trace samples, especially those that are prone to degradation inside the injection port.

## PACKING OPTIONS

Proper selection of liner packing material and position improves sample vaporization and prevents nonvolatile compounds from entering the column. Sample characteristics and injection technique will dictate packing use. Analyses of high molecular weight analytes, especially in split mode, benefit from the use of packing.

### PACKING MATERIAL

Glass wool is the most common packing material. However, broken wool fibers can expose undegraded areas, increasing the potential for analyte degradation. CarboFrit™ (highly dense and inert, Restek unique packing) and deactivated glass beads are alternative packings that minimize analyte breakdown.

### PACKING POSITION

- Packing placed near the bottom of the liner prevents nonvolatile compounds and septum particles from entering the column. Liners designed for splitless applications often have packing near the bottom, since the long analyte residence time in the liner is usually adequate to vaporize the sample.
- Packing near the middle of the liner enhances vaporization and can improve reproducibility. Precision™ liners are designed with built-in stops to keep the wool properly positioned to wipe the needle. Good needle maintenance is critical as a burred needle can pull the packing out of position, eliminating its effectiveness.



Precision™ liners keep wool in position injection after injection.

## GEOMETRY

Many inlet liners are designed with special geometries. They serve two purposes: to aid vaporization and to protect the sample, especially during splitless injections.

### ENHANCE VAPORIZATION

To avoid molecular weight (MW) discrimination (a phenomenon where high MW compounds are not vaporized efficiently and are therefore under-represented in the analyzed sample), some liners are designed with complex flow paths to aid vaporization.

### PROTECT THE SAMPLE

Some samples are prone to degradation inside of the injector, especially when in contact with hot metal surfaces. Several liners are designed specifically to minimize contact with the injection port.



Some liners combine both features! →

## Restek exclusive!

Drilled Uniliner® inlet liners allow direct injections on EPC-equipped CCs.

Drilled Uniliner® inlet liners are necessary for direct injection; they create a leak-free seal with the column—assuring virtually complete sample transfer and preventing contact with the injection port. Two designs are available, one with the hole near the top for analytes that elute away from the solvent peak, and one with a hole near the bottom for analytes eluting closer to the solvent peak.

## DEACTIVATION

Liners and their packing materials need to provide highly inert pathways to guard against sample adsorption (reversible or irreversible) and sample degradation. There are three prominent deactivation options to choose from.

### SILTEK® DEACTIVATION

Siltek® deactivated liners offer the most chemically inert sample pathway—perfect for low-level analyses or highly active compounds, where preventing sample loss and degradation is critical.

### INTERMEDIATE POLARITY (IP) DEACTIVATION

For most analyses, IP deactivation offers good recovery and reproducibility for both polar and nonpolar compounds—making IP an excellent general-purpose deactivation.

### BASE DEACTIVATION

Base deactivation (BD) is ideal for the analysis of basic compounds, such as amines and basic drugs. It prevents analyte adsorption which manifests as either irreproducible results or peak tailing. Couple BD liners with BD columns for best results.

## Restek exclusive!

Siltek® treated metal inlet liners—inert as glass with no chipping!



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## VOLUME AND INNER DIAMETER

Sample expansion volume and linear velocity should be considered when choosing liner dimensions.

### SAMPLE VOLUME EXPANSION

When a liquid sample is vaporized inside an inlet liner, its volume expands considerably. Care should be taken to match the effective liner volume and the expanded volume of the injected sample. If the expansion volume is exceeded, the sample will be forced back into the gas lines, causing irreproducible peak areas and sample carryover.

Injection Volume (µL)	Expansion Volume (µL)				
	H <sub>2</sub> O	C <sub>2</sub> S	CH <sub>2</sub> Cl <sub>2</sub>	Hexane	Isooctane
0.5	710	212	200	98	78
1.0	1420	423	401	195	155
2.0	2840	846	802	390	310
5.0	7100	2120	2000	975	775

*For a straight, 4mm ID, 78.5mm long liner, the crossed out expansion volumes represent those that would exceed the volume of the liner.*

### LINER VELOCITY

Choosing a liner with a narrow inner diameter will give a faster linear velocity (for a given flow rate), which will move the sample onto the column quickly, improving efficiency and helping keep peak widths narrow. This is particularly important for gaseous samples introduced via purge-and-trap or static headspace techniques, or when 0.18mm, 0.15mm, and 0.10mm ID columns are used.

## LINER MAINTENANCE

Inlet liners are key consumables and need to be changed regularly to avoid the following problems:

- Sample degradation resulting in poor response.
- Sample adsorption resulting in poor peak shape (tailing).
- Sample discrimination.
- Irreproducibility.
- Extraneous peaks from contamination or cored septum particles.

Be sure to condition your liners at an appropriate temperature (e.g. 20°C higher than the operating inlet temperature) for a short period of time to prepare them for use.



Siltek® Deactivation means **ULTIMATE** inertness

