All liners are
100%
deactivated

All liners are shipped intermediate polarity (IP) deactivated unless otherwise requested.

A) Straight Tube

B) Gooseneck

C) Recessed Gooseneck

D) Double Gooseneck

E) Recessed Double Gooseneck

F) Drilled Uniliner®

hole near top

hole near bottom

G) Splitless with Wool

Inlet Liners for Splitless Injection—Benefits & Drawbacks

The residence time of the sample in a splitless liner is dependent on liner geometry, gas velocity, and sample vaporization time. Splitless liners usually are designed as straight tubes, with alternative designs, such as a gooseneck restriction, which help contain the sample cloud in the injector and minimize the breakdown of compounds sensitive to catalytic decomposition from contact with metal inlet parts. Liners packed with wool help promote sample vaporization, as well as trap nonvolatile residue to prevent column contamination. Some of the more commonly used splitless liners are described below.

A) Straight Tube

Use for samples containing a narrow molecular weight distribution and for analytes not prone to thermal decomposition. Packing with wool is recommended. Wool aids in vaporization of high molecular weight compounds and minimizes discrimination.

Benefits:
- Low cost.

Drawbacks:
- Potential decomposition of active compounds such as endrin and phenols when packed with wool.
- Prone to high molecular weight discrimination.
- Sample exposed to metal surface below liner.

B) Gooseneck

Benefits:
- Decreases sample contact with metal inlet parts.
- Improves sample transfer to column.

Drawbacks:
- No known drawbacks.

C) Recessed Gooseneck

Recessed gooseneck liners offer the same benefits as gooseneck or double gooseneck liners, but the base of the recessed gooseneck can be packed with wool. Also, this liner can be used with a two-hole ferrule, for dual-column analysis.

Benefits:
- Increases splitless efficiency.
- Decreases breakdown of active compounds such as endrin and DDT.
- Chamber contains sample vaporization cloud.
- Can be packed with wool.

Drawbacks:
- No known drawbacks.

D) Double Gooseneck

Benefits:
- Decreases sample backflash.
- Decreases injection port discrimination.

Drawbacks:
- Cannot be packed with wool—only *recessed* double goosenecks can be packed with wool.
- Difficult to clean.

E) Recessed Double Gooseneck

Best liner for catalytically labile or high molecular weight compounds. Isolates sample from metal injection port parts. Use the cyclo-version for dirty samples.

Benefits:
- Highest splitless efficiency.
- Breakdown of active compounds decreased.
- Chamber contains vaporization cloud.
- Can be packed with wool.

Drawbacks:
- Higher cost than straight splitless liners.

F) Drilled Uniliner®

A hole drilled into this liner allows direct injection in EPC systems and reduces sample discrimination, compared to typical splitless injections. The Drilled Uniliner® with the hole near the bottom is recommended for semivolatile analysis or when compounds of interest could be affected by a tailing solvent peak. The Drilled Uniliner® with the hole near the top is recommended for aqueous injections, chlorinated pesticides, as well as analysis in which the compounds of interest elute away from the solvent peak.

Benefits:
- Excellent transfer of analytes to column.
- Decreases injection port discrimination.
- Removes excess solvent vapor.
- Eliminates the need for wool.
- Less adsorption—no sample contact with metal parts below liner.

Drawbacks:
- Higher amounts of nonvolatile materials transferred to column.

G) Splitless with Wool

Wool provides a large surface area, to allow rapid vaporization of the sample and deliver a uniform vapor cloud to the split point. The low mass of the wool fiber promotes complete vaporization.

Benefits:
- Low cost.
- Reproducible performance.

Drawbacks:
- Wool can be adsorptive, especially if fibers are broken.
- High maintenance requirements.

Inlet Liners for Split Injection—Benefits & Drawbacks

Split liners are designed with mixing chambers and tortuous flow paths to fully vaporize the sample into a homogeneous vapor cloud before it reaches the split point. All Restek split liners are fully deactivated using a high-temperature silanizing reagent. This caps surface silanol groups so active compounds in the sample don't degrade or adsorb onto the hot glass surface.

To trap nonvolatile residue and prevent column contamination when analyzing dirty samples, pack split liners with wool, CarboFrit™ packing, or fused silica beads. Some of the more commonly used inlet liners are described below.

All liners are **100%** deactivated

All liners are shipped intermediate polarity (IP) deactivated unless otherwise requested.

A) Split Liner with Wool

The wool provides a large surface area to allow rapid vaporization of the sample and deliver a uniform vapor cloud to the split point. The low mass of the wool fiber promotes complete vaporization.

Benefits:
- Low cost.
- Reproducible performance.

Drawbacks:
- Wool can be adsorptive, especially if fibers are broken.
- High maintenance requirements.

B) Laminar Cup Splitter

The sample flows through a small opening and encounters the head of the elongated glass cup. It then travels around the outside of the elongated cup; the flow is inverted twice. Larger volume injections are possible because the liquid is trapped at the inner base and cannot escape until vaporized.

Benefits:
- Recommended by chromatography expert Dr. Konrad Grob[1].
- Vaporizes up to 5µL samples.
- Best splitter liner for high molecular weight compounds.
- Laminar flow profile provides highest resolution.

Drawbacks:
- Costly.

C) Frit Splitter

The sample must pass through the porous ceramic frit. The high surface area and tortuous flow path ensure complete vaporization.

Benefits:
- Traps septum particles and residue.

Drawbacks:
- Ceramic frit can be active.
- Difficult to clean.

D) Cup Splitter

The sample flows through a mini-funnel and encounters a glass cup. The flow path then inverts twice before reaching the split point.

Benefits:
- Tortuous flow path aids in sample vaporization.
- Minimizes molecular weight discrimination.
- Can be packed with wool to trap particles.

E) Cyclosplitter® (Patent # 5,119,669)

This patented design incorporates a cylindrical glass spiral in the sample pathway, providing a large area for sample vaporization.

Benefits:
- Ideal for dirty samples.
- Allows many injections of dirty samples before cleaning is required.
- Easy to clean.

Drawbacks:
- Not recommended for large volume injections.

F) Baffle Splitter

The baffle induces turbulent flow that directs the sample against the wall of the glass liner.

Benefits:
- Reproducible performance.

Drawbacks:
- Prone to molecular weight discrimination.
- Septum particles and residue can enter column.
- Subject to incomplete vaporization.

G) *mini*-Lam Split Liner

The flow principle is basically the same as in the laminar cup splitter. The *mini*-Lam liner design incorporates a shortened, inverted laminar cup. Use a two-hole ferrule to adapt the *mini*-Lam liner for dual-column analysis in a capillary injection port.

Benefits:
- Similar to laminar cup splitter, but less expensive.
- Vaporizes up to 4µL samples.
- Ideal for high molecular weight compounds.
- Easy to clean.

Drawbacks:
- No known drawbacks.

H) Precision™ Liner

Wool is placed at the injection point to maximize vaporization and help wipe the needle during injection. Wool stays in position during pressure pulses in the inlet and during injection.

Benefits:
- Maximizes vaporization.
- Improved reproducibility.

Drawbacks:
- No known drawbacks.

A) Split Liner with Wool

B) Laminar Cup Splitter

C) Frit Splitter

D) Cup Splitter

E) Cyclosplitter®

F) Baffle Splitter

G) *mini*-Lam Split Liner

H) Precision™ Liner

[1]*Injectors Providing Complete Sample Evaporation Above the Column Entrance in Vaporizing GC Injections*, K. Grob and C. Wagner, HRC & CC, Vol. 16, p. 429.

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100%
deactivated

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free literature

A Guide to Direct and On-column Flash Vaporization Injection

Download your free copy from www.restek.com

Technical Guide
lit. cat.# 59882A

A) Standard Uniliner®

B) Open-Top Uniliner®

C) Cyclo-Uniliner®

D) Drilled Uniliner®

hole near top

hole near bottom

Hole makes direct injection possible with EPC-equipped Agilent 6890 GCs!

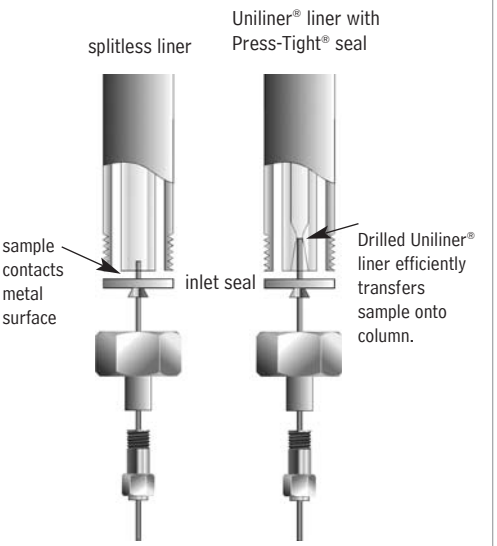
Direct Injection Mode Using a Uniliner® Liner — An Alternative to Splitless Injections!

Many problems associated with splitless analysis occur because there is a gap around the outside of the column and the inside of the liner. Sample vapors deposit on the metal inlet parts or fall below the tip of the column and are swept out of the split vent during the purge-on mode. The diagram illustrates how the gentle Press-Tight® taper in a Uniliner® liner eliminates sample contact with the hot, catalytic metal disk surface (inlet seal), by making a leak-tight connection between the column and liner.

A splitless injection mimics a direct injection when the inlet is configured to the purge-off mode. The purge-on mode simply sweeps the sample vapors that may have contacted the metal inlet seal away from the inlet. Analysts can replace a splitless liner with a Uniliner® liner and obtain additional benefits over a traditional splitless analysis. Adsorption of active compounds is greatly reduced, peak areas for higher molecular weight compounds are increased (i.e., less discrimination) and, because all of the sample is delivered to the head of the column, sensitivity is enhanced over conventional splitless analysis.

A Uniliner® liner can be used as a direct replacement for a splitless liner. It is easily installed in a splitless inlet in almost the same manner as a splitless liner, except that it must be operated continuously in the purge-off mode. The tight seal between the column inlet and the Press-Tight® taper prevents the sample from escaping out of the split vent. Uniliner® liners should be operated at column flow rates between 5 and 10cc/min., to minimize peak tailing and to sharpen early-eluting peaks. The taper is designed to accommodate 0.32 or 0.53mm ID columns. Request Restek's Guide to Direct/On-Column Flash Vaporization Injections (lit. cat.# 59882A) for more information on optimizing direct injections.

A Uniliner® liner prevents the sample from contacting metal parts at the base of a splitless injection port. This eliminates many problems, such as reduced response for high molecular weight compounds, adsorption, and catalytic desorption in the inlet, providing overall higher sensitivity.



Inlet Liners for Direct Injection

A) Standard Uniliner® Liner

The buffer volume chamber contains the sample vapor cloud and prevents contact with metal injection port parts. Peak tailing is reduced and larger injections can be made. Because of the hourglass design, samples should be relatively clean or dirt might be funneled into the column inlet.

B) Open-Top Uniliner® Liner

Open-top Uniliner® liners are ideal for extremely dirty samples because they are packed with wool that traps dirt and sample residue. Contaminated wool is easily replaced and the liner can be cleaned with a nylon brush or pipe cleaner.

C) Cyclo-Uniliner® Liner

The glass spiral provides an excellent vaporization surface for high and low molecular weight samples. Dirt is trapped on the first turn of the spiral, reducing subsequent residue/sample interaction. In comparison to liners packed with wool, Cyclo-Uniliner® liners allow up to five times as many dirty sample injections before calibration curves degrade.

D) Drilled Uniliner® Liner

Ideal for use with EPC-equipped GC systems. The hole equalizes pressure and maximizes sensitivity. The Drilled Uniliner® with the hole near the bottom is recommended for semivolatile analysis or when compounds of interest could be affected by a tailing solvent peak. The Drilled Uniliner® with the hole near the top is recommended for aqueous injections, chlorinated pesticides, as well as analysis in which the compounds of interest elute away from the solvent peak.