

Ultra Selective Liquid Chromatography™ Technology

Choose Columns Fast. Develop Methods Faster.

What is Ultra Selective Liquid Chromatography™ (USLC®) technology? This technique is the directed application of orthogonal selectivity—the most influential factor affecting peak separation, or resolution—to provide the practicing chromatographer with the best tools for choosing columns and developing methods faster. Through our extensive study of reversed-phase chromatography, Restek created the widest range of selectivity in the industry using just four unique stationary phases: the USLC® column set. We also defined a simple approach to choosing a column with the appropriate selectivity for any application.

Selectivity Drives Separations

Quickly and effectively resolve analytes by understanding and controlling selectivity through USLC® technology.

One of the most significant, yet least understood, steps of method development is finding the proper stationary phase for a particular separation. As sample complexity increases, achieving adequate resolution between matrix components and target analytes becomes more difficult. Despite recent advancements in column format, such as sub-2-micron packings and pellicular particles, resolution can still be difficult to obtain because, while these formats can increase chromatographic efficiency and analysis speed, they do not significantly influence resolution. Selectivity, as shown in Equation 1, is the single most powerful factor affecting resolution, and it is largely dependent upon stationary phase composition.

Equation 1: Selectivity has the greatest mathematical effect on resolution.

$$R = \frac{1}{4} \sqrt{N} \times \left(\frac{k}{k+1} \right) \times (\alpha - 1)$$

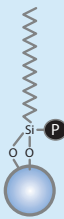
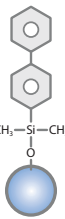
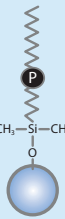
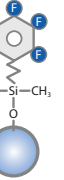
Efficiency Retention Factor Selectivity

Real Diversity in Phase Chemistry

A small set of defined orthogonal columns means faster separations and more robust methods.

While numerous bonded phases are available for reversed-phase chromatography, many (e.g., C8 and C18) are similar and offer only moderate changes in retention rather than significant differences in selectivity. Method development is less laborious and time-consuming when you use a full range of column selectivities, including orthogonal phase chemistries like polar-embedded, phenyl, and fluorophenyl columns. Restek has led the development of the unique USLC® column set across these phase classes to provide analysts with a more effective range of column selectivities and innovative column chemistries for method development. The USLC® column set (Figure 1) provides the widest range of reversed-phase selectivity available with just four columns and can be used to guide proper stationary phase selection—the least understood yet most significant part of method development.

Figure 1: Restek® columns offer the widest range of unique and effective phase chemistries to aid the chromatographer in choosing columns fast and developing methods faster.

Restek® USLC® Phase (column class)	Aqueous C18 (alkyl)	Biphenyl (phenyl)	IBD (polar embedded)	PFP Propyl (fluorophenyl)
				
Ligand Type	Proprietary polar modified and functionally bonded C18	Unique Biphenyl	Proprietary polar functional embedded alkyl	Fluorophenyl
Properties	<ul style="list-style-type: none"> • General-purpose with a well-balanced retention profile. • Compatible with 100% aqueous mobile phases. • Ideal for multi-component LC-MS analyses. 	<ul style="list-style-type: none"> • Increased retention for dipolar, unsaturated, or conjugated solutes. • Enhanced selectivity when used with protic (methanol) mobile phase. • Ideal for increasing sensitivity and selectivity in LC-MS analyses. 	<ul style="list-style-type: none"> • Increased retention for acids and water-soluble compounds. • Compatible with 100% aqueous mobile phases. • Capable of both reversed-phase and HILIC separations. 	<ul style="list-style-type: none"> • Increased retention for both charged bases and electronegative compounds. • Capable of both reversed-phase and HILIC separations. • Ideal for increasing sensitivity and selectivity in LC-MS analyses.

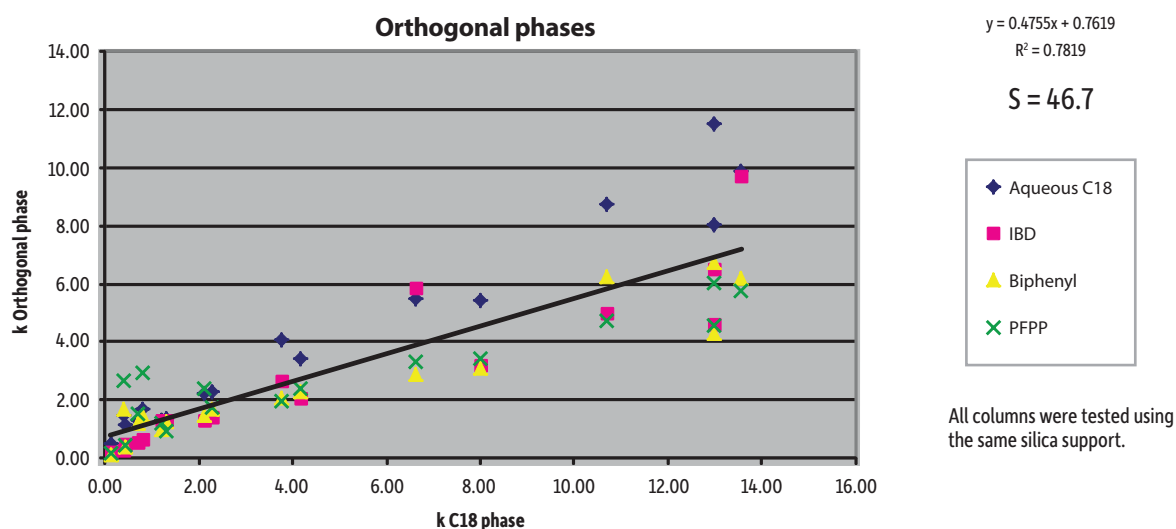
Evaluating and Extending Selectivity

The Restek® USLC® column set offers the highest range of alternate selectivity available.

The diverse selectivity provided by USLC® columns can be demonstrated empirically using the hydrophobic-subtraction model [1]. This model is a novel procedure for characterizing selectivity that uses test probes to define the solute and stationary phase interactions in reversed-phase separations. Restek is leading the commercial application of this model by implementing it in the development of USLC® bonded phases. To evaluate phase selectivity using the hydrophobic-subtraction model, the retention characteristics of the solute probes are compared across different phases relative to a C18 benchmark with all columns using the same silica base.

The resulting scatter plot is an excellent way to visualize selectivity. Stationary phases with similar selectivity show high linearity when graphed. However, stationary phases with alternate selectivity—even orthogonality—produce significant scatter around the regression line. The high degree of scatter shown in Figure 2 shows just how diverse the phases in the USLC® column set are. When we quantify column selectivity based on this correlation by calculating the selectivity (S) statistic [2], the resulting value of 46.7 shows that the USLC® column set truly has the highest range of selectivity available.

Figure 2: Restek has extended the selectivity range for commercially available columns and defined a column set—the four USLC® phases—that is ideal for fast column choice and faster method development.



References

- [1] L.R. Snyder, J.W. Dolan, P.W. Carr, *The Hydrophobic-Subtraction Model of Reversed-Phase Column Selectivity*, J. Chromatogr. A 1060 (2004) 77.
 [2] U.D. Neue, J.E. O’Gara, A. Mendez, *Selectivity in Reversed-Phase Separations Influence of the Stationary Phase*, J. Chromatogr. A 1127 (2006) 161.

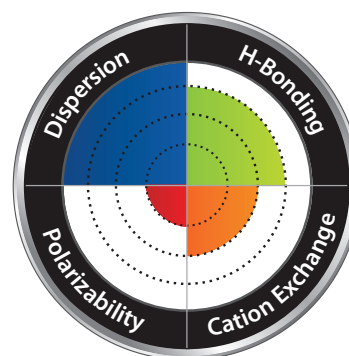
➤ USLC® Column Interaction Profile

Put simply, selectivity is the retention of one compound relative to another. Therefore, because solutes will be retained to different degrees by different molecular interactions, we can fundamentally define a column’s selectivity based on the molecular interactions it delivers.

Each USLC® column is optimized for a different chemical interaction. The pie chart provided for each USLC® stationary phase in this catalog (Figure 3) identifies the same four molecular interactions (color coded to correspond to the retention of a different solute type). The more rings shown for a given interaction, the more significant a role it plays in defining solute retention.

If you know what type of column interaction you need for your analysis, use these charts to select your USLC® column.

Figure 3: A look at a sample USLC® column interaction profile.





USLC® Columns
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Develop Methods Faster.

www.restek.com/uslc

USLC® Method Development Toolbox

- Ultra Selective Liquid Chromatography™ (USLC®) method development toolbox contains all four USLC® stationary phases in one convenient package.
- Available for UHPLC (1.9 µm) and HPLC (3 or 5 µm) in 50, 100, or 150 mm lengths.
- Included selection guide makes it even easier to pick the right column the first time.

Description	Size	Includes	qty.	cat.#
Pinnacle DB USLC Method Development Toolbox	1.9 µm, 2.1 mm x 50 mm	(1) each: Biphenyl (9409252), Aqueous C18 (9418252), IBD (9425252), PFP Propyl (9419252)	kit	25800
Pinnacle DB USLC Method Development Toolbox	1.9 µm, 2.1 mm x 100 mm	(1) each: Biphenyl (9409212), Aqueous C18 (9418212), IBD (9425212), PFP Propyl (9419212)	kit	25807
Ultra USLC Method Development Toolbox	3 µm, 2.1 mm x 50 mm	(1) each: Biphenyl (9109352), Aqueous C18 (9178352), IBD (9175352), PFP Propyl (9179352)	kit	25801
Ultra USLC Method Development Toolbox	3 µm, 2.1 mm x 100 mm	(1) each: Biphenyl (9109312), Aqueous C18 (9178312), IBD (9175312), PFP Propyl (9179312)	kit	25802
Ultra USLC Method Development Toolbox	3 µm, 3.0 mm x 100 mm	(1) each: Biphenyl (910931E), Aqueous C18 (917831E), IBD (917531E), PFP Propyl (917931E)	kit	25803
Ultra USLC Method Development Toolbox	5 µm, 2.1 mm x 50 mm	(1) each: Biphenyl (9109552), Aqueous C18 (9178552), IBD (9175552), PFP Propyl (9179552)	kit	25804
Ultra USLC Method Development Toolbox	5 µm, 2.1 mm x 100 mm	(1) each: Biphenyl (9109512), Aqueous C18 (9178512), IBD (9175512), PFP Propyl (9179512)	kit	25805
Ultra USLC Method Development Toolbox	5 µm, 4.6 mm x 150 mm	(1) each: Biphenyl (9109565), Aqueous C18 (9178565), IBD (9175565), PFP Propyl (9179565)	kit	25806

Mobile Phase Management 101

Neatly Keep Mobile Phase Lines Where They Belong

Hub-Cap Bottle Tops and Adaptors
See [page 340](#).



Hub-Cap (assembly of the bottle cap and plug)

Transfer and Filter Mobile Phase in a Single Step

Hub-Cap Filters
See [page 341](#).



Extend Column Life

Bluestem Glass Solvent Filter
See [page 343](#).



Avoid Messy Spills Around Mobile Phase Waste Containers

Waste Overflow Indicator
See [page 341](#).



Prepare and Maintain Mobile Phases Without Dissolved Gas or Unnecessary Costs

Mobile Phase Sparge Filter
See [page 342](#).

