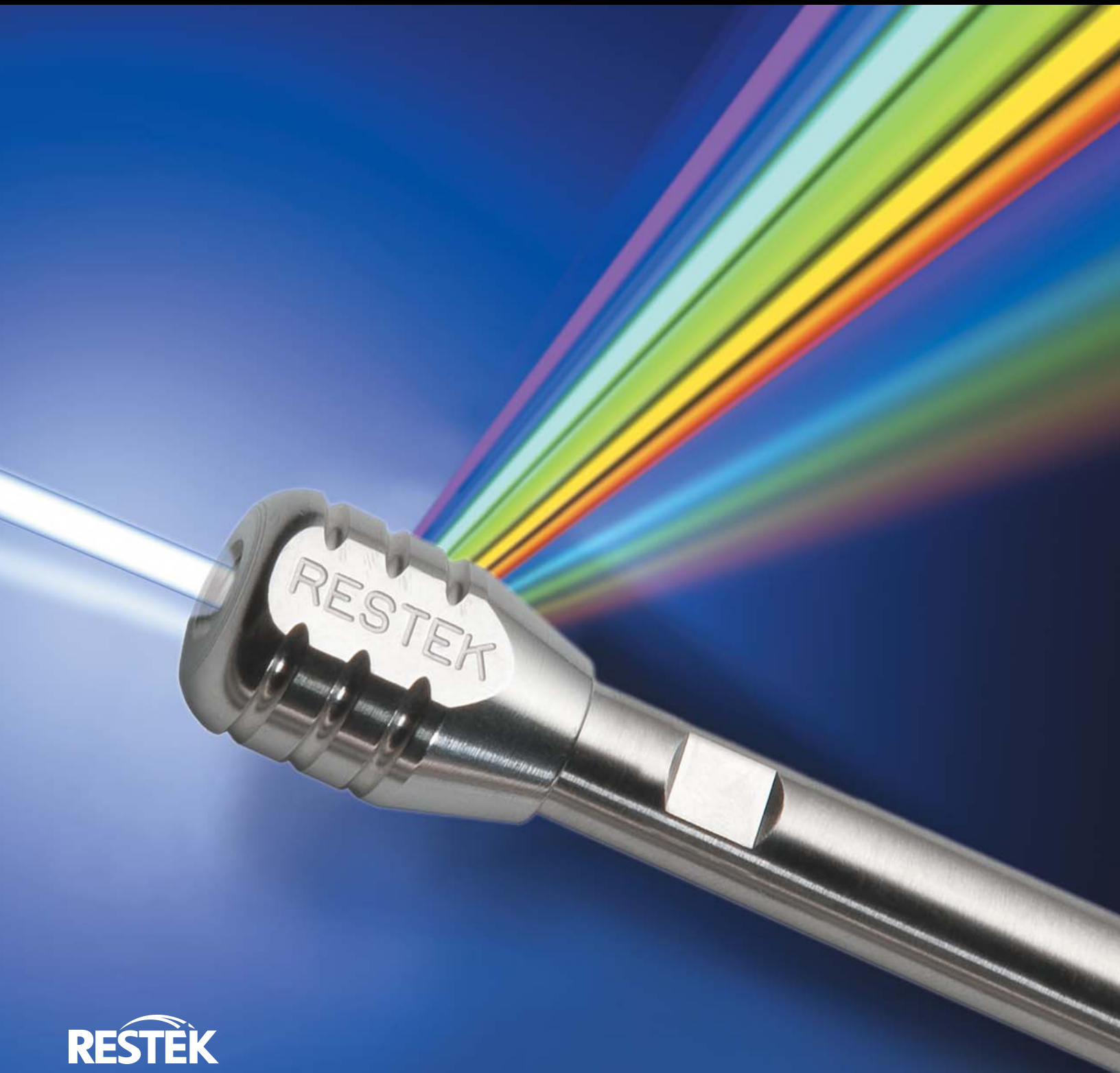


RESTEK USLC™

Ultra Selective Liquid Chromatography™



RESTEK

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What is Ultra Selective Liquid Chromatography™? USLC™ is the directed application of selectivity—the most influential factor affecting resolution—to provide practicing chromatographers with the best tools for fast, effective method development. Restek has extensively studied reversed phase column selectivity, in order to create the widest range of USLC™ stationary phase chemistries available and to define a simple approach to finding a column with appropriate selectivity.

Selectivity Drives Separations

By understanding and controlling selectivity through USLC™, chromatographers have the best opportunity for fast, effective analyte resolution.

One of the most significant, yet least understood, choices in method development is finding the proper stationary and mobile phase chemistry 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.

Real Diversity in Phase Chemistry

More column choices mean faster separations and more robust methods.

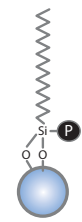
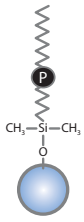
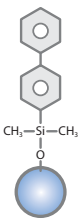
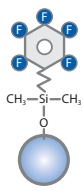
While numerous bonded phases are available for reversed phase chromatography, many are similar and offer only moderate changes in retention (e.g. C8 and C18), rather than significant differences in selectivity. Method development is less laborious and time-consuming when using a full range of column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

Equation 1: Selectivity, the focus of USLC™, is of the greatest mathematical significance to resolution.

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

Efficiency Retention Factor Selectivity

Figure 1: Restek columns offer the widest range of unique and effective column chemistries to aid the chromatographer in fast and easy method development.

Restek USLC™ Phase (column class)	Aqueous C18 (alkyl)	IBD (polar embedded)	Biphenyl (phenyl)	PFP Propyl (fluorophenyl)
	 Aqueous C18	 IBD	 Biphenyl	 PFP Propyl
Ligand type	Proprietary polar modified and functionally bonded C18	Proprietary polar functional embedded alkyl	Unique Biphenyl	Proprietary end-capped pentafluorophenyl propyl
Characteristics and uses	<ul style="list-style-type: none"> C18 phase for balanced retention of multiple solute types. Compatible with up to 100% aqueous mobile phases. 	<ul style="list-style-type: none"> Enhanced retention of polar acids. Moderate retention of both acidic and basic solutes. 	<ul style="list-style-type: none"> Increased retention of aromatic, unsaturated, conjugated solutes, or solutes containing an electron withdrawing ring substituent. Enhanced retention and selectivity when used with methanolic mobile phases. 	<ul style="list-style-type: none"> Increased retention of protonated bases and solutes containing aromatic moieties.

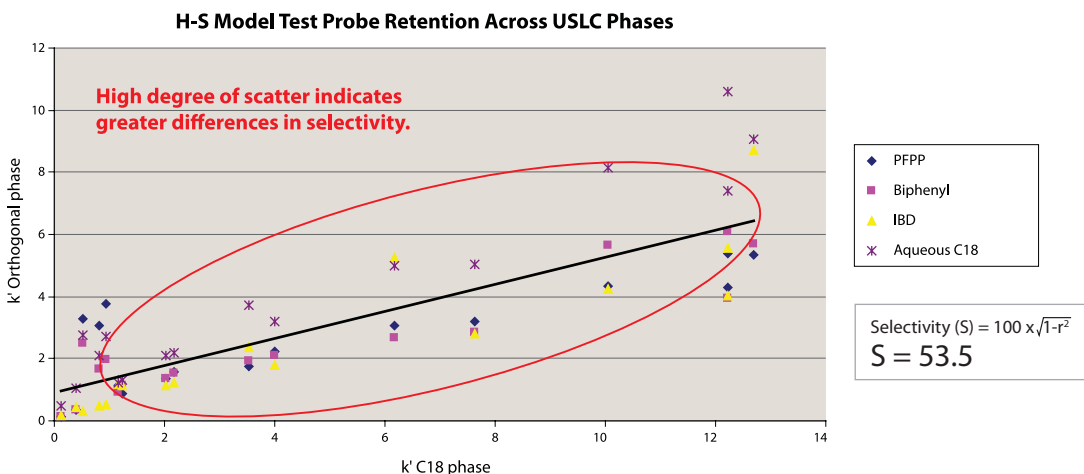


Evaluating and Extending Selectivity

Restek leads the industry in USLC™ phase diversity, extending stationary phase selectivity.

The diversity in 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 research and 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 C18 on the same silica base. In this approach, the range of selectivity is indicated by the degree of scatter along the regression line; high correlations indicate similarity and low correlations represent changes in selectivity across phases (Figure 2). The difference in selectivity across columns can then be quantified based on the correlation by calculating the selectivity (S) statistic for the comparison [2].

Figure 2 Restek has extended the selectivity range for reversed phase separations as illustrated by the hydrophobic-subtraction model test probes and corresponding selectivity (S) value.



USLC™ Columns: Selectivity Choices Accelerate Method Development Separations

Restek USLC™ columns offer the widest range of selectivities available and are an integral part of successful method development (Figure 3). Ideal for column switching systems, these columns provide the orthogonal separations needed to create optimal resolution and robust methods. Combining USLC™ phases with a suitable column format (Figure 4) gives practicing chromatographers the most powerful tool available for successful method development.

Figure 3: Restek offers the widest range of phase selectivities for HPLC and UHPLC.

Column Type	Column Line								
	Restek			Waters			Phenomenex	Agilent	
	Pinnacle DB	Ultra	Viva	Acquity CSH	Acquity HSS	Acquity BEH	Kinetex	Zorbax RRHD	Poroshell 120
Alkyl (C18 and C8)	●	●	●	●	●	●	●	●	●
Phenyl	●	●	●	●		●			
Polar Embedded Alkyl	●	●	●						
Fluorophenyl	●	●	●	●			●		





Figure 4: Restek USLC™ phases are available on several silica lines to accommodate any instrument platform or chromatographic application.

Column line (silica)	Pinnacle DB (Base deactivated, moderate retention silica for scalable UHPLC and HPLC analyses)	Ultra (Highest purity silica for traditional HPLC analyses)	Viva (Wide pore silica for biological separations using HPLC)
Particle diameters (µm)			
• UHPLC	1.9		
• HPLC		3 and 5	5
Stationary phases			
C18	•	•	•
C8	•	•	•
Aqueous C18	•	•	
Biphenyl	•	•	•
PFP Propyl	•	•	•
IBD	•	•	
Silica	•	•	•

We're here to help!

To discuss the right selectivity for your separation or to find a comparable column, **contact us at support@restek.com or 800-356-1688.**



USLC Phases fit any HPLC or UHPLC instrument

Columns are available for any instrument platform and scale. Classes include: capillary (<1.0 mm ID), microbore (1.0 mm ID), narrow bore (2.1-3.0 mm ID), standard bore (3.2-4.6 mm ID), semi-prep (10-21.2 mm ID), and prep (30-50 mm ID).

PATENTS & TRADEMARKS

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References

- [1] L.R. Snyder, J.W. Dolan, P.W. Carr, J. Chromatogr. A 1060 (2004) 77.
- [2] U.D. Neue, J.E. O'Gara, A. Mendez, J. Chromatogr. A 1127 (2006) 161.