LC Columns

U.S. Pharmacopeia Cross-Reference 153
Tables and Reference 154
Raptor™ SPP Columns 155–159
USLC® Columns 160–162
Columns for UHPLC 163–168
Columns for HPLC 169–174
Columns for Bioseparations 175–177
Application-Specific Columns 178–183
Prep Columns 184–187
Bulk Packing Materials 187
UHPLC Filters 188
HPLC Guard Cartridge Systems 189–191
LC Column & Detector Test Mixes 475



U.S. Pharmacopeia Cross-Reference

L1	Octadecyl silane chemically bonded to porous silica or ceramic microparticles; 1.7 to 10 µm in diameter or a monolithic rod. *Raptor™ ARC-18 (p. 158), Raptor™ C18 (p. 158), Pinnacle® DB Aqueous C18 (p. 163), Pinnacle® DB C18 (p. 166), Ultra Aqueous C18 (p. 169), Ultra C18 (p. 171), Viva C18 (p. 175)*
L3	Porous silica particles; 5 to 10 µm in diameter. *Pinnacle® DB Silica (p. 168), Ultra Silica (p. 174), Viva Silica (p. 177)*
L7	Octylsilane chemically bonded to totally porous silica particles; 1.7 to 10 µm in diameter. *Pinnacle® DB C8 (p. 167), Ultra C8 (p. 172), Viva C8 (p. 175)*
L8	An essentially monomolecular layer of aminopropylsilane chemically bonded to totally porous silica gel support; 3 to 10 µm in diameter. *Ultra Amino (p. 174)*
L10	Nitrile groups chemically bonded to porous silica particles; 3 to 10 µm in diameter. *Pinnacle® DB Cyano (p. 167), Ultra Cyano (p. 174)*
L11	Phenyl groups chemically bonded to porous silica particles; 1.7 to 10 µm in diameter. *Raptor™ Biphenyl (p. 157), Pinnacle® DB Biphenyl (p. 165), Ultra Biphenyl (p. 170), Ultra Aromax (p. 173), Viva Biphenyl (p. 176)*
L13	Trimethylsilane chemically bonded to porous silica particles; 3 to 10 µm in diameter. *Ultra C1 (p. 173)*
L26	Butyl silane chemically bonded to totally porous silica particles; 3 to 10 µm in diameter. *Ultra C4 (p.172), Viva C4 (p.176)*
L43	Pentafluorophenyl groups chemically bonded to silica particles by a propyl spacer; 5 to 10 µm in diameter. *Pinnacle® DB PFP Propyl (p. 166), Ultra PFP Propyl (p. 171), Viva PFP Propyl (p. 176)*
L68	Spherical, porous silica; 100 µm or less in diameter, the surface of which has been covalently modified with alkyl amide groups and not end-capped. *Pinnacle® DB IBD (p. 164), Ultra IBD (p. 169)*

EXP® fittings


coupler


hand-tight

Reusable fittings for easy, yet reliable HPLC & UHPLC connections

- Hand-tight fitting style achieves effortless HPLC seals—no tools needed for a 8,700+ psi seal.
- Both hand-tight and hex-head styles wrench-tighten for reliable UHPLC use up to 20,000+ psi!
- Patented ferrule can be installed repeatedly without compromising high-pressure seal.
- Hybrid design combines the durability of titanium with the sealing ability of PEEK.
- Cutting-edge system provides ZDV (zero dead volume) connection to any 10-32 female port.
- Compatible with 1/16" PEEK and stainless steel tubing.

See **page 335**.

www.restek.com/exp


hex-head

Optimal Linear Velocities

Column ID (mm)	Optimal flow rate (mL/min)* 1.9 µm dp	3 µm dp	5 µm dp	2.7 µm Raptor™	5 µm Raptor™
4.6	—	1.5	1.0	1.6	1.0
3.2	—	0.7	0.5	0.8	0.5
3.0	1.1	0.6	0.4	0.7	0.4
2.1	0.5	0.3	0.2	0.3	0.2
1.0	—	0.07	0.05	0.08	0.05

* Optimal flow rates are mobile phase dependent; table above is provided as a guide.

Common Classifications for LC Columns by Internal Diameter

Classification	Internal Diameter
Capillary	<1.0 mm ID
Micro bore	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
Prep	30–50 mm ID

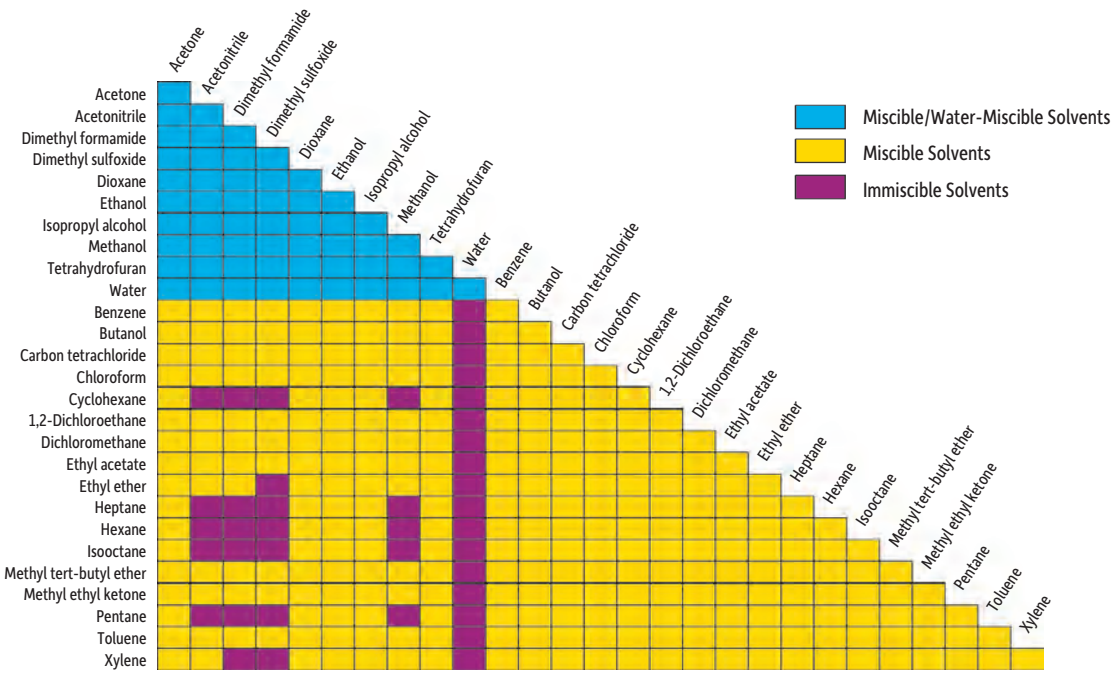
HPLC Pump Pressure Conversion Table

Pressure	psi	atm	kg/cm²	torr	kPa	bar	inches Hg
1 psi =	1	0.068	0.0703	51.713	6.8948	0.06895	2.0359
1 atm =	14.696	1	1.0332	760	101.32	1.0133	29.921
1 kg/cm² =	14.223	0.967	1	735.5	98.06	0.9806	28.958
1 torr =	0.0193	0.00132	0.00136	1	0.1330	0.00133	0.0394
1 kPa =	0.1450	0.00987	0.0102	7.52	1	0.0100	0.2962
1 bar =	14.5038	0.9869	1.0197	751.88	100	1	29.5300
1 in Hg =	0.49612	0.0334	0.0345	25.400	3.376	0.03376	1

To convert a pressure, multiply the units in the left-most column by the conversion factors listed in the columns to the right.

For example: 10 psi x 0.068 = 0.68 atm
10 bar x 29.5300 = 295.300 inches Hg

Solvent Miscibility and Solubility



Raptor™ LC Columns



NEW!

SPP speed.
USLC® resolution.

A new species of column.

Restek is excited to announce the evolution of superficially porous particles with the introduction of Raptor™ LC columns and guards.

Superficially porous particles (commonly referred to as SPP or "core-shell" particles) changed the world of LC by dramatically boosting column efficiency and reducing analysis times, but they were only the beginning. With Raptor™ LC columns, Restek chemists have combined the speed of SPP with the resolution of highly selective USLC® technology. This new species of chromatographic column allows you to more easily achieve peak separation and faster analysis times without expensive UHPLC instrumentation.

- Higher efficiency for drastically faster analysis times.
- Better selectivity for substantially improved resolution.
- Increased sample throughput with existing HPLC instrumentation.
- Long-lasting ruggedness for dependable reproducibility.

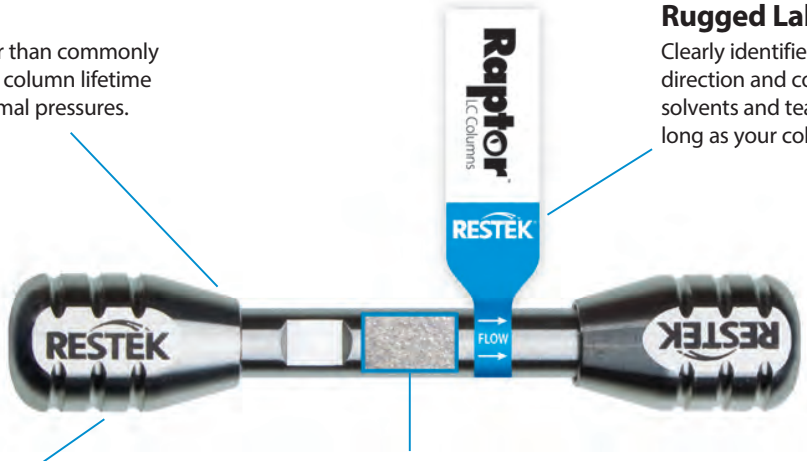
Selectivity Accelerated

Put Raptor™ LC columns and guards to the test on your most challenging workflows!

Dissecting the Raptor™ LC Column

Larger 2 µm Frit
Prevents clogging better than commonly used 0.5 µm frits; boosts column lifetime and helps maintain optimal pressures.

Rugged Label
Clearly identifies both flow direction and column; resists solvents and tearing to last as long as your column does.



Proprietary Column-Packing Technique
Provides greater pressure stability (600 bar for 2.7 µm; 400 bar for 5 µm); achieves higher linear velocities without sacrificing efficiency or lifetime.

Raptor™ SPP Particles

Robust 2.7 and 5 µm Particles
Let you run high-speed analyses without UHPLC.

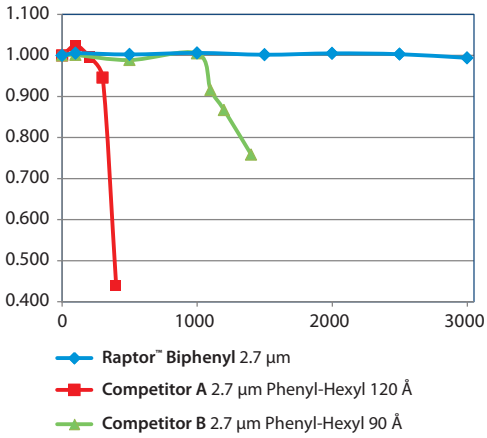
Narrow Silica Distribution
Ensures high efficiency and consistent flows.

Updated Bonding and QC
Guarantee retention time stability, run to run and column to column.

Pressure Stability

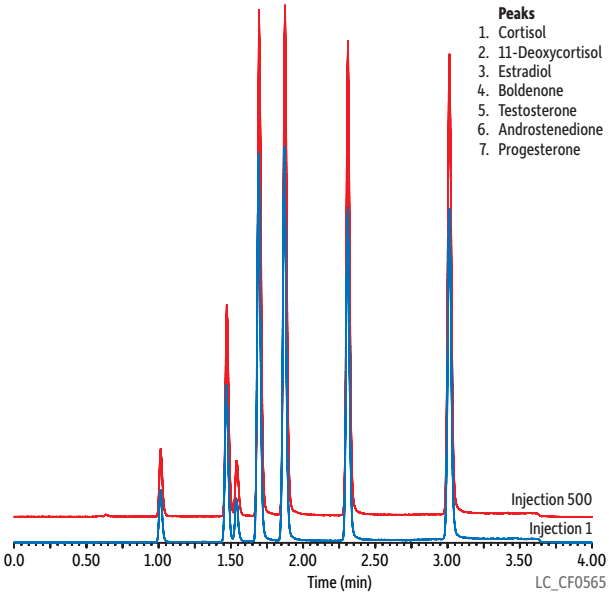
At high pressures, competitor phenyl-hexyl columns experience a quick and sharp drop-off in efficiency, but Raptor™ columns are unaffected to at least 3,000 injections.

% Efficiency vs # of Injections
Raptor™ 2.7 µm Column vs Competitor
50 x 2.1 mm Phenyl-Hexyls @ 600 bar



Reproducibility

Even after hundreds of injections, a Raptor™ column will provide consistent, reliable data.



Column: Raptor™ Biphenyl (cat.# 9309A1E); Dimensions: 100 mm x 3.0 mm ID; Particle Size: 2.7 µm; Pore Size: 90 Å; Temp.: 30 °C; **Sample:** Diluent: initial mobile phase; Conc.: 50 ng/mL; Inj. Vol.: 5 µL **Mobile Phase:** A: 0.1% formic acid in water, B: 0.1% formic acid in acetonitrile; **Gradient (%B):** 0.00 min (40%), 3.00 min (80%), 3.01 min (40%), 5.00 min (40%); **Flow:** 0.700 mL/min; **Detector:** Waters Xevo TQ-S; Ion Mode: ESI+; **Instrument:** Waters.

Raptor™ EXP® Guard Column

To help protect your investment and further extend the life of our already-rugged Raptor™ LC columns, we have mated our new superficially porous particles with patent-pending guard column hardware developed by Optimize Technologies. A Raptor™ LC guard column cartridge in an EXP® direct connect holder is the ultimate in column protection.

Patented Titanium Hybrid Ferrules

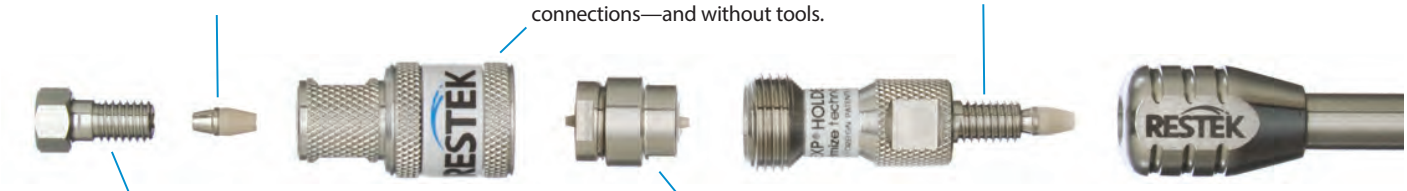
Can be installed repeatedly without compromising high-pressure seal.

Free-Turn® Architecture

Allows you to change cartridges without breaking inlet/outlet fluid connections—and without tools.

Auto-Adjusting Connection

Provides ZDV (zero dead volume) connection to any 10-32 female port.



Flexible Design

Replace nut with longer or even tool-free options to best suit your needs.

Unidirectional Raptor™ Cartridge

In-Tandem Development
Made to pair perfectly with Raptor™ LC columns.

Superior Packing Technique
Withstands 600 bar (2.7 µm) / 400 bar (5 µm) operating pressures.

Restek® Quality
Backed by the manufacturing and QC systems you trust.

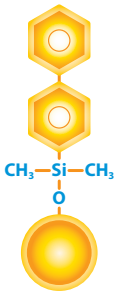
Raptor™ Biphenyl LC Columns (USP L11)

NEW!

Chromatographic Properties

The innovative Biphenyl is Restek's most popular LC stationary phase because it is particularly adept at separating compounds that are hard to resolve or that elute early on C18 and other phenyl chemistries. As a result, the rugged Raptor™ Biphenyl column is extremely useful for fast separations in bioanalytical testing applications like drug and metabolite analyses, especially those that require a mass spectrometer (MS). Increasing retention of early-eluting compounds can limit ionization suppression, and the heightened selectivity helps eliminate the need for complex mobile phases that are not well-suited for MS detection.

Length	2.1 mm cat.#	3.0 mm cat.#	4.6 mm cat.#
2.7 µm Columns			
30 mm	9309A32	9309A3E	9309A35
50 mm	9309A52	9309A5E	9309A55
100 mm	9309A12	9309A1E	9309A15
150 mm	9309A62	9309A6E	9309A65
5 µm Columns			
30 mm	—	930953E	—
50 mm	9309552	930955E	9309555
100 mm	9309512	930951E	9309515
150 mm	9309562	930956E	9309565
250 mm	—	—	9309575



Column Characteristics:

Stationary Phase Category: Phenyl (L11)
Ligand Type: Biphenyl
Particle: 2.7 µm or 5 µm superficially porous silica (SPP or "core-shell")
Pore Size: 90 Å
Surface Area: 150 m^2/g (2.7 µm) or 100 m^2/g (5 µm)
Recommended Usage:
pH range: 1.5–8.0
Maximum Temperature: 80 °C
Maximum Pressure: 600 bar / 8,700 psi (2.7 µm) or 400 bar / 5,800 psi (5 µm)

Properties:

- Increased retention for dipolar, unsaturated, or conjugated solutes.
- Enhanced selectivity when used with methanolic mobile phase.
- Ideal for increasing sensitivity and selectivity in LC-MS analyses.

Switch to a Biphenyl when:

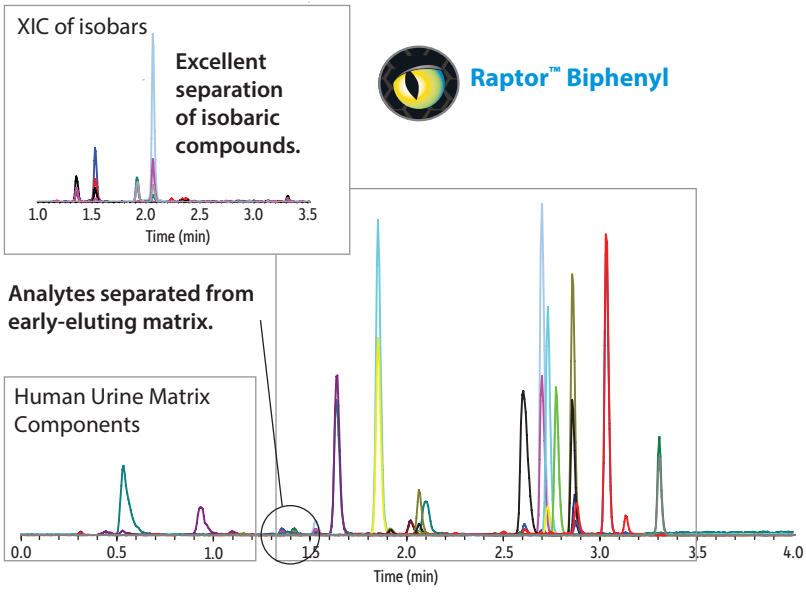
- Limited selectivity is observed on a C18.
- You need to increase retention of hydrophilic aromatics.

USLC® Column Interaction Profile

(See page 161 for more information.)



Pain Panel in Urine on Raptor™ Biphenyl (50 x 3.0 mm) by LC-MS/MS



For compound listing including isobars, visit **www.restek.com** and search for LC_CF0568.

Column	Raptor™ Biphenyl (cat.# 9309A5E)
Dimensions:	50 mm x 3.0 mm ID
Particle Size:	2.7 µm
Temp.:	30 °C
Sample	
Diluent:	Urine:mobile phase A:mobile phase B (17:76:7)
Conc.:	10-100 ng/mL
Inj. Vol.:	10 µL
Mobile Phase	
A:	Water + 0.1% formic acid
B:	Methanol + 0.1% formic acid

Time (min)	Flow (mL/min)	%A	%B
0.00	0.6	90	10
1.50	0.6	55	45
2.50	0.6	0	100
3.70	0.6	0	100
3.71	0.6	90	10
5.00	0.6	90	10

Detector	AB SCIEX API 4000™ MS/MS
Ion Source:	TurboIonSpray®
Ion Mode:	ESI+
Instrument	API LC-MS/MS
Notes	Lorazepam was prepared at 100 ng/mL; all other analytes are 10 ng/mL.

Raptor™ ARC-18 LC Columns (USP L1)

NEW!

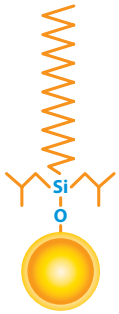
Chromatographic Properties

Designed and intended specifically for use on LC-MS/MS systems, the Raptor™ ARC-18 column offers a well-balanced retention profile without the drawbacks of using an ordinary C18 in the harsh, acidic mobile phases needed for mass spectrometry (MS). Even after extended use in these low-pH (≤ 2.0) conditions, the sterically protected ARC-18 offers consistent retention, peak shape, and response for charged bases, neutral acids, small polar compounds, and more. For the rapid analysis of large, multiclass assays by LC-MS/MS, the acid-resistant Raptor™ ARC-18 truly is *ahead of the curve*.

Length	2.1 mm cat.#	3.0 mm cat.#	4.6 mm cat.#
2.7 µm Columns			
30 mm	9314A32	9314A3E	9314A35
50 mm	9314A52	9314A5E	9314A55
100 mm	9314A12	9314A1E	9314A15
150 mm	9314A62	9314A6E	9314A65
5 µm Columns			
30 mm	—	931453E	—
50 mm	9314552	931455E	9314555
100 mm	9314512	931451E	9314515
150 mm	9314562	931456E	9314565
250 mm	—	—	9314575

Column Characteristics:

Stationary Phase Category: C18, octadecylsilane (L1)
Ligand Type: Sterically protected C18
Particle: 2.7 µm or 5 µm superficially porous silica (SPP or "core-shell")
Pore Size: 90 Å
Surface Area: 150 m^2/g (2.7 µm) or 100 m^2/g (5 µm)
Recommended Usage:
pH range: 1.0–8.0
Maximum Temperature: 80 °C
Maximum Pressure: 600 bar / 8,700 psi (2.7 µm) or 400 bar / 5,800 psi (5 µm)



Properties:

- Well-balanced retention profile.
- Sterically protected and acid-resistant to resist harsh, low-pH mobile phases.
- Ideal for use with sensitive detectors like mass spec.

Switch to an ARC-18 when:

- You are analyzing large, multiclass lists by LC-MS/MS.
- Strongly acidic (pH 1–3) mobile phases are required.

USLC® Column Interaction Profile

(See page 161 for more information.)



Raptor™ C18 LC Columns (USP L1)

NEW!

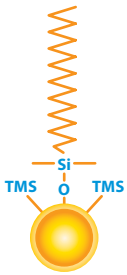
Chromatographic Properties

When you need a general-purpose LC column, don't just grab any C18. Choose the speed, efficiency, and long-lasting ruggedness of the Raptor™ C18. This traditional end-capped C18 offers the highest hydrophobic retention of any Raptor™ phase, and it is compatible with a wide range of mobile phases from moderately acidic to neutral (pH 2–8). Whether for food safety or environmental or bioanalytical analyses, this phase offers consistently excellent data quality in less time across myriad reversed-phase applications, matrices, and compound classes. To lower costs and improve profitability, you need columns to last longer, data to be reproducible, and existing HPLC instrumentation to run faster. Get there with the only general-purpose C18 that gives you *Selectivity Accelerated*.

Length	2.1 mm cat.#	3.0 mm cat.#	4.6 mm cat.#
2.7 µm Columns			
30 mm	9304A32	9304A3E	9304A35
50 mm	9304A52	9304A5E	9304A55
100 mm	9304A12	9304A1E	9304A15
150 mm	9304A62	9304A6E	9304A65
5 µm Columns			
30 mm	—	930453E	—
50 mm	9304552	930455E	9304555
100 mm	9304512	930451E	9304515
150 mm	9304562	930456E	9304565
250 mm	—	—	9304575

Column Characteristics:

Stationary Phase Category: C18, octadecylsilane (L1)
Ligand Type: End-capped C18
Particle: 2.7 µm or 5 µm superficially porous silica (SPP or "core-shell")
Pore Size: 90 Å
Surface Area: 150 m^2/g (2.7 µm) or 100 m^2/g (5 µm)
Recommended Usage:
pH range: 2.0–8.0
Maximum Temperature: 80 °C
Maximum Pressure: 600 bar / 8,700 psi (2.7 µm) or 400 bar / 5,800 psi (5 µm)



Properties:

- Compatible with moderately acidic to neutral mobile phases (pH 2–8).
- Excellent data quality in food, environmental, bioanalytical, and other applications.

Switch to a C18 when:

- You need a general-purpose column for reversed-phase chromatography.
- You need to increase retention of hydrophobic compounds.

USLC® Column Interaction Profile

(See page 161 for more information.)



Raptor™ EXP® Guard Column Cartridges

- Free-Turn® architecture lets you change cartridges by hand without breaking inlet/outlet fluid connections—no tools needed.
- Patented titanium hybrid ferrules can be installed repeatedly without compromising high-pressure seal.
- Auto-adjusting design provides ZDV (zero dead volume) connection to any 10-32 female port.
- Guard column cartridges require EXP® direct connect holder (cat.# 25808).
- Pair with EXP® hand-tight fitting (cat.# 25937–25939) for tool-free installation.

To help protect your investment and further extend the life of our already-rugged LC columns, Restek offers the patent-pending guard column hardware developed by Optimize Technologies. A Restek® LC guard cartridge in an EXP® direct connect holder is the ultimate in column protection.

NEW!



Raptor™ EXP® Guard Column Cartridge

Learn more about the Raptor™ EXP® guard column on page 156!

Description	Particle Size	qty.	5 x 2.1 mm cat.#	5 x 3.0 mm cat.#	5 x 4.6 mm cat.#
Raptor ARC-18 EXP Guard Column Cartridge	2.7 µm	3-pk.	9314A0252	9314A0253	9314A0250
Raptor ARC-18 EXP Guard Column Cartridge	5 µm	3-pk.	931450252	931450253	931450250
Raptor Biphenyl EXP Guard Column Cartridge	2.7 µm	3-pk.	9309A0252	9309A0253	9309A0250
Raptor Biphenyl EXP Guard Column Cartridge	5 µm	3-pk.	930950252	930950253	930950250
Raptor C18 EXP Guard Column Cartridge	2.7 µm	3-pk.	9304A0252	9304A0253	9304A0250
Raptor C18 EXP Guard Column Cartridge	5 µm	3-pk.	930450252	930450253	930450250

Maximum cartridge pressure: 600 bar / 8,700 psi (2.7 µm) or 400 bar / 5,800 psi (5 µm)

EXP® Direct Connect Holder

NEW!

Description	qty.	cat.#
EXP Direct Connect Holder for EXP Guard Cartridges (includes hex-head fitting & 2 ferrules)	ea.	25808

Maximum holder pressure: 20,000 psi (1,400 bar)



25808
EXP® Direct Connect Holder

also available



Hand-Tight Nut (cat.# 25937–25939)
Upgrade the supplied nut to install your Raptor™ EXP® guard column by hand—no tools needed.



Long Hex-Head Nut (cat.# 25934)
Extend the nut on your Raptor™ EXP® guard column for easier access in tight spaces—no more bumped knuckles.



EXP® Hand-Tight Coupler (cat.# 25940)
Achieve tool-free 8,700+ psi (600 bar) seals anywhere in your LC system with EXP® hand-tight couplers and connectors.

See **page 335** for more EXP® hex-head fittings, couplers, replacement parts, and more.

RESTEK® USLC®

Ultra Selective Liquid Chromatography™
www.restek.com/uslc

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 fast 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.

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

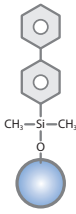
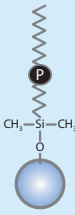
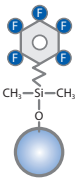
Efficiency *Retention Factor* *Selectivity*

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	• General-purpose with a well-balanced retention profile. • Compatible with 100% aqueous mobile phases. • Ideal for multi-component LC-MS analyses.	• 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.	• Increased retention for acids and water-soluble compounds. • Compatible with 100% aqueous mobile phases. • Capable of both reversed-phase and HILIC separations.	• 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.

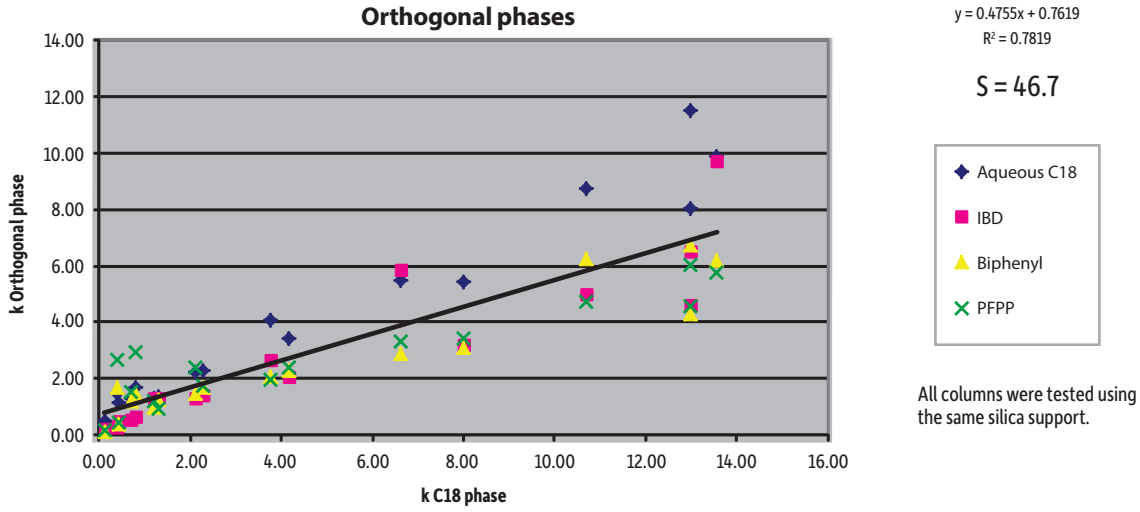
Evaluating and Extending Selectivity

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.

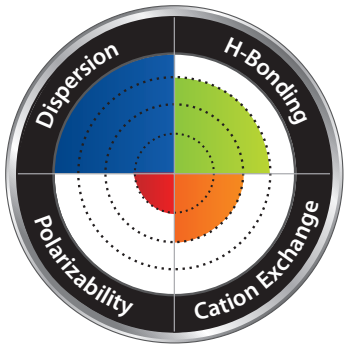
USLC® Column Interaction Profile

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
Choose Columns Fast.
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**.



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**.



Prepare and Maintain Mobile Phases Without Dissolved Gas or Unnecessary Costs

Mobile Phase Sparge Filter
See **page 342**.



Avoid Messy Spills Around Mobile Phase Waste Containers

Waste Overflow Indicator
See **page 341**.



Pinnacle® DB Columns: 1.9, 3, or 5 µm particles; 140 Å pore size

Restek® Pinnacle® DB columns are built for optimal UHPLC performance.

Pinnacle® DB columns are 100% manufactured by Restek in our Bellefonte, Pennsylvania, facility. Because performance begins with the support, our Pinnacle® DB UHPLC columns start with base-deactivated spherical silica that is optimized for UHPLC stability. From there, we bond them with a wide variety of phases to give chromatographers a stable and selective column. Get the most out of your UHPLC system. Combine selectivity and efficiency by using Restek® Pinnacle® DB UHPLC columns.

Pinnacle® DB Aqueous C18 Columns (USP L1)

Restek-manufactured silica

Chromatographic Properties

The Restek® Aqueous C18 is a rugged, reversed-phase column with a well-balanced retention profile. It can effectively retain more types of solutes than a conventional C18 and is ideal for multicomponent LC-MS analyses. The general-purpose Aqueous C18 boasts high reproducibility and compatibility with many mobile phase conditions—even 100% aqueous. And when used with a gradient, it eliminates the all-too-common issue of multiple compounds eluting near the column void time.

Length	2.1 mm ID cat.#	3.0 mm ID cat.#	4.6 mm ID cat.#
1.9 µm Columns			
30 mm	9418232	—	—
50 mm	9418252	—	—
100 mm	9418212	—	—
3 µm Columns			
30 mm	9418332	941833E	9418335
50 mm	9418352	941835E	9418355
100 mm	9418312	941831E	9418315
150 mm	9418362	941836E	9418365
5 µm Columns			
30 mm	9418532	941853E	9418535
50 mm	9418552	941855E	9418555
100 mm	9418512	941851E	9418515
150 mm	9418562	941856E	9418565
200 mm	9418522	941852E	9418525
250 mm	9418572	941857E	9418575



Column Characteristics:

particle size:	1.9 µm, 3 µm, or 5 µm, spherical
pore size:	140 Å
carbon load:	6%
pH range:	2.5 to 8
temperature limit:	80 °C
USP phase code:	L1
phase category:	modified C18
ligand type:	proprietary polar modified and functionally bonded C18

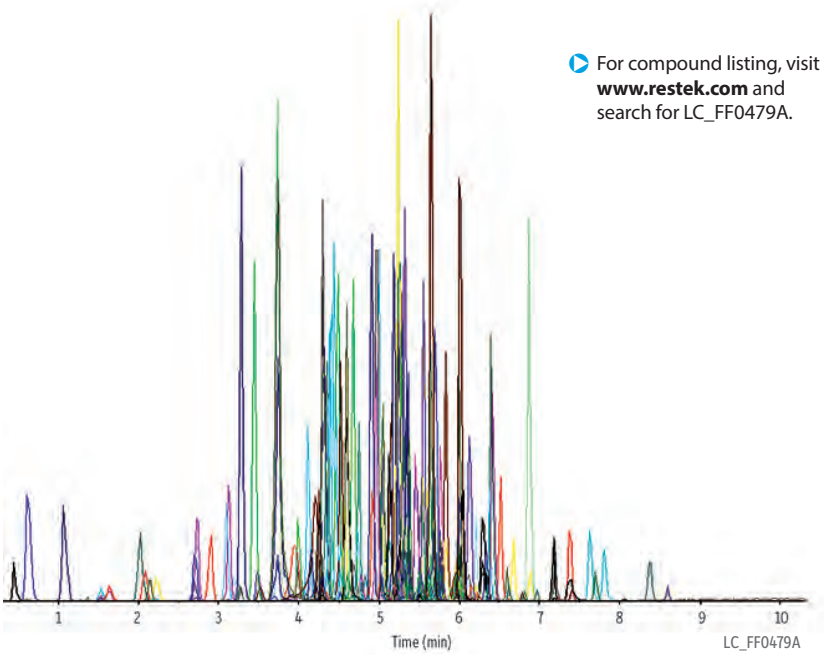
Aqueous C18

USLC® Column Interaction Profile

(See page 161 for more information.)



Pesticides on Pinnacle® DB Aqueous C18 (LC-MS/MS, ESI+)



For compound listing, visit **www.restek.com** and search for LC_FF0479A.

Column	Pinnacle® DB Aqueous C18 (cat.# 9418252)
Dimensions:	50 mm x 2.1 mm ID
Particle Size:	1.9 µm
Pore Size:	140 Å
Temp.:	35 °C
Sample	multicomponent pesticide standard
Diluent:	water
Conc.:	33.3 ppb each pesticide
Inj. Vol.:	5 µL
Mobile Phase	
A:	10 mM NH_4OAc in water
B:	10 mM NH_4OAc in methanol

Time (min)	%B
0	10
1	10
8	90
10	90
11	10

Flow:	0.60 mL/min
Max Pressure:	~517 bar
Detector	Applied Biosystems/MDS Sciex LC-MS/MS
Model #:	4000 QTRAP® LC-MS/MS system
Ion Source:	TurboIonSpray®
Ion Spray Voltage:	5 kV
Gas 1:	40 psi (275.8 kPa)
Gas 2:	60 psi (413.7 kPa)
Source Temp.:	500 °C
Instrument	Shimadzu UFLCXR

Pinnacle® DB IBD UHPLC Columns (USP L68)

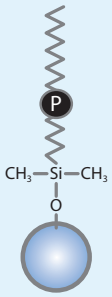
Restek-manufactured silica

Chromatographic Properties

The Restek® IBD is a polar-embedded column that acts as a strong hydrogen bonder and may be the most versatile column available today. With a unique polar group, this column is very retentive and selective for acids. It also provides symmetrical peak shape for strong bases. Restek's IBD is compatible with 100% aqueous mobile phases and can be used under reversed-phase or HILIC conditions to retain very polar, ionic compounds in highly organic mobile phases.

Column Characteristics:

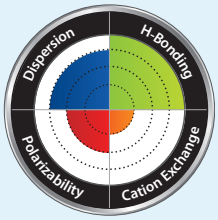
particle size:	1.9 µm, spherical
pore size:	140 Å
end-cap:	no
pH range:	2.5 to 8
temperature limit:	80 °C
USP phase code:	L68
phase category:	polar-embedded alkyl
ligand type:	proprietary polar functional embedded alkyl



IBD

USLC® Column Interaction Profile

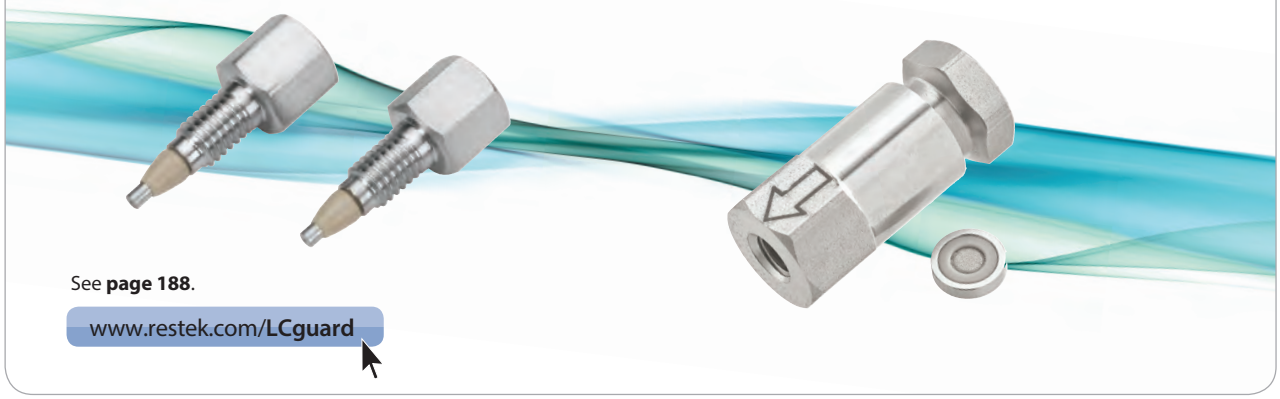
(See page 161 for more information.)



Length	2.1 mm ID cat.#
1.9 µm Columns	
30 mm	9425232
50 mm	9425252
100 mm	9425212

Protect your column and your UHPLC performance with UltraShield and UltraLine UHPLC filters

A cost-effective way to extend the lifetime of any UHPLC column without sacrificing your UHPLC performance on any LC system.



See **page 188**.

www.restek.com/LCguard

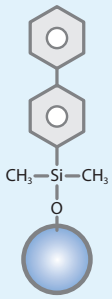
Pinnacle® DB Biphenyl Columns (USP L11)

Restek-manufactured silica

Chromatographic Properties

Since 2005, the Restek® Biphenyl has offered a greater degree of dispersion than conventional phenyls and a greater degree of polarizability than phenyl hexyls, creating higher selectivity and a greater range of usability. Because of these heightened interactions, this column shows substantial increases in retention—especially for dipolar, unsaturated, or conjugated solutes—and enhanced orthogonal selectivity when using methanol mobile phases. It is ideal for increasing sensitivity and selectivity in LC-MS analyses.

Length	2.1 mm ID cat.#	3.0 mm ID cat.#	4.6 mm ID cat.#
1.9 µm Columns			
30 mm	9409232	—	—
50 mm	9409252	—	—
100 mm	9409212	—	—
3 µm Columns			
30 mm	9409332	940933E	9409335
50 mm	9409352	940935E	9409355
100 mm	9409312	940931E	9409315
150 mm	9409362	940936E	9409365
5 µm Columns			
30 mm	9409532	940953E	9409535
50 mm	9409552	940955E	9409555
100 mm	9409512	940951E	9409515
150 mm	9409562	940956E	9409565
200 mm	9409522	940952E	9409525
250 mm	9409572	940957E	9409575



Column Characteristics:

particle size:	1.9 µm, 3 µm, or 5 µm, spherical
pore size:	140 Å
carbon load:	8%
end-cap:	yes
pH range:	2.5 to 8
temperature limit:	80 °C
USP phase:	L11
phase category:	phenyl
ligand type:	unique Biphenyl

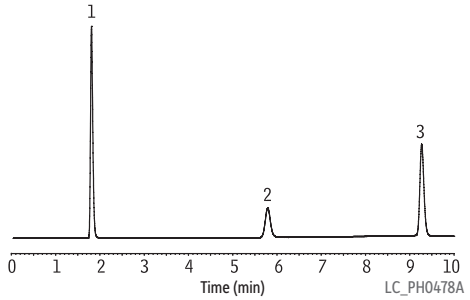
Biphenyl

USLC® Column Interaction Profile

(See page 161 for more information.)



NSAIDs on Pinnacle® DB Biphenyl



Peaks
1. Uracil (void marker)
2. Tenoxicam
3. Sulfinpyrazone

Column	Pinnacle® DB Biphenyl (cat.# 9409565)
Dimensions:	150 mm x 4.6 mm ID
Particle Size:	5 µm
Pore Size:	140 Å
Temp.:	30 °C
Sample	
Diluent:	0.1% formic acid in water:methanol (40:60)
Conc.:	100 µg/mL each component (see peak list)
Inj. Vol.:	10 µL
Mobile Phase	
A:	0.1% formic acid in water
B:	methanol

Time (min)	%B
0.00	60
2.0	60
8.0	90
20.0	90
20.1	60

Flow:	1.0 mL/min
Detector	UV/Vis @ 254 nm
Instrument	Shimadzu Prominence

Pinnacle® DB PFP Propyl Columns (USP L43)

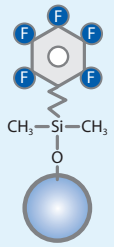
Restek-manufactured silica

Chromatographic Properties

The Restek® PFP Propyl is a great choice for the retention and selectivity of charged bases, electronegative compounds, and amine-containing compounds. Unlike a conventional cyano column, the Restek® PFP Propyl is much more amenable to LC-MS because it is more reliable and efficient with acidic mobile phases. This versatile column is also compatible with highly aqueous mobile phases and HILIC separations.

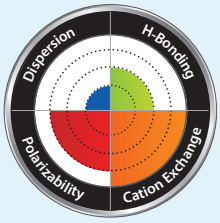
Column Characteristics:

particle size:	1.9 µm, 3 µm, or 5 µm, spherical
pore size:	140 Å
carbon load:	6%
end-cap:	yes
pH range:	2.5 to 8
temperature limit:	80 °C
USP phase code:	L43
phase category:	fluorophenyl propyl
ligand type:	pentafluorophenyl propyl



PFP Propyl

USLC® Column Interaction Profile
(See page 161 for more information.)



Length	2.1 mm ID cat.#	3.0 mm ID cat.#	4.6 mm ID cat.#
1.9 µm Columns			
30 mm	9419232	—	—
50 mm	9419252	—	—
100 mm	9419212	—	—
3 µm Columns			
30 mm	9419332	941933E	9419335
50 mm	9419352	941935E	9419355
100 mm	9419312	941931E	9419315
150 mm	9419362	941936E	9419365
5 µm Columns			
30 mm	9419532	941953E	9419535
50 mm	9419552	941955E	9419555
100 mm	9419512	941951E	9419515
150 mm	9419562	941956E	9419565
200 mm	9419522	941952E	9419525
250 mm	9419572	941957E	9419575

Pinnacle® DB C18 Columns (USP L1)

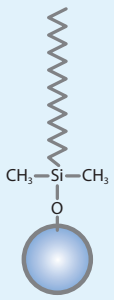
Restek-manufactured silica

Chromatographic Properties

The general-purpose Restek® C18 is a conventional monomeric octadecylsilane column suitable for analyses of a wide range of compounds from acidic through slightly basic.

Column Characteristics:

particle size:	1.9 µm, 3 µm, or 5 µm, spherical
pore size:	140 Å
carbon load:	11%
end-cap:	yes
pH range:	2.5 to 8
temperature limit:	80 °C
USP phase code:	L1
phase category:	C18, octadecylsilane
ligand type:	monomeric C18



C18

Length	2.1 mm ID cat.#	3.0 mm ID cat.#	4.6 mm ID cat.#
1.9 µm Columns			
30 mm	9414232	—	—
50 mm	9414252	—	—
100 mm	9414212	—	—
3 µm Columns			
30 mm	9414332	941433E	9414335
50 mm	9414352	941435E	9414355
100 mm	9414312	941431E	9414315
5 µm Columns			
30 mm	9414532	941453E	9414535
50 mm	9414552	941455E	9414555
100 mm	9414512	941451E	9414515
150 mm	9414562	941456E	9414565
200 mm	9414522	941452E	9414525
250 mm	9414572	941457E	9414575

also available

Trident Direct Guard Column System
See page 189.



Looking for an equivalent column?

Restek has extensively studied column selectivity and can provide you with an accurate recommendation. Please contact Restek® Technical Support or your local Restek® representative.

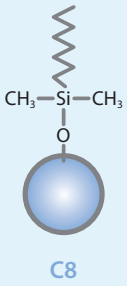
Pinnacle® DB C8 Columns (USP L7)

Restek-manufactured silica

Chromatographic Properties

Our C8 is a conventional monomeric octylsilane column offering a shorter alkyl chain to provide less hydrophobic retention and improved basic peak shape over a traditional C18 phase. Like our C18, this general-purpose Restek® C8 is suitable for a wide range of compounds from acidic through slightly basic.

Length	2.1 mm ID cat.#	3.0 mm ID cat.#	4.6 mm ID cat.#
1.9 µm Columns			
30 mm	9413232	—	—
50 mm	9413252	—	—
100 mm	9413212	—	—
3 µm Columns			
30 mm	9413332	941333E	9413335
50 mm	9413352	941335E	9413355
100 mm	9413312	941331E	9413315
5 µm Columns			
30 mm	9413532	941353E	9413535
50 mm	9413552	941355E	9413555
100 mm	9413512	941351E	9413515
150 mm	9413562	941356E	9413565
200 mm	9413522	941352E	9413525
250 mm	9413572	941357E	9413575



Column Characteristics:

particle size:	1.9 µm, 3 µm, or 5 µm, spherical
pore size:	140 Å
carbon load:	6%
end-cap:	yes
pH range:	2.5 to 8
temperature limit:	80 °C
USP phase code:	L7
phase category:	C8, octylsilane
ligand type:	monomeric C8

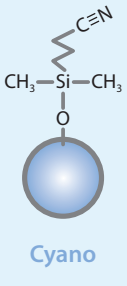
Pinnacle® DB Cyano Columns (USP L10)

Restek-manufactured silica

Chromatographic Properties

The Restek® Cyano is a traditional monomeric cyanopropylsilane that is recommended for assays where alternate selectivity, or confirmation, to a C18 or C8 column is desired. It can be used in normal-phase, reversed-phase (best with mobile phase pH between 5 and 7), and HILIC modes. It is an excellent choice for the analysis of protonated bases.

Length	2.1 mm ID cat.#	3.0 mm ID cat.#	4.6 mm ID cat.#
1.9 µm Columns			
30 mm	9416232	—	—
50 mm	9416252	—	—
100 mm	9416212	—	—
5 µm Columns			
30 mm	9416532	941653E	9416535
50 mm	9416552	941655E	9416555
100 mm	9416512	941651E	9416515
150 mm	9416562	941656E	9416565
200 mm	9416522	941652E	9416525
250 mm	9416572	941657E	9416575



Column Characteristics:

particle size:	1.9 µm or 5 µm, spherical
pore size:	140 Å
carbon load:	4%
end-cap:	yes
pH range:	2.5 to 8
temperature limit:	80 °C
USP phase code:	L10
phase category:	cyano
ligand type:	cyanopropylsilane



Whether it's on our new Raptor™ SPP or the proven Pinnacle® DB and Ultra supports, Restek's LC Manufacturing group bonds our silica with stationary phases that offer maximum selectivity and reliability.

Pinnacle® DB Silica Columns (USP L3)

Restek-manufactured silica

Chromatographic Properties

Base-deactivated spherical silica is useful for normal-phase or HILIC separations.

Column Characteristics:

particle size:	1.9 µm, 3 µm, or 5 µm, spherical
pore size:	140 Å
end-cap:	no
pH range:	2.5 to 8
temperature limit:	80 °C
USP phase code:	L3
phase category:	bare silica
ligand type:	none



Silica

Length	2.1 mm ID cat.#	3.0 mm ID cat.#	4.6 mm ID cat.#
1.9 µm Columns			
30 mm	9410232	—	—
50 mm	9410252	—	—
100 mm	9410212	—	—
3 µm Columns			
30 mm	9410332	941033E	9410335
50 mm	9410352	941035E	9410355
100 mm	9410312	941031E	9410315
150 mm	9410362	941036E	9410365
5 µm Columns			
30 mm	9410532	941053E	9410535
50 mm	9410552	941055E	9410555
100 mm	9410512	941051E	9410515
150 mm	9410562	941056E	9410565
200 mm	9410522	941052E	9410525
250 mm	9410572	941057E	9410575

Pinnacle® DB PAH UHPLC Columns

Restek-manufactured silica

Chromatographic Properties

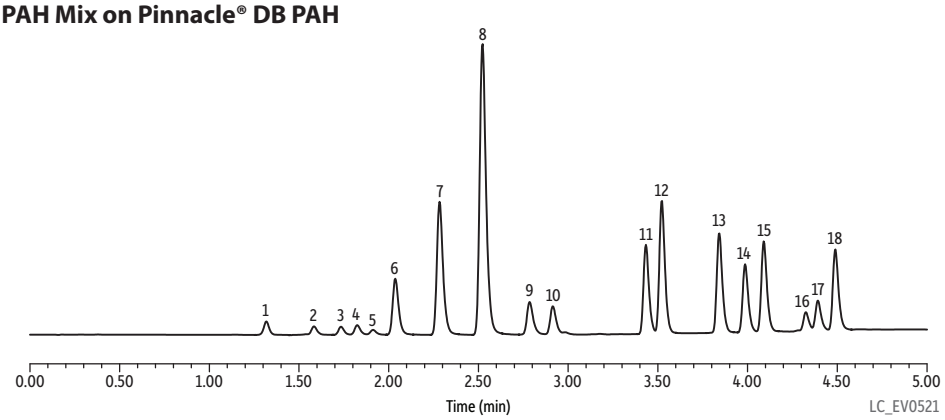
Specifically designed to resolve complex mixtures of polycyclic aromatic hydrocarbons (PAHs). Get complete resolution of all 16 EPA 610 PAHs, plus two other routinely analyzed PAH compounds, in less than five minutes to greatly reduce run times and increase sample throughput.

Column Characteristics:

particle size:	1.9 µm, spherical
pore size:	140 Å
end-cap:	no
pH range:	2.5 to 8
temperature limit:	80 °C

Length	2.1 mm ID cat.#
1.9 µm Columns	
30 mm	9470232
50 mm	9470252
100 mm	9470212

PAH Mix on Pinnacle® DB PAH



Peaks
1. Naphthalene
2. Acenaphthylene
3. 1-Methylnaphthalene
4. 2-Methylnaphthalene
5. Acenaphthene
6. Fluorene
7. Phenanthrene
8. Anthracene
9. Fluoranthene
10. Pyrene
11. Benzo[a]anthracene
12. Chrysene
13. Benzo[b]fluoranthene
14. Benzo[k]fluoranthene
15. Benzo[a]pyrene
16. Dibenzo[a,h]anthracene
17. Benzo[ghi]perylene
18. Indeno[1,2,3-cd]pyrene

Column	Pinnacle® DB PAH (cat.# 9470252)
Dimensions:	50 mm x 2.1 mm ID
Particle Size:	1.9 µm
Pore Size:	140 Å
Temp.:	30 °C
Sample	EPA Method 8310 PAH Mixture (cat.# 31841)
Diluent:	acetonitrile
Conc.:	10 µg/mL
Inj. Vol.:	1 µL

Mobile Phase				
A:	water			
B:	acetonitrile			
	Time (min)	**Flow (mL/min)**	**%A**	**%B**
	0	0.8	60	40
	2	0.8	40	60
	4	0.8	0	100
	4.5	0.8	0	100
	4.51	0.8	60	40
	5	0.8	60	40
Max Pressure:	724 bar			
Detector	Photo diode array @ 254, 4.8 nm			
Instrument	Waters			

Ultra HPLC Columns: 3 or 5 µm particles; 100 Å pore size

The Ultra line represents Restek's broadest selection of stationary phases on a single silica support. Made of high-purity, type-B silica that minimizes activity and creates high-density bonding, these columns are designed for selective and reliable HPLC applications.

Ultra Aqueous C18 Columns (USP L1)

Chromatographic Properties

The Restek® Aqueous C18 is a rugged, reversed-phase column with a well-balanced retention profile. It can effectively retain more types of solutes than a conventional C18 and is ideal for multicomponent LC-MS analyses. The general-purpose Aqueous C18 boasts high reproducibility and compatibility with many mobile phase conditions—even 100% aqueous. And when used with a gradient, it eliminates the all-too-common issue of multiple compounds eluting near the column void time.

Length	2.1 mm ID cat.#	3.0 mm ID cat.#	4.6 mm ID cat.#
3 µm Columns			
30 mm	9178332	917833E	9178335
50 mm	9178352	917835E	9178355
100 mm	9178312	917831E	9178315
150 mm	9178362	917836E	9178365
5 µm Columns			
30 mm	9178532	917853E	9178535
50 mm	9178552	917855E	9178555
100 mm	9178512	917851E	9178515
150 mm	9178562	917856E	9178565
200 mm	9178522	917852E	9178525
250 mm	9178572	917857E	9178575

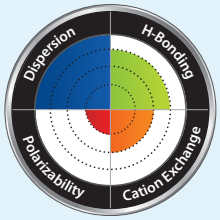


Column Characteristics:

particle size:	3 µm or 5 µm, spherical
pore size:	100 Å
carbon load:	15%
end-cap:	no
pH range:	2.5 to 8
temperature limit:	80 °C
USP phase code:	L1
phase category:	modified C18
ligand type:	proprietary polar modified and functionally bonded C18

Aqueous C18

USLC® Column Interaction Profile
(See page 161 for more information.)

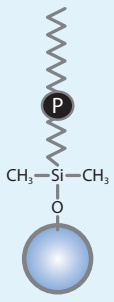


Ultra IBD Columns (USP L68)

Chromatographic Properties

The Restek® IBD is a polar-embedded column that acts as a strong hydrogen bonder and may be the most versatile column available today. With a unique polar group, this column is very retentive and selective for acids. It also provides symmetrical peak shape for strong bases. Restek's IBD is compatible with 100% aqueous mobile phases and can be used under reversed-phase or HILIC conditions to retain very polar, ionic compounds in highly organic mobile phases.

Length	2.1 mm ID cat.#	3.0 mm ID cat.#	4.6 mm ID cat.#
3 µm Columns			
30 mm	9175332	917533E	9175335
50 mm	9175352	917535E	9175355
100 mm	9175312	917531E	9175315
150 mm	9175362	917536E	9175365
5 µm Columns			
30 mm	9175532	917553E	9175535
50 mm	9175552	917555E	9175555
100 mm	9175512	917551E	9175515
150 mm	9175562	917556E	9175565
200 mm	9175522	917552E	9175525
250 mm	9175572	917557E	9175575



Column Characteristics:

particle size:	3 µm or 5 µm, spherical
pore size:	100 Å
carbon load:	12%
end-cap:	no
pH range:	2.5 to 8
temperature limit:	80 °C
USP phase code:	L68
phase category:	polar-embedded alkyl
ligand type:	proprietary polar functional embedded alkyl

IBD

USLC® Column Interaction Profile
(See page 161 for more information.)



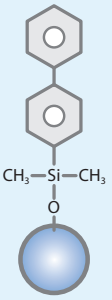
Ultra Biphenyl Columns (USP L11)

Chromatographic Properties

Since 2005, the Restek® Biphenyl has offered a greater degree of dispersion than conventional phenyls and a greater degree of polarizability than phenyl hexyls, creating higher selectivity and a greater range of usability. Because of these heightened interactions, this column shows substantial increases in retention—especially for dipolar, unsaturated, or conjugated solutes—and enhanced orthogonal selectivity when using methanol mobile phases. It is ideal for increasing sensitivity and selectivity in LC-MS analyses.

Column Characteristics:

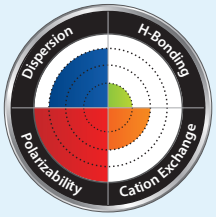
particle size:	3 µm or 5 µm, spherical
pore size:	100 Å
carbon load:	15%
end-cap:	yes
pH range:	2.5 to 8
temperature limit:	80 °C
USP phase:	L11
phase category:	phenyl
ligand type:	unique Biphenyl



Biphenyl

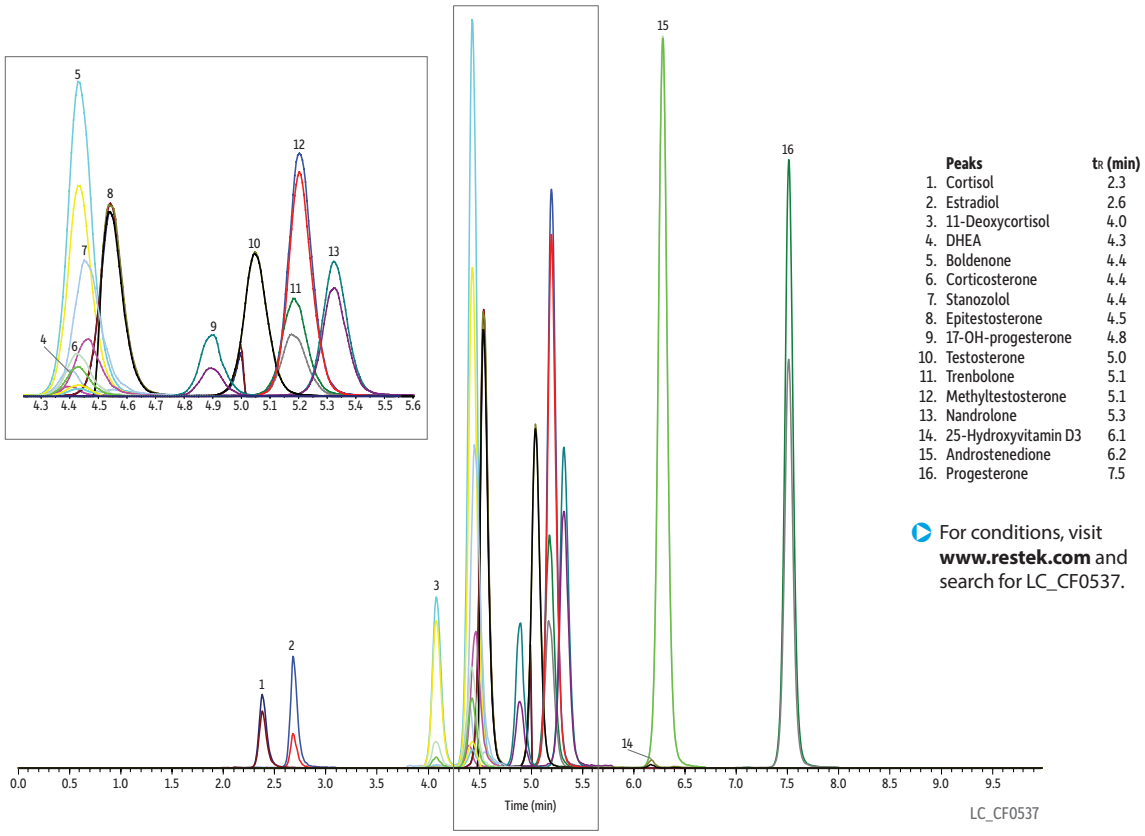
USLC® Column Interaction Profile

(See page 161 for more information.)



Length	2.1 mm ID cat.#	3.0 mm ID cat.#	4.6 mm ID cat.#
3 µm Columns			
30 mm	9109332	910933E	9109335
50 mm	9109352	910935E	9109355
100 mm	9109312	910931E	9109315
150 mm	9109362	910936E	9109365
5 µm Columns			
30 mm	9109532	910953E	9109535
50 mm	9109552	910955E	9109555
100 mm	9109512	910951E	9109515
150 mm	9109562	910956E	9109565
200 mm	9109522	910952E	9109525
250 mm	9109572	910957E	9109575

Steroid Panel Analysis on the Ultra Biphenyl



Peaks	tR (min)
1. Cortisol	2.3
2. Estradiol	2.6
3. 11-Deoxycortisol	4.0
4. DHEA	4.3
5. Boldenone	4.4
6. Corticosterone	4.4
7. Stanozolol	4.4
8. Epitestosterone	4.5
9. 17-OH-progesterone	4.8
10. Testosterone	5.0
11. Trenbolone	5.1
12. Methyltestosterone	5.1
13. Nandrolone	5.3
14. 25-Hydroxyvitamin D3	6.1
15. Androstenedione	6.2
16. Progesterone	7.5

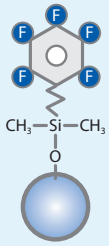
For conditions, visit **www.restek.com** and search for LC_CF0537.

Ultra PFP Propyl Columns (USP L43)

Chromatographic Properties

The Restek® PFP Propyl is a great choice for the retention and selectivity of charged bases, electronegative compounds, and amine-containing compounds. Unlike a conventional cyano column, the Restek® PFP Propyl is much more amenable to LC-MS because it is more reliable and efficient with acidic mobile phases. This versatile column is also compatible with highly aqueous mobile phases and HILIC separations.

Length	2.1 mm ID cat.#	3.0 mm ID cat.#	4.6 mm ID cat.#
3 µm Columns			
30 mm	9179332	917933E	9179335
50 mm	9179352	917935E	9179355
100 mm	9179312	917931E	9179315
150 mm	9179362	917936E	9179365
5 µm Columns			
30 mm	9179532	917953E	9179535
50 mm	9179552	917955E	9179555
100 mm	9179512	917951E	9179515
150 mm	9179562	917956E	9179565
200 mm	9179522	917952E	9179525
250 mm	9179572	917957E	9179575



Column Characteristics:

particle size:	3 µm or 5 µm, spherical
pore size:	100 Å
carbon load:	11%
end-cap:	yes
pH range:	2.5 to 8
temperature limit:	80 °C
USP phase code:	L43
phase category:	fluorophenyl propyl
ligand type:	pentafluorophenyl propyl

PFP Propyl

USLC® Column Interaction Profile

(See page 161 for more information.)

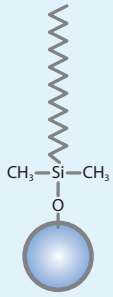


Ultra C18 Columns (USP L1)

Chromatographic Properties

The general-purpose Restek® C18 is a conventional monomeric octadecylsilane column suitable for analyses of a wide range of compounds from acidic through slightly basic.

Length	2.1 mm ID cat.#	3.0 mm ID cat.#	4.0 mm ID cat.#	4.6 mm ID cat.#
3 µm Columns				
30 mm	9174332	917433E	—	9174335
50 mm	9174352	917435E	—	9174355
100 mm	9174312	917431E	—	9174315
150 mm	9174362	917436E	—	9174365
5 µm Columns				
30 mm	9174532	917453E	—	9174535
50 mm	9174552	917455E	—	9174555
100 mm	9174512	917451E	9174514	9174515
150 mm	9174562	917456E	9174564	9174565
200 mm	9174522	917452E	—	9174525
250 mm	9174572	917457E	—	9174575



Column Characteristics:

particle size:	3 µm or 5 µm, spherical
pore size:	100 Å
carbon load:	20%
end-cap:	yes
pH range:	2.5 to 8
temperature limit:	80 °C
USP phase code:	L1
phase category:	C18, octadecylsilane
ligand type:	monomeric C18

C18

also available

200+ compound multiresidue pesticides standard kits for LC-MS/MS and GC-MS/MS!



See **pages 568–571**.

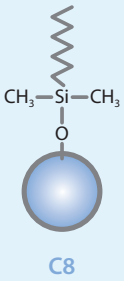
Ultra C8 Columns (USP L7)

Chromatographic Properties

Our C8 is a conventional monomeric octylsilane column offering a shorter alkyl chain to provide less hydrophobic retention and improved basic peak shape over a traditional C18 phase. Like our C18, this general-purpose Restek® C8 is suitable for a wide range of compounds from acidic through slightly basic.

Column Characteristics:

particle size:	3 µm or 5 µm, spherical
pore size:	100 Å
carbon load:	12%
end-cap:	yes
pH range:	2.5 to 8
temperature limit:	80 °C
USP phase code:	L7
phase category:	C8, octylsilane
ligand type:	monomeric C8



Length	2.1 mm ID cat.#	3.0 mm ID cat.#	4.0 mm ID cat.#	4.6 mm ID cat.#
3 µm Columns				
30 mm	9103332	910333E	—	9103335
50 mm	9103352	910335E	—	9103355
100 mm	9103312	910331E	—	9103315
150 mm	9103362	910336E	—	9103365
5 µm Columns				
30 mm	9103532	910353E	—	9103535
50 mm	9103552	910355E	—	9103555
100 mm	9103512	910351E	9103514	9103515
150 mm	9103562	910356E	9103564	9103565
200 mm	9103522	910352E	—	9103525
250 mm	9103572	910357E	—	9103575

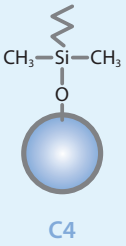
Ultra C4 Columns (USP L26)

Chromatographic Properties

Exceptionally stable C4 packing with high bonding coverage and base deactivation. Less retention than C18 or C8 phases.

Column Characteristics:

particle size:	3 µm or 5 µm, spherical
pore size:	100 Å
carbon load:	9%
end-cap:	yes
pH range:	2.5 to 8
temperature limit:	80 °C
USP phase code:	L26
phase category:	C4, butylsilane
ligand type:	monomeric C4



Length	2.1 mm ID cat.#	3.0 mm ID cat.#	4.6 mm ID cat.#
3 µm Columns			
30 mm	9102332	910233E	9102335
50 mm	9102352	910235E	9102355
100 mm	9102312	910231E	9102315
150 mm	9102362	910236E	9102365
5 µm Columns			
30 mm	9102532	910253E	9102535
50 mm	9102552	910255E	9102555
100 mm	9102512	910251E	9102515
150 mm	9102562	910256E	9102565
200 mm	9102522	910252E	9102525
250 mm	9102572	910257E	9102575



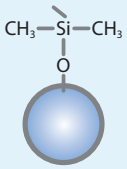
Our LC Manufacturing experts follow tightly controlled processes to ensure that you receive robust and reliable columns every time you order from Restek.

Ultra C1 Columns (USP L13)

Chromatographic Properties

This exceptionally stable C1 phase features our least-retentive reversed-phase hydrocarbon packing.

Length	2.1 mm ID cat.#	3.0 mm ID cat.#	4.6 mm ID cat.#
3 µm Columns			
30 mm	9101332	910133E	9101335
50 mm	9101352	910135E	9101355
100 mm	9101312	910131E	9101315
150 mm	9101362	910136E	9101365
5 µm Columns			
30 mm	9101532	910153E	9101535
50 mm	9101552	910155E	9101555
100 mm	9101512	910151E	9101515
150 mm	9101562	910156E	9101565
200 mm	9101522	910152E	9101525
250 mm	9101572	910157E	9101575



C1

Column Characteristics:

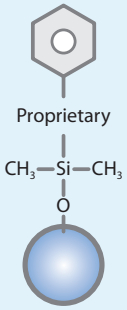
particle size:	3 µm or 5 µm, spherical
pore size:	100 Å
carbon load:	5%
pH range:	2.5 to 8
temperature limit:	80 °C
USP phase code:	L13
phase category:	trimethylsilane
ligand type:	monomeric C1

Ultra Aromax Columns (USP L11)

Chromatographic Properties

Ultra Aromax is a unique reversed-phase material that exhibits extreme retention and selectivity for aromatic and/or unsaturated compounds. This column is a great alternative to our Biphenyl phase when increased retention is required, and it's an excellent choice for gradient LC-MS analyses when conventional columns are not giving adequate retention or selectivity.

Length	2.1 mm ID cat.#	3.0 mm ID cat.#	4.6 mm ID cat.#
3 µm Columns			
30 mm	9127332	912733E	9127335
50 mm	9127352	912735E	9127355
100 mm	9127312	912731E	9127315
150 mm	9127362	912736E	9127365
5 µm Columns			
30 mm	9127532	912753E	9127535
50 mm	9127552	912755E	9127555
100 mm	9127512	912751E	9127515
150 mm	9127562	912756E	9127565
200 mm	9127522	912752E	9127525
250 mm	9127572	912757E	9127575



Aromax

Column Characteristics:

particle size:	3 µm or 5 µm, spherical
pore size:	100 Å
carbon load:	17%
end-cap:	yes
pH range:	2.5 to 8
temperature limit:	80 °C
USP phase code:	L11
phase category:	phenyl
ligand type:	proprietary phenyl ligand



All the Right Tools—
All in One Toolbox

Get 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.

See **page 162**.

www.restek.com/**uslc**

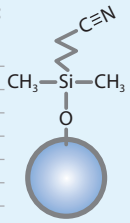
Ultra Cyano Columns (USP L10)

Chromatographic Properties

The Restek® Cyano is a traditional monomeric cyanopropylsilane that is recommended for assays where alternate selectivity, or confirmation, to a C18 or C8 column is desired. It can be used in normal-phase, reversed-phase (best with mobile phase pH between 5 and 7), and HILIC modes. It is an excellent choice for the analysis of protonated bases.

Column Characteristics:

particle size:	3 µm or 5 µm, spherical
pore size:	100 Å
carbon load:	8%
end-cap:	yes
pH range:	2.5 to 8
temperature limit:	80 °C
USP phase code:	L10
phase category:	cyano
ligand type:	cyanopropylsilane



Cyano

Length	2.1 mm ID cat.#	3.0 mm ID cat.#	4.6 mm ID cat.#
3 µm Columns			
30 mm	9106332	910633E	9106335
50 mm	9106352	910635E	9106355
100 mm	9106312	910631E	9106315
150 mm	9106362	910636E	9106365
5 µm Columns			
30 mm	9106532	910653E	9106535
50 mm	9106552	910655E	9106555
100 mm	9106512	910651E	9106515
150 mm	9106562	910656E	9106565
200 mm	9106522	910652E	9106525
250 mm	9106572	910657E	9106575

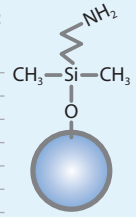
Ultra Amino Columns (USP L8)

Chromatographic Properties

The general-purpose Restek® Amino is an aminopropylsilane that offers reproducible retention and efficiency. It is a great choice for the normal-phase or HILIC analysis of simple sugars.

Column Characteristics:

particle size:	3 µm or 5 µm, spherical
pore size:	100 Å
carbon load:	2%
end-cap:	no
pH range:	2.5 to 8
temperature limit:	80 °C
USP phase code:	L8
phase category:	amino
ligand type:	aminopropylsilane



Amino

Length	3.0 mm ID cat.#	4.6 mm ID cat.#
3 µm Columns		
30 mm	910733E	9107335
50 mm	910735E	9107355
100 mm	910731E	9107315
150 mm	910736E	9107365
5 µm Columns		
30 mm	910753E	9107535
50 mm	910755E	9107555
100 mm	910751E	9107515
150 mm	910756E	9107565
200 mm	910752E	9107525
250 mm	910757E	9107575

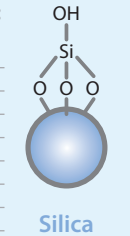
Ultra Silica Columns (USP L3)

Chromatographic Properties

Base-deactivated spherical silica is useful for normal-phase or HILIC separations.

Column Characteristics:

particle size:	3 µm or 5 µm, spherical
pore size:	100 Å
end-cap:	no
pH range:	2.5 to 8
temperature limit:	80 °C
USP phase code:	L3
phase category:	bare silica
ligand type:	none



Silica

Length	2.1 mm ID cat.#	3.0 mm ID cat.#	4.6 mm ID cat.#
3 µm Columns			
30 mm	9100332	910033E	9100335
50 mm	9100352	910035E	9100355
100 mm	9100312	910031E	9100315
150 mm	9100362	910036E	9100365
5 µm Columns			
30 mm	9100532	910053E	9100535
50 mm	9100552	910055E	9100555
100 mm	9100512	910051E	9100515
150 mm	9100562	910056E	9100565
200 mm	9100522	910052E	9100525
250 mm	9100572	910057E	9100575

Viva HPLC Columns: 3 or 5 µm particles; 300 Å pore size

Restek-manufactured silica

- Excellent for separating peptides or proteins.
- Rugged, spherical particles with 300 Å pore size.
- High proportion of pore/surface area available to large molecules.

Viva columns are based on a wide pore material we designed for optimal large-molecule separations. In developing Viva silica, we found that although many commercial wide-pore silicas meet the standard 300 Å mean pore size, most have very broad distributions about this mean, with a significant portion of their pore volume falling below 150 Å. This means a large portion of the surface area is unavailable to larger molecules. Viva columns have a narrow distribution around the mean pore size, permitting a larger portion of the silica surface to play a role in the separation.

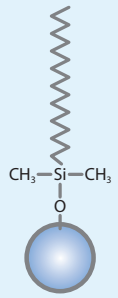
Viva C18 Columns (USP L1)

Restek-manufactured silica

Chromatographic Properties

The general-purpose Restek® C18 is a conventional monomeric octadecylsilane column suitable for analyses of a wide range of compounds from acidic through slightly basic.

Length	1.0 mm ID cat.#	2.1 mm ID cat.#	3.0 mm ID cat.#	4.6 mm ID cat.#
3 µm Columns				
30 mm	9514331	9514332	951433E	9514335
50 mm	9514351	9514352	951435E	9514355
100 mm	9514311	9514312	951431E	9514315
150 mm	9514361	9514362	951436E	9514365
5 µm Columns				
30 mm	9514531	9514532	951453E	9514535
50 mm	9514551	9514552	951455E	9514555
100 mm	9514511	9514512	951451E	9514515
150 mm	9514561	9514562	951456E	9514565
200 mm	9514521	9514522	951452E	9514525
250 mm	9514571	9514572	951457E	9514575



C18

Column Characteristics:

particle size:	3 µm or 5 µm, spherical
pore size:	300 Å
carbon load:	9%
end-cap:	yes
pH range:	2.5 to 8
temperature limit:	80 °C
USP phase code:	L1
phase category:	C18, octadecylsilane
ligand type:	monomeric C18

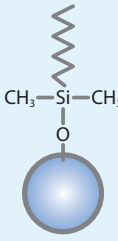
Viva C8 Columns (USP L7)

Restek-manufactured silica

Chromatographic Properties

Our C8 is a conventional monomeric octylsilane column offering a shorter alkyl chain to provide less hydrophobic retention and improved basic peak shape over a traditional C18 phase. Like our C18, this general-purpose Restek® C8 is suitable for a wide range of compounds from acidic through slightly basic.

Length	1.0 mm ID cat.#	2.1 mm ID cat.#	3.0 mm ID cat.#	4.6 mm ID cat.#
5 µm Columns				
30 mm	9513531	9513532	951353E	9513535
50 mm	9513551	9513552	951355E	9513555
100 mm	9513511	9513512	951351E	9513515
150 mm	9513561	9513562	951356E	9513565
200 mm	9513521	9513522	951352E	9513525
250 mm	9513571	9513572	951357E	9513575



C8

Column Characteristics:

particle size:	5 µm, spherical
pore size:	300 Å
carbon load:	5%
end-cap:	yes
pH range:	2.5 to 8
temperature limit:	80 °C
USP phase code:	L7
phase category:	C8, octylsilane
ligand type:	monomeric C8

Viva C4 Columns (USP L26)

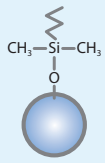
Restek-manufactured silica

Chromatographic Properties

Base-deactivated, wide-pore packing exhibits excellent peak shape for a wide range of compounds. Less retention in reversed-phase assays than Viva C18 or Viva C8.

Column Characteristics:

particle size:	5 µm, spherical
pore size:	300 Å
carbon load:	3.5%
end-cap:	yes
pH range:	2.5 to 8
temperature limit:	80 °C
USP phase code:	L26
phase category:	C4, butylsilane
ligand type:	monomeric C4



C4

Length	1.0 mm ID cat.#	2.1 mm ID cat.#	3.0 mm ID cat.#	4.6 mm ID cat.#
5 µm Columns				
30 mm	9512531	9512532	951253E	9512535
50 mm	9512551	9512552	951255E	9512555
100 mm	9512511	9512512	951251E	9512515
150 mm	9512561	9512562	951256E	9512565
200 mm	9512521	9512522	951252E	9512525
250 mm	9512571	9512572	951257E	9512575

Viva Biphenyl Columns (USP L11)

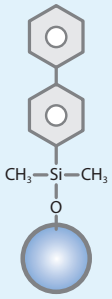
Restek-manufactured silica

Chromatographic Properties

Since 2005, the Restek® Biphenyl has offered a greater degree of dispersion than conventional phenyls and a greater degree of polarizability than phenyl hexyls, creating higher selectivity and a greater range of usability. Because of these heightened interactions, this column shows substantial increases in retention—especially for dipolar, unsaturated, or conjugated solutes—and enhanced orthogonal selectivity when using methanol mobile phases. It is ideal for increasing sensitivity and selectivity in LC-MS analyses.

Column Characteristics:

particle size:	5 µm, spherical
pore size:	300 Å
carbon load:	7%
end-cap:	yes
pH range:	2.5 to 8
temperature limit:	80 °C
USP phase:	L11
phase category:	phenyl
ligand type:	unique Biphenyl



Biphenyl

Length	1.0 mm ID cat.#	2.1 mm ID cat.#	3.0 mm ID cat.#	4.6 mm ID cat.#
5 µm Columns				
30 mm	9516531	9516532	951653E	9516535
50 mm	9516551	9516552	951655E	9516555
100 mm	9516511	9516512	951651E	9516515
150 mm	9516561	9516562	951656E	9516565
200 mm	9516521	9516522	951652E	9516525
250 mm	9516571	9516572	951657E	9516575

Viva PFP Propyl Columns (USP L43)

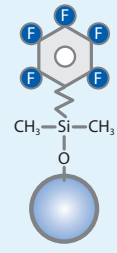
Restek-manufactured silica

Chromatographic Properties

The Restek® PFP Propyl is a great choice for the retention and selectivity of charged bases, electronegative compounds, and amine-containing compounds. Unlike a conventional cyano column, the Restek® PFP Propyl is much more amenable to LC-MS because it is more reliable and efficient with acidic mobile phases. This versatile column is also compatible with highly aqueous mobile phases and HILIC separations.

Column Characteristics:

particle size:	5 µm, spherical
pore size:	300 Å
carbon load:	5%
end-cap:	yes
pH range:	2.5 to 8
temperature limit:	80 °C
USP phase code:	L43
phase category:	fluorophenyl propyl
ligand type:	pentafluorophenyl propyl



PFP Propyl

Length	1.0 mm ID cat.#	2.1 mm ID cat.#	3.0 mm ID cat.#	4.6 mm ID cat.#
5 µm Columns				
30 mm	9519531	9519532	951953E	9519535
50 mm	9519551	9519552	951955E	9519555
100 mm	9519511	9519512	951951E	9519515
150 mm	9519561	9519562	951956E	9519565
200 mm	9519521	9519522	951952E	9519525
250 mm	9519571	9519572	951957E	9519575

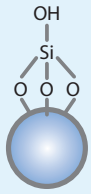
Viva Silica Columns (USP L3)

Restek-manufactured silica

Chromatographic Properties

Base-deactivated spherical silica is useful for normal-phase or HILIC separations.

Length	1.0 mm ID cat.#	2.1 mm ID cat.#	3.0 mm ID cat.#	4.6 mm ID cat.#
5 µm Columns				
30 mm	9510531	9510532	951053E	9510535
50 mm	9510551	9510552	951055E	9510555
100 mm	9510511	9510512	951051E	9510515
150 mm	9510561	9510562	951056E	9510565
200 mm	9510521	9510522	951052E	9510525
250 mm	9510571	9510572	951057E	9510575



Silica

Column Characteristics:

particle size:	5 µm, spherical
pore size:	300 Å
pH range:	2.5 to 8
temperature limit:	80 °C
USP phase code:	L3
phase category:	bare silica
ligand type:	none

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