

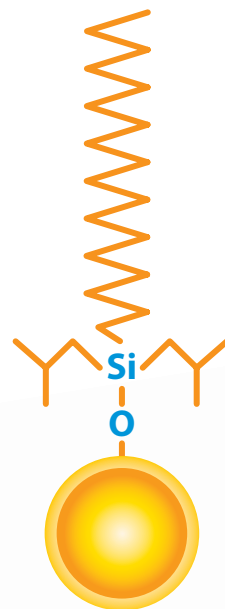
Raptor

LC Columns

Selectivity Accelerated

Ahead of the Curve for Large,
Multiclass Lists by Mass Spec

Stationary Phase: **ARC-18**



RESTEK

Pure Chromatography

www.restek.com/raptor

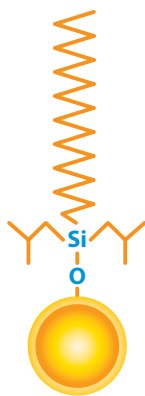
The Raptor ARC-18 Column

With Raptor LC columns, Restek chemists became the first to combine the speed of 2.7 and 5 μm superficially porous particles (also known as SPP or “core-shell” particles) with the resolution of highly selective USLC technology, improving separations and speeding up analysis times with standard HPLC instruments. Raptor then evolved to bring that same improved speed, efficiency, and selectivity to UHPLC analyses by offering 1.8 μm particle columns. Learn more about Raptor LC columns at www.restek.com/raptor

The birth of Restek’s Raptor SPP LC column line began with the innovative Biphenyl phase, but it quickly grew to include a new Restek phase: the ARC-18. Designed and intended specifically for use on LC-MS/MS systems, the Raptor ARC-18 column features 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*.

Column Description:



Stationary Phase Category:

C18, octadecylsilane (L1)

Ligand Type:

Sterically protected C18

Particle:

1.8 μm , 2.7 μm , or 5 μm superficially porous silica (SPP or “core-shell”)

Pore Size:

90 Å

Surface Area:

125 m^2/g (1.8 μm),
130 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: 1,034 bar/15,000 psi* (1.8 μm),
600 bar/8,700 psi (2.7 μm); 400 bar/5,800 psi (5 μm)

* For maximum lifetime, recommended maximum pressure for 1.8 μm particles is 830 bar/12,000 psi.

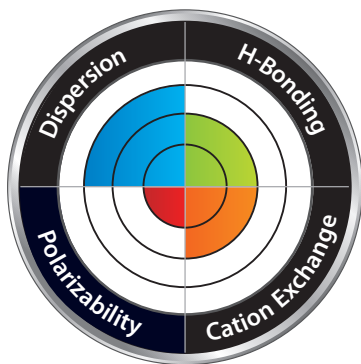
Properties:

- Well-balanced retention profile.
- Sterically protected 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.
- You require strongly acidic (pH 1–3) mobile phases.

Column Interaction Profile:



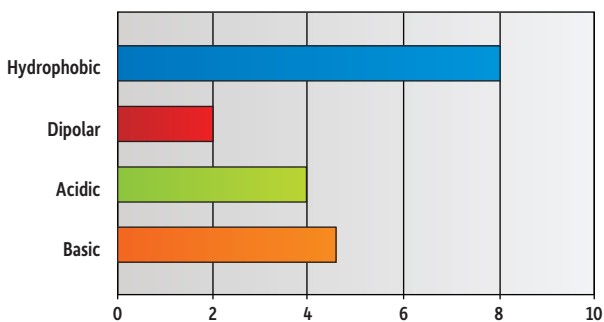
Defining Solute Interaction:

- Dispersion

Complementary Solute Interactions:

- Hydrogen bonding
- Cation exchange

Solute Retention Profile:



Target Analyte Structure:

- Hydrocarbons

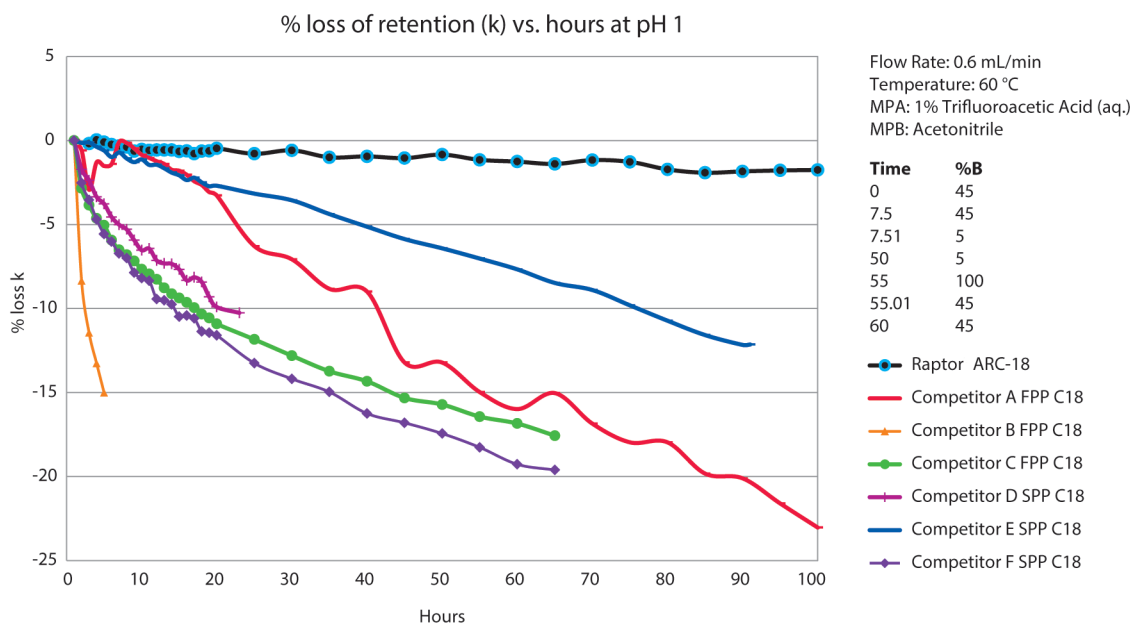
Target Analyte Functionalities:

- Hydrophobic compounds
- Protonated bases

A Proprietary Bonded Phase Born for LC-MS/MS

The Raptor ARC-18 column was designed to stand up to even the harshest acidic MS conditions. It utilizes a proprietary bonding procedure that arranges our sterically protected ligand to resist acid hydrolysis, which reduces phase degradation and bleed. This cutting-edge column lets you increase ionization efficiency and boost sensitivity in your mass spec by using low-pH mobile phases—without the fear of retention drift over time. ARC-18 columns maintain a stable retention profile (Figure 1) in mobile phases well under pH 2.0.

Figure 1: Steric protection helps the Raptor ARC-18 column endure low-pH MS mobile phases without sacrificing retention.



The Standard for Reproducibility for SPP Core-Shell Columns

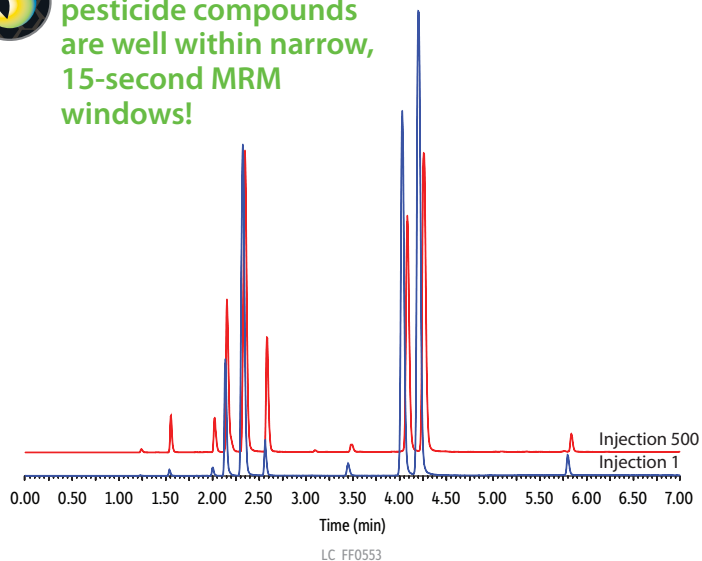
To keep your productivity high and your lab expenses low, Raptor ARC-18 columns must produce exceptional selectivity and fast analysis times not just once, but every time. Ruggedness and repeatability are essential, which is why from the silica and the bonding technique, to the packing process and upgraded hardware, every decision that went into creating this column was made to ensure superlative reproducibility, from injection to injection (Figure 2) and from lot to lot (Figure 3). We also adopted new quality control (QC) specifications to guarantee the retention time stability you need for worry-free analyses.

One of the greatest advantages of an SPP column is the ability to operate at higher linear velocities without losing efficiency as you would with a conventional fully porous particle column. But, these higher velocities can also generate higher backpressures that rob you of performance. Like all Raptor columns, our ARC-18 can handle increased pressures and handle them longer than other manufacturers' SPP columns, to help you achieve *Selectivity Accelerated* while offering outstanding reproducibility and maintaining efficiency—even in aggressive MS conditions.

Figure 2: Even after hundreds of injections with a highly acidic mobile phase like 0.2% formic acid, a Raptor ARC-18 column will provide consistent, reliable data.



After 500 injections, pesticide compounds are well within narrow, 15-second MRM windows!



Column: Raptor ARC-18 (cat.# 9314A12); Dimensions: 100 mm x 2.1 mm ID; Particle Size: 2.7 µm; Temp.: 50 °C; **Sample:** LC multiresidue pesticide standard #1 (cat.# 31972); Diluent: Water; Conc.: 20 ng/mL; Inj. Vol.: 5 µL; **Mobile Phase:** A: Water + 2 mM ammonium formate + 0.2% formic acid, B: Methanol + 2 mM ammonium formate + 0.2% formic acid; **Gradient (%B):** 0.00 min (5%), 2.00 min (60%), 4.00 min (75%), 6.00 min (100%), 7.00 (100%), 7.01 min (5%), 9.50 (5%); **Flow:** 0.4 mL/min; **Detector:** Waters Xevo TQ-S; Ion Source: Waters Zspray ESI; Ion Mode: ESI+; Mode: MRM; **Instrument:** Waters ACQUITY UPLC I-Class.

Figure 3: From one lot to the next, every Raptor ARC-18 column you purchase will perform the same.



Excellent lot-to-lot reproducibility helps ensure longevity for critical workflows.

Column: Raptor ARC-18 (cat.# 9314A12); Dimensions: 100 mm x 2.1 mm ID; Particle Size: 2.7 µm; Temp.: 50 °C; **Sample:** LC multiresidue pesticide standard #1 (cat.# 31972); Diluent: Water; Conc.: 20 ng/mL; Inj. Vol.: 5 µL; **Mobile Phase:** A: Water + 2 mM ammonium formate + 0.2% formic acid, B: Methanol + 2 mM ammonium formate + 0.2% formic acid; Max Pressure: 525 bar; **Gradient (%B):** 0.00 min (5%), 2.00 min (60%), 4.00 min (75%), 6.00 min (100%), 7.00 (100%), 7.01 min (5%), 9.50 (5%); **Flow:** 0.4 mL/min; **Detector:** Waters Xevo TQ-S; Ion Source: Waters Zspray ESI; Ion Mode: ESI+; Mode: MRM; **Instrument:** Waters ACQUITY UPLC I-Class.

Well-Balanced Retention to Quickly Separate Large, Multiclass Analyte Lists

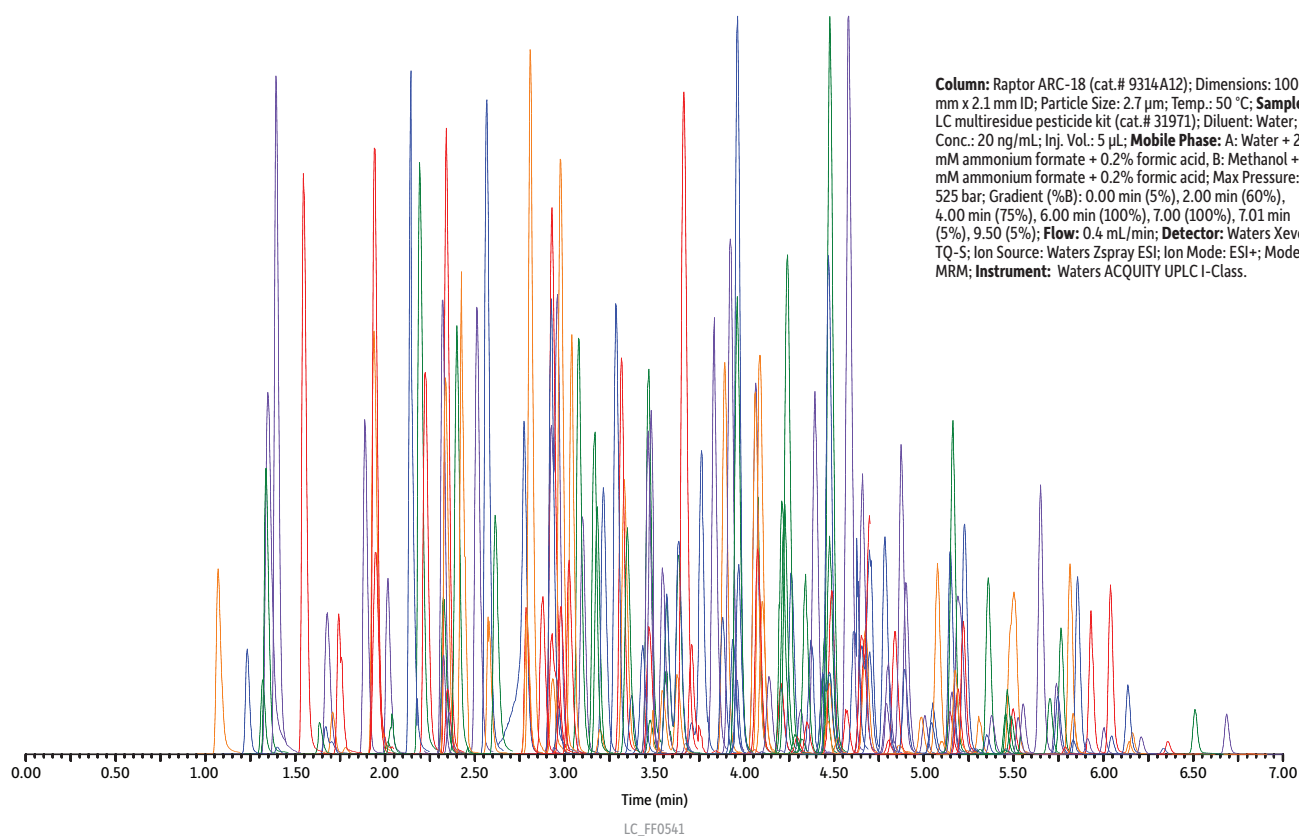
In order to analyze large lists of compounds, especially across multiple classes, your column must be capable of spreading analytes out over the gradient to ensure accurate detector response and quantitation. In designing the Raptor ARC-18 column, we adjusted our bonding procedures to form an ideal ligand density that offers balanced retention for the rapid analysis of large, multiclass assays. As shown in Figure 4, even a 204-compound pesticide screen can be reliably completed in just 9.5 minutes. The Raptor ARC-18 column exhibits the balanced retention, selectivity, and performance needed for critical multiclass workflows in any industry or lab.

Figure 4: With its balanced retention profile, the Raptor ARC-18 column is ideally suited to analyze large, cross-class compound lists.



**204 pesticides in just
9.5 minutes!**

For a complete compound list, visit www.restek.com/multiresidue select the LC Multiresidue Pesticide Kit (cat.# 31971).

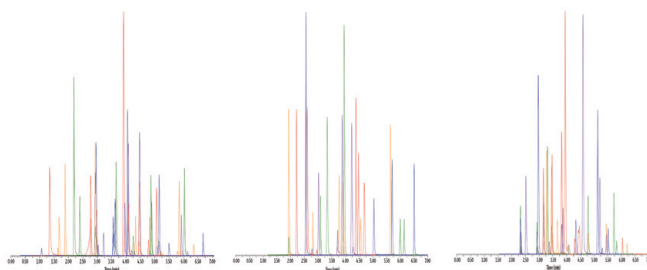


Column: Raptor ARC-18 (cat.# 9314A12); Dimensions: 100 mm x 2.1 mm ID; Particle Size: 2.7 μ m; Temp.: 50 °C; **Sample:** LC multiresidue pesticide kit (cat.# 31971); Diluent: Water; Conc.: 20 ng/mL; Inj. Vol.: 5 μ L; **Mobile Phase:** A: Water + 2 mM ammonium formate + 0.2% formic acid; B: Methanol + 2 mM ammonium formate + 0.2% formic acid; Max Pressure: 525 bar; Gradient (%B): 0.00 min (5%), 2.00 min (60%), 4.00 min (75%), 6.00 min (100%), 7.00 min (100%), 7.01 min (5%), 9.50 min (5%); **Flow:** 0.4 mL/min; **Detector:** Waters Xevo TQ-S; Ion Source: Waters Zspray ESI; Ion Mode: ESI+; Mode: MRM; **Instrument:** Waters ACQUITY UPLC I-Class.

Note:

When combining a large number of compounds with different chemical functionalities, mix stability can be an issue. In formulating our LC multiresidue pesticide standard kit (cat.# 31971), we extensively studied the 204 compounds involved, then grouped them into as few mixes as possible while still ensuring maximum long-term stability and reliability. For quantitative analysis, we recommend analyzing each mix separately to ensure accurate results for every compound.

To view separate chromatograms of each mix, visit www.restek.com/multiresidue



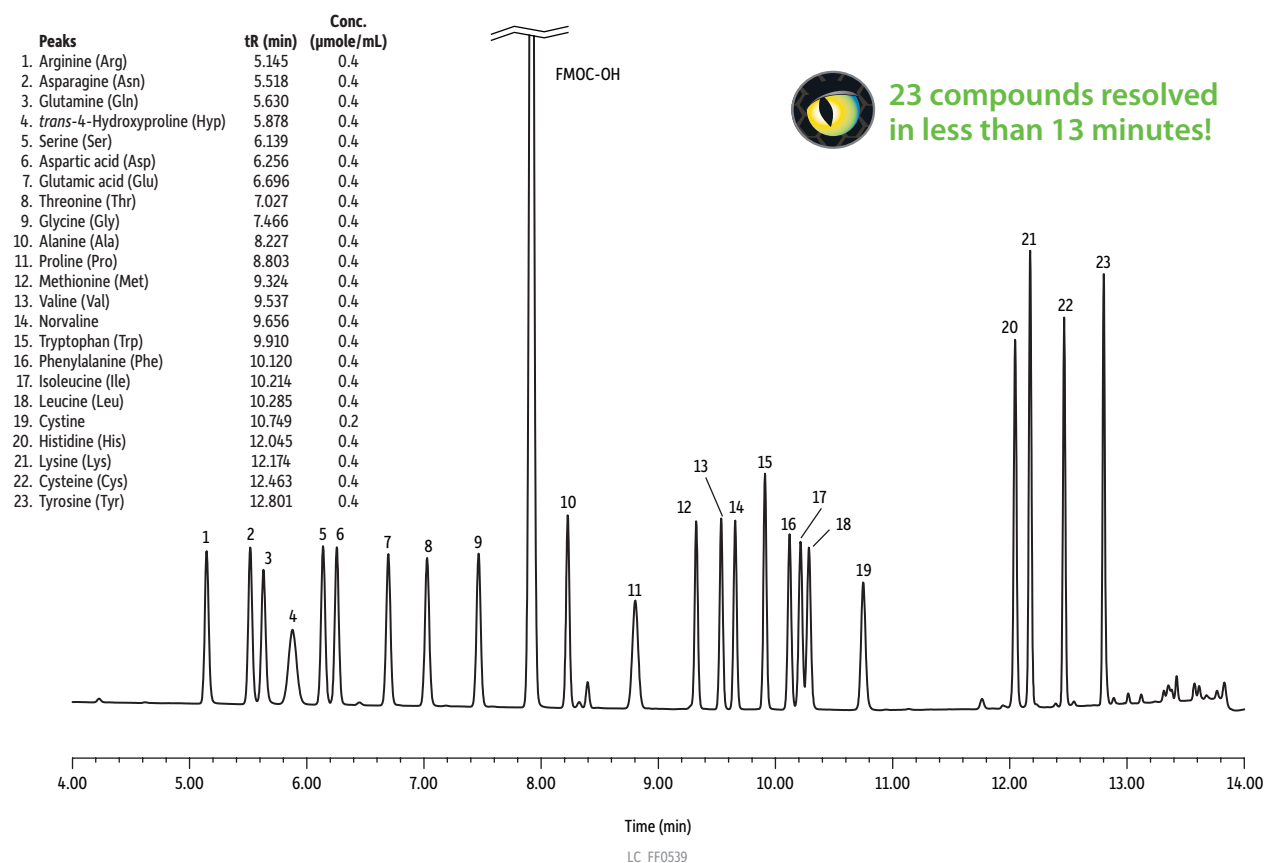
Speed Up Challenging Analyses with Simple Mobile Phases and Methods

From food safety to bioanalytical work, whether you use traditional HPLC or UHPLC instruments, we're all looking to simplify setup while still getting reliable, reproducible data. Instead of wasting time and resources—and making your job harder in the process—you can greatly improve your productivity by selecting a better column for your existing instrumentation. By switching to a Raptor ARC-18 column for your LC-MS/MS analyses, you can increase your sample throughput and make your job easier by maintaining, or even improving, your data quality using simple mobile phases and method conditions on your existing instrumentation. Put the ARC-18 to work in your lab today to experience *Selectivity Accelerated!*

Amino Acids with Standard Columns on UV or Mass Spec

Instead of purchasing specialty amino acid columns or dedicated analyzers, use Raptor ARC-18 columns with your standard HPLC and UV detector to perform routine analyses of 23 common amino acids. Using 9-fluorenylmethyl-chloroformate (FMOC) derivatization and simple mobile phases, you can separate, detect, and quantitate amino acids without specialty instrumentation (Figure 5). Because of the ARC-18's compatibility with MS-friendly mobile phases, these UV methods can also be easily transferred to your mass spectrometer. And, since it is a Raptor column, it will hold up to extended use without losing selectivity or performance.

Figure 5: Raptor ARC-18 columns exhibit excellent retention and resolution of amino acids derivatized with FMOC, including isomers leucine and isoleucine.



Column: Raptor ARC-18 (cat.# 9314A1E); Dimensions: 100 mm x 3 mm ID; Particle Size: 2.7 µm; Temp.: 30 °C; **Sample:** Diluent: 0.1 N HCl; Conc.: 0.4 µmole/mL for each amino acid (0.2 µmole/mL for cystine); Inj. Vol.: 1 µL; **Mobile Phase:** A: 0.1% Formic acid + 20 mM ammonium formate in water, B: 0.1% Formic acid + 10 mM ammonium formate in 90:10 acetonitrile:water; **Gradient (%B):** 0.00 min (20%), 6.25 min (40%), 9.00 min (60%), 10.00 min (60%), 13.00 (100%), 13.01 min (20%), 15.00 (20%); **Flow:** 0.8 mL/min; **Detector:** UV/Vis @ 265, 4.8 nm; **Instrument:** Waters ACQUITY UPLC H-Class; **Notes:** Derivatization reaction: 50 µL amino acid mix + 100 µL 0.2 N borate buffer (pH 10.0) + 50 µL 15 mM 9-fluorenylmethyl-chloroformate solution + 50 µL acetonitrile; the injection can be performed after 5 minutes of reaction time.

Fat-Soluble Vitamins with Accelerated Run Times

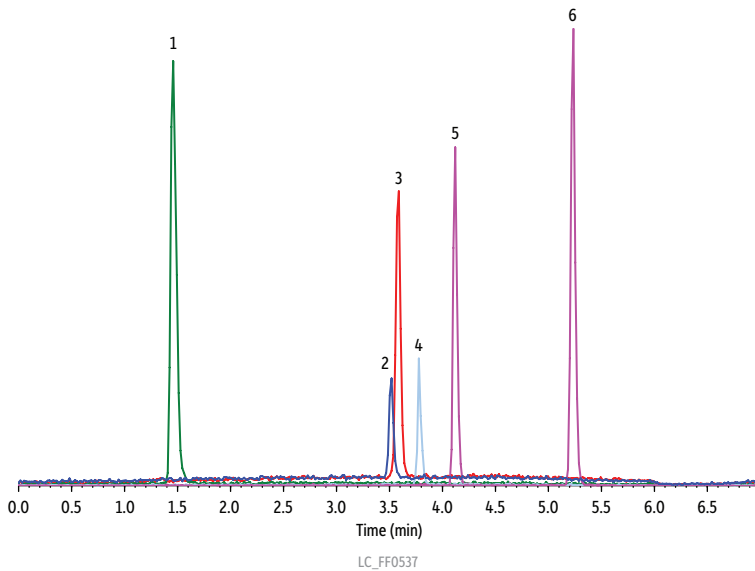
Separating fat-soluble vitamins by LC can be time-consuming. The Raptor ARC-18 column, however, can analyze these difficult compounds using reversed-phased chromatography (RPC) in less time than traditional columns to increase productivity. The ARC-18 also stands up to the low-pH, MS-friendly mobile phases that promote ionization and fast separation while providing the balanced retention profile necessary for this important food safety workflow (Figure 6).

Toxic Substances in Agricultural Matrices Using LC

When it comes to analyzing toxic substances in agricultural matrices (e.g., aflatoxins in wheat), speed is of paramount importance. A Raptor ARC-18 column retains *and* separates these compounds with simple mobile phases—in a rapid time frame that maximizes your productivity (Figure 7).

Figure 6: The ARC-18 makes quick work of fat-soluble vitamins A, D, E, and K by LC-MS/MS

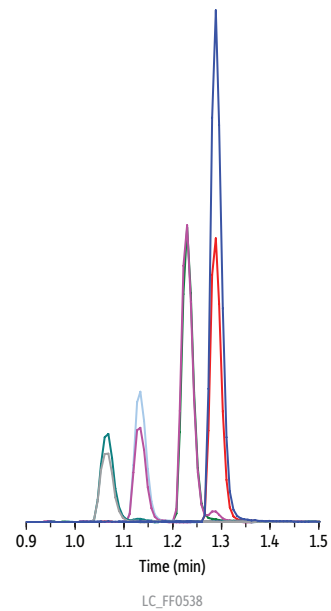
Peaks	t _R (min)	Precursor Ion	Product Ion											
1. Retinol	1.46	269.4	93.3											
2. Vitamin D2	3.52	397.5	379.6											
3. Vitamin D3	3.58	367.5	4. γ -Tocopherol	3.78	417.6	151.4	5. α -Tocopherol	4.12	431.7	165.4	6. Vitamin K1	5.23	451.4	187.3
4. γ -Tocopherol	3.78	417.6	151.4											
5. α -Tocopherol	4.12	431.7	165.4											
6. Vitamin K1	5.23	451.4	187.3											



Column: Raptor ARC-18 (cat.# 9314A12); Dimensions: 100 mm x 2.1 mm ID; Particle Size: 2.7 μ m; Temp.: 40 $^{\circ}$ C;
Sample: Diluent: Methanol; Conc.: 100 ng/mL; Inj. Vol.: 5 μ L; **Mobile Phase:** A: 0.1% Formic acid + 5 mM ammonium formate in water, B: 0.1% Formic acid + 5 mM ammonium formate in methanol; Max Pressure: 190 bar; **Gradient (%B):** 0.00 min (90%), 4.0 min (100%), 5.0 min (100%), 5.01 min (90%), 7.0 (90%); **Flow:** 0.5 mL/min; **Detector:** AB SCIEX API 4000; Ion Source: TurbolonSpray; Ion Mode: ESI+; Mode: MRM; **Instrument:** Shimadzu UFLCxR.

Figure 7: The ARC-18 elutes four common aflatoxins in under 1.5 minutes with an overall cycle time of 2.5 minutes!

Peaks	t _R (min)	Q1	Q3 Quantifier	Q3 Qualifier
1. Aflatoxin G2	1.07	331.1	245.1	189.1
2. Aflatoxin G1	1.13	329.0	243.1	200.1
3. Aflatoxin B2	1.23	315.0	259.1	287.1
4. Aflatoxin B1	1.29	313.0	285.1	241.1



Column: Raptor ARC-18 (cat.# 9314A5E); Dimensions: 50 mm x 3.0 mm ID; Particle Size: 2.7 μ m; Temp.: 45 $^{\circ}$ C; **Sample:** Diluent: Acetonitrile:water (50:50); Conc.: 100 ng/mL; Inj. Vol.: 10 μ L; **Mobile Phase:** A: 5 mM Ammonium formate + 0.1% formic acid in water; B: 0.1% Formic acid in methanol; **Gradient (%B):** 0.00 min (35%), 1.50 min (95%), 1.51 min (35%), 2.50 (35%); **Flow:** 0.700 mL/min; **Detector:** Applied Biosystems/MDS Sciex LC-MS/MS; Ion Source: TurbolonSpray; Ion Mode: ESI+; **Instrument:** Shimadzu UFLCxR.

For Consistent Retention, Peak Shape, and Response with Mass Spec, Grab the Column that Thrives in Low pH Conditions

Raptor ARC-18 LC Columns



Length	2.1 mm cat.#	3.0 mm cat.#	4.6 mm cat.#
1.8 µm Columns			
30 mm	9314232	—	—
50 mm	9314252	931425E	—
100 mm	9314212	931421E	—
150 mm	9314262	—	—
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

EXP Reusable Fittings for HPLC & UHPLC for 10-32 fittings and 1/16" tubing

Effortlessly achieve 8,700+ psi HPLC seals by hand! (Wrench tighten to 20,000+ psi.) Hybrid titanium/PEEK seal can be installed repeatedly without compromising your seal.

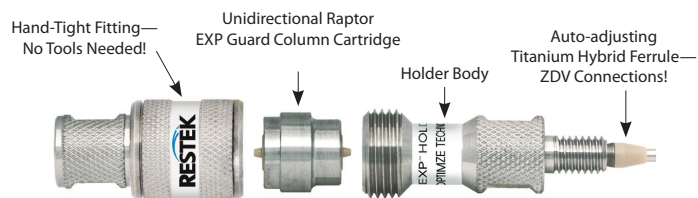


Description	qty.	cat.#
EXP Hand-Tight Fitting (Nut w/Ferrule)	ea.	25937
EXP Hand-Tight Fitting (Nut w/Ferrule)	10-pk.	25938
EXP Hand-Tight Nut (w/o Ferrule)	ea.	25939

Hybrid Ferrule U.S. Patent No. 8201854, EXP Holders U.S. Patent No. 8696902, EXP2 Wrench U.S. Patent No. D766055. Other U.S. and Foreign Patents Pending. The EXP, Free-Turn, and the Opti- prefix are registered trademarks of Optimize Technologies, Inc.

Experience *Selectivity Accelerated*.
Order the Raptor ARC-18 today at
www.restek.com/raptor

Raptor EXP Guard Cartridges—for All Raptor Columns



Protect your investment, extend the life of our already-rugged LC columns, and change guard column cartridges by hand without breaking fluid connections—no tools needed! Great with any Raptor column to get ultimate protection from particulates and matrix contamination, especially when using dilute-and-shoot or other minimal sample preparation techniques.

EXP Direct Connect Holder

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)

Raptor EXP Guard Column Cartridges

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	UHPLC	3-pk.	9314U0252	9314U0253	
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

1,034 bar/15,000 psi* (UHPLC), 600 bar/8,700 psi (2.7 µm); 400 bar/5,800 psi (5 µm).

* For maximum lifetime, recommended maximum pressure for 1.8 µm particles is 830 bar/12,000 psi.

Raptor SPP LC columns combine the speed of SPP with the resolution of USLC technology.
Learn more at www.restek.com/raptor

UltraShield UHPLC PreColumn Filter—for 1.8 µm Raptor Columns

Pair 1.8 µm Raptor columns with an UltraShield filter instead of a guard cartridge to protect against particulates, minimize extra column volume, and maximize UHPLC sample throughput when using SPE, SLE, or other extensive sample preparations.



Description	Filter Porosity	qty.	cat.#
UltraShield UHPLC PreColumn Filter	0.2 µm frit	ea.	25809
		5-pk.	25810
		10-pk.	25811

Questions about this or any other Restek product?

Contact us or your local Restek representative (www.restek.com/contact-us).

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RESTEK
Pure Chromatography

www.restek.com



Lit. Cat.# GNBR1970D-UNV

Raptor

LC Columns

Selectivity Accelerated

Fast, Rugged Raptor Columns
with Time-Tested Selectivity

Stationary Phase:
Biphenyl



RESTEK

Pure Chromatography

www.restek.com/raptor

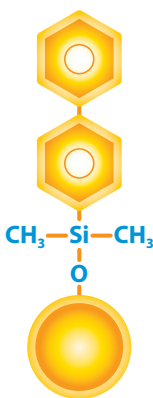
The Raptor Biphenyl Column

With Raptor LC columns, Restek chemists became the first to combine the speed of 2.7 and 5 μm superficially porous particles (also known as SPP or “core-shell” particles) with the resolution of highly selective USLC technology, improving separations and speeding up analysis times with standard HPLC instruments. Raptor then evolved to bring that same improved speed, efficiency, and selectivity to UHPLC analyses by offering 1.8 μm particle columns. Learn more about Raptor LC columns at www.restek.com/raptor

Our top priority when developing our SPP line was to create a version of our innovative Biphenyl. The industry-leading 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 such as 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.

In 2005, Restek was the first to bring you the benefits of the Biphenyl ligand, and we have the experience to maximize the SPP performance of this premier phenyl chemistry for today’s challenging workflows.

Column Description:



Stationary Phase Category:

Phenyl (L11)

Ligand Type:

Biphenyl

Particle:

1.8 μm , 2.7 μm , or 5 μm superficially porous silica (SPP or “core-shell”)

Pore Size:

90 Å

Surface Area:

125 m^2/g (1.8 μm),
130 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: 1,034 bar/15,000 psi* (1.8 μm),
600 bar/8,700 psi (2.7 μm); 400 bar/5,800 psi (5 μm)

* For maximum lifetime, recommended maximum pressure for 1.8 μm particles is 830 bar/12,000 psi.

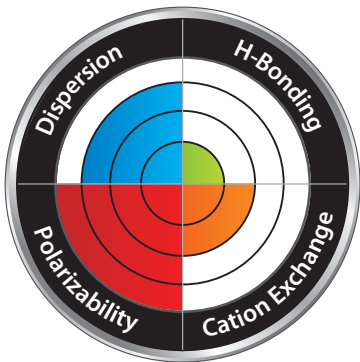
Properties:

- 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:

- You observe limited selectivity on a C18.
- You need to increase retention of hydrophilic aromatics.

Column Interaction Profile:



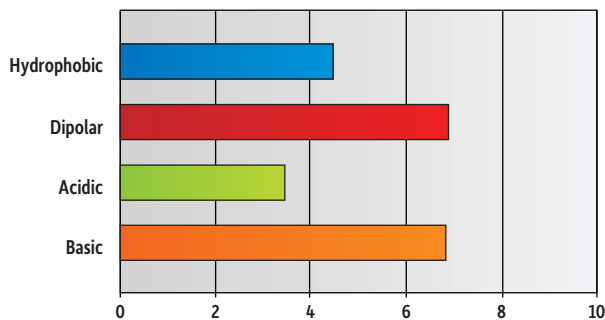
Defining Solute Interactions:

- Polarizability
- Dispersion

Complementary Solute Interaction:

- Cation exchange

Solute Retention Profile:



Target Analyte Structures:

- Aromatic
- Dipolar

Target Analyte Functionalities:

- Hydrophilic aromatics
- Strong dipoles
- Lewis acids
- Dipolar, unsaturated, or conjugated compounds
- Fused-ring compounds with electron withdrawing groups

More Aromatic Selectivity than Ordinary Phenyl-Hexyls

SPP core-shell columns commonly employ traditional phenyl-hexyl stationary phases, but the innovative Biphenyl ligand, developed by Restek's chemists, is the next generation of phenyl column chemistry. It provides greater aromatic selectivity than commercially available phenyl-hexyl columns [1] and a greater degree of dispersion than conventional phenyls. As a result, the Raptor Biphenyl allows you to more easily separate bioanalytical compounds such as aromatics (Figures 1 and 2), which elute early or are hard to separate on C18 or other phenyl chemistries.

[1] In-house testing based on: M.R. Euerby, P. Petersson, W. Campbell, W. Roe, Chromatographic classification and comparison of commercially available reversed-phase liquid chromatographic columns containing phenyl moieties using principal component analysis, J. Chromatogr. A 1154 (2007) 138–151.

Figure 1: Raptor Biphenyl columns exhibit the highest aromatic selectivity compared to other SPP phenyl columns.

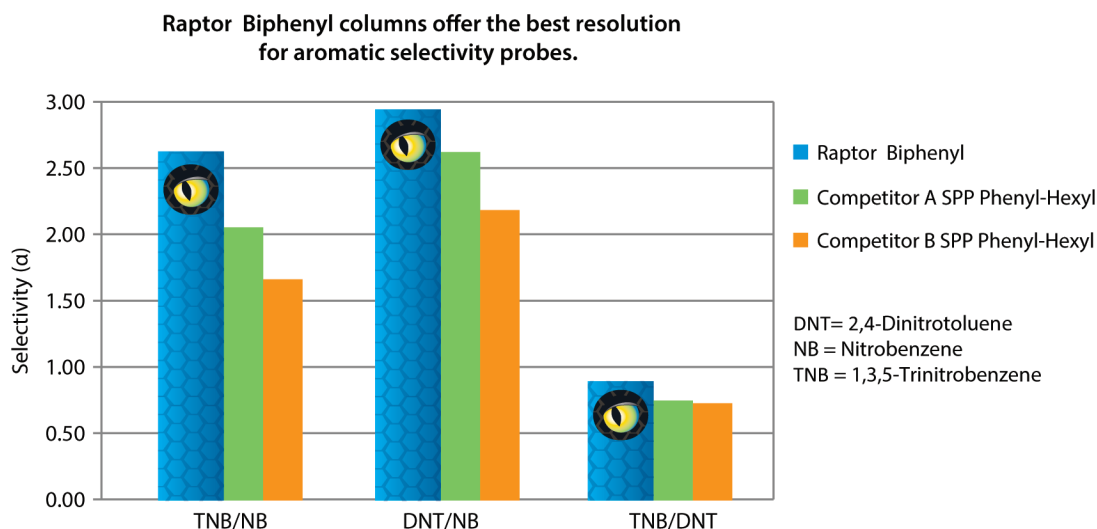
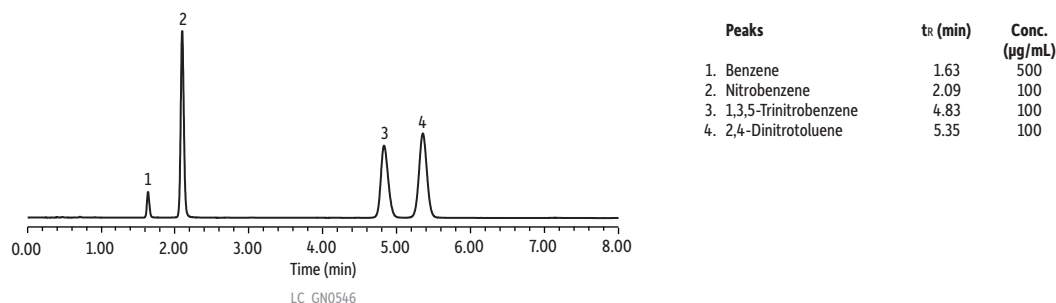


Figure 2: Raptor Biphenyl columns show increased retention for compounds containing electron withdrawing groups. Retention and elution order are dramatically different from a traditional C18.



Column: Raptor Biphenyl (cat.# 9309A55); Dimensions: 50 mm x 4.6 mm ID; Particle Size: 2.7 μm ; Pore Size: 90 Å; Temp.: 40 °C; **Sample:** Diluent: acetonitrile; Conc.: 100-500 $\mu\text{g/mL}$; Inj. Vol.: 1 μL **Mobile Phase:** water: methanol (50:50); Flow: 1.2 mL/min; **Detector:** Waters ACQUITY PDA @ 254 nm; **Instrument:** Waters ACQUITY UPLC H-Class.

The New Standard for Performance and Durability for SPP Core-Shell Columns

Pressure Stability:

One of the greatest advantages of an SPP column is the ability to achieve fast, efficient separations by operating at higher linear velocities than are possible with a conventional fully porous particle column. However, these higher velocities can also result in higher backpressures. Raptor columns were designed to handle the increased pressures needed to achieve *Selectivity Accelerated*, and handle it far better than other SPP columns on the market (Figure 3).

Reproducibility:

To help keep your productivity high and your lab budget low, we know that Raptor Biphenyl columns must produce exceptional selectivity and fast analysis times not just once, but every time. Ruggedness and repeatability are essential, which is why, from the silica and the bonding technique to the packing process and upgraded hardware, every decision that went into creating this column was made to ensure superlative reproducibility, from injection to injection (Figure 4) and from lot to lot (Figure 5), regardless of column dimension (Figure 6). We also adopted new quality control (QC) specifications to guarantee the retention time stability you need for worry-free MRM analyses.

Figure 4: Even after hundreds of injections, a Raptor Biphenyl column will provide consistent, reliable data.

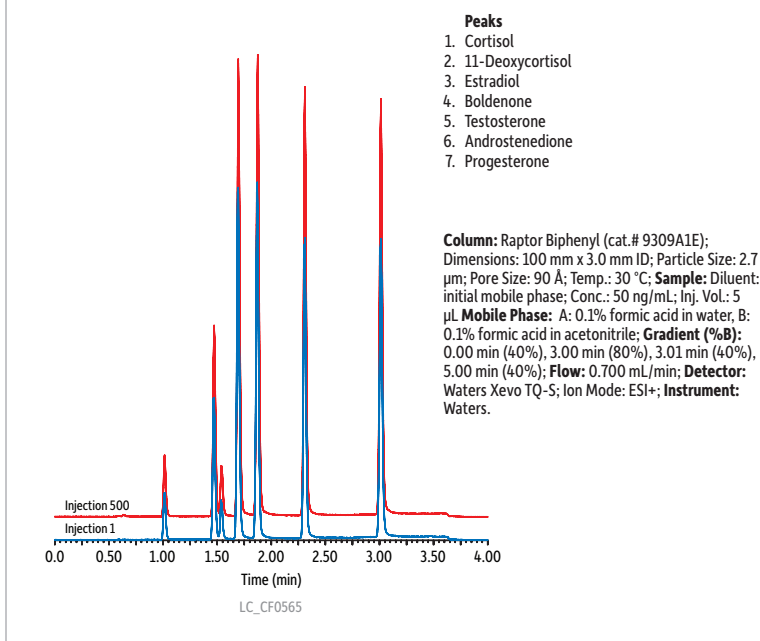


Figure 3: At high pressures, competitor phenyl-hexyl columns experience a quick and sharp drop-off in efficiency, but Raptor Biphenyl columns are unaffected to at least 3,000 injections.

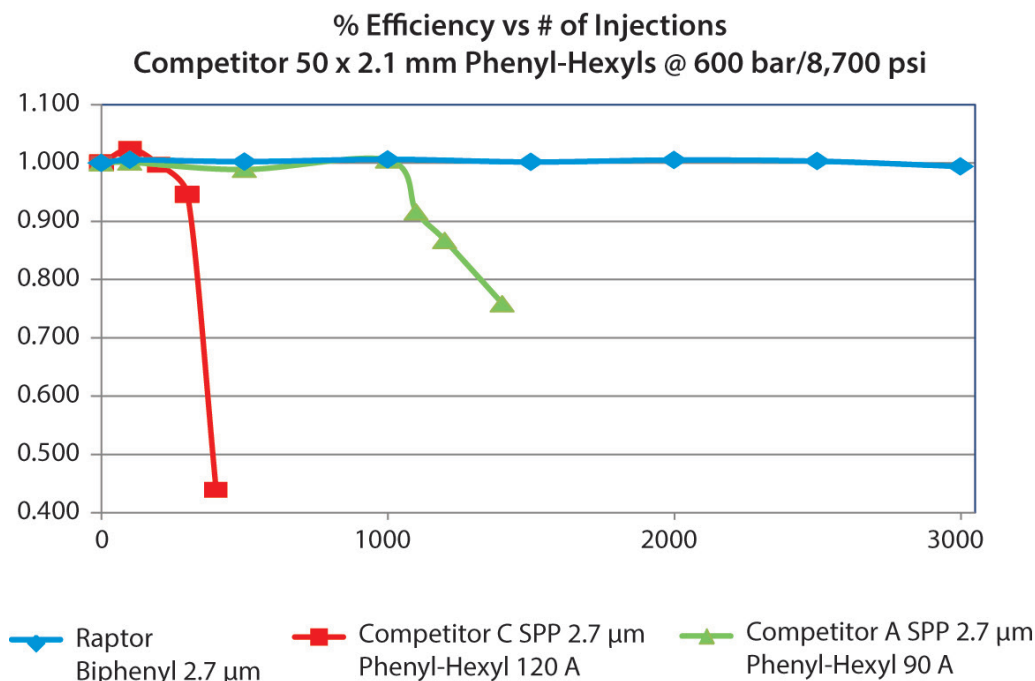
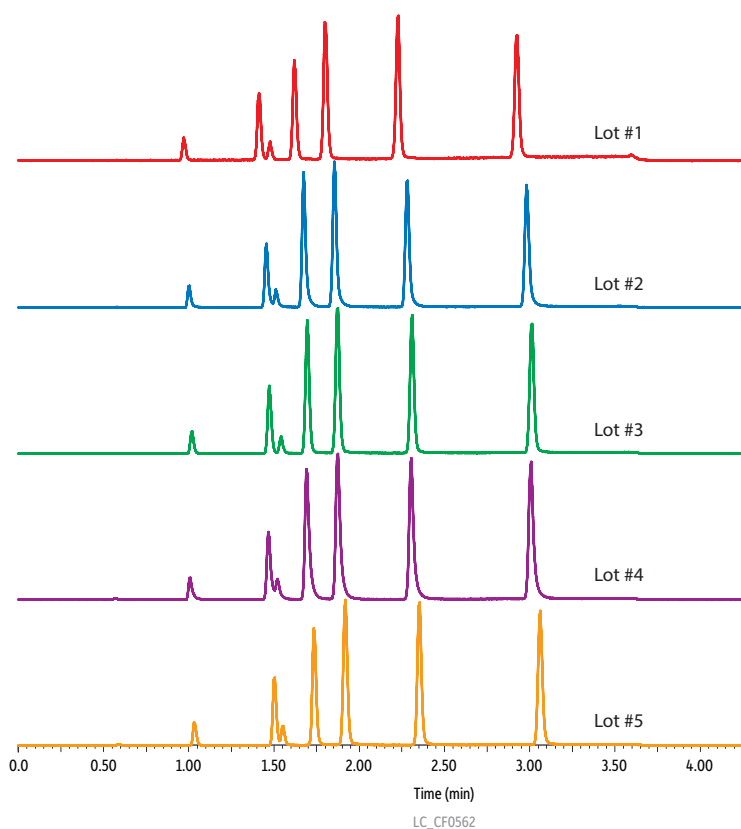


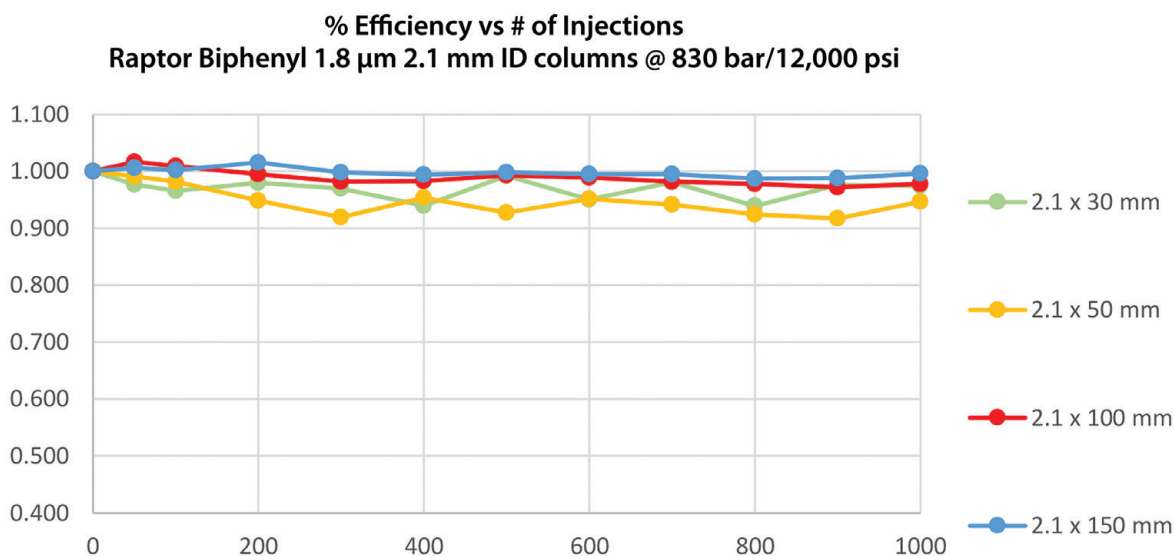
Figure 5: From one lot to the next, every Raptor Biphenyl column you purchase will perform the same.



- Peaks**
1. Cortisol
 2. 11-Deoxycortisol
 3. Estradiol
 4. Boldenone
 5. Testosterone
 6. Androstenedione
 7. Progesterone

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.

Figure 6: Regardless of the dimension, Raptor columns are rugged enough to last well past 1,000 injections, even in the high-pressure conditions of UHPLC.



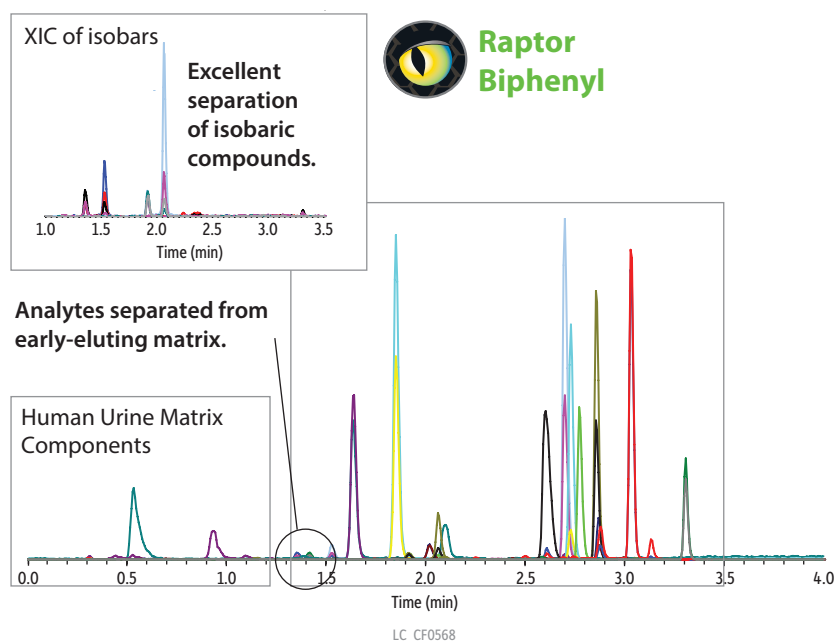
Clinically Proven to Optimize Your Bioanalytical Workflows

For over a decade, the Restek Biphenyl has been the column of choice for clinical testing because of its ability to provide highly retentive, selective, and rugged reversed-phase separations of drugs and metabolites. By bringing the speed of SPP to the Biphenyl family, the Raptor Biphenyl provides clinical labs with an even faster option for a wide variety of clinical assays.

Rugged Pain Panels from Urine in Under 3.5 Minutes

Pain panels can be difficult to optimize and reproduce due to the limited selectivity of C18 and phenyl-hexyl phases, but not on the Raptor Biphenyl. Complete your pain panel analysis with a 5-minute cycle time and complete isobaric resolution using Raptor Biphenyl columns (Figure 7). Popular competitor columns offer tailing peaks, longer run times, and coelutions; the Raptor Biphenyl exhibits the selectivity and performance needed for this critical analysis.

Figure 7: Raptor Biphenyl columns offer pain panel analyses with complete isobaric resolution in under 5 minutes!

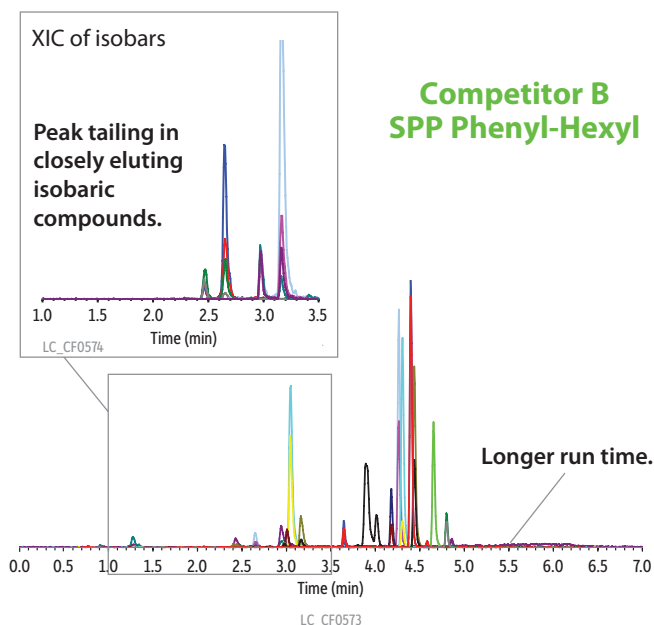


Peaks	tr (min)	Precursor ion	Product ion 1	Product ion 2
1. Morphine*	1.34	286.2	152.3	165.3
2. Oxycodone	1.40	302.1	227.3	198.2
3. Hydromorphone*	1.52	286.1	185.3	128.2
4. Amphetamine	1.62	136.0	91.3	119.2
5. Methamphetamine	1.84	150.0	91.2	119.3
6. Codeine*	1.91	300.2	165.4	153.2
7. Oxycodone	2.02	316.1	241.3	256.4
8. Hydrocodone*	2.06	300.1	199.3	128.3
9. Norbuprenorphine	2.59	414.1	83.4	101.0
10. Meprobamate	2.61	219.0	158.4	97.2
11. Fentanyl	2.70	337.2	188.4	105.2
12. Buprenorphine	2.70	468.3	396.4	414.5
13. Flurazepam	2.73	388.2	315.2	288.3
14. Sufentanil	2.77	387.2	238.5	111.3
15. Methadone	2.86	310.2	265.3	105.3
16. Carisoprodol	2.87	261.2	176.3	158.1
17. Lorazepam	3.03	321.0	275.4	303.1
18. Diazepam	3.31	285.1	193.2	153.9

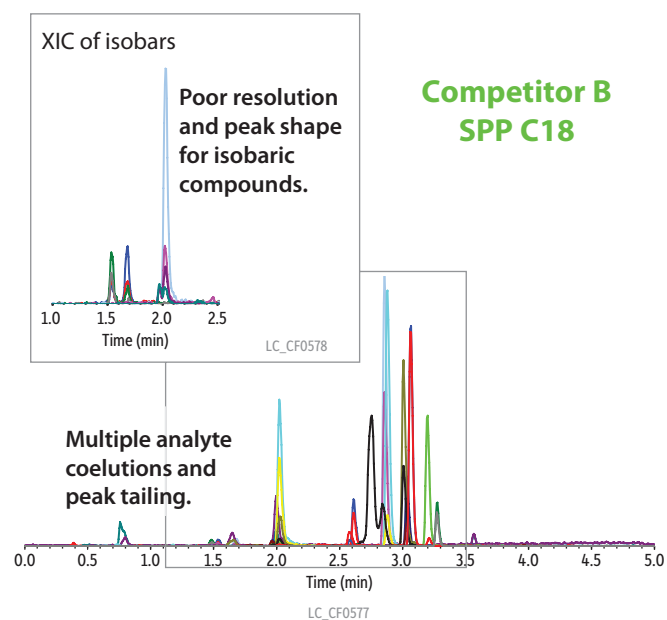
Column: Raptor Biphenyl (cat.# 9309A5E)
Dimensions: 50 mm x 3.0 mm ID
Particle Size: 2.7 µm
Pore Size: 90 Å
Temp.: 30 °C
Sample:
Diluent: urine:mobility phase A:mobility phase B (17:76:7)
Conc.: 10-100 ng/mL
Inj. Vol.: 10 µL
Mobile Phase:
A: 0.1% formic acid in water
B: 0.1% formic acid in methanol
Gradient (%B): 0.00 min (10%), 1.50 min (45%), 2.50 min (100%), 3.70 min (100%), 3.71 min (10%) 5.00 min (10%)
Flow: 0.6 mL/min
Detector: AB SCIEX API 4000 MS/MS
Ion Source: TurbolonSpray
Ion Mode: ESI+
Instrument: API LC-MS/MS
Notes: Lorazepam was prepared at 100 ng/mL; all other analytes are 10 ng/mL.

*An extracted ion chromatogram (XIC) of the isobars is presented in the inset.

Figure 7 (cont.)



Column: Competitor B SPP C18
Dimensions: 50 mm x 4.6 mm ID
Particle Size: 2.6 µm
Pore Size: 100 Å
Temp.: 22 °C
Sample:
Diluent: urine:mobility phase A:mobility phase B (17:76:7)
Conc.: 10-100 ng/mL
Inj. Vol.: 10 µL
Mobile Phase:
A: 10 mM ammonium formate in water
B: 0.1% formic acid in methanol
Gradient (%B): 0.00 min (5%), 4.00 min (100%), 5.00 min (100%), 5.10 min (5%), 7.00 min (5%)
Flow: 0.6 mL/min
Detector: AB SCIEX API 4000 MS/MS
Ion Source: TurbolonSpray
Ion Mode: ESI+
Instrument: API LC-MS/MS
Notes: Lorazepam was prepared at 100 ng/mL; all other analytes are 10 ng/mL. **Note:** Column and conditions used were specifically recommended or published by the manufacturer for this assay.

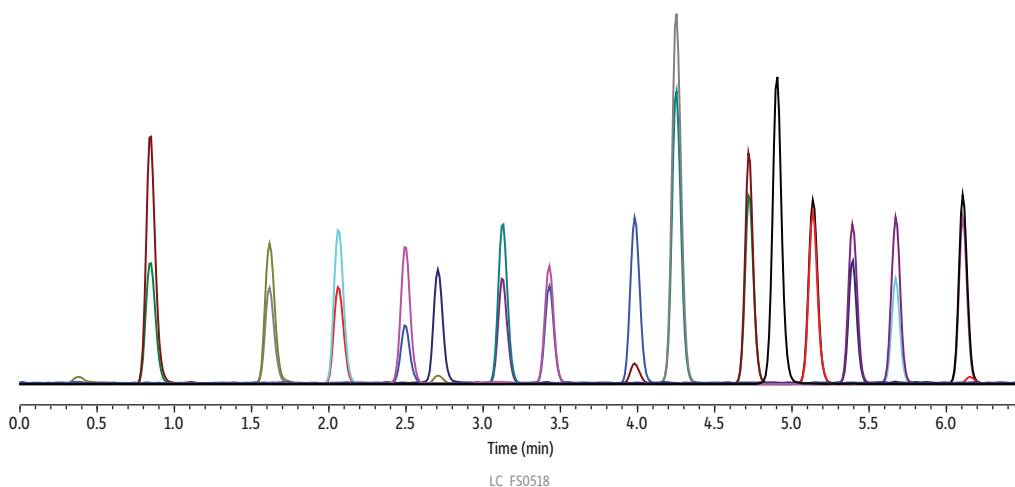


Column: Competitor B SPP C18
Dimensions: 50 mm x 3.0 mm ID
Particle Size: 2.6 µm
Pore Size: 100 Å
Temp.: 25 °C
Sample:
Diluent: urine:mobility phase A:mobility phase B (17:76:7)
Conc.: 10-100 ng/mL
Inj. Vol.: 10 µL
Mobile Phase:
A: 10 mM ammonium formate in water
B: 0.1% formic acid in methanol
Gradient (%B): 0.00 min (5%), 3.00 min (100%), 4.00 min (100%), 4.10 min (5%), 5.00 min (5%)
Flow: 0.5 mL/min
Detector: AB SCIEX API 4000 MS/MS
Ion Source: TurbolonSpray
Ion Mode: ESI+
Instrument: API LC-MS/MS
Notes: Lorazepam was prepared at 100 ng/mL; all other analytes are 10 ng/mL. **Note:** Column and conditions used were specifically recommended or published by the manufacturer for this assay.

Bisphenols Resolved Quickly with Biphenyl Selectivity, Not Mobile Phase Adjustments

With health and safety analyses—like the evaluation of bisphenols in consumer products—speed, reliability, and simplicity are crucial. The Raptor Biphenyl column is able to resolve challenging bioanalytical compound sets quickly (e.g., 15 bisphenols in 8 minutes shown below [Figures 8 & 9]) using a simple gradient of mobile phases that require NO additives. When you need baseline resolution for UV detection or high-throughput mass spectrometer applications, especially when fast, trusted, and easy solutions are so vital, the rugged and reproducible Raptor Biphenyl column is the ideal choice.

Figure 8: Separate bisphenols fast with NO mobile phase additives.

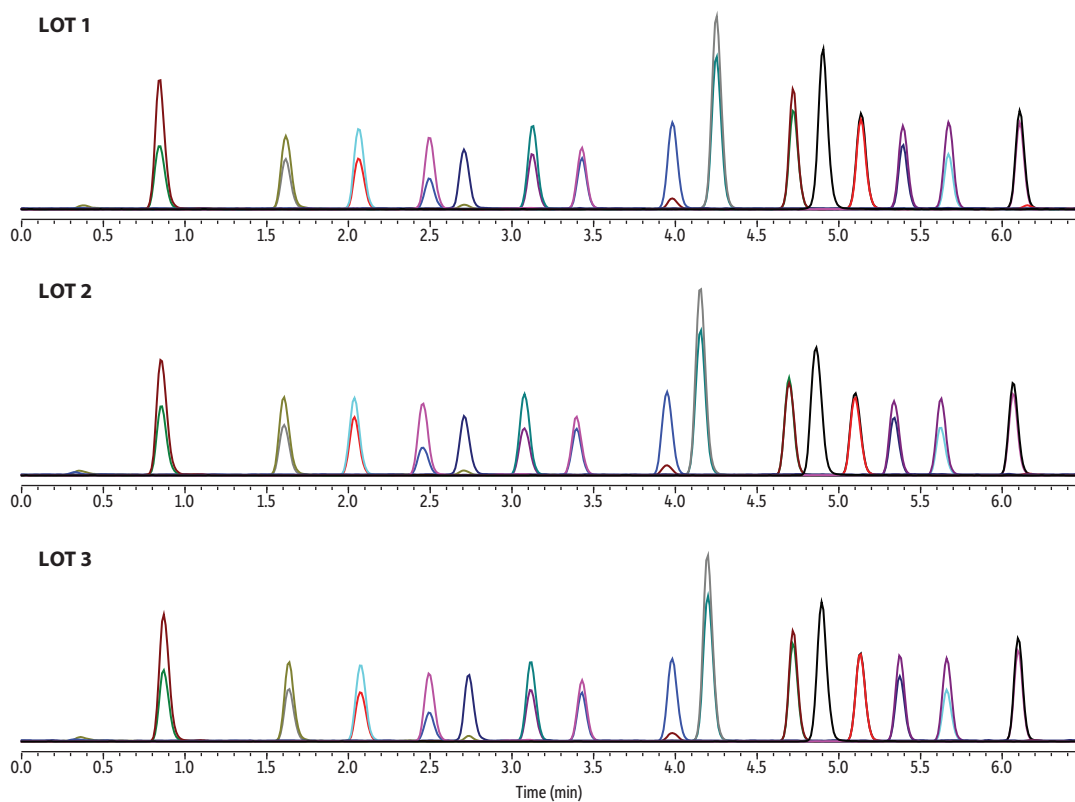


Peaks	Conc. t _R (min)	(ng/mL)	Precursor Ion	Product Ion	Product Ion
1. Bisphenol S	0.84	5.00	249.2	108.1	92.1
2. Bisphenol F	1.62	350	199.3	93.1	105.1
3. Bisphenol E	2.06	100	213.3	198.3	197.4
4. Bisphenol A	2.50	100	227.3	212.3	133.1
5. Bisphenol AF	2.71	2.00	335.2	265.3	177.3
6. Bisphenol B	3.13	100	241.3	212.4	211.3
7. Bisphenol C	3.43	350	255.3	240.4	147.3
8. Bisphenol AP	3.98	25.0	289.3	274.3	273.3
9. Bisphenol Z	4.25	250	267.2	173.4	145.2
10. Bisphenol G	4.72	250	311.2	295.4	296.4
11. Bisphenol FL	4.90	50.0	348.8	256.2	-
12. Bisphenol BP	5.14	50.0	351.2	273.3	274.3
13. Bisphenol M	5.39	15.0	345.2	330.3	251.4
14. Bisphenol P	5.67	50.0	345.2	330.4	315.3
15. Bisphenol PH	6.11	350	379.2	209.4	364.4

Column	Raptor Biphenyl (cat.# 9309252)			
Dimensions:	50 mm x 2.1 mm ID			
Particle Size:	1.8 μm			
Pore Size:	90 Å			
Temp.:	25 °C			
Sample				
Diluent:	75:25 Water:methanol			
Conc.:	2.00-350 ng/mL			
Inj. Vol.:	2 μL			
Mobile Phase				
A:	Water			
B:	Methanol			
Time (min)	Flow (mL/min)	%A	%B	
0.00	0.45	50	50	
6.50	0.45	10	90	
6.51	0.45	50	50	
8.00	0.45	50	50	

Detector	MS/MS
Ion Mode:	ESI-
Mode:	MRM
Instrument	UHPLC

Figure 9: Lot-to-lot reproducibility means the same performance column after column for bisphenols and other health and safety analyses.



LC_FS0519

Peaks	Conc. tr (min)	(ng/mL)	Precursor Ion	Product Ion	Product Ion
1. Bisphenol S	0.84	5.00	249.2	108.1	92.1
2. Bisphenol F	1.62	350	199.3	93.1	105.1
3. Bisphenol E	2.06	100	213.3	198.3	197.4
4. Bisphenol A	2.50	100	227.3	212.3	133.1
5. Bisphenol AF	2.71	2.00	335.2	265.3	177.3
6. Bisphenol B	3.13	100	241.3	212.4	211.3
7. Bisphenol C	3.43	350	255.3	240.4	147.3
8. Bisphenol AP	3.98	25.0	289.3	274.3	273.3
9. Bisphenol Z	4.25	250	267.2	173.4	145.2
10. Bisphenol G	4.72	250	311.2	295.4	296.4
11. Bisphenol FL	4.90	50.0	348.8	256.2	-
12. Bisphenol BP	5.14	50.0	351.2	273.3	274.3
13. Bisphenol M	5.39	15.0	345.2	330.3	251.4
14. Bisphenol P	5.67	50.0	345.2	330.4	315.3
15. Bisphenol PH	6.11	350	379.2	209.4	364.4

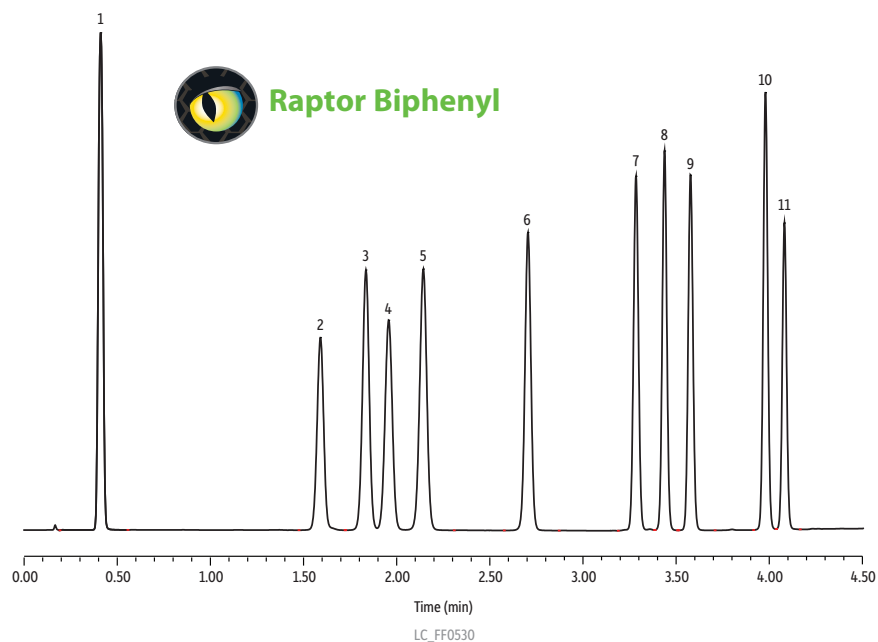
Time (min)	Flow (mL/min)	%A	%B
0.00	0.45	50	50
6.50	0.45	10	90
6.51	0.45	50	50
8.00	0.45	50	50

Column	Raptor Biphenyl (cat.# 9309252)
Dimensions:	50 mm x 2.1 mm ID
Particle Size:	1.8 µm
Pore Size:	90 Å
Temp.:	25 °C
Sample	
Diluent:	75:25 Water:methanol
Conc.:	2.00-350 ng/mL
Inj. Vol.:	2 µL
Mobile Phase	
A:	Water
B:	Methanol
Detector	MS/MS
Ion Mode:	ESI-
Mode:	MRM
Instrument	UHPLC

Fast Analysis of Sulfur Antibiotics without Coelutions

Even with high-efficiency UHPLC particles, C18 and ordinary phenyl columns fail to achieve baseline separation of sulfonamides. Not only does the Raptor Biphenyl have the selectivity to easily and completely separate these difficult compounds (Figure 10), it does so in well under 5 minutes!

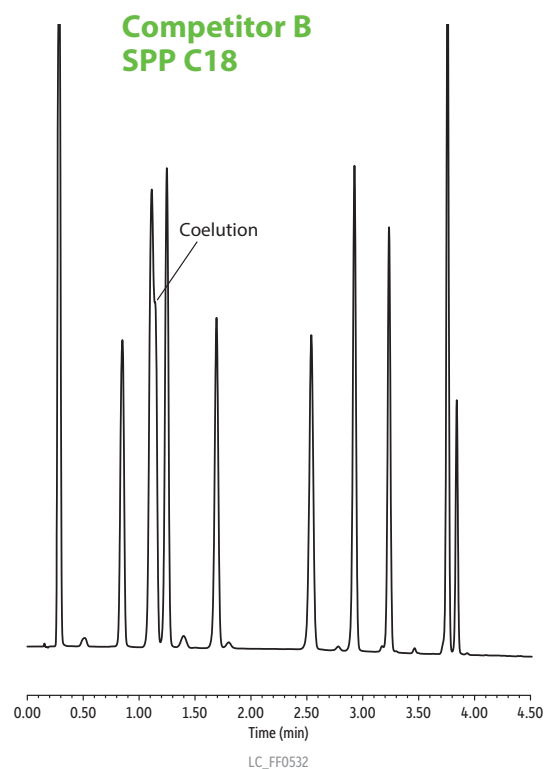
Figure 10: Sulfonamides pose no problems for analysis, even at high linear velocities. Increased retention of early-eluting sulfanilamide also helps limit ionization suppression.



Peaks	tr(min)
1. Sulfanilamide	0.41
2. Sulfadiazine	1.59
3. Sulfapyridine	1.84
4. Sulfathiazole	1.96
5. Sulfamerazine	2.14
6. Sulfamethazine	2.71
7. Sulfachlorpyridazine	3.29
8. Sulfadoxine	3.44
9. Sulfisoxazole	3.58
10. Sulfadimethoxine	3.98
11. Sulfaquinoxaline	4.08

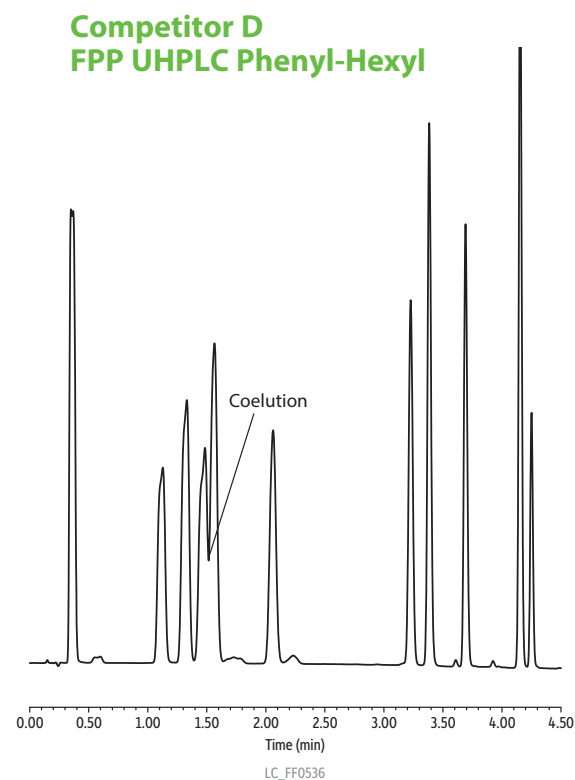
Column: Raptor Biphenyl (cat.# 9309A5E)
Dimensions: 50 mm x 3.0 mm ID
Particle Size: 2.7 µm
Pore Size: 90 Å
Temp.: 20 °C
Sample:
Diluent: 0.1% formic acid in water
Conc.: 50 µg/mL
Inj. Vol.: 5 µL
Mobile Phase:
A: 0.1% formic acid in water
B: 0.1% formic acid in acetonitrile;
Gradient (%B): 0.00 min (5%), 2.00 min (10%), 4.50 min (35%), 4.51 min (5%), 5.50 min (5%)
Flow: 1.5 mL/min
Detector: Waters ACQUITY PDA @ 260, 4.8 nm
Instrument: Waters ACQUITY UPLC H-Class.

Figure 10 (cont.)



- Peaks**
1. Sulfanilamide
 2. Sulfadiazine
 3. Sulfapyridine
 4. Sulfathiazole
 5. Sulfamerazine
 6. Sulfamethazine
 7. Sulfachlorpyridazine
 8. Sulfadoxine
 9. Sulfisoxazole
 10. Sulfadimethoxine
 11. Sulfaquinoxaline

Column: Competitor B SPP C18
Dimensions: 50 mm x 3.0 mm ID
Particle Size: 2.6 μ m
Pore Size: 100 Å
Temp.: 20 °C
Sample:
Diluent: 0.1% formic acid in water
Conc.: 50 μ g/mL
Inj. Vol.: 5 μ L
Mobile Phase:
A: 0.1% formic acid in water
B: 0.1% formic acid in acetonitrile
Gradient (%B): 0.00 min (5%), 2.00 min (10%), 4.50 min (35%), 4.51 min (5%), 5.50 min (5%);
1.5 mL/min
Flow:
Detector: Waters ACQUITY PDA @ 260, 4.8 nm
Instrument: Waters ACQUITY UPLC H-Class.



Column: Competitor D FPP Phenyl-Hexyl
Dimensions: 50 mm x 2.1 mm ID
Particle Size: 1.7 μ m
Temp.: 20 °C
Sample:
Diluent: 0.1% formic acid in water
Conc.: 50 μ g/mL
Inj. Vol.: 5 μ L
Mobile Phase:
A: 0.1% formic acid in water
B: 0.1% formic acid in acetonitrile
Gradient (%B): 0.00 min (5%), 2.00 min (10%), 4.50 min (35%), 4.51 min (5%), 5.50 min (5%);
0.75 mL/min;
Flow:
Detector: Waters ACQUITY PDA @ 260, 4.8 nm
Instrument: Waters ACQUITY UPLC H-Class.
Note: Flow rate scaled to particle size

Accelerated Performance and Time-Tested Biphenyl Selectivity for Clinical Diagnostic, Pain, Pharma, and Environmental Labs

Raptor Biphenyl LC Columns



Length	2.1 mm cat.#	3.0 mm cat.#	4.6 mm cat.#
1.8 µm Columns			
30 mm	9309232	—	—
50 mm	9309252	930925E	—
100 mm	9309212	930921E	—
150 mm	9309262	—	—
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

EXP Reusable Fittings for HPLC & UHPLC for 10-32 fittings and 1/16" tubing

Effortlessly achieve 8,700+ psi HPLC seals by hand! (Wrench tighten to 20,000+ psi.) Hybrid titanium/PEEK seal can be installed repeatedly without compromising your seal.

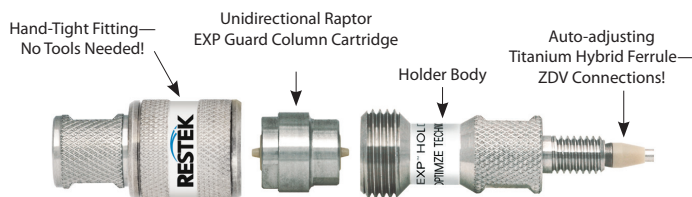


Description	qty.	cat.#
EXP Hand-Tight Fitting (Nut w/Ferrule)	ea.	25937
EXP Hand-Tight Fitting (Nut w/Ferrule)	10-pk.	25938
EXP Hand-Tight Nut (w/o Ferrule)	ea.	25939

Hybrid Ferrule U.S. Patent No. 8201854, EXP Holders U.S. Patent No. 8696902, EXP2 Wrench U.S. Patent No. D766055. Other U.S. and Foreign Patents Pending. The EXP, Free-Turn, and the Opti- prefix are registered trademarks of Optimize Technologies, Inc.

Experience *Selectivity Accelerated*.
Order the Raptor Biphenyl today at
www.restek.com/raptor

Raptor EXP Guard Cartridges—for All Raptor Columns



Protect your investment, extend the life of our already-rugged LC columns, and change guard column cartridges by hand without breaking fluid connections—no tools needed! Great with any Raptor column to get ultimate protection from particulates and matrix contamination, especially when using dilute-and-shoot or other minimal sample preparation techniques.

EXP Direct Connect Holder

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)

Raptor EXP Guard Column Cartridges

Description	Particle Size	qty.	5 x 2.1 mm cat.#	5 x 3.0 mm cat.#	5 x 4.6 mm cat.#
Raptor Biphenyl EXP Guard Column Cartridge	UHPLC	3-pk.	9309U0252	9309U0253	
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

1,034 bar/15,000 psi* (UHPLC), 600 bar/8,700 psi (2.7 µm); 400 bar/5,800 psi (5 µm).

* For maximum lifetime, recommended maximum pressure for 1.8 µm particles is 830 bar/12,000 psi.

Raptor SPP LC columns combine the speed of SPP with the resolution of USLC technology.

Learn more at www.restek.com/raptor

UltraShield UHPLC PreColumn Filter—for 1.8 µm Raptor Columns

Pair 1.8 µm Raptor columns with an UltraShield filter instead of a guard cartridge to protect against particulates, minimize extra column volume, and maximize UHPLC sample throughput when using SPE, SLE, or other extensive sample preparations.



Description	Filter Porosity	qty.	cat.#
UltraShield UHPLC PreColumn Filter	0.2 µm frit	ea.	25809
		5-pk.	25810
		10-pk.	25811

Questions about this or any other Restek product?

Contact us or your local Restek representative (www.restek.com/contact-us).

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RESTEK
Pure Chromatography

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Lit. Cat.# GNBR1891C-UNV

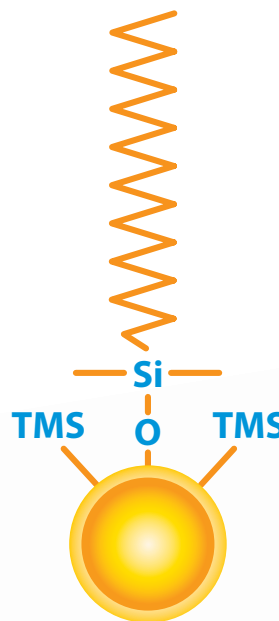
Raptor

LC Columns

Selectivity Accelerated

Raptor Speed, Efficiency,
and Ruggedness—in C18

Stationary Phase:
C18



RESTEK

Pure Chromatography

www.restek.com/raptor

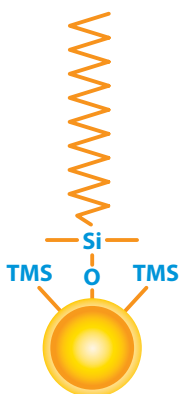
The Raptor C18 Column

With Raptor LC columns, Restek chemists became the first to combine the speed of 2.7 and 5 μm superficially porous particles (also known as SPP or “core-shell” particles) with the resolution of highly selective USLC technology, improving separations and speeding up analysis times with standard HPLC instruments. Raptor then evolved to bring that same improved speed, efficiency, and selectivity to UHPLC analyses by offering 1.8 μm particle columns. Learn more about Raptor LC columns at www.restek.com/raptor

Even though every LC lab has a cache of C18s, not all C18s are created equal. Because the chemistry tends to be similar, the silica support that carries this ubiquitous octadecylsilane phase becomes vitally important. 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 SPP LC column.

The traditional end-capped Raptor 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, environmental, or bioanalytical analyses, this phase offers consistently excellent data quality in less time across myriad reversed-phase applications, matrices, and compound classes.

Column Description:



Stationary Phase Category:

C18, octadecylsilane (L1)

Ligand Type:

End-capped C18

Particle:

1.8 μm , 2.7 μm , or 5 μm superficially porous silica (SPP or “core-shell”)

Pore Size:

90 Å

Surface Area:

125 m^2/g (1.8 μm),
130 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: 1,034 bar/15,000 psi* (1.8 μm),
600 bar/8,700 psi (2.7 μm); 400 bar/5,800 psi (5 μm)

* For maximum lifetime, recommended maximum pressure for 1.8 μm particles is 830 bar/12,000 psi.

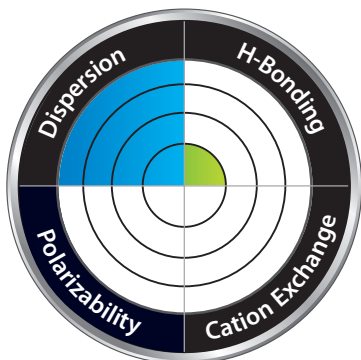
Properties:

- 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.

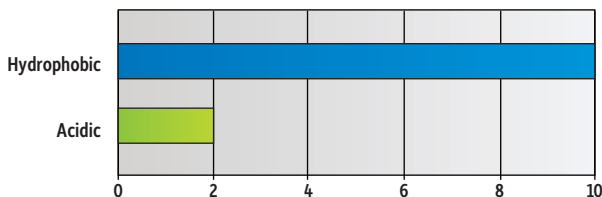
Column Interaction Profile:



Defining Solute Interaction:

- Dispersion

Solute Retention Profile:



Target Analyte Structure:

- Hydrocarbons

Target Analyte Functionalities:

- Hydrophobic compounds

Raptor C18 Performance: Speed, Efficiency, and Ruggedness in Action

Raptor C18 columns provide outstanding dependability and data quality with high efficiency and peak symmetry, and they are built to exacting specifications that make your columns exceptionally consistent and improve their lifetime. 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*.

Figure 1: Comparing 50 mm x 2.1 mm sub-2 µm C18 columns, Raptor columns maintain reliable performance past 1,000 injections, consistently matching or beating the competition.

Expect consistently high performance over 1,000 injections

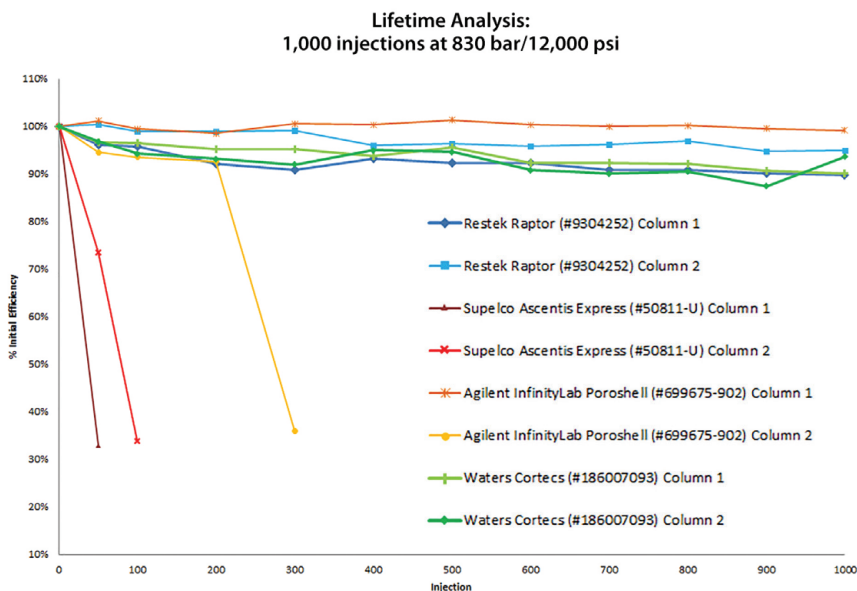
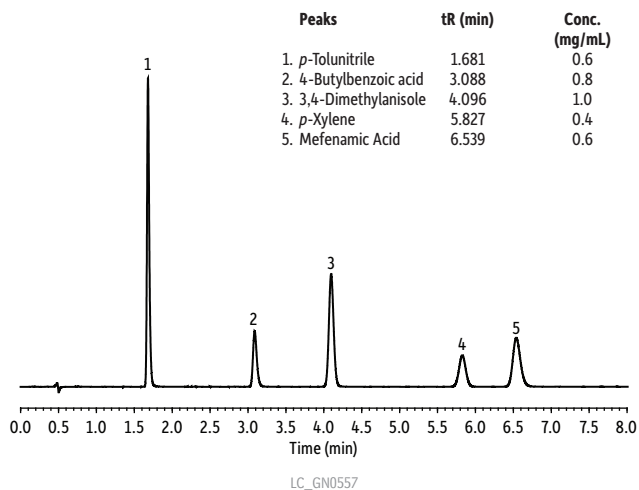


Figure 2: Raptor columns' stringent quality control (QC) specifications guarantee outstanding peak shape, even with active compounds, for superior data quality.

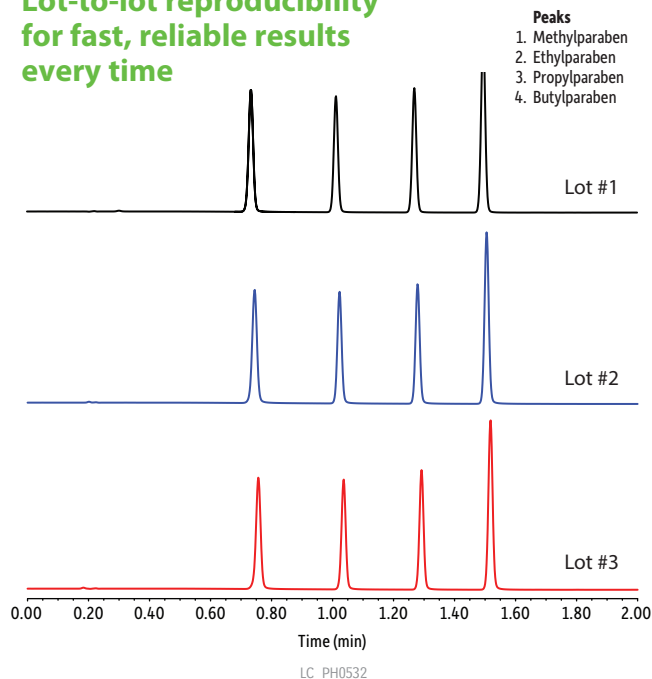
Outstanding peak shapes for top-notch data



Column: Raptor C18 (cat.# 9304A1E); Dimensions: 100 mm x 3 mm ID; Particle Size: 2.7 µm; Pore Size: 90 Å; Temp.: 30 °C; **Sample:** Diluent: Acetonitrile:water:phosphoric acid (65:34:1); Inj. Vol.: 1 µL; **Mobile Phase:** A: 0.05% Formic acid in water, B: 0.05% Formic acid in acetonitrile; **Gradient (%B):** 0.00 min (45% B), 8.00 min (45% B); **Flow:** 0.8 mL/min; **Detector:** UV/Vis @ 220 nm; Cell Temp.: 40 °C; **Instrument:** HPLC.

Figure 3: Lot-to-lot reproducibility is the key to keeping your productivity high and budget low. You can expect the same exceptional performance from every Raptor C18 column you purchase.

Lot-to-lot reproducibility for fast, reliable results every time



Column: Raptor C18 (cat.# 9304512); Dimensions: 100 mm x 2.1 mm ID; Particle Size: 5 µm; Temp.: 40 °C; **Sample:** Conc.: 100 µg/mL in water; Inj. Vol.: 1 µL; **Mobile Phase:** A: Water, B: Acetonitrile; **Gradient (%B):** 0.00 min (20% B), 2.00 min (80% B), 2.01 min (20% B), 3.50 min (20% B); **Flow:** 1.0 mL/min; **Detector:** PDA @ 254 nm; **Instrument:** UHPLC.

Boost Your Productivity with Raptor C18 Columns

When developing an assay, it is important to consider how productive your method will be. Because superficially porous, or “core-shell” particles are well known for very high efficiency with minimal backpressure, they are ideal for decreasing analysis time (Figure 4). With its general-purpose applicability and SPP core-shell particles, the Raptor C18 column lets you quickly develop faster methods, thereby boosting your productivity.

Figure 4: SPP particles, like those in the Raptor C18 column, are one important step towards total method optimization.

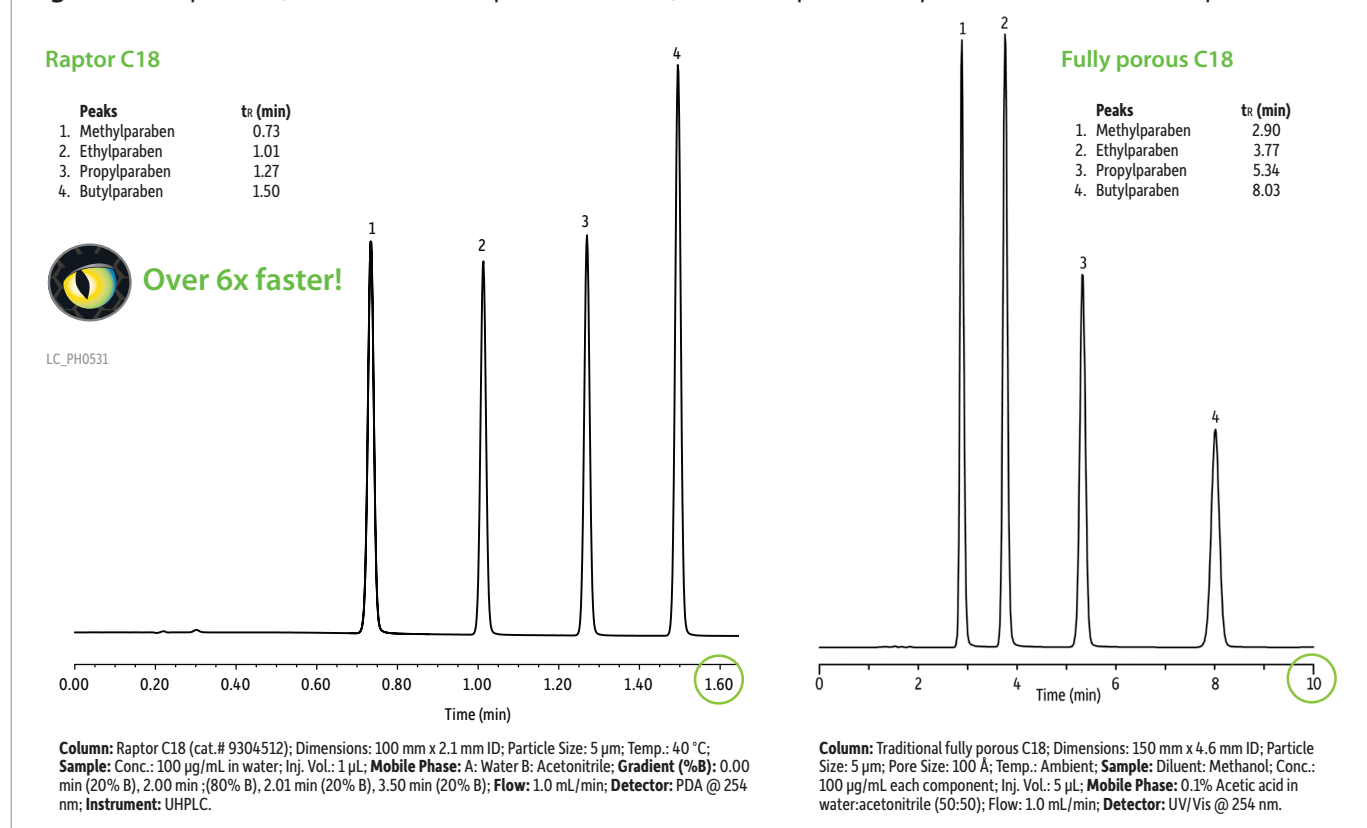
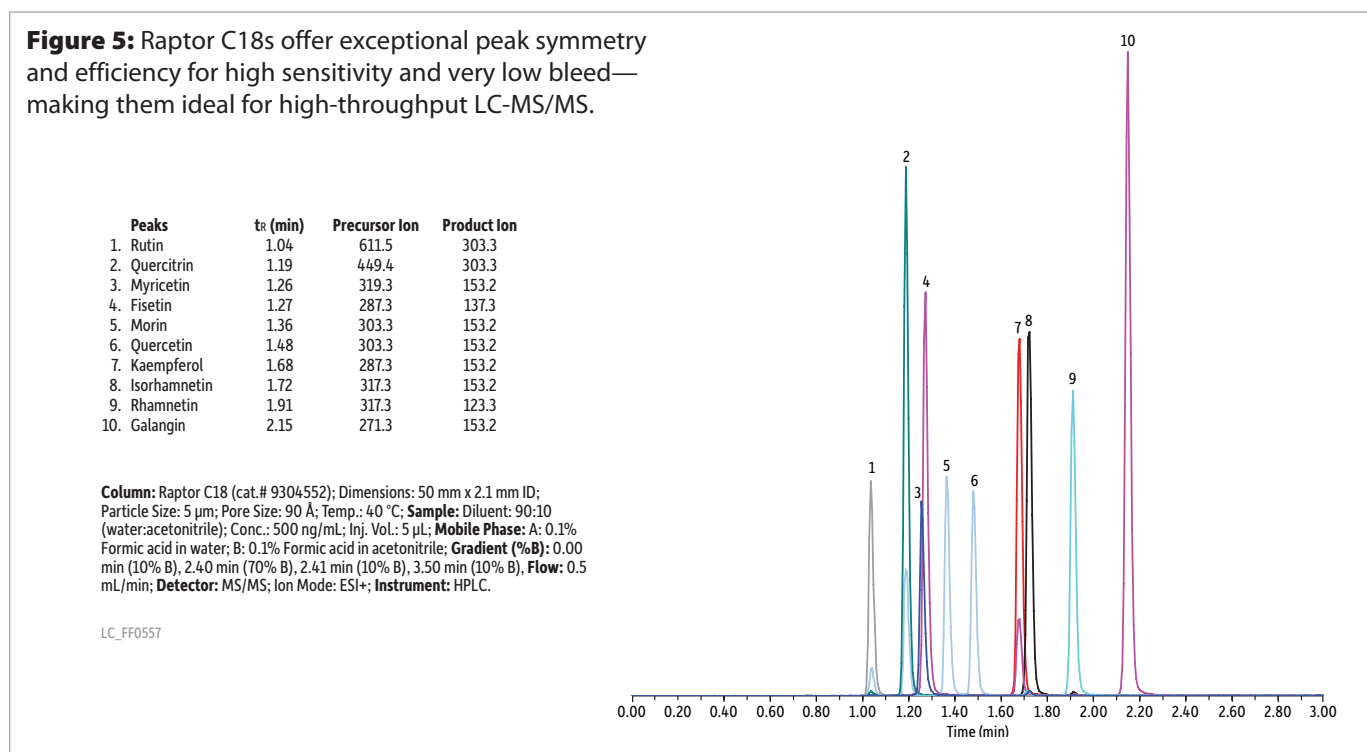


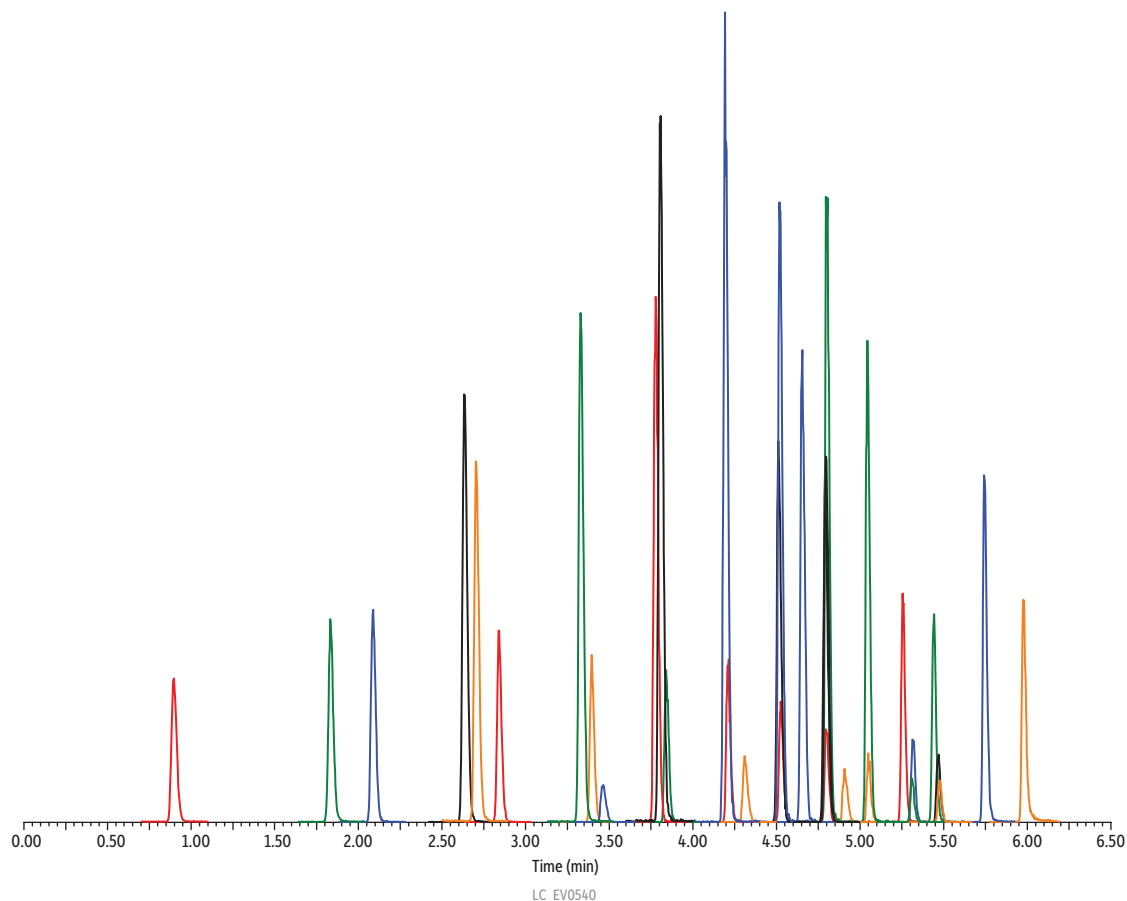
Figure 5: Raptor C18s offer exceptional peak symmetry and efficiency for high sensitivity and very low bleed—making them ideal for high-throughput LC-MS/MS.



Your Go-To Column for Fast and Dependable Analyses on Any Instrument

C18 columns are often a method developer's first choice, not only for their trusted performance but also for their effectiveness with many types of compound and instrument. The Raptor C18 was designed to build on that foundation, offering usability, peak symmetry, efficiency, and dependability—with the unmatched reproducibility, speed, and reliability of a Raptor SPP LC column. Whether you are doing environmental, food safety, or bioanalytical work (Figures 5 and 6), you will finish your work faster if you choose the right column the first time. For general-purpose applications, the Raptor C18 is your best first choice.

Figure 6: Get the data quality and short analysis times you need with Raptor C18 columns, as shown here with perfluorinated compounds (PFCs).



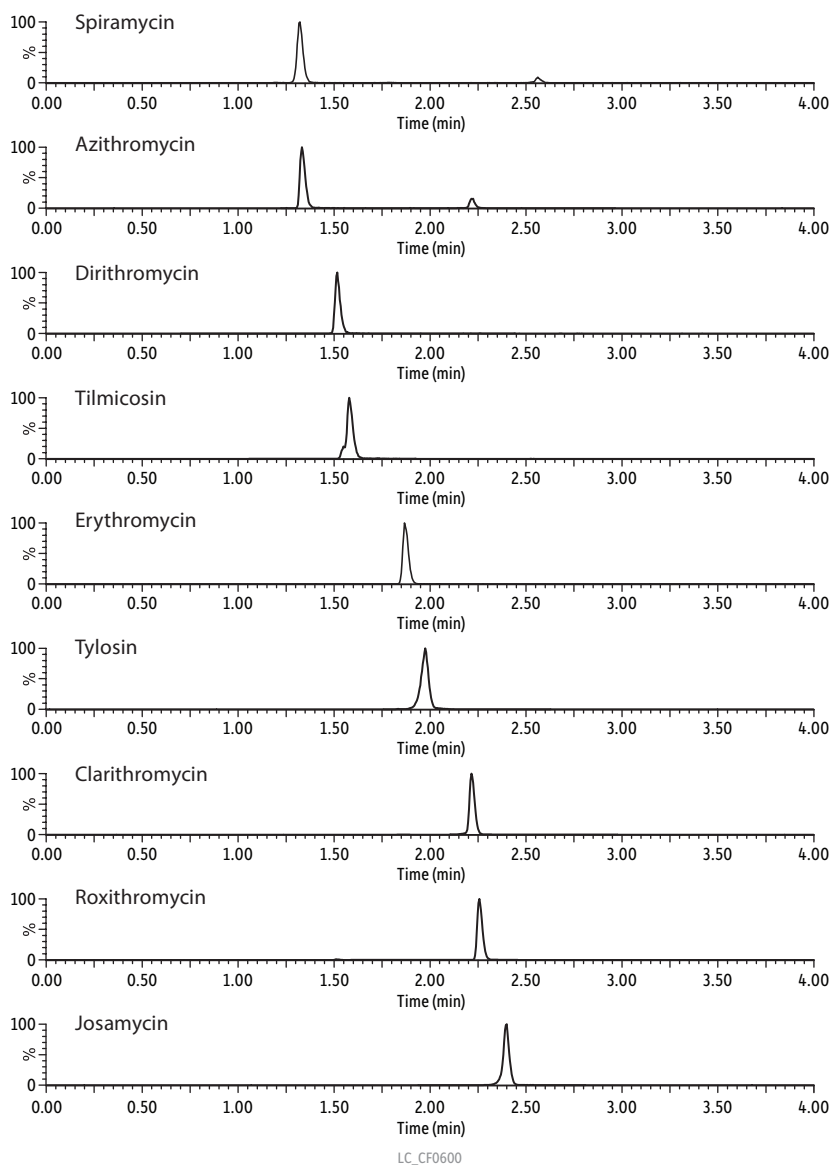
Peaks	Conc. (ng/mL)	ts (min)	Precursor Ion	Product Ion	Peaks	Conc. (ng/mL)	ts (min)	Precursor Ion	Product Ion
1. Perfluorobutanoic acid (PFBA)	0.90	5	213.07	169.07	18. Perfluorononane sulfonic acid (PFNS)	4.53	5	549.17	79.98
2. Perfluoropentanoic acid (PFPeA)	1.83	5	263.10	219.11	19. N-methyl perfluorooctane sulfonamidoacetic acid (N-MeFOSAA)	4.66	5	570.20	419.17
3. Perfluorobutane sulfonic acid (PFBS)	2.09	5	299.10	79.99	20. Perfluorododecane sulfonic acid (PFDS)	4.79	5	599.17	79.98
4. 1H, 1H, 2H, 2H-perfluorohexane sulfonic acid (4:2 FTS)	2.63	5	327.10	307.08	21. N-ethyl perfluorooctane sulfonamidoacetic acid (N-EtFOSAA)	4.79	5	584.20	419.18
5. Perfluorohexanoic acid (PFHxA)	2.70	5	313.10	269.12	22. Perfluorooctane sulfonamide (FOSA)	4.79	5	498.17	77.97
6. Perfluoropentane sulfonic acid (PFPeS)	2.84	5	349.10	79.98	23. Perfluoroundecanoic acid (PFUNA)	4.80	5	563.23	519.24
7. Perfluoroheptanoic acid (PFHpA)	3.33	5	363.16	319.09	24. 2-Perfluorodecyl ethanoic acid (FDEA)	4.91	250	577.23	493.18
8. Perfluorohexane sulfonic acid (PFHxS)	3.39	5	399.13	79.98	25. Perfluorododecanoic acid (PFDoA)	5.04	5	613.23	569.19
9. 2-Perfluorohexyl ethanoic acid (FHEA)	3.46	250	377.13	293.07	26. 1H, 1H, 2H, 2H-perfluorododecane sulfonic acid (10:2 FTS)	5.05	5	627.23	607.20
10. 1H, 1H, 2H, 2H-perfluorooctane sulfonic acid (6:2 FTS)	3.78	5	427.17	407.18	27. Perfluorotridecanoic acid (PFTrDA)	5.25	5	663.23	619.21
11. Perfluorooctanoic acid (PFOA)	3.81	5	413.16	369.10	28. N-methyl perfluorooctane sulfonamide (N-MeFOSA)	5.31	5	512.17	169.07
12. Perfluoroheptane sulfonic acid (PFHpS)	3.84	5	449.17	79.98	29. N-methyl perfluorooctane sulfonamidoethanol (N-MeFOSE)	5.31	50	616.27	59.11
13. Perfluorononanoic acid (PFNA)	4.19	5	463.16	419.19	30. Perfluorotetradecanoic acid (PFTeDA)	5.44	5	713.23	669.23
14. Perfluorooctane sulfonic acid (PFOS)	4.21	5	499.17	79.98	31. N-ethyl perfluorooctane sulfonamide (N-EtFOSA)	5.47	5	526.23	169.06
15. 2-Perfluorooctyl ethanoic acid (FOEA)	4.31	250	477.17	393.15	32. N-ethyl perfluorooctane sulfonamidoethanol (N-EtFOSE)	5.47	50	630.33	59.11
16. 1H, 1H, 2H, 2H-perfluorodecane sulfonic acid (8:2 FTS)	4.51	5	527.17	507.16	33. Perfluorohexadecanoic acid (PFHxDA)	5.74	5	813.30	769.28
17. Perfluorodecanoic acid (PFDA)	4.52	5	513.17	469.16	34. Perfluorooctadecanoic acid (PFODA)	5.98	5	913.30	869.32

Column: Raptor C18 (cat.# 9304565); Dimensions: 150 mm x 4.6 mm ID; Particle Size: 5 µm; Temp.: 30 °C; **Sample:** Phenylurea pesticide mixture (cat.# 32434); Inj. Vol.: 2 µL; **Mobile Phase:** A: 0.1% Formic acid in water; B: 0.1% Formic acid in acetonitrile; **Gradient (%B)** 0.00 min (30% B), 7.00 min (55% B), 7.01 min (30% B), 10.00 min (30% B); **Flow:** 2 (mL/min); **Detector:** PDA @ 245 nm; **Instrument:** HPLC; **Notes:** This method is not EPA 532 tested or compliant.

The Perfect Complement to High-Throughput Mass Spec

Fast LC-MS/MS screens with their exacting MRM transitions place severe demands on your LC column. The Raptor C18 can easily and dependably handle mass spec analysis of closely related compounds like macrolide antibiotics, which are widely used in human and veterinary medicine (Figure 7). Because it's a Raptor LC column, this C18 provides the reproducibility and consistent retention required for precise MRM analyses (see p. 3).

Figure 7: Confidently analyze closely eluting compounds, like macrolide antibiotics in this bioanalytical analysis, by LC-MS/MS.



Peaks	tr (min)	Precursor Ion	Product Ion
1. Spiramycin	1.32	844.21	174.28
2. Azithromycin	1.33	750.14	591.83
3. Dirithromycin	1.52	836.26	158.23
4. Tilmicosin	1.58	870.23	174.29
5. Erythromycin	1.87	735.09	158.23
6. Tylosin	1.98	917.26	174.28
7. Clarithromycin	2.22	749.11	158.22
8. Roxithromycin	2.26	838.21	158.23
9. Josamycin	2.40	829.15	109.18

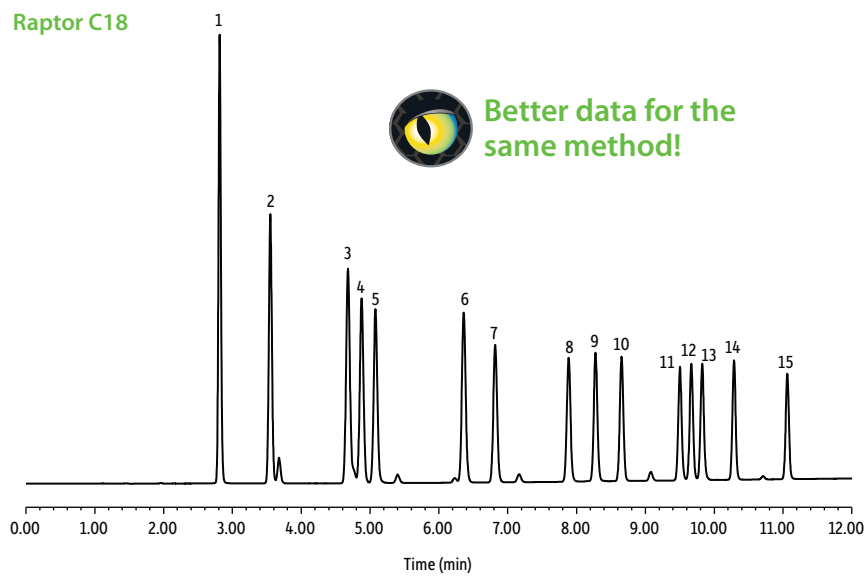
Column: Raptor C18 (cat.# 9304512); Dimensions: 100 mm x 2.1 mm ID; Particle Size: 5 µm; Pore Size: 90 Å; Temp.: 40 °C; **Sample:** Diluent: Water:acetonitrile (50:50); Conc.: 100 ng/mL; Inj. Vol.: 5 µL; **Mobile Phase:** A: 0.1% Formic acid in water; B: 0.1% Formic acid in acetonitrile; **Gradient (%B)** 0.00 min (20% B), 3.00 min (65% B), 3.01 min (20% B), 4.50 min (20% B); **Flow:** 0.4 mL/min; **Detector:** MS/MS; Ion Mode: ESI+; **Instrument:** UHPLC.

Improve Resolution on Your Current Methods

To quickly improve your data quality without altering conditions, add a Raptor C18 SPP column to your existing C18 methods. As exemplified in Figure 8 with EPA method TO-11A, which determines toxic compounds in ambient air, the Raptor C18 offers better peak separation than a traditional fully porous C18 under the same conditions.

Figure 8: Make a good method even better with improved resolution by switching your traditional fully porous C18 for a Raptor C18 column.

Raptor C18

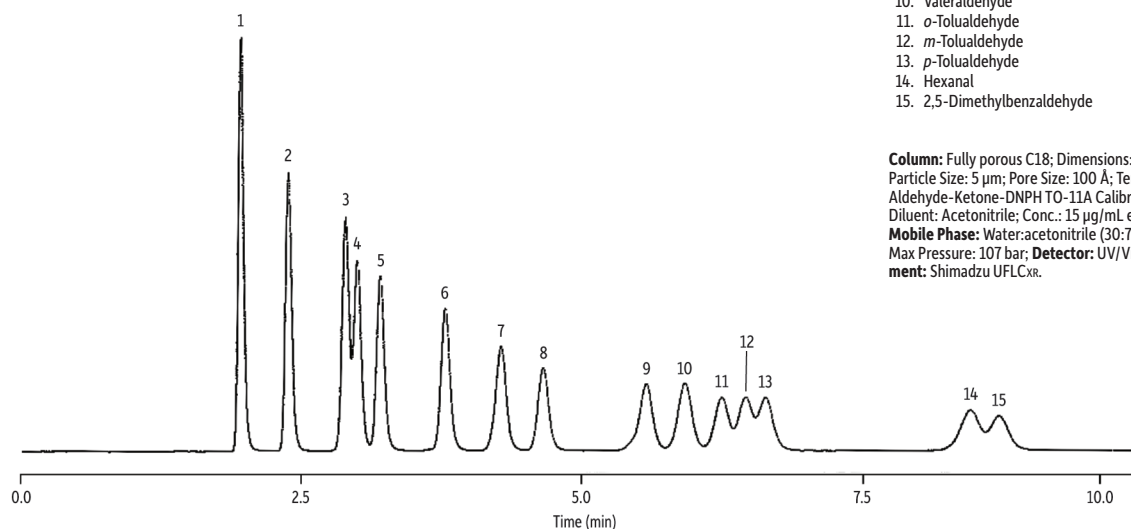


Peaks	tr (min)
1. Formaldehyde	2.814
2. Acetaldehyde	3.551
3. Acrolein	4.678
4. Acetone	4.877
5. Propionaldehyde	5.078
6. Crotonaldehyde	6.361
7. Butyraldehyde	6.818
8. Benzaldehyde	7.884
9. Isovaleraldehyde	8.276
10. Valeraldehyde	8.653
11. o-Tolualdehyde	9.502
12. m-Tolualdehyde	9.667
13. p-Tolualdehyde	9.825
14. Hexanal	10.287
15. 2,5-Dimethylbenzaldehyde	11.064

Column: Raptor C18 (cat.# 9304A65); Dimensions: 150 mm x 4.6 mm ID; Particle Size: 2.7 µm; Pore Size: 90 Å; Temp.: 30 °C; **Sample:** Aldehyde-ketone-DNPH TO-11A calibration mix (cat.# 31808); Diluent: Acetonitrile; Conc.: 15 µg/mL; Inj. Vol.: 2 µL; **Mobile Phase:** A: Water; B: Methanol: acetonitrile (650:50)*; **Gradient (%B)** 0.00 min (70% B), 5.00 min (75% B), 11.00 min (90% B), 11.01 min (100% B), 12.00 min (100% B), 12.01 min (70% B), 14.00 min (70% B); **Flow:** 0.8 mL/min; **Detector:** UV/Vis @ 365, 4.8 nm; **Instrument:** UHPLC; **Notes:** *Mobile phase B was prepared by combining 650 mL methanol and 50 mL acetonitrile.

LC_EV0532

Fully porous C18



Peaks	tr (min)
1. Formaldehyde	1.954
2. Acetaldehyde	2.376
3. Acrolein	2.884
4. Acetone	2.987
5. Propionaldehyde	3.190
6. Crotonaldehyde	3.777
7. Butyraldehyde	4.273
8. Benzaldehyde	4.653
9. Isovaleraldehyde	5.572
10. Valeraldehyde	5.919
11. o-Tolualdehyde	6.242
12. m-Tolualdehyde	6.454
13. p-Tolualdehyde	6.634
14. Hexanal	8.450
15. 2,5-Dimethylbenzaldehyde	8.715

Column: Fully porous C18; Dimensions: 150 mm x 4.6 mm ID; Particle Size: 5 µm; Pore Size: 100 Å; Temp.: 25 °C; **Sample:** Aldehyde-Ketone-DNPH TO-11A Calibration Mix (cat.# 31808); Diluent: Acetonitrile; Conc.: 15 µg/mL each; Inj. Vol.: 10 µL; **Mobile Phase:** Water:acetonitrile (30:70); Flow: 1.5 mL/min; Max Pressure: 107 bar; **Detector:** UV/Vis @ 365, 1 nm; **Instrument:** Shimadzu UFLCXR.

Lower Costs and Improve Profitability with the Only General-Purpose C18 That Gives You Selectivity Accelerated

Raptor C18 LC Columns



Length	2.1 mm cat.#	3.0 mm cat.#	4.6 mm cat.#
1.8 µm Columns			
30 mm	9304232	—	—
50 mm	9304252	930425E	—
100 mm	9304212	930421E	—
150 mm	9304262	—	—
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

EXP Reusable Fittings for HPLC & UHPLC

for 10-32 fittings and 1/16" tubing

Effortlessly achieve 8,700+ psi HPLC seals by hand! (Wrench tighten to 20,000+ psi.) Hybrid titanium/PEEK seal can be installed repeatedly without compromising your seal.



Description	qty.	cat.#
EXP Hand-Tight Fitting (Nut w/Ferrule)	ea.	25937
EXP Hand-Tight Fitting (Nut w/Ferrule)	10-pk.	25938
EXP Hand-Tight Nut (w/o Ferrule)	ea.	25939

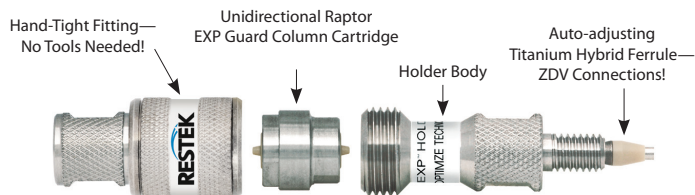
Hybrid Ferrule U.S. Patent No. 8201854, EXP Holders U.S. Patent No. 8696902, EXP2 Wrench U.S. Patent No. D766055. Other U.S. and Foreign Patents Pending. The EXP, Free-Turn, and the Opti- prefix are registered trademarks of Optimize Technologies, Inc.

Experience *Selectivity Accelerated*.

Order the Raptor C18 today at

www.restek.com/raptor

Raptor EXP Guard Cartridges—for All Raptor Columns



Protect your investment, extend the life of our already-rugged LC columns, and change guard column cartridges by hand without breaking fluid connections—no tools needed! Great with any Raptor column to get ultimate protection from particulates and matrix contamination, especially when using dilute-and-shoot or other minimal sample preparation techniques.

EXP Direct Connect Holder

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)

Raptor EXP Guard Column Cartridges

Description	Particle Size	qty.	5 x 2.1 mm cat.#	5 x 3.0 mm cat.#	5 x 4.6 mm cat.#
Raptor C18 EXP Guard Column Cartridge	UHPLC	3-pk.	9304U0252	9304U0253	—
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

1,034 bar/15,000 psi* (UHPLC), 600 bar/8,700 psi (2.7 µm); 400 bar/5,800 psi (5 µm).

* For maximum lifetime, recommended maximum pressure for 1.8 µm particles is 830 bar/12,000 psi.

Raptor SPP LC columns combine the speed of SPP with the resolution of USLC technology.

Learn more at www.restek.com/raptor

UltraShield UHPLC PreColumn Filter—for 1.8 µm Raptor Columns

Pair 1.8 µm Raptor columns with an UltraShield filter instead of a guard cartridge to protect against particulates, minimize extra column volume, and maximize UHPLC sample throughput when using SPE, SLE, or other extensive sample preparations.



Description	Filter Porosity	qty.	cat.#
UltraShield UHPLC PreColumn Filter	0.2 µm frit	ea.	25809
		5-pk.	25810
		10-pk.	25811

Questions about this or any other Restek product?

Contact us or your local Restek representative (www.restek.com/contact-us).

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Pure Chromatography

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Lit. Cat.# GNBR2246B-UNV

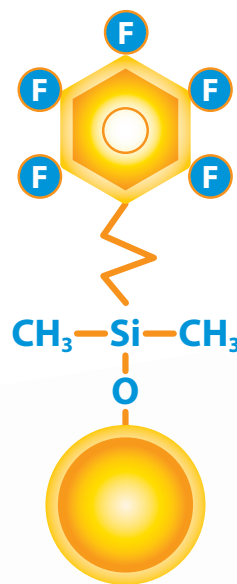
Raptor

LC Columns

Selectivity Accelerated

Get the Power of HILIC and
RP Modes in One LC Column

Stationary Phase:
FluoroPhenyl



RESTEK

Pure Chromatography

www.restek.com/raptor

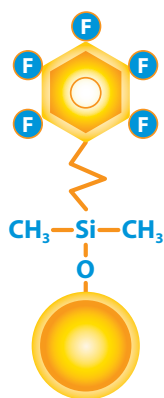
The Raptor FluoroPhenyl Column

With Raptor LC columns, Restek chemists became the first to combine the speed of 2.7 and 5 μm superficially porous particles (also known as SPP or “core-shell” particles) with the resolution of highly selective USLC technology, improving separations and speeding up analysis times with standard HPLC instruments. Raptor then evolved to bring that same improved speed, efficiency, and selectivity to UHPLC analyses by offering 1.8 μm particle columns. Learn more about Raptor LC columns at www.restek.com/raptor

With the addition of Raptor FluoroPhenyl columns, Restek further expanded the speed and reliability of Raptor column technology into the HILIC realm. Restek's Raptor FluoroPhenyl phase offers chromatographers the ability to run in reversed-phase or HILIC mode for a variety of compounds. The Restek Raptor FluoroPhenyl column is also amenable to LC-MS because it is extremely reliable and efficient with acidic mobile phases.

Switch to a Raptor FluoroPhenyl LC column for reliable performance in *both* reversed-phase and HILIC modes.

Column Description:



Stationary Phase Category:

Pentafluorophenyl propyl (L43)

Ligand Type:

Fluorophenyl

Particle:

1.8 μm , 2.7 μm , or 5 μm superficially porous silica (SPP or “core-shell”)

Pore Size:

90 Å

Surface Area:

125 m^2/g (1.8 μm),
130 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: 1,034 bar/15,000 psi* (1.8 μm),
600 bar/8,700 psi (2.7 μm); 400 bar/5,800 psi (5 μm)

* For maximum lifetime, recommended maximum pressure for 1.8 μm particles is 830 bar/12,000 psi.

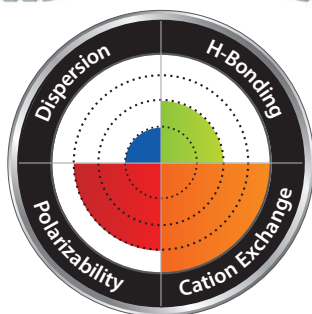
Properties:

- Capable of both reversed-phase and HILIC separations.
- Ideal for increasing sensitivity and selectivity in LC-MS analyses.
- Offers increased retention for charged bases.

Switch to a Raptor FluoroPhenyl LC column when:

- You observe limited retention and selectivity on a C18 for basic compounds.
- You need increased retention of hydrophilic compounds.

Column Interaction Profile:



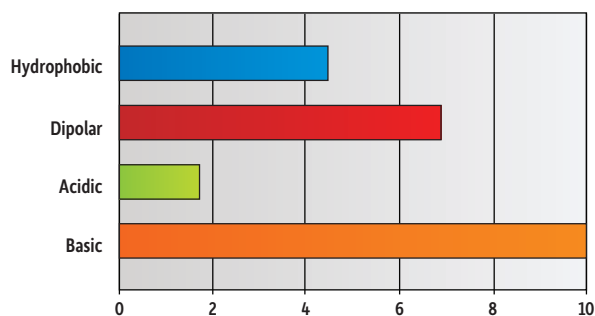
Defining Solute Interaction:

- Cation exchange

Complementary Solute Interactions:

- Polarizability
- Dispersion

Solute Retention Profile:



Target Analyte Structures:

- Nitrogen-containing

Target Analyte Functionalities:

- Protonated amines
- Quaternary ammonium compounds
- Positively charged moieties
- Lewis bases

Raptor FluoroPhenyl Columns: Rugged, Check—Reproducible, Double Check.

Of course, Raptor FluoroPhenyl columns are rugged; that is to be expected. And, they are exceptionally reproducible as well. Reproducibility can be an issue for fluorinated phenyl phases, which is why we engineered all our columns for dependable performance. Lot to lot, column to column, and injection to injection, every Raptor FluoroPhenyl column gives a consistent performance that you can count on: consider it done.

Figure 1: Raptor FluoroPhenyl columns maintain efficiency in any dimension or particle size—even at their maximum recommended operating pressures—so you can run at high linear velocities with confidence.

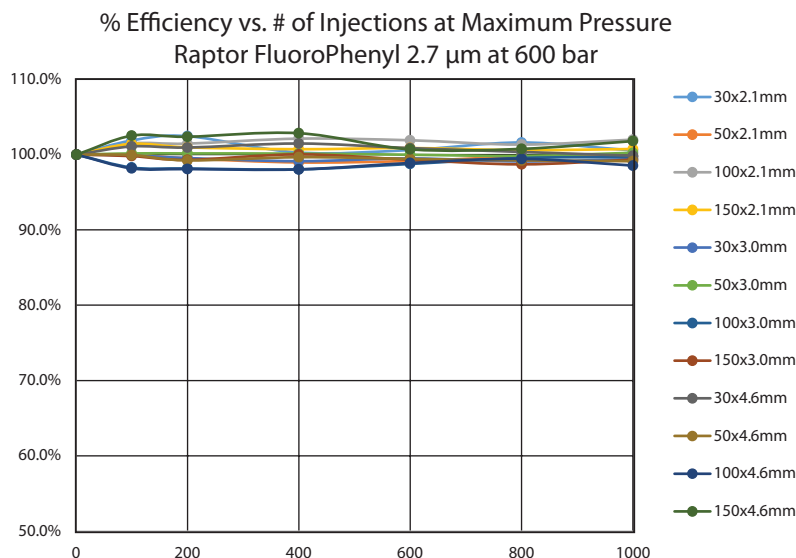
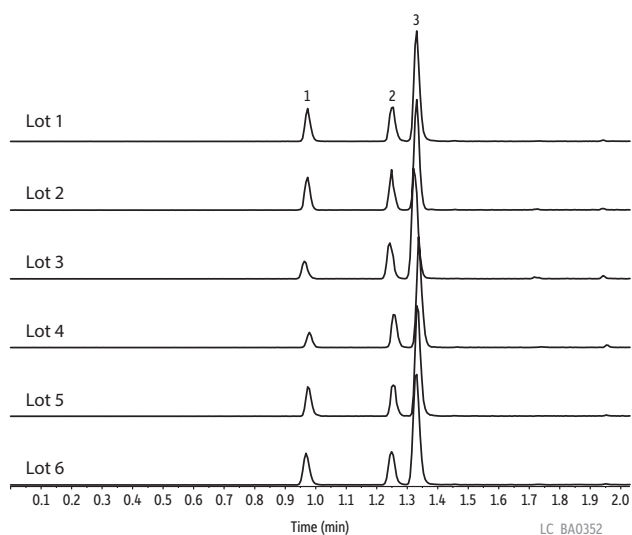


Figure 2: Strict quality control ensures Raptor FluoroPhenyl columns are exceptionally reproducible, so you get predictable performance from every column.



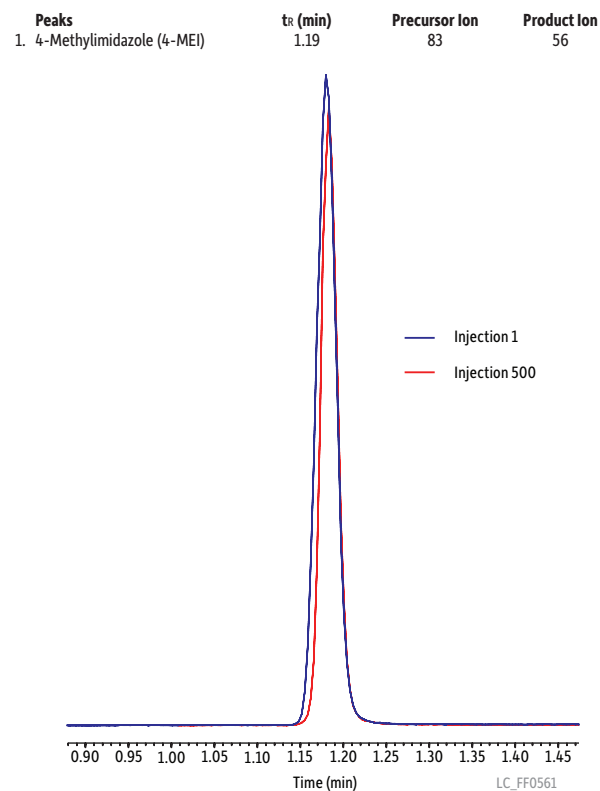
Reliable, reproducible fluorophenyl column performance.

Peaks	tr (min)	Precursor Ion	Product Ion 1	Product Ion 2
1. Baccatin III	0.97	587.0	405.1	105.0
2. Docetaxel	1.25	808.1	527.3	226.1
3. Paclitaxel	1.33	854.1	569.3	286.2



Column: Raptor FluoroPhenyl (cat.# 931955E); Dimensions: 50 mm x 3 mm ID, Particle Size: 5 µm; Temp.: 35 °C; **Sample:** Diluent: Water; Conc.: 100 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 (25% B), 2.00 (95% B), 2.01 (25% B), 3.50 (25% B); **Flow:** 0.8 mL/min; **Detector:** MS/MS; Ion Mode: ESI+; Mode: MRM; **Instrument:** UHPLC.

Figure 3: From start to finish, Raptor FluoroPhenyl columns provide accurate, reproducible results.



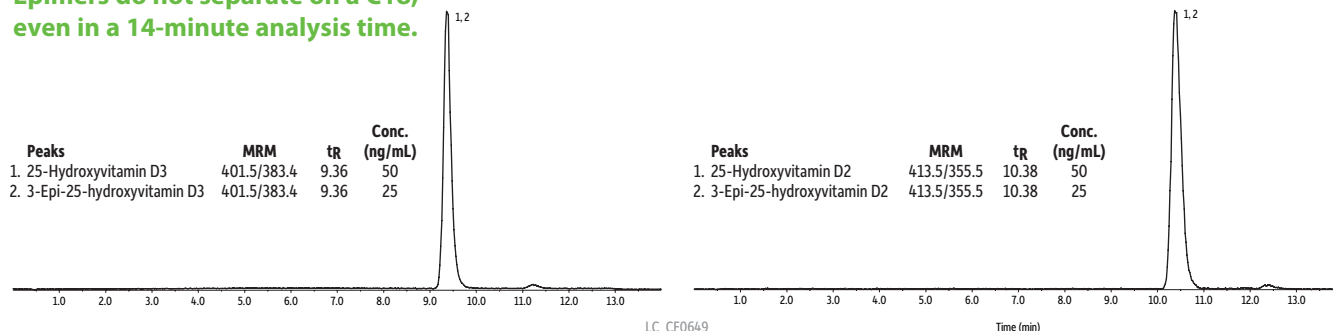
Column: Raptor FluoroPhenyl (cat.# 9319A52); Dimensions: 50 mm x 2.1 mm ID, Particle Size: 2.7 µm; Temp.: 35 °C; **Sample:** Diluent: Acetonitrile; Conc.: 100 ng/mL; Inj. Vol.: 5 µL; **Mobile Phase:** A: 0.1% Formic acid in water; B: 0.1% Formic acid in acetonitrile; **Gradient (%B):** 0.00 min (95% B), 2.00 (30% B), 2.01 (95% B), 3.50 (95% B); **Flow:** 0.6 mL/min; **Detector:** MS/MS; Ion Mode: ESI+; Mode: MRM; **Instrument:** UHPLC.

More Separating Power than a C18

C18 columns work well for many compounds, but they just don't work for everything. Raptor FluoroPhenyl columns can provide greater selectivity and retention for analytes that are not easily separated by C18 phase chemistry. For example, interest in vitamin D status is on the rise in clinical diagnostics, but accurate analysis is only possible if the epimeric forms of both vitamin D2 and D3 25-hydroxy metabolites can be distinguished. Typical reversed-phase C18 columns cannot separate these isobaric epimers, which differ in bioactivity, but the new Raptor FluoroPhenyl column provides adequate chromatographic resolution so accurate results are generated and the proper diagnosis can be made.

Figure 4: Reversed-phase C18 columns do not have the right selectivity or retention mechanism to separate the epimers of vitamin D2 and D3 25-hydroxy metabolites.

Epimers do not separate on a C18, even in a 14-minute analysis time.

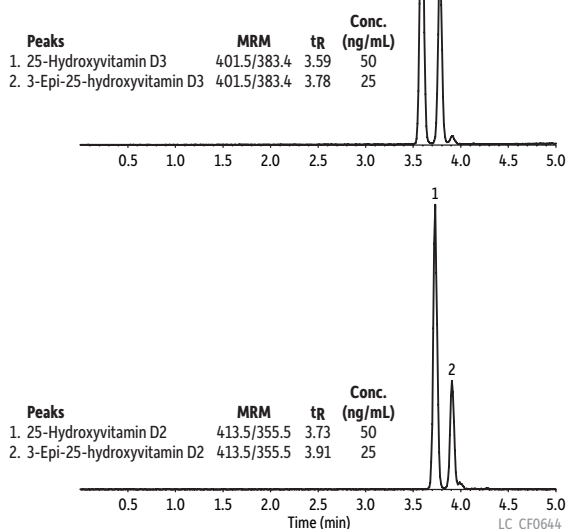


Column: Raptor ARC-18 (cat.# 9314A12); Dimensions: 100 mm x 2.1 mm ID, Particle Size: 2.7 µm; Temp.: 30 °C; **Sample:** Diluent: Water:methanol (50:50); Conc.: 25-50 ng/mL; Inj. Vol.: 5 µL; **Mobile Phase:** A: 0.1% Formic acid in water; B: Methanol; **Gradient (%B):** 0.00 min (75% B), 4.00 (80% B), 12.00 (80% B), 12.10 (75% B); 14.00 (75% B); **Flow:** 0.5 mL/min; **Detector:** MS/MS; Ion Mode: ESI+; Mode: MRM; **Instrument:** HPLC.

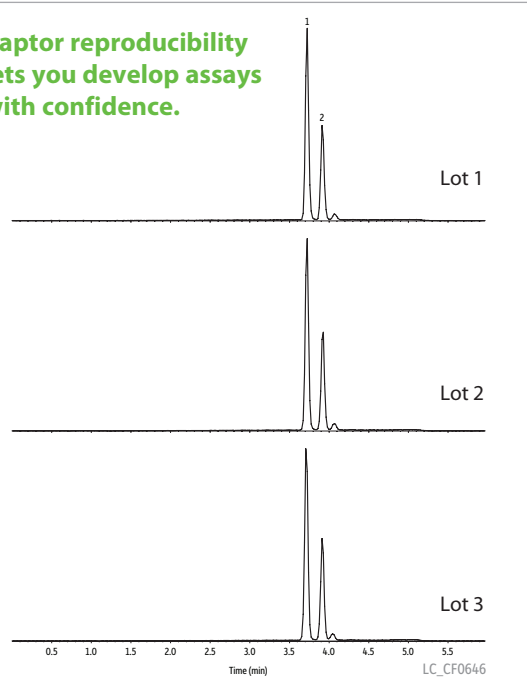
Figure 5: Raptor FluoroPhenyl columns have the selectivity and retention you need to quickly and easily separate compounds that coelute on a C18, such as the epimeric forms of vitamin D2 and D3 25-hydroxy metabolites.



Raptor FluoroPhenyl columns easily separate compounds that coelute on a C18.



Raptor reproducibility lets you develop assays with confidence.



Column: Raptor FluoroPhenyl (cat.# 9319A1E); Dimensions: 100 mm x 3 mm ID, Particle Size: 2.7 µm; Temp.: 30 °C; **Sample:** Diluent: Water:methanol (50:50); Conc.: 25-50 ng/mL; Inj. Vol.: 5 µL; **Mobile Phase:** A: 0.1% Formic acid in water; B: Methanol; **Gradient (%B):** 0.00 min (75% B), 4.00 (85% B), 4.10 (100% B), 5.00 (100% B), 5.01 (75% B), 7.00 (75% B); **Flow:** 0.6 mL/min; **Detector:** MS/MS; Ion Mode: ESI+; Mode: MRM; **Instrument:** HPLC.

Get the Power of HILIC and RP Modes in One LC Column

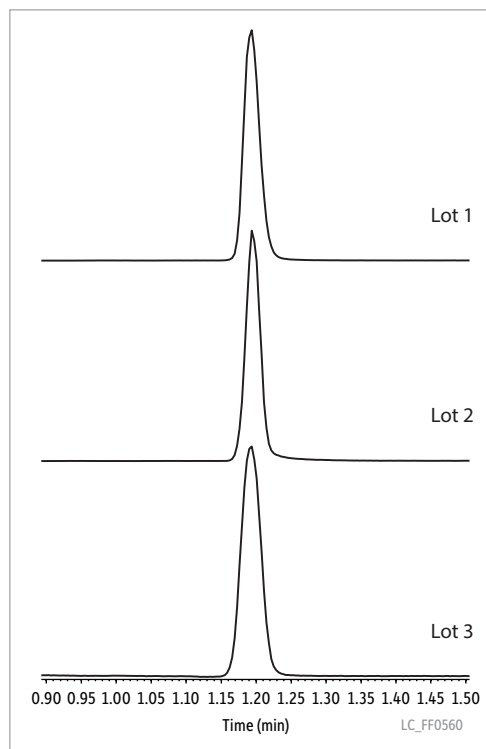
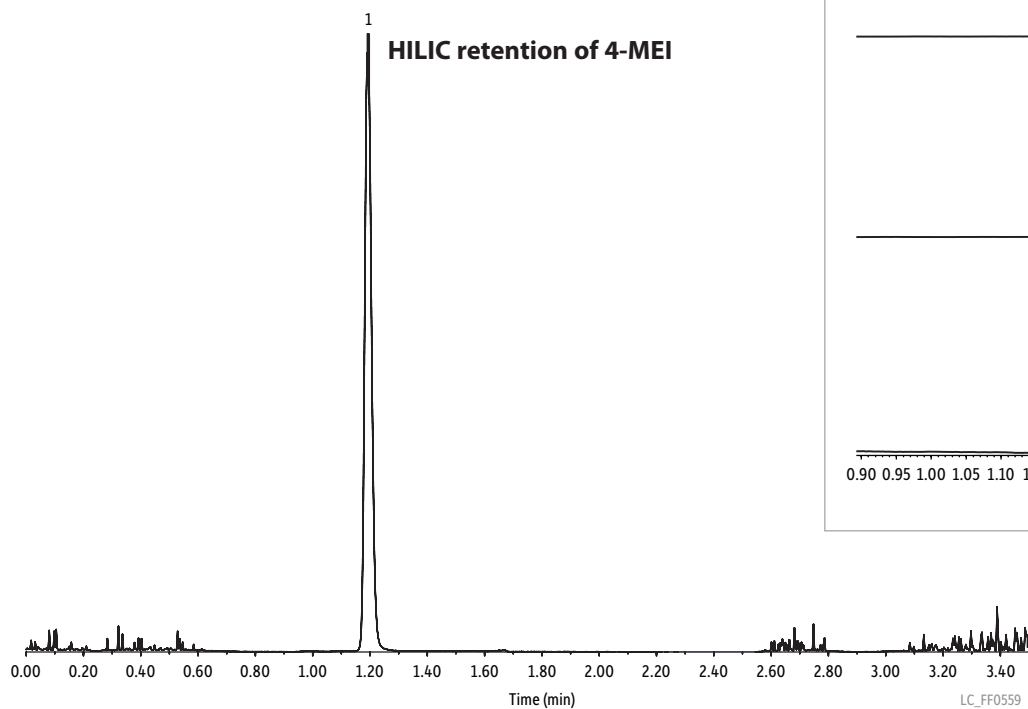
HILIC chromatography is becoming the go-to solution for compounds that are difficult to retain on a C18. The Raptor FluoroPhenyl column gives chromatographers the flexibility to evaluate compound retention in both reversed-phase and HILIC modes. The analysis of 4-methylimidazole (4-MEI), which is a byproduct of caramel coloring in foods and beverages, can be problematic by reversed-phase chromatography due to very limited retention. However, 4-MEI is well retained on a Raptor FluoroPhenyl column and can easily be analyzed using HILIC mode and simple LC and LC-MS/MS compatible mobile phases.

Figure 6: Sometimes, adequate retention cannot be obtained with a C18. The Raptor FluoroPhenyl column performs dependably in either HILIC or RP mode, so you can use the mode that is best for your analytes.



Raptor FluoroPhenyl columns give you the flexibility to work in both reversed-phase and HILIC modes.

Peaks	tr (min)	Precursor Ion	Product Ion
1. 4-Methylimidazole (4-MEI)	1.19	83	56



Column: Raptor FluoroPhenyl (cat.# 9319A52); Dimensions: 50 mm x 2.1 mm ID; Particle Size: 2.7 µm; Temp.: 35 °C; **Sample:** Diluent: Acetonitrile; Conc.: 100 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 (95% B), 2.00 (30% B), 2.01 (95% B), 3.50 (95% B); **Flow:** 0.6 mL/min; **Detector:** MS/MS; Ion Mode: ESI+; Mode: MRM; **Instrument:** UHPLC.

Fast, Accurate Analysis of Basic Compounds

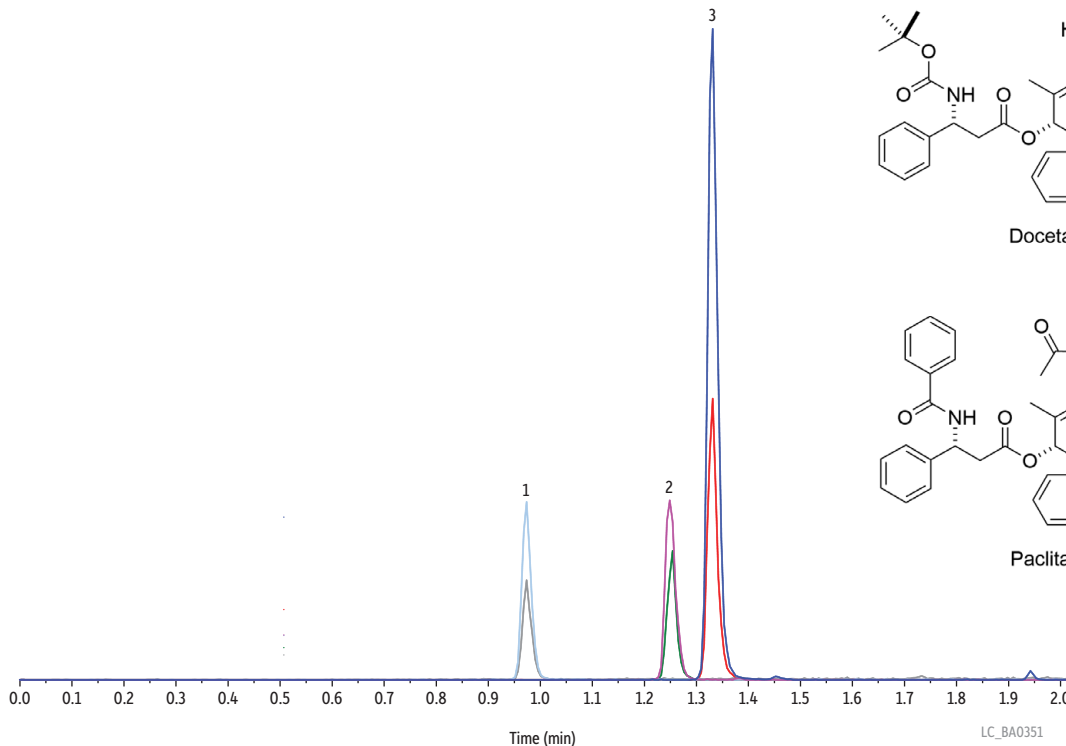
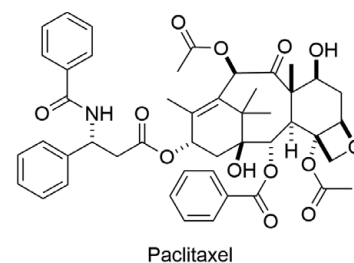
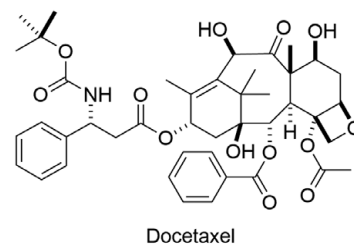
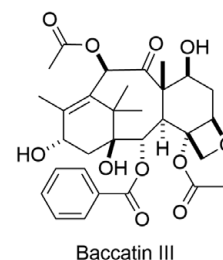
Taxane drugs—such as paclitaxel, docetaxel, and their precursor, baccatin III—are early chemotherapy treatment options. Accurate analysis is critical because these drugs are used for many types of metastatic cancers. As shown here, the selectivity of the Raptor FluoroPhenyl column provides excellent retention and resolution of these structurally similar compounds. Reliable results for these basic compounds can be obtained in fast analysis times using LC-MS/MS friendly solvents.

Figure 7: Raptor FluoroPhenyl columns allow taxane drugs and other basic compounds to be separated quickly and effectively.



Raptor FluoroPhenyl columns have the retention needed for fast, accurate analysis of basic compounds.

Peaks	t _r (min)	Precursor Ion	Product Ion 1	Product Ion 2
1. Baccatin III	0.97	587.0	405.1	105.0
2. Docetaxel	1.25	808.1	527.3	226.1
3. Paclitaxel	1.33	854.1	569.3	286.2



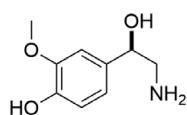
Column: Raptor FluoroPhenyl (cat.# 931955E); Dimensions: 50 mm x 3 mm ID, Particle Size: 5 µm; Temp.: 35 °C; **Sample:** Diluent: Water; Conc.: 100 ng/mL; Inj. Vol.: 5 µL; **Mobile Phase:** A: 0.1% Formic acid in water; B: 0.1% Formic acid in acetonitrile; **Gradient (%B):** 0.00 (25% B), 2.00 (95% B), 2.01 (25% B), 3.50 (25% B); **Flow:** 0.8 mL/min; **Detector:** MS/MS; Ion Mode: ESI+; Mode: MRM; **Instrument:** UHPLC.

Exceptional Selectivity for Clinical Analyses

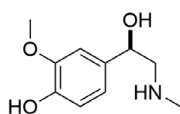
The analysis of normetanephrine and metanephrine provides another example of the power of Raptor FluoroPhenyl columns for analyzing basic compounds. Accurately determining these metabolites of epinephrine/norepinephrine in plasma or urine is one of the best diagnostic tests for neuroendocrine tumors (pheochromocytomas). Normetanephrine and metanephrine are difficult to retain by typical C18 reversed-phase chromatography; however, the Raptor FluoroPhenyl column provides a simple, fast chromatographic solution to this challenging assay. The Raptor FluoroPhenyl column's unique combination of aromatic retention and cation exchange mechanisms are not provided by a C18 column and result in reliable, high-quality separations.

Figure 8: Rapid analysis of metanephrine and normetanephrine on a Raptor FluoroPhenyl column.

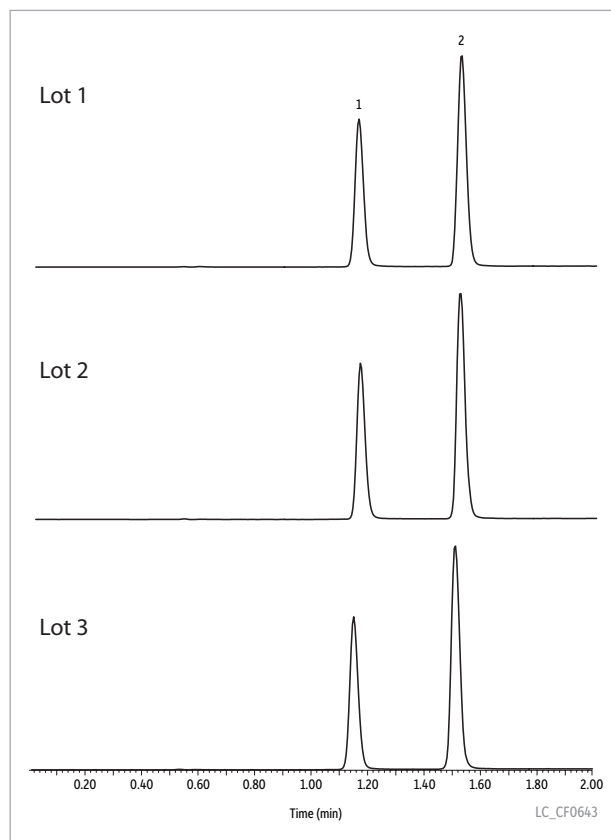
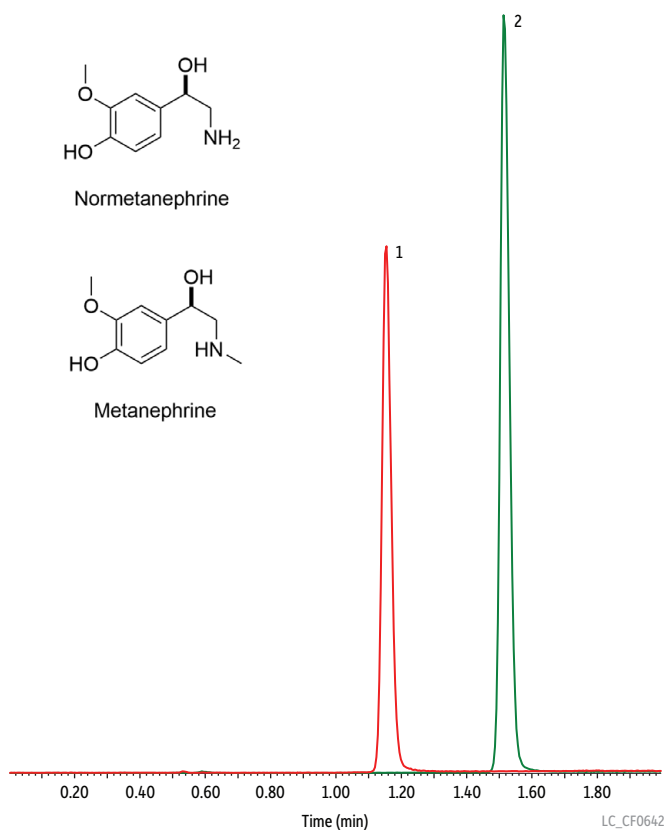
Peaks	t _R (min)	Precursor Ion	Product Ion 1	Product Ion 2
1. Normetanephrine	1.15	166.1	121.1	134.0
2. Metanephrine	1.52	180.1	165.1	148.3



Normetanephrine



Metanephrine



Column: Raptor FluoroPhenyl (cat.# 9319A12); Dimensions: 100 mm x 2.1 mm ID; Particle Size: 2.7 µm; Temp.: 30 °C; **Sample:** Diluent: Water; Conc.: 20 ng/mL; Inj. Vol.: 5 µL; **Mobile Phase:** A: 0.2% Formic acid in water; B: Methanol; **Gradient (%B):** 0.00 min (2% B), 2.00 (40% B), 2.01 (2% B), 6.00 (2% B); Flow: 0.4 mL/min; **Detector:** MS/MS; Ion Mode: ESI+; Mode: MRM; **Instrument:** UHPLC.

Dependable Raptor FluoroPhenyl Columns Give You the Flexibility to Use Both HILIC and RP Modes

Raptor FluoroPhenyl LC Columns (USP L43)



Length	2.1 mm cat.#	3.0 mm cat.#	4.6 mm cat.#
1.8 µm Columns			
30 mm	9319232	—	—
50 mm	9319252	931925E	—
100 mm	9319212	931921E	—
150 mm	9319262	—	—
2.7 µm Columns			
30 mm	9319A32	9319A3E	9319A35
50 mm	9319A52	9319A5E	9319A55
100 mm	9319A12	9319A1E	9319A15
150 mm	9319A62	9319A6E	9319A65
5 µm Columns			
30 mm	—	931953E	—
50 mm	9319552	931955E	9319555
100 mm	9319512	931951E	9319515
150 mm	9319562	931956E	9319565
250 mm	—	—	9319575

EXP Reusable Fittings for HPLC & UHPLC for 10-32 fittings and 1/16" tubing

Effortlessly achieve 8,700+ psi HPLC seals by hand! (Wrench tighten to 20,000+ psi.) Hybrid titanium/PEEK seal can be installed repeatedly without compromising your seal.

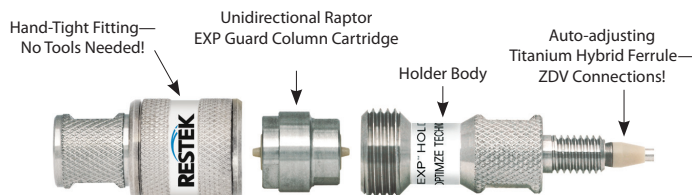


Description	qty.	cat.#
EXP Hand-Tight Fitting (Nut w/Ferrule)	ea.	25937
EXP Hand-Tight Fitting (Nut w/Ferrule)	10-pk.	25938
EXP Hand-Tight Nut (w/o Ferrule)	ea.	25939

Hybrid Ferrule U.S. Patent No. 8201854, EXP Holders U.S. Patent No. 8696902, EXP2 Wrench U.S. Patent No. D766055. Other U.S. and Foreign Patents Pending. The EXP, Free-Turn, and the Opti- prefix are registered trademarks of Optimize Technologies, Inc.

Experience *Selectivity Accelerated*.
Order the Raptor FluoroPhenyl today
at www.restek.com/raptor

Raptor EXP Guard Cartridges—for All Raptor Columns



Protect your investment, extend the life of our already-rugged LC columns, and change guard column cartridges by hand without breaking fluid connections—no tools needed! Great with any Raptor column to get ultimate protection from particulates and matrix contamination, especially when using dilute-and-shoot or other minimal sample preparation techniques.

EXP Direct Connect Holder

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)

Raptor EXP Guard Column Cartridges

Description	Particle Size	qty.	5 x 2.1 mm cat.#	5 x 3.0 mm cat.#	5 x 4.6 mm cat.#
Raptor FluoroPhenyl EXP Guard Column Cartridge	UHPLC	3-pk.	9319U0252	9319U0253	
Raptor FluoroPhenyl EXP Guard Column Cartridges	2.7 µm	3-pk.	9319A0252	9319A0253	9319A0250
Raptor FluoroPhenyl EXP Guard Column Cartridges	5 µm	3-pk.	931950252	931950253	931950250

1,034 bar/15,000 psi* (UHPLC), 600 bar/8,700 psi (2.7 µm); 400 bar/5,800 psi (5 µm).
* For maximum lifetime, recommended maximum pressure for 1.8 µm particles is 830 bar/12,000 psi.

Raptor SPP LC columns combine the speed of SPP with the resolution of USLC technology.
Learn more at www.restek.com/raptor

UltraShield UHPLC PreColumn Filter—for 1.8 µm Raptor Columns

Pair 1.8 µm Raptor columns with an UltraShield filter instead of a guard cartridge to protect against particulates, minimize extra column volume, and maximize UHPLC sample throughput when using SPE, SLE, or other extensive sample preparations.

Description	Filter		
	Porosity	qty.	cat.#
UltraShield UHPLC PreColumn Filter	0.2 µm frit	ea.	25809
		5-pk.	25810
		10-pk.	25811



RESTEK
Pure Chromatography

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Lit. Cat.# GNBR2368B-UNV

Stationary Phase: **Polar X**

Raptor

LC Columns

Selectivity Accelerated

Separate a Wide Variety of Polar Analytes with a Novel Hybrid Stationary Phase

- No time-consuming derivatization or complex ion pairing.
- Switch between retention modes with simple mobile phase changes and short equilibration times.
- Ideal for increasing sensitivity and selectivity in LC-MS analyses.



RESTEK

Pure Chromatography

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Simplify the Analysis of Polar Compounds

Analyzing polar compounds using liquid chromatography has historically been a challenge. Poor retention and peak shape, complex mobile phases that may not be MS-friendly, long equilibration times, low sensitivity, and sample derivatization are all complications that reduce lab efficiency and productivity. However, the development of a novel column that is specifically designed for the analysis of a broad range of polar compounds allows scientists to avoid these problems by taking advantage of the true power of chromatography.

Providing the True Power of Chromatography

One of the most significant, yet least understood, aspects of method performance is the importance of using the proper stationary phase for a particular separation. For the analysis of polar compounds, reversed-phase columns do not provide adequate retention without the use of complex mobile phases or sample derivatization to compensate for the lack of effective interactions between the analytes and the column. But, by matching analytes to a stationary phase that provides purpose-built resolving power, you can avoid complex sample preparation procedures, save time and money, and reduce opportunities for error.

The Raptor Polar X stationary phase is specifically designed to selectively retain polar analytes through a balance of two retention mechanisms. This unique hybrid phase is ideal for analyzing a wide variety of polar compounds, especially when coupled with mass spectrometry. Simplify the analysis of polar compounds with the resolving power of Raptor Polar X columns from Restek.

Column Description

Pore Size:
90 Å

Particle:
2.7 µm superficially porous particle (SPP) silica

Surface Area:
130 m²/g

End-Cap:
Proprietary

Carbon Load:
Proprietary

USP Phase Code:
NA

Phase Category:
Proprietary

Ligand Type:
Proprietary

Recommended Usage:
pH Range: 2-8

Maximum Temperature: 60 °C

Maximum Pressure: 600 bar/8700 psi



Properties:

- Excellent resolution and separation of a wide variety of polar compounds.
- Combines HILIC and ion-exchange retention mechanisms together in a single ligand.
- Broadly applicable for polar compound analysis spanning different industries and methods.

Switch to a Raptor Polar X when:

- You are analyzing neutral, acidic, basic, or permanently charged polar compounds.
- Performing LC-MS/MS analysis of polar compounds.
- You are struggling to retain or elute polar compounds and considering ion chromatography.

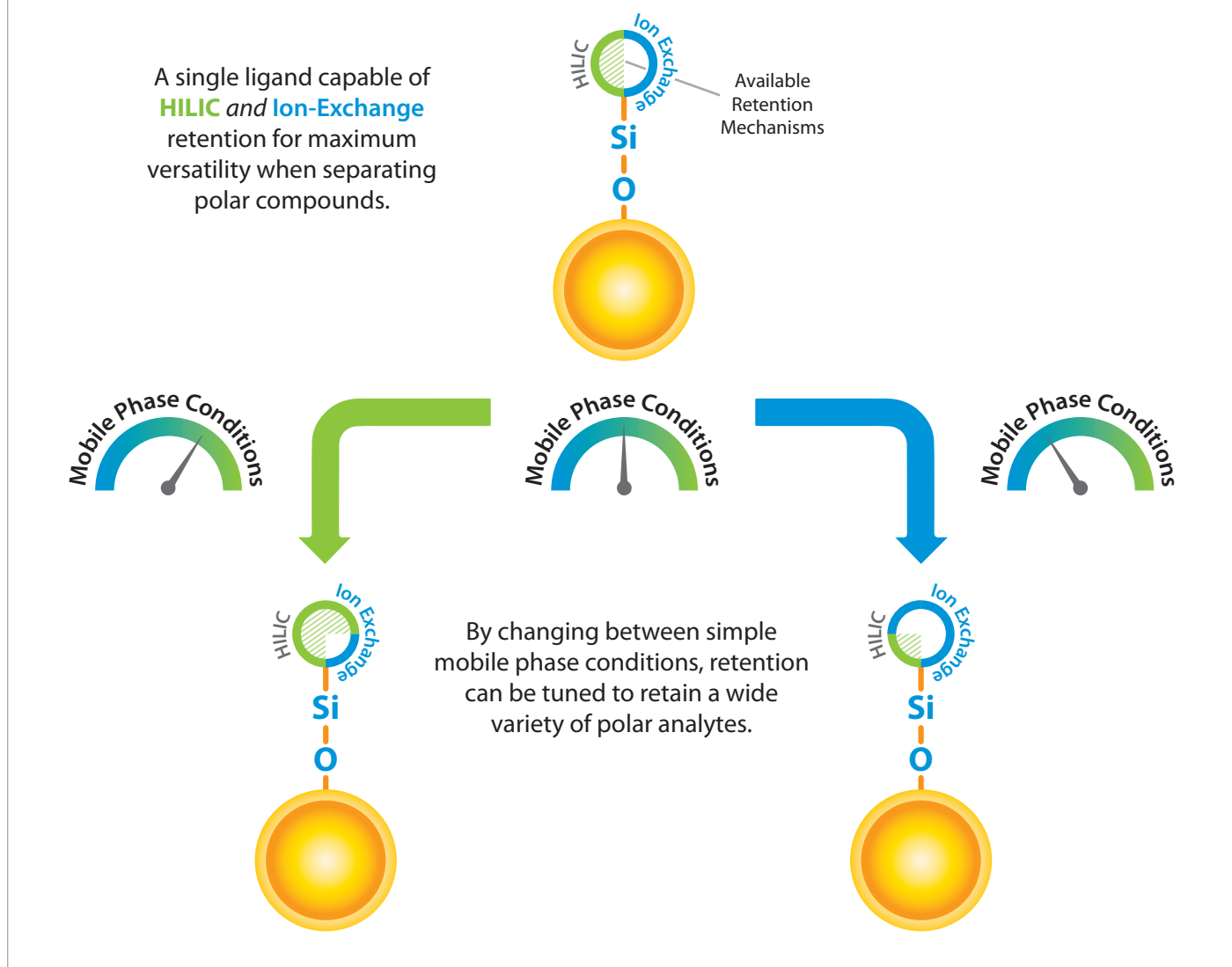


Greater Than the Sum of Its Parts

Recognizing that the retention mechanisms most commonly used to retain polar compounds are hydrophilic interaction chromatography (HILIC) and ion-exchange approaches, Restek has developed a novel stationary phase chemistry that combines both modes on a single ligand. Because this unique ligand is bound to superficially porous particles, Raptor Polar X columns both reliably retain and efficiently separate a broad range of polar analytes.

Typical application-specific columns favor one retention mode over another, and gains made in the retention of one type of polar compound come at the expense of the performance for others. In contrast, with the Raptor Polar X column's patent-pending phase chemistry, two independent retention mechanisms are available for use, which provides truly balanced and flexible retention (Figure 1). Simple changes to mobile phase conditions allow analysts to switch between modes and selectively tune retention for the compounds of interest without needing long equilibration times before use or between samples.

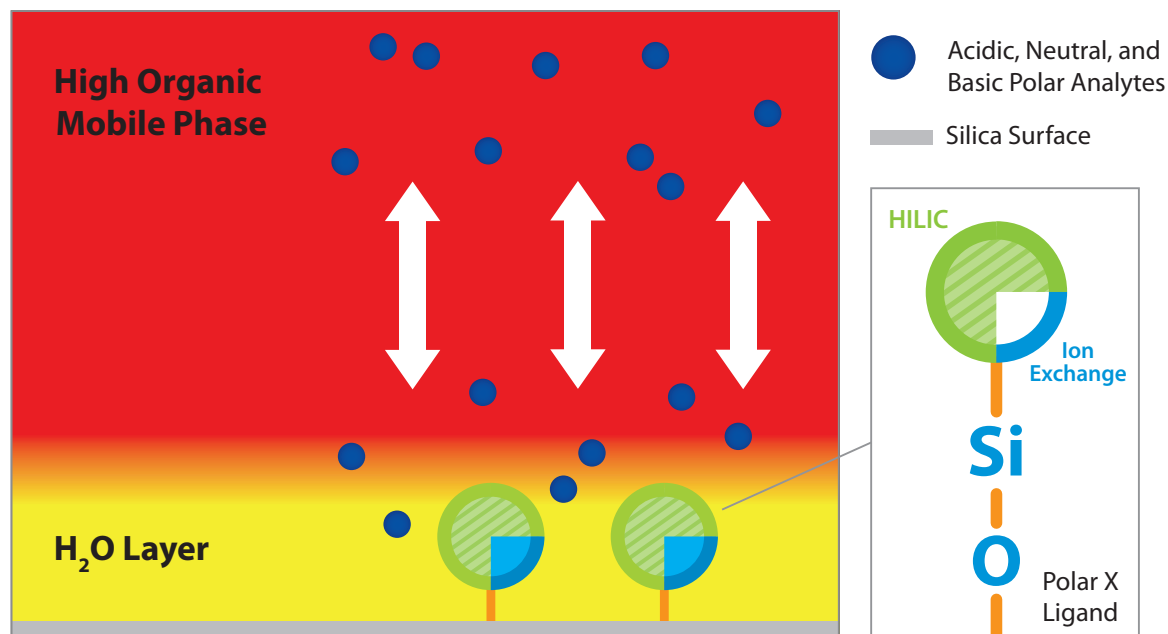
Figure 1: The Raptor Polar X column can quickly and easily be switched between polar retention modes by simple changes in mobile phase conditions, providing an unprecedented ability to retain and separate a wide variety of polar compounds, even in the same analysis.



How It Works: Switching Retention Modes

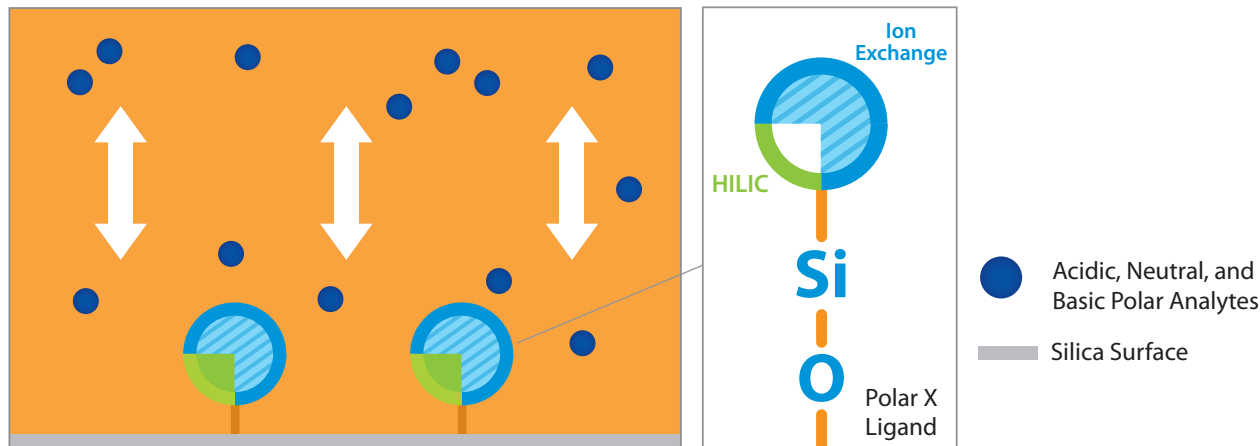
When using a mobile phase with a relatively high percentage of acetonitrile to water, a layer of water is formed at the surface of the silica into which polar compounds can partition. Partitioning into the water layer results in effective interactions between polar analytes and the ligand bound to the silica surface (Figure 2). The novel Raptor Polar X ligand chemistry makes this technique even easier, allowing for faster-than-ever column equilibration and re-equilibration. This means new columns are ready for use quickly, and sample throughput increases because less re-equilibration time is required between samples.

Figure 2: The rapid formation of a water layer at the silica surface allows a wide range of polar analytes to partition between the acetonitrile in the mobile phase and the water layer. This partitioning, along with interactions with the stationary phase, defines the HILIC retention mechanism.



For smaller polar compounds, these high-percentage acetonitrile conditions generate strong interactions between the analytes and the stationary phase, leading to excellent retention of small, highly polar, charged compounds. To fine-tune retention, simply increase the amount of water in the mobile phase. This will draw the charged, polar compounds into the mobile phase, effectively eluting them. When moving to a higher percent water mobile phase, the distinct HILIC partitioning retention will diminish and the stationary phase's ion-exchange characteristics will become the dominant retention mechanism (Figure 3).

Figure 3: Under mobile phase conditions with higher water content, ion-exchange mechanisms take over as the dominant mode of retention for the analysis of polar compounds.



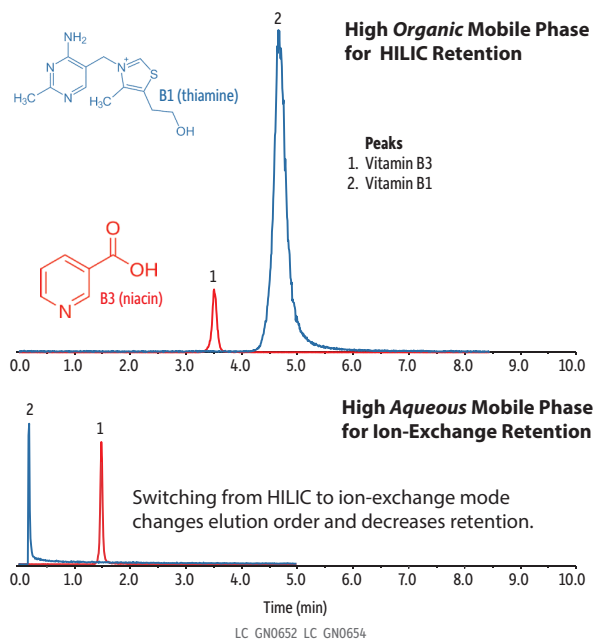
Retention Mode Switching: An Example

To illustrate these principles in action, Figure 4 demonstrates how two different types of polar compounds interact with the stationary phase, and how their responses are affected by simple mobile phase changes. In this example, we analyzed two water-soluble vitamins: vitamin B3 (niacin), which is an organic acid, and vitamin B1 (thiamine), which has a permanent positive charge.

In the top chromatogram, a highly organic mobile phase was used, which is favorable to HILIC separations. Using the Raptor Polar X column under these conditions, a water layer quickly forms on the surface of the silica particles. This allows polar compounds to partition from the acetonitrile layer into the water layer where they can also interact with the silica surface and the stationary phase. In this way, polar compounds are retained through hydrophilic interactions with the stationary phase and are still eluted under highly organic mobile phase conditions. This is very favorable for LC-MS/MS analysis because of the improved desolvation and increased ionization efficiency.

The bottom chromatogram highlights the chromatographic changes that are seen when the retention mechanism is switched by moving to a mobile phase with a higher percentage of water. As we move further away from ideal HILIC conditions, both vitamin B1 and vitamin B3 are less retained. This is because as the percentage of water in the mobile phase increases, conditions shift away from HILIC retention and toward the ion exchange retention characteristics of the phase. The elution order also changes because vitamin B1 is less retained than vitamin B3 under ion-exchange conditions.

Figure 4: Simple changes to easy-to-prepare, MS-friendly mobile phases can emphasize or deemphasize the different retention mechanisms available with the novel Raptor Polar X phase chemistry.



Column: Raptor Polar X (cat.# 9311A52); Dimensions: 50 mm x 2.1 mm ID, Particle Size: 2.7 µm; Temp.: 30 °C; **Sample:** Diluent: 0.1% Formic acid in acetonitrile; **Mobile Phase:** Flow: 0.5 mL/min; **Detector:** LC-MS/MS; Ion Source: Electrospray; Ion Mode: ESI+; **Instrument:** HPLC; **Notes:** Mobile phase A: Water, 5 mM ammonium formate, 0.1% formic acid; Mobile phase B: Acetonitrile, 0.1% formic acid; Top chromatogram: 95% B, 10 min run, 2 µL injection (100 ppm B3, 0.01 ppm B1); Bottom chromatogram: 60% B, 5 min run, 0.5 µL injection (100 ppm B3, 0.1 ppm B1).

Well-Balanced Hybrid Retention Lets You Analyze More Compounds with a Single Method

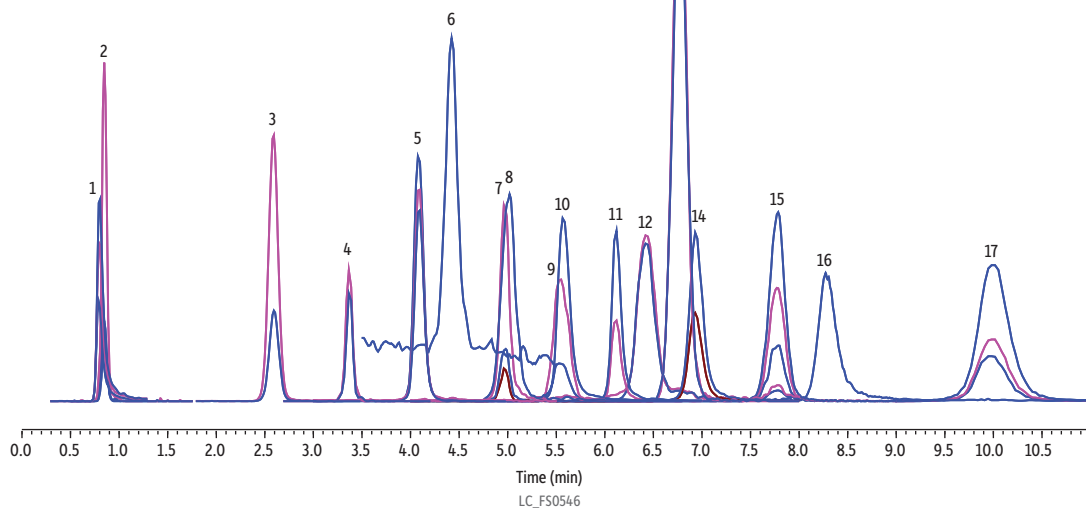
It is common for columns to specialize: to focus on a single type of interaction to the exclusion of others. This approach works well when the target analytes all share the same characteristics; however, polar compounds vary widely in their chemical traits. For the analysis of polar compounds, a specialized approach to column selection often means having to use multiple methods with different columns or conditions for each type of compound. As shown in the following examples, the hybrid phase chemistry of Raptor Polar X columns is a better alternative because the multimode retention profile allows a wide variety of target analytes to be analyzed in the same method.

QuPpe-Inspired List of Polar Contaminants

The European **Quick Polar Pesticides (QuPpe)** method includes a range of polar analytes from anionic polar herbicides, such as glyphosate and related compounds, to a variety of oxychloro contaminants, including chlorate and perchlorate. As shown in Figure 5, the Raptor Polar X column retains and quickly separates this diverse mix with the last compound eluting around 10.5 minutes and a total run time of only 13 minutes. This separation is performed with simple unbuffered mobile phases, acidified with 0.5% formic acid to reduce peak broadening and tailing. The method demonstrated in Figure 5 was also able to separate compounds that have similar mass fragments, like AMPA from N-acetyl AMPA and fosetyl aluminum from phosphonic acid and phosphoric acid (a commonly observed matrix component and source of interference).

Figure 5: In this analysis of polar compounds, a diverse group of analytes can all be successfully separated in a single run with the uniquely balanced retention characteristics of the Raptor Polar X column.

Peaks	t_r (min)	Conc. (ng/mL)	Precursor Ion	Product Ion 1	Product Ion 2	Product Ion 3	Precursor 2	Product Ion 2
1. Aminomethylphosphonic acid (AMPA)	0.805	200	110.1	79.1	63.1	81.1	-	-
2. Bialophos	0.847	100	322.2	88.2	216.1	134.2	-	-
3. Perchlorate	2.593	5	101.0	84.95	-	-	98.9	83
4. Glufosinate	3.376	200	180.2	85.2	95.1	-	-	-
5. 3-(Methylphosphinico) propionic acid (MPPA)	4.076	100	151.0	63.0	107.1	133.2	-	-
6. Trifluoroacetic acid (TFA)	4.423	20	113.0	69.1	19.1	-	-	-
7. 2-Hydroxyethane phosphonic acid (HEPA)	4.969	100	125.1	79.0	95.0	63	-	-
8. Difluoroacetic acid (DFA)	5.018	200	95.0	51.1	-	-	-	-
9. Chlorate	5.542	100	85.0	69.0	-	-	83.0	67.1
10. Ethephon	5.564	200	143.1	107.2	-	-	-	-
11. Glyphosate	6.113	200	168.1	63.1	79.1	-	-	-
12. Bromide	6.423	2000	80.9	80.9	-	-	79.0	79.0
13. Bromate	6.771	600	129.0	113	-	-	127	111.1
14. N-acetyl AMPA	6.932	200	152.1	110.1	62.9	-	-	-
15. Fosetyl aluminum	7.775	80	109.1	81.0	63.0	78.9	-	-
16. Phosphonic acid	8.275	500	81.1	62.9	-	-	-	-
17. N-acetyl glufosinate	9.980	200	222.2	136.1	134.1	59.0	-	-



Column: Raptor Polar X (cat.# 9311A32); Dimensions: 30 mm x 2.1 mm ID, Particle Size: 2.7 μ m; Pore Size: 90 \AA ; Temp.: 35 $^{\circ}\text{C}$; **Sample:** Diluent: Water; Inj. Vol.: 1 μ L; **Mobile Phase:** A: Water, 0.5% formic acid; B: Acetonitrile, 0.5% formic acid; Gradient (%B): 0.00 min (65% B), 5.0 min (10% B), 11.5 min (10% B), 11.51 min (65% B), 13 min (65% B); Flow: 0.5 mL/min; **Detector:** MS/MS; Ion Mode: ESI-; Mode: MRM; **Instrument:** UHPLC.

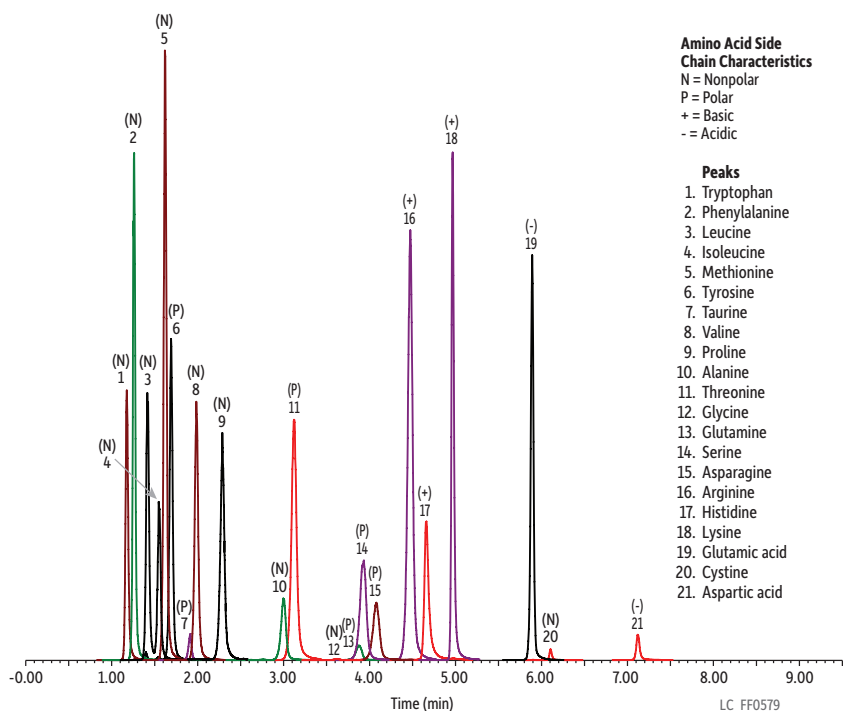
Underivatized Amino Acids

Amino acids are a diverse group of very polar compounds that are commonly analyzed with reversed-phase or ion-exchange chromatography using pre- or post-column derivatization. Direct analysis of underivatized amino acids is challenging due to limited retention and poor chromatographic performance. However, underivatized amino acids with nonpolar, polar, positively charged, and negatively charged side chains are all retained and easily separated in one method on a Raptor Polar X column. Figure 6 shows the analysis of 21 amino acids, including a taurine supplement, in a liquid baby formula matrix using a simple protein precipitation and direct analysis of the resulting extract.

Ultrashort- to Long-Chain PFAS

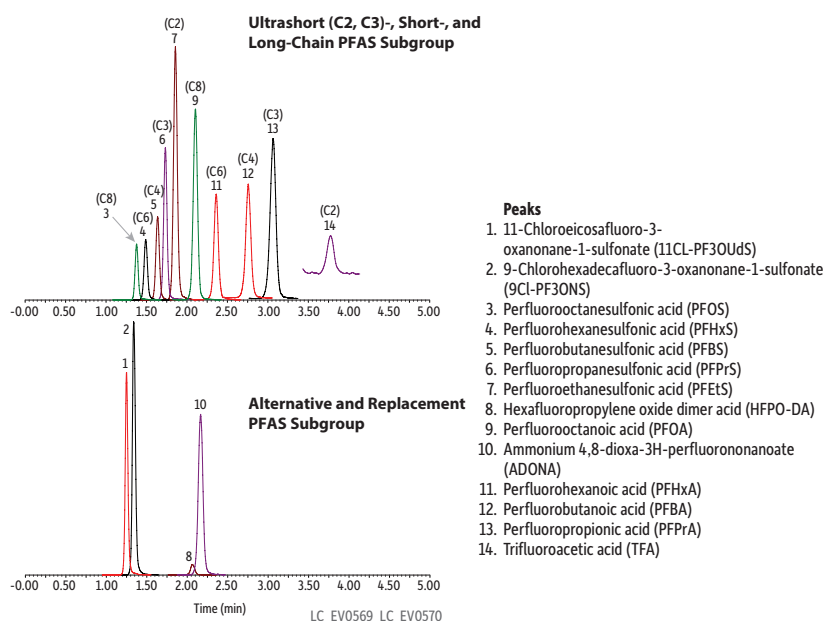
The last illustration of the Raptor Polar X column's ability to maximize method productivity is an application that paves a path for future testing. Current LC-MS/MS methods for per- and polyfluoroalkyl substances (PFAS) analysis are focused on short-chain (C4-C6), long-chain (C8 and up), and alternative compounds and do not include emerging ultrashort-chain (C2 and C3) compounds. Typical reversed-phase methods for PFAS analysis do not have sufficient retention for ultrashort-chain PFAS; whereas, other methods based on anionic exchange often have too much retention, resulting in poor chromatographic performance. Because of the balanced retention mechanisms found in the Raptor Polar X column, ultrashort-chain PFAS and long chain PFAS can all be analyzed in a single 5-minute isocratic run (Figure 7).

Figure 6: Compounds with various polarities, such as these amino acids, can all be analyzed using the same method on a Raptor Polar X column.



Column: Raptor Polar X (cat.# 9311A12); Dimensions: 100 mm x 2.1 mm ID, Particle Size: 2.7 µm; Temp.: 30 °C; **Sample:** Diluent: 20:80 Water:acetonitrile, 0.01 N HCl; Conc.: Endogenous amino acids; Inj. Vol.: 5 µL; **Mobile Phase:** A: Water, 0.5% formic acid; B: 9:1 Acetonitrile:water, 20 mM ammonium formate, pH 3.0; Gradient (%B): 0.00 min (88% B), 3.50 min (88% B), 8.00 min (30% B), 8.01 min (88% B), 10.0 min (88% B); Flow: 0.5 mL/min; **Detector:** MS/MS; Ion Mode: ESI+; Mode: MRM; **Instrument:** UHPLC; **Notes:** *Sample Preparation:* A 200 µL aliquot of protein hydrolysate formula (Similac ALIMENTUM) was mixed with 800 µL of acetonitrile and 10 µL of 1 N HCl. After centrifugation at 4000 rpm for 5 minutes, the supernatant was diluted 20-fold with 20:80 water:acetonitrile (0.01 N HCl) and injected for analysis. *Mobile Phase B Preparation:* To make 500 mL of mobile phase B, measure ~45 mL of water into a small beaker and add 1 mL of 10 M ammonium formate solution. Adjust pH to 3.0 by adding formic acid and then bring the volume to 50 mL with water. Combine this 50 mL ammonium formate solution (pH 3.0) with 450 mL of acetonitrile to complete the preparation.

Figure 7: Ultrashort-chain, legacy, and alternative PFAS analyzed with a single method on the novel Raptor Polar X stationary phase.



Column: Raptor Polar X (cat.# 9311A52); Dimensions: 50 mm x 2.1 mm ID, Particle Size: 2.7 µm; Temp.: 40 °C; **Sample:** Diluent: 50:50 Water:-methanol; Conc.: 400 ng/L; Inj. Vol.: 10 µL; **Mobile Phase:** A: Water, 10 mM ammonium formate, 0.05% formic acid; B: 60:40 Acetonitrile:methanol, 0.05% formic acid; Gradient (%B): 0.00 min (85% B), 8.00 min (85% B); Flow: 0.5 mL/min; **Detector:** MS/MS; Ion Mode: ESI-; Mode: MRM; **Instrument:** UHPLC.

Multimode Retention Combines Balance and Strength

Although Raptor Polar X columns are designed to have well-balanced retention characteristics for the analysis of polar compounds, the presence of multiple mechanisms does not dilute their individual strength. Here, we illustrate the retentive power of Raptor Polar X columns using direct large volume injection for trace-level analysis of glyphosate in water.

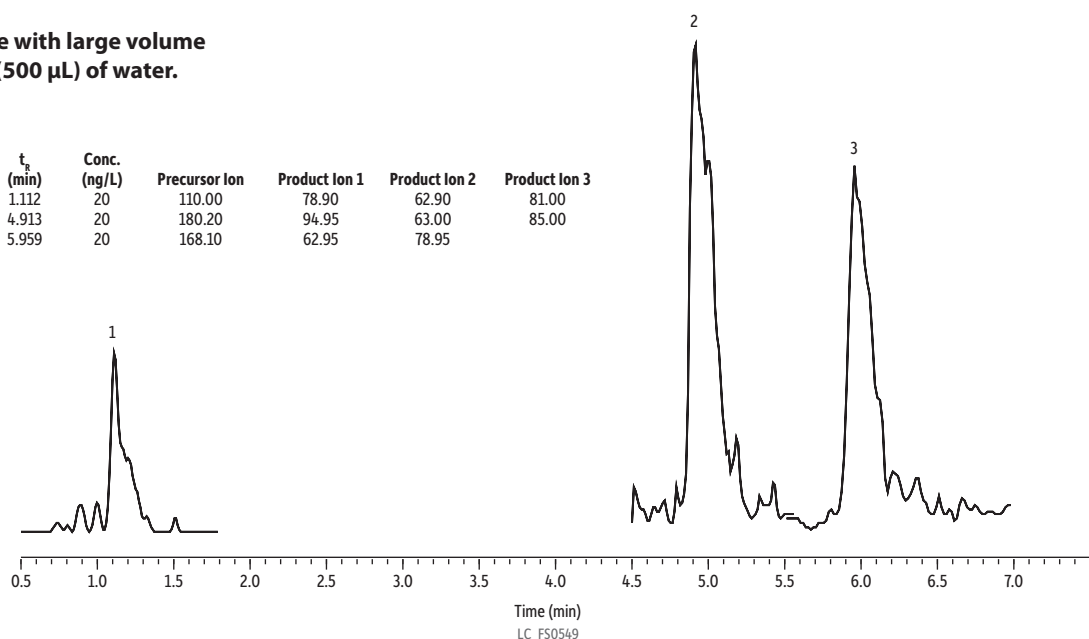
Methods for glyphosate in water often also include its main metabolite, AMPA, and glufosinate, which is another commonly used herbicide with a similar chemical structure. These polar anionic target compounds must be detected at low part-per-trillion (ppt) levels, but this is difficult primarily because (1) they are not retained on reversed-phase columns, and (2) they often display poor response due to chelation with metal surfaces along the sample flow path through the LC-MS/MS system. Derivatization and ion-pairing reagents are often used to improve performance, but they can be unfriendly to the instrument and require additional sample preparation time.

Figure 8 shows the analysis of 20 ppt concentrations of glyphosate, AMPA, and glufosinate in HPLC-grade water using direct 500 μ L injections. Under these challenging aqueous conditions, most columns would not be able to retain such hydrophilic polar analytes, and peak shape and sensitivity would suffer. However, retention on the Raptor Polar X column is strong enough to capture and hold target compounds even during the injection of large volumes of water. Strong retention results in good peak shape and response, which allows for easy identification and integration. Similar performance was observed over a range of concentrations as shown in the 100–1000 ppt calibration curves presented in Figure 9.

Figure 8: The Raptor Polar X column effectively retains anionic polar herbicides during direct large volume water injections at concentrations as low as 20 ppt.

- **Compatible with large volume injections (500 μ L) of water.**

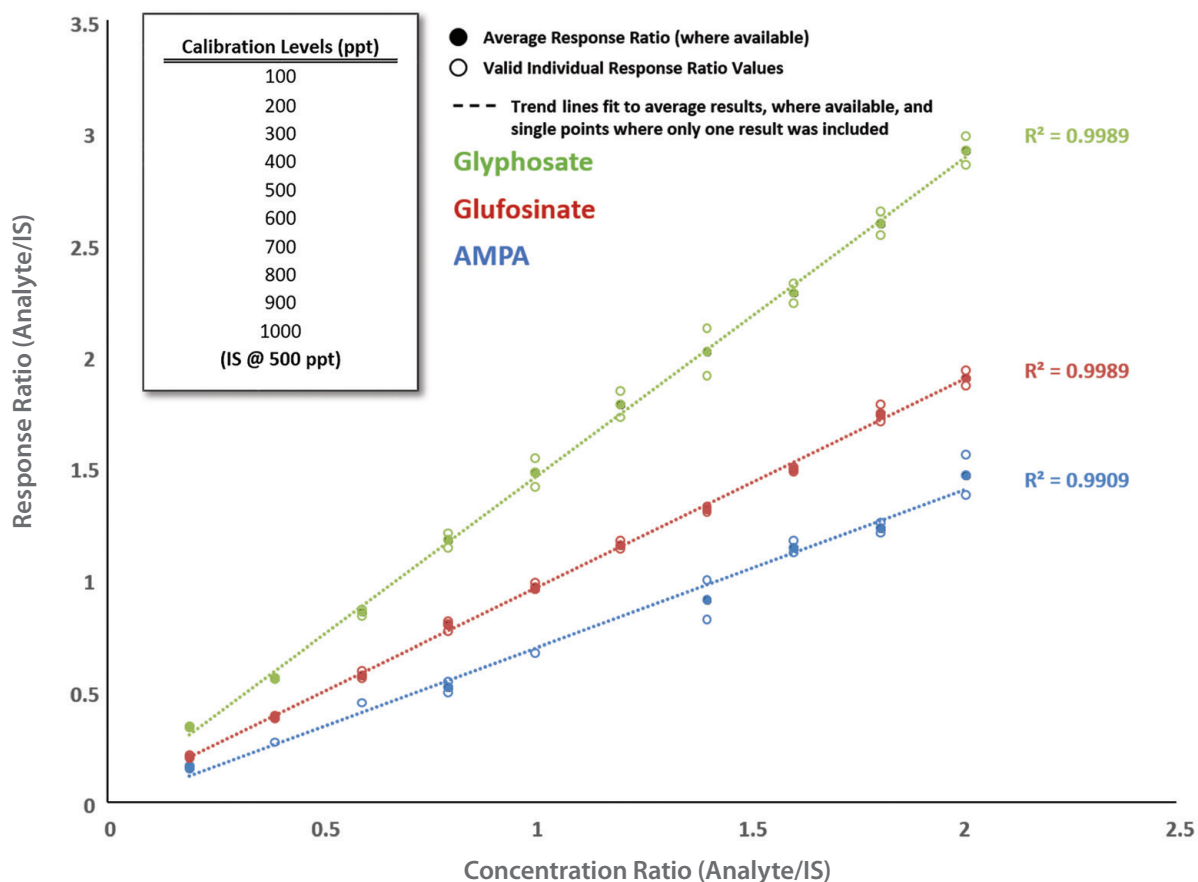
Peaks	t_R (min)	Conc. (ng/L)	Precursor Ion	Product Ion 1	Product Ion 2	Product Ion 3
1. AMPA	1.112	20	110.00	78.90	62.90	81.00
2. Glufosinate	4.913	20	180.20	94.95	63.00	85.00
3. Glyphosate	5.959	20	168.10	62.95	78.95	



Column: Raptor Polar X (cat.# 9311A32); Dimensions: 30 mm x 2.1 mm ID, Particle Size: 2.7 μ m; Pore Size: 90 \AA ; Temp.: 30 $^{\circ}$ C; **Sample:** Diluent: HPLC water; Inj. Vol.: 500 μ L; **Mobile Phase:** A: Water, 0.5% formic acid; B: Acetonitrile, 0.5% formic acid; Gradient (%B): 0.00 min (95% B), 1.0 min (95% B), 3.0 min (10% B), 9.0 min (10% B), 9.01 min (95% B), 10.5 min (95% B); Flow: 0.5 mL/min; **Detector:** MS/MS; Ion Mode: ESI-; Mode: MRM; **Instrument:** UHPLC.

Figure 9: 100–1000 ppt calibration curves using isotopically labeled internal standards and direct large volume injections of water on the Raptor Polar X column.

Calibration Curves for Polar Anionic Herbicides in HPLC Grade Water (Isotopically Labeled Internal Standards Used)



To Passivate or Not to Passivate?

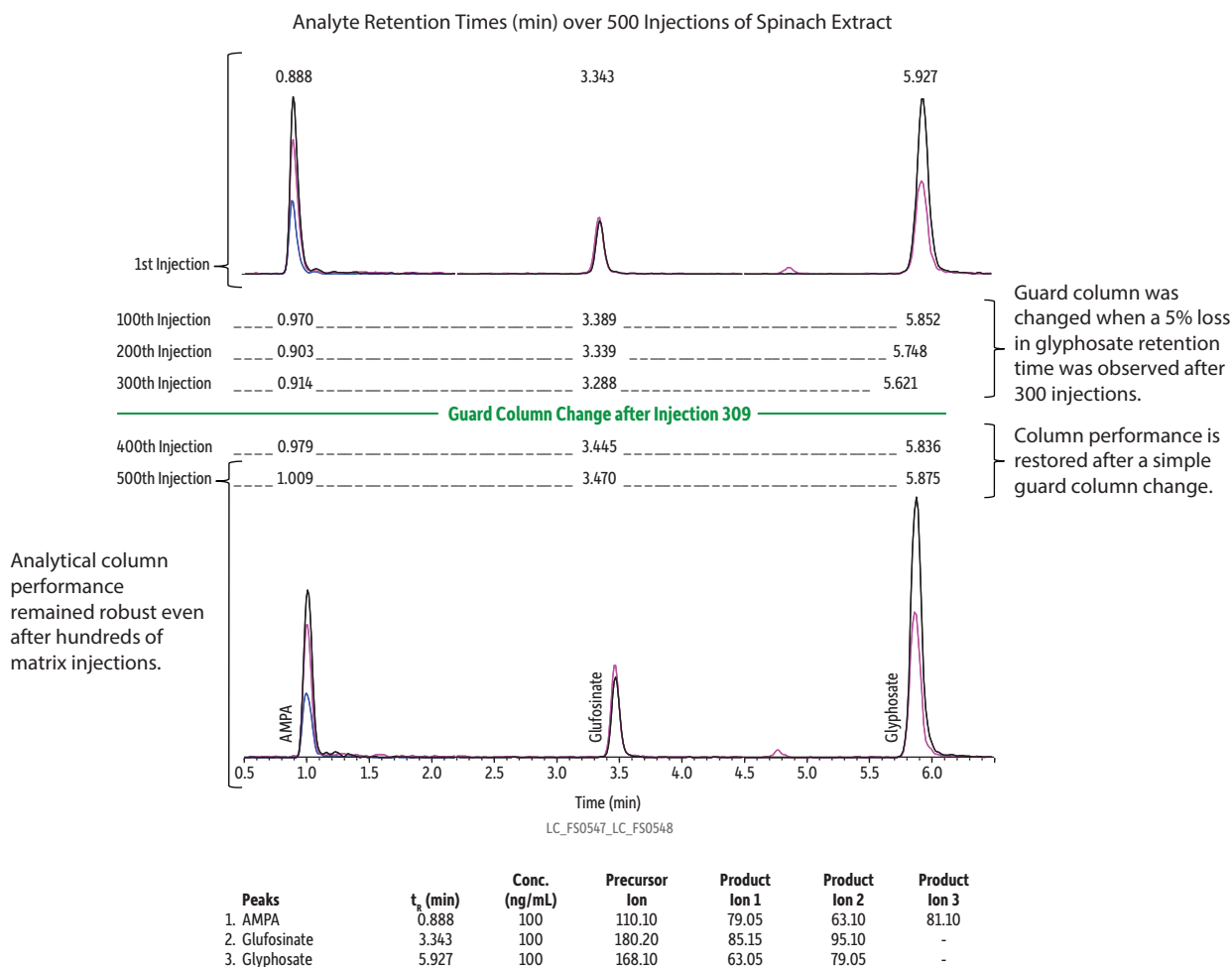
Glyphosate can be difficult to analyze at trace levels because it chelates with active metal sites in an LC system. Even though the Raptor Polar X column contains a treated sample flow path and arrives in your lab ready for initial use, metal components along the sample flow path through the LC instrument may benefit from passivation. Whether or not passivation is required will depend on the application and on your particular instrument setup, but for the analysis of polar compounds that are known to chelate, such as glyphosate, Restek recommends treating your system with LC passivation solution (cat.# 32475) prior to running samples.



A Novel Stationary Phase Built on the Time-Tested Foundation of Raptor Quality

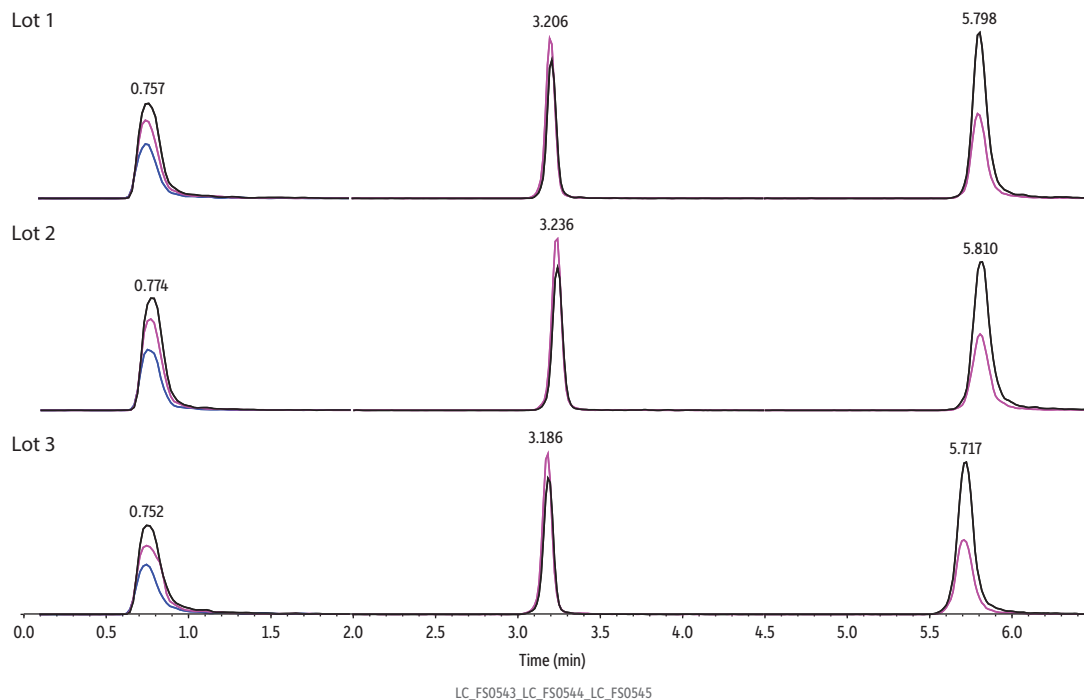
The Raptor Polar X has been designed, manufactured, and tested to the same exacting standards that have made Raptor columns synonymous with quality. Whether it's robust injection-to-injection performance when analyzing real-world samples in challenging matrices like spinach (Figure 10) or reliable column-to-column performance when it is eventually time to replace the column (Figure 11), you can count on Raptor brand quality. In addition, the single ligand approach to the Raptor Polar X column's hybrid retention functionality helps ensure that each column is made uniformly and can withstand even aggressive conditions such as large volume water injections without loss of stationary phase.

Figure 10: Excellent peak shape and retention time stability after hundreds of injections of a spinach extract demonstrate the robust performance of Raptor Polar X columns for the analysis of polar compounds.



Column: Raptor Polar X (cat.# 9311A32); Dimensions: 30 mm x 2.1 mm ID, Particle Size: 2.7 μ m; Pore Size: 90 \AA ; Guard Column: Raptor Polar X guard column cartridge 5 mm, 2.1 mm ID, 2.7 μ m (cat.# 9311A0252) Temp.: 35 $^{\circ}$ C; **Sample:** Spinach extract; Inj. Vol.: 2 μ L; **Mobile Phase:** A: Water, 0.5% formic acid; B: Acetonitrile, 0.5% formic acid; Gradient (%B): 0.00 min (65% B), 5.0 min (10% B), 6.5 min (10% B), 6.51 min (65% B), 8 min (65% B); Flow: 0.5 mL/min; **Detector:** MS/MS; Ion Mode: ESI-; Mode: MRM; **Instrument:** UHPLC; **Notes:** Frozen spinach was added to a Blixer processor with dry ice (3:1-4:1 ratio) and then ground into a very fine powder. The homogenate was placed into the freezer immediately. A 5.0 gram sample of the spinach powder was weighed into a 50 mL centrifuge tube (cat.# 25846). According to the QuPPe method (Quick Polar Pesticides Method), 5.0 mL of methanol with 1.0% formic acid was added into the centrifuge tube. The tube was shaken by hand for 1 min and then by a mechanical shaker vigorously for 5 min. After centrifuging for 10 min at 4200 rpm, the supernatant was filtered through a 0.22 μ m filter (cat.# 23984). The final extract was fortified with the AMPA, glufosinate and glyphosate at a final concentration of 100 ng/mL.

Figure 11: Raptor Polar X columns provide reliable lot-to-lot reproducibility.



Peaks	Conc. (ng/mL)	Precursor Ion	Product Ion 1	Product Ion 2	Product Ion 3
1. AMPA	100	110.10	79.05	63.10	81.10
2. Glufosinate	100	180.20	85.15	95.10	-
3. Glyphosate	100	168.10	63.05	79.05	-

Column: Raptor Polar X (cat.# 9311A32); Dimensions: 30 mm x 2.1 mm ID, Particle Size: 2.7 µm; Pore Size: 90 Å; Temp.: 35 °C; **Sample:** Diluent: Water; Inj. Vol.: 5 µL; **Mobile Phase:** A: Water, 0.5% formic acid; B: Acetonitrile, 0.5% formic acid; Gradient (%B): 0.00 min (65% B), 5.0 min (10% B), 6.5 min (10% B), 6.51 min (65% B), 8 min (65% B); Flow: 0.5 mL/min; **Detector:** MS/MS; Ion Mode: ESI-; Mode: MRM; **Instrument:** UHPLC.

Raptor Polar X Columns: Revolutionizing the LC Analysis of Polar Compounds

Poor retention, low response, complex sample preparation procedures...the analysis of polar compounds historically has posed challenges to both data quality and lab productivity. Now, Raptor Polar X columns—with their novel phase chemistry that blends HILIC and ion-exchange retention on a single ligand—significantly simplify the analysis of these difficult and varied compounds. And, by bonding that unique ligand to superficially porous particles (SPP), Restek has created a phase that retains and efficiently separates a wide variety of polar compounds. The synergy created by these features results in an unparalleled ability to analyze a wide variety of polar compounds, providing a powerful, productive, and versatile tool for LC scientists across many industries.

Raptor Polar X LC Columns

- Reliably analyze a wide variety of polar analytes (acidic, basic, and neutral) without time-consuming derivatization or complex ion pairing.
- Switch between HILIC and ion-exchange retention modes with simple mobile phase changes and short equilibration times.
- 2.7 μm Raptor core-shell particles provide the speed of SPP with greater efficiency and capacity than 5 μm particles.
- Ideal for increasing sensitivity and selectivity in LC-MS analyses.

ID	Length	qty.	cat.#
2.7 μm Particles			
	30 mm	ea.	9311A32
2.1 mm	50 mm	ea.	9311A52
	100 mm	ea.	9311A12

LC Passivation Solution

Methylenediphosphonic acid (Medronic Acid) (1984-15-2)

Description	CAS #	Conc. in Solvent	cat.#
Methylenediphosphonic acid (Medronic Acid)	1984-15-2	1,760 $\mu\text{g}/\text{mL}$, Methanol (HPLC grade)/Water (50:50), 1mL/ampul	32475 (ea.)

Raptor EXP Guard Column Cartridges and EXP Direct Connect Holder

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, especially when using dilute-and-shoot or other limited sample preparation techniques.

Description	Particle Size	Size	qty.	cat.#
Raptor Polar X EXP Guard Column Cartridge	2.7 μm	5 x 2.1 mm	3-pk.	9311A0252

Maximum cartridge pressure: 600 bar/8700 psi (2.7 μm)

Hybrid Ferrule U.S. Patent No. 8201854, EXP Holders U.S. Patent No. 8696902, EXP2 Wrench U.S. Patent No. D766055. Other U.S. and Foreign Patents Pending. The EXP, Free-Turn, and the Opti- prefix are registered trademarks of Optimize Technologies, Inc.

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)

Hybrid Ferrule U.S. Patent No. 8201854, EXP Holders U.S. Patent No. 8696902, EXP2 Wrench U.S. Patent No. D766055. Other U.S. and Foreign Patents Pending. The EXP, Free-Turn, and the Opti- prefix are registered trademarks of Optimize Technologies, Inc.



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