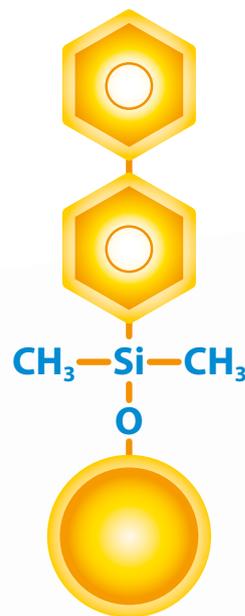


Stationary Phase: **Biphenyl**

Raptor[™]
LC Columns

Selectivity Accelerated

Fast, Rugged Raptor[™] Columns
with Time-Tested Selectivity



RESTEK[®]

Pure Chromatography

BGB GC | LC
MS | CE

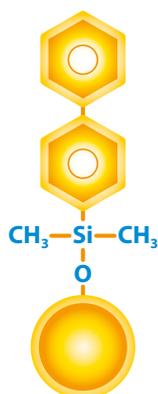
The Raptor™ Biphenyl Column

With Raptor™ LC columns, Restek chemists became the first to combine the speed of superficially porous particles (also known as SPP or “core-shell” particles) with the resolution of highly selective USLC® technology. This new breed of chromatographic column allows you to more easily achieve peak separation and faster analysis times without expensive UHPLC instrumentation.

Our top priority when developing our new 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 like drug and metabolite analyses, especially those that require a mass spectrometer (MS). Increasing retention of early-eluting compounds can limit ionization suppression, and the heightened selectivity helps eliminate the need for complex mobile phases that are not well suited for MS detection.

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:

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

Pore Size:

90 Å

Surface Area:

150 m²/g (2.7 μm)
or 100 m²/g (5 μm)

Recommended Usage:

pH Range: 1.5–8.0

Maximum Temperature: 80 °C

Maximum Pressure: 600 bar / 8,700 psi (2.7 μm)

or 400 bar / 5,800 psi (5 μm)

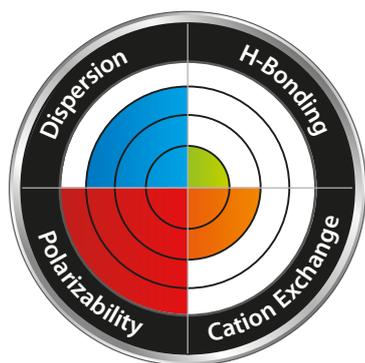
Properties:

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

Switch to a Biphenyl when:

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

Column Interaction Profile:



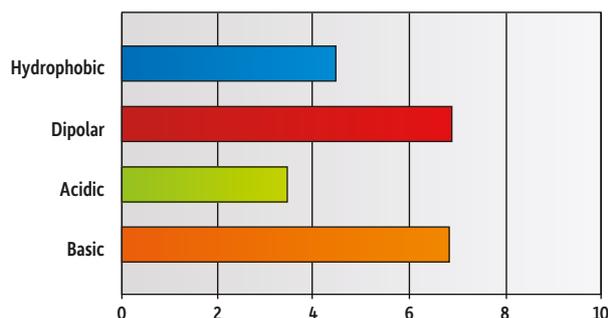
Defining Solute Interactions:

- Polarizability
- Dispersion

Complementary Solute Interaction:

- Cation exchange

Solute Retention Profile:

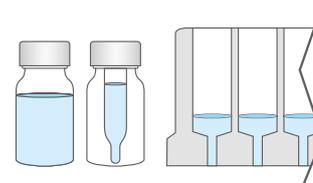


Target Analyte Structures:

- 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 like 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.

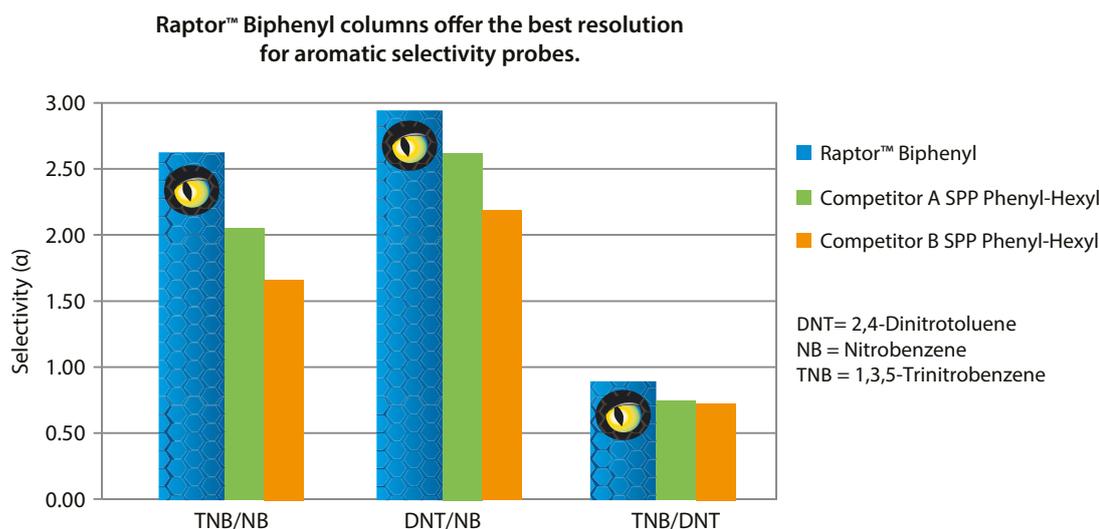
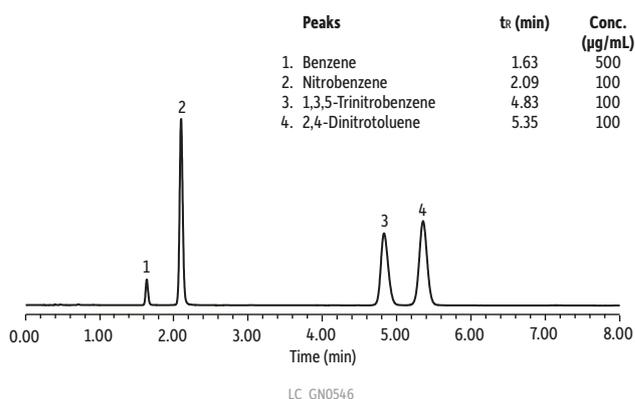


Figure 2: Raptor™ Biphenyl columns show increased retention for compounds containing electron withdrawing groups. Retention and elution order are dramatically different from a traditional C18.



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.

Part of the USLC® column set!

RESTEK®  **USLC®**

Ultra Selective Liquid Chromatography™

Learn more about USLC® technology, phase profiles, and more at www.restek.com/uslc

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

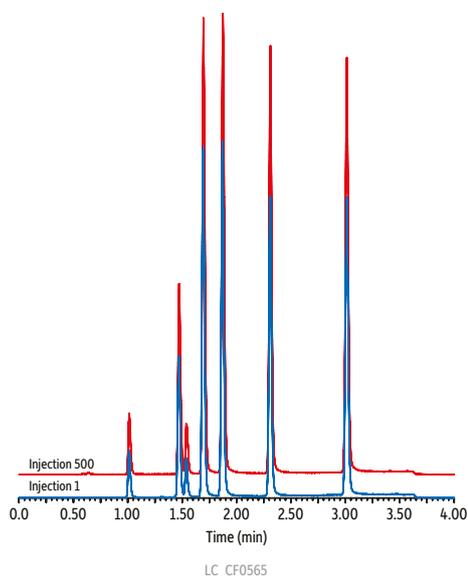
Pressure Stability:

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 back pressures. 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). 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.



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 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.

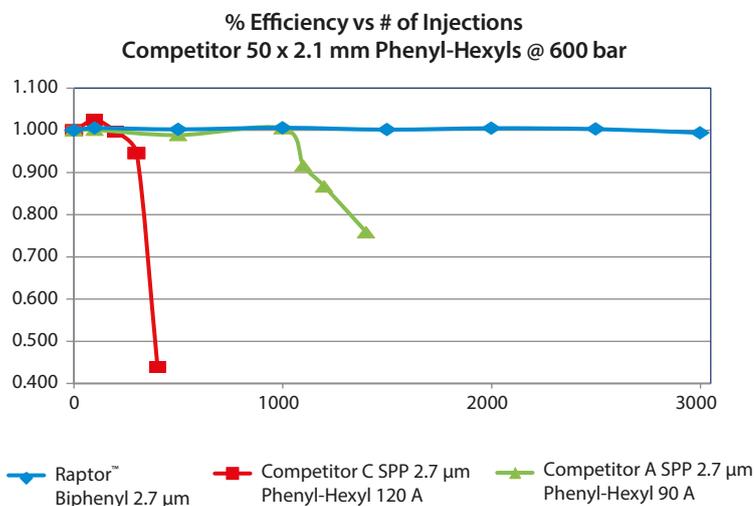
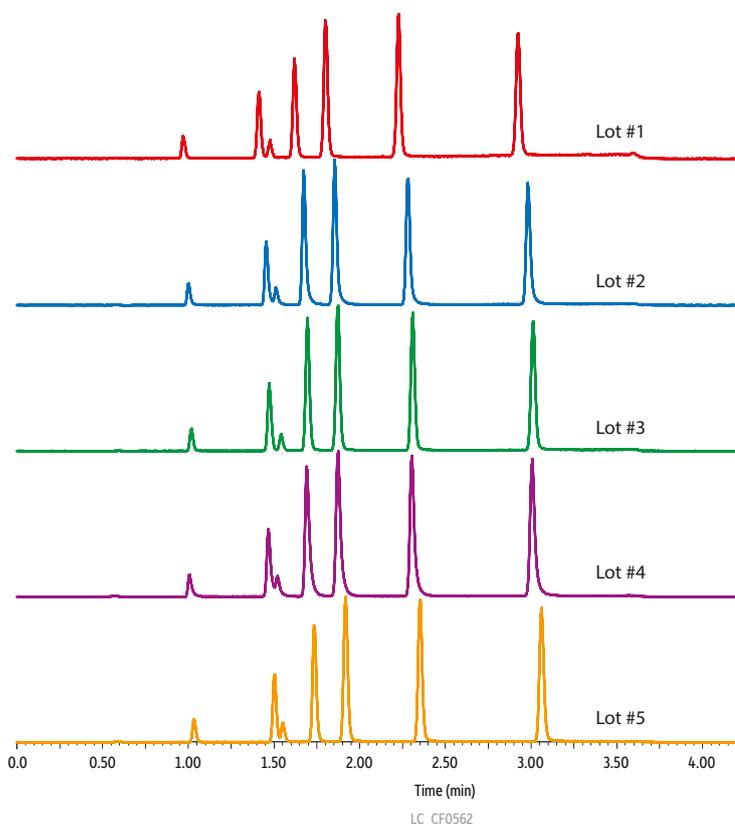


Figure 5: From one lot to the next, every Raptor™ Biphenyl column you purchase will perform the same.



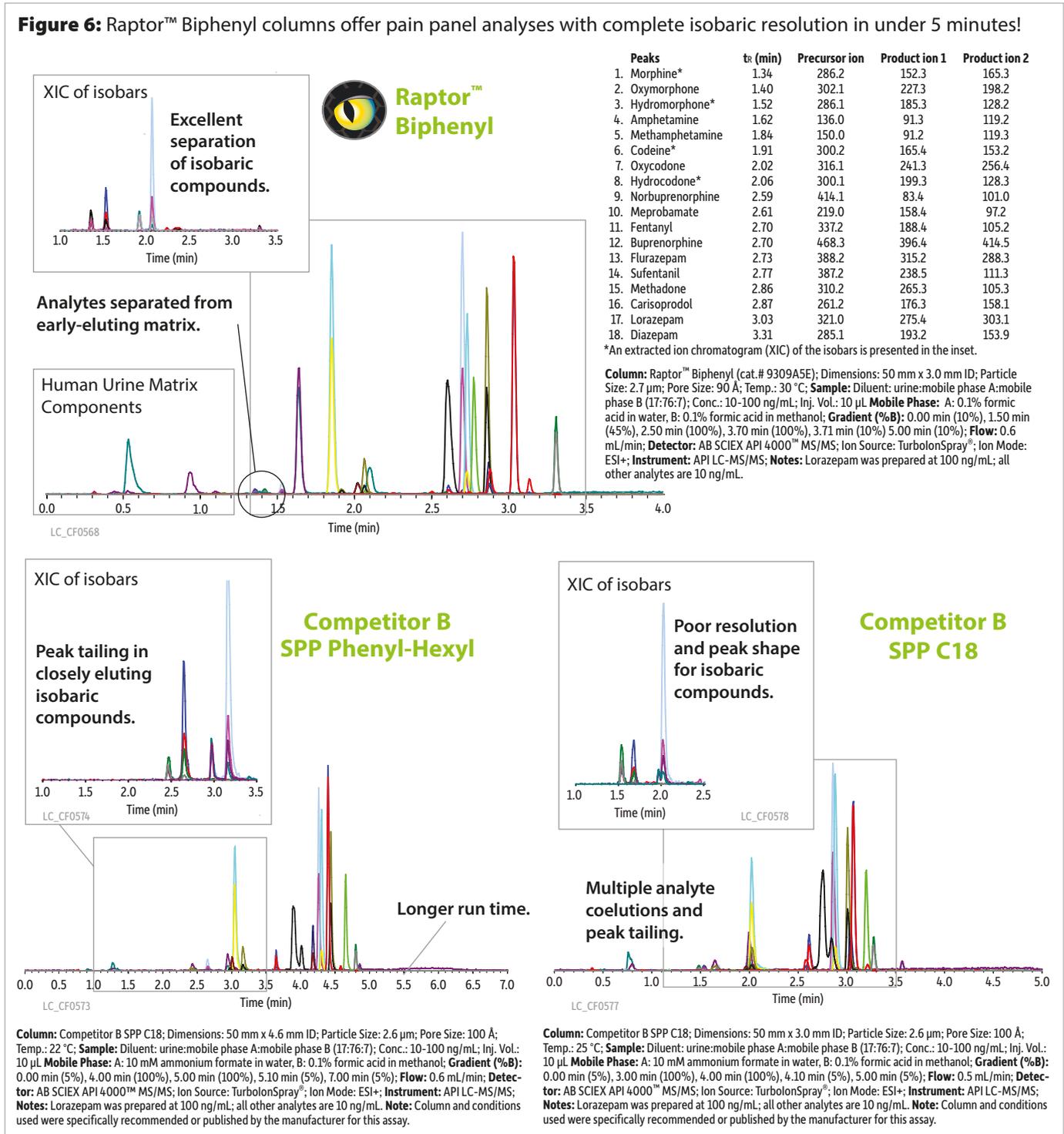
See Figure 4 for compound list and conditions.

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

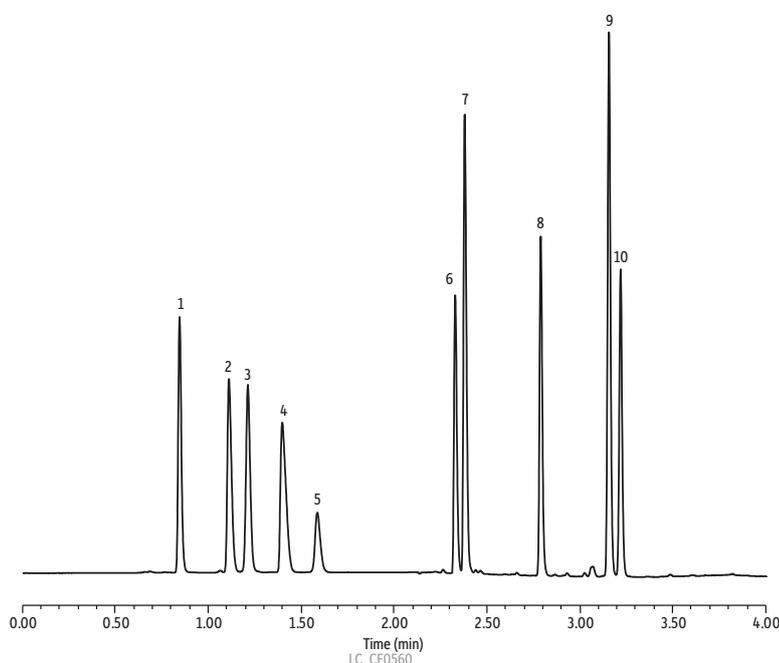
Pain panels can be difficult to optimize and reproduce due to the limited selectivity of C18 and phenyl-hexyl phases, but not on the Raptor™ Biphenyl. Complete your pain panel analysis with a 5-minute cycle time and complete isobaric resolution using Raptor™ Biphenyl columns (Figure 6). Popular competitor columns offer tailing peaks, longer run times, and coelutions; the Raptor™ Biphenyl exhibits the selectivity and performance needed for this critical analysis.



Catecholamines and NSAIDs Without Ion Pairing, HILIC, or Complex Mobile Phases

Analyzing catecholamine compounds can be problematic by liquid chromatography and often forces chemists to turn to aqueous normal phase / HILIC or ion-pairing reagents that are not well suited for mass spectrometry (MS). Raptor™ Biphenyl columns easily retain and separate these difficult compounds using simple, MS-friendly mobile phases in a time frame that maximizes your productivity (Figure 7). Raptor™ Biphenyl also offers fast, efficient analysis of nonsteroidal anti-inflammatory drugs (NSAIDs) with LC-MS friendly solvents.

Figure 7: Separate catecholamine and other neurotransmitter compounds fast without ion pairing or HILIC.

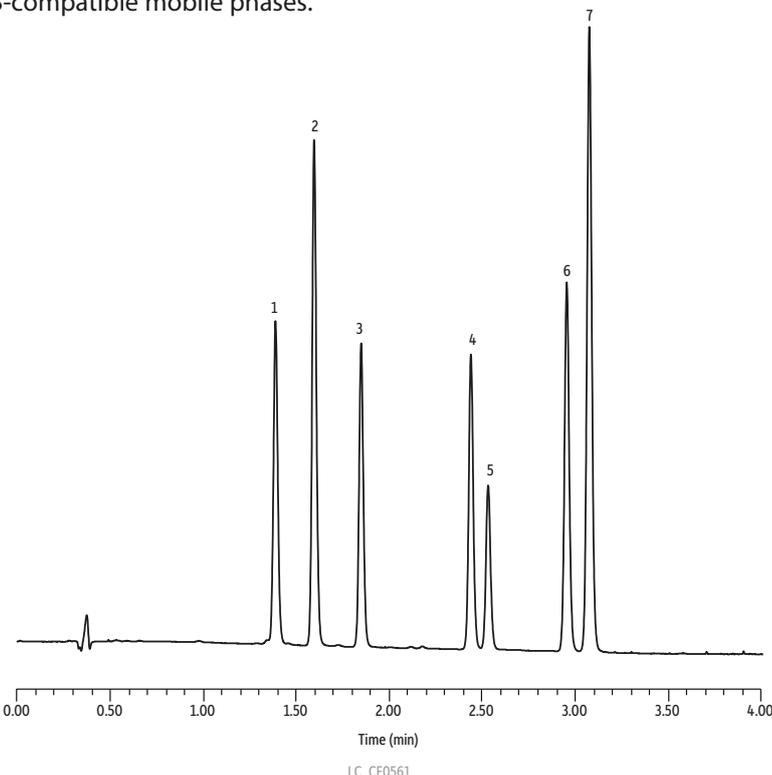


Peaks	tr (min)
1. Norepinephrine	0.85
2. Epinephrine	1.11
3. L-Dihydroxyphenylalanine	1.21
4. Dopamine	1.40
5. Tyrosine	1.59
6. 3-Methoxytyramine*	2.33
7. Serotonin	2.38
8. (3,4-Dihydroxyphenyl)acetic acid*	2.79
9. 5-Hydroxyindoleacetic acid**	3.16
10. Homovanillic acid*	3.22

* Dopamine metabolite, ** serotonin metabolite

Column: Raptor™ Biphenyl (cat.# 9309A62); Dimensions: 150 mm x 2.1 mm ID; Particle Size: 2.7 µm; Pore Size: 90 Å; Temp.: 30 °C; **Sample:** Diluent: water; Conc.: 50 µg/mL; Inj. Vol.: 1 µL **Mobile Phase:** A: 0.1% formic acid in water, B: 0.1% formic acid in acetonitrile; **Gradient (%B):** 0.00 min (0%), 4.00 min (70%), 4.01 min (0%), 5.00 min (0%); **Flow:** 0.4 mL/min; **Detector:** Waters Acquity® PDA @ 280 nm; **Instrument:** Waters Acquity® UPLC H-Class.

Figure 8: Nonsteroidal anti-inflammatory drugs (NSAIDs) are also easily resolved with Raptor™ Biphenyl using UV- and MS-compatible mobile phases.



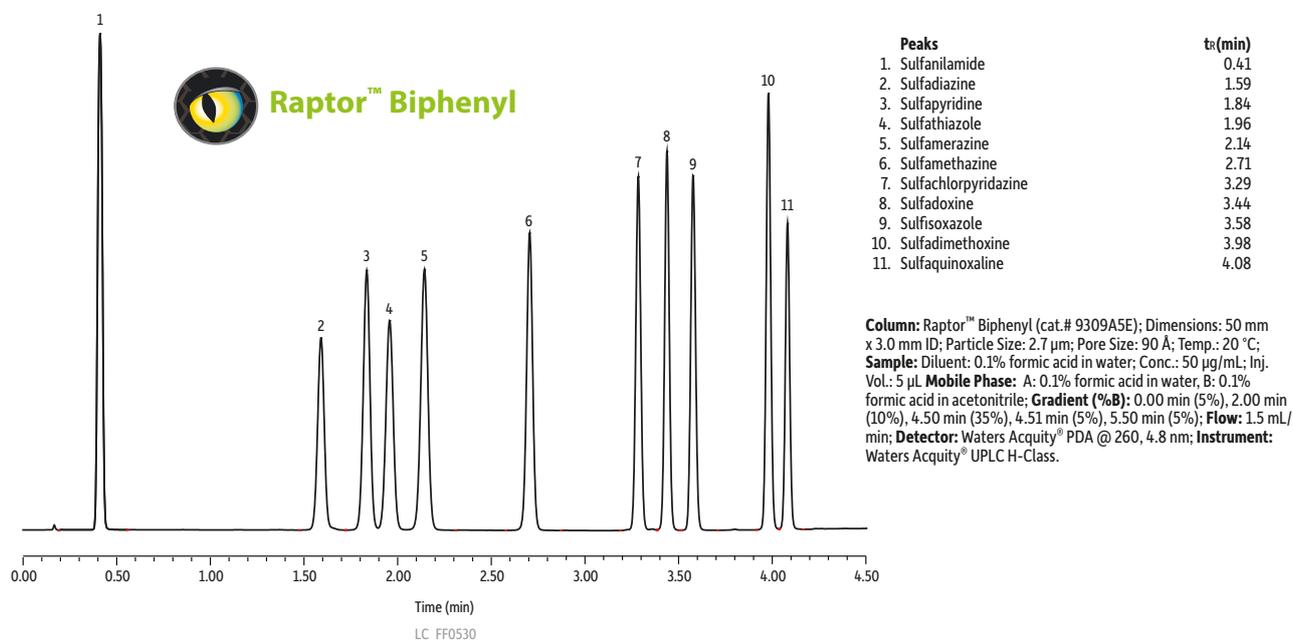
Peaks	tr (min)	Conc. (µg/mL)
1. Piroxicam	1.39	25
2. Sulindac	1.60	25
3. Naproxen	1.85	25
4. Fenoprofen	2.44	100
5. Ibuprofen	2.54	200
6. Diclofenac	2.96	25
7. Indomethacin	3.08	25

Column: Raptor™ Biphenyl (cat.# 9309A12); Dimensions: 100 mm x 2.1 mm ID; Particle Size: 2.7 µm; Pore Size: 90 Å; Temp.: 40 °C; **Sample:** Diluent: water:acetonitrile (65:35); Conc.: 25-200 µg/mL; 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 (35%), 4.00 min (60%), 4.01 min (35%), 5.00 min (35%); **Flow:** 0.6 mL/min; **Detector:** Waters Acquity® PDA @ 270 nm; **Instrument:** Waters Acquity® UPLC H-Class.

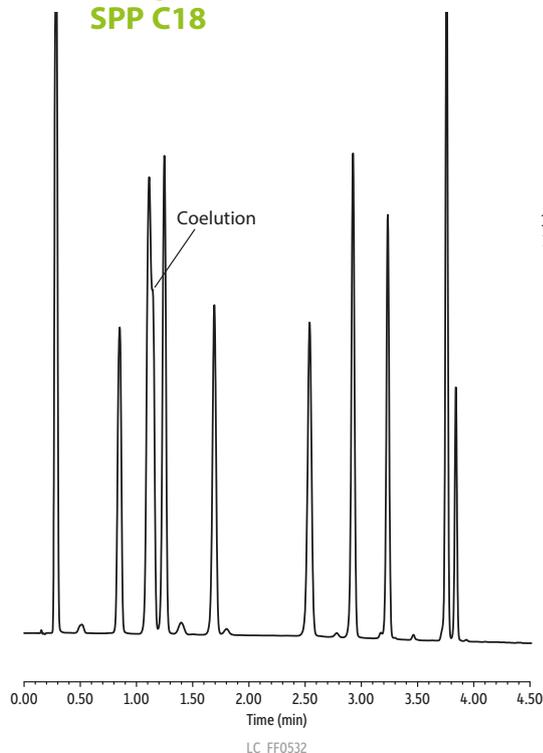
Fast Analysis of Sulfur Antibiotics Without Coelutions

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 9), it does so in well under 5 minutes!

Figure 9: Sulfonamides pose no problems for analysis, even at high linear velocities. Increased retention of early-eluting sulfanilamide also helps limit ionization suppression.

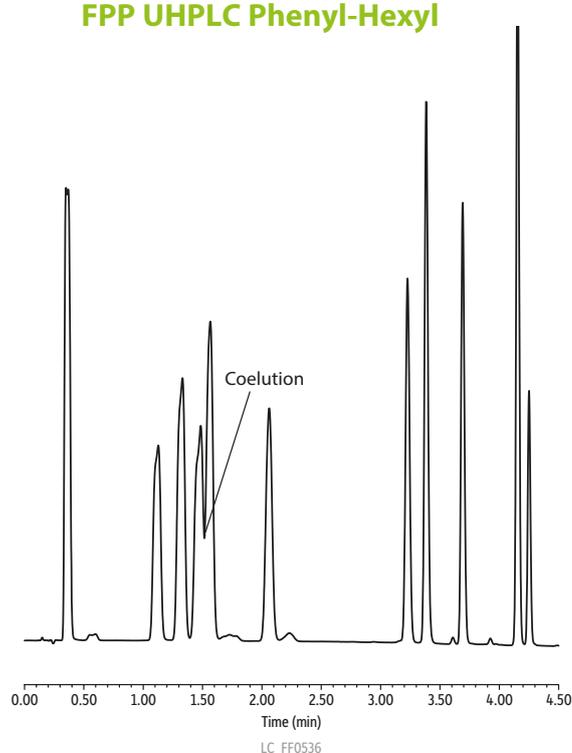


Competitor B SPP C18



Column: Competitor B SPP C18; Dimensions: 50 mm x 3.0 mm ID; Particle Size: 2.6 µm; Pore Size: 100 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.

Competitor D FPP UHPLC Phenyl-Hexyl



Column: Competitor D FPP Phenyl-Hexyl; Dimensions: 50 mm x 2.1 mm ID; Particle Size: 1.7 µm; 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:** 0.75 mL/min; **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.#
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

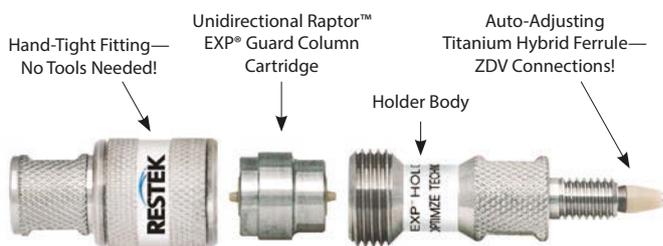
Effortlessly achieve 8,700+ psi HPLC seals by hand! (Wrench-tighten to 20,000+ psi.) Hybrid titanium/PEEK seal can be installed repeatedly without compromising your seal.



Description	ea.	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, Optimize Technologies. Optimize Technologies EXP Holders are Patent Pending. Other U.S. and Foreign Patents Pending. The Opti- prefix is a registered trademark of Optimize Technologies, Inc.

Raptor™ EXP® Guard Cartridges



Protect your investment and extend the life of our already-rugged LC columns and change guard column cartridges by hand without breaking fluid connections—no tools needed!

EXP® Direct Connect Holder

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

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 Cartridge	2.7 μm	3-pk.	9309A0252	9309A0253	9309A0250
Raptor Biphenyl EXP Guard Cartridge	5 μm	3-pk.	930950252	930950253	930950250

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

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

Experience *Selectivity Accelerated*. Order the Raptor™ Biphenyl today at www.bgb-info.com/raptor