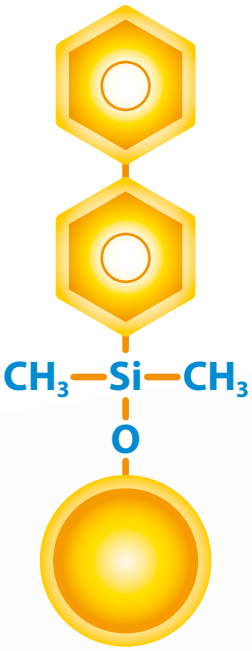
Raptor
LC Columns

Selectivity Accelerated

Fast, Rugged Raptor Columns with Time-Tested Selectivity

Stationary Phase:

Biphenyl



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 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.bgb-shop.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

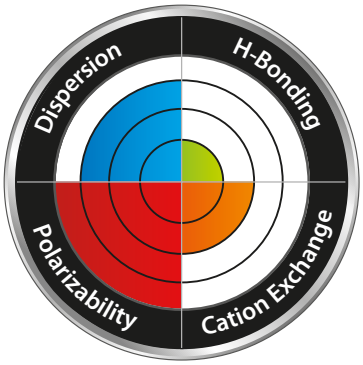
Maximum Pressure: 1,034 bar/15,000 psi* (1.8 µm),
600 bar/8,700 psi (2.7 µm); 400 bar/5,800 psi (5 µm)

** 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.

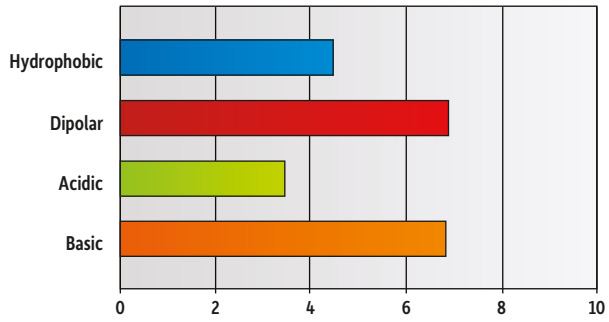
Column Interaction Profile:



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.

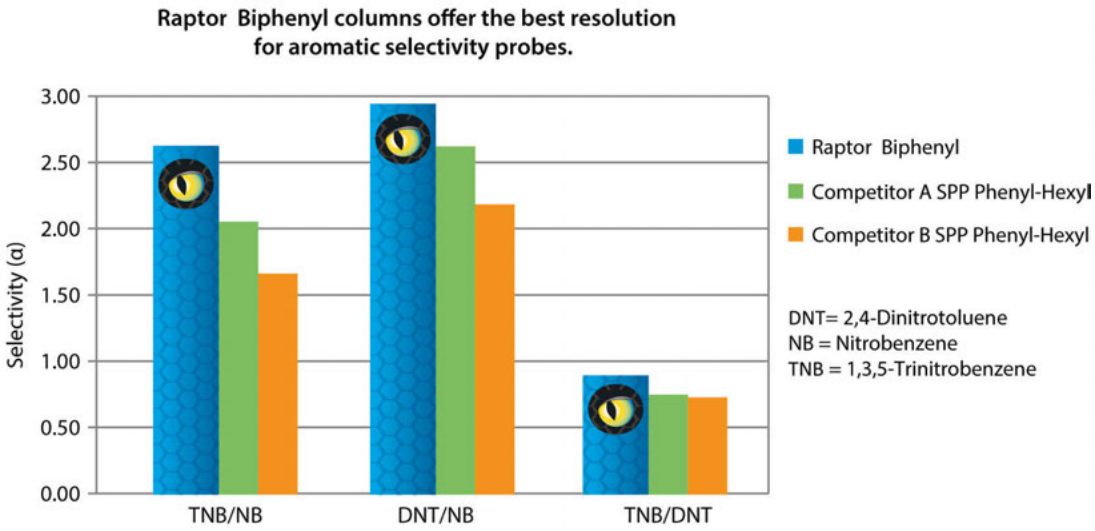
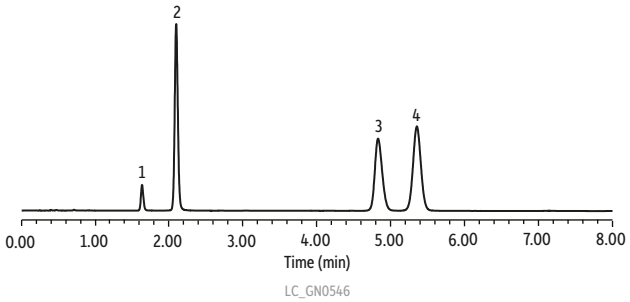


Figure 2: Raptor Biphenyl columns show increased retention for compounds containing electron withdrawing groups. Retention and elution order are dramatically different from a traditional C18.



Peaks	t_R (min)	Conc. (µg/mL)
1. Benzene	1.63	500
2. Nitrobenzene	2.09	100
3. 1,3,5-Trinitrobenzene	4.83	100
4. 2,4-Dinitrotoluene	5.35	100

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 µg/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.

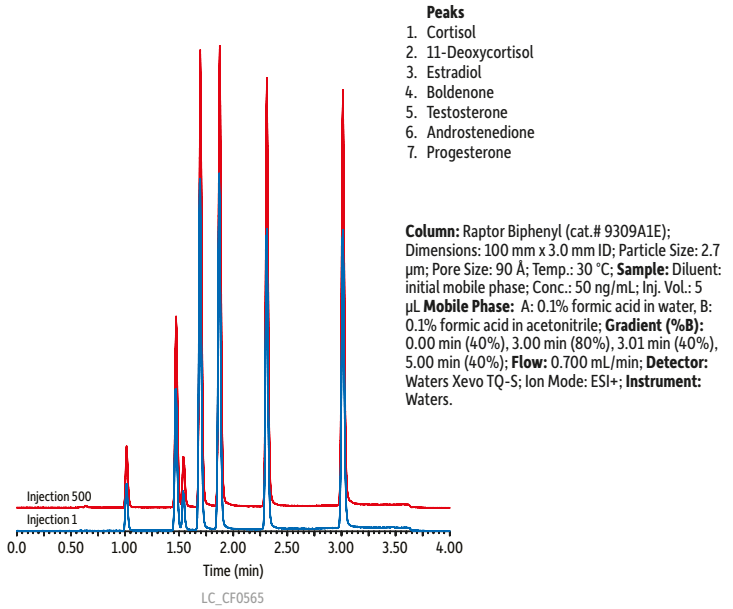


Figure 3: At high pressures, competitor phenyl-hexyl columns experience a quick and sharp drop-off in efficiency, but Raptor Biphenyl columns are unaffected to at least 3,000 injections.

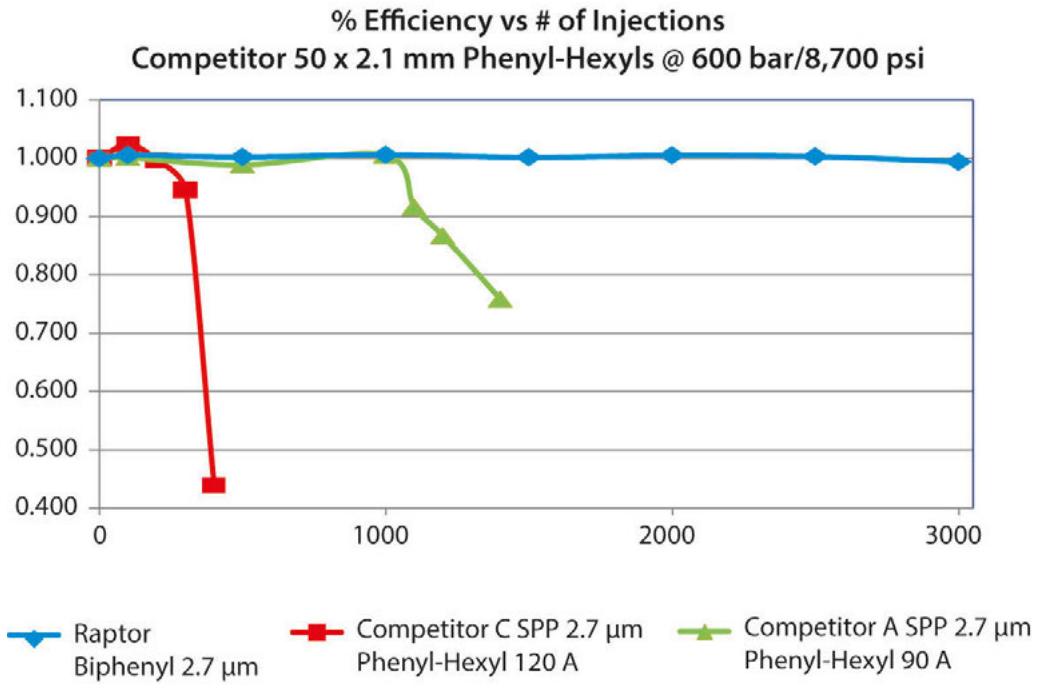
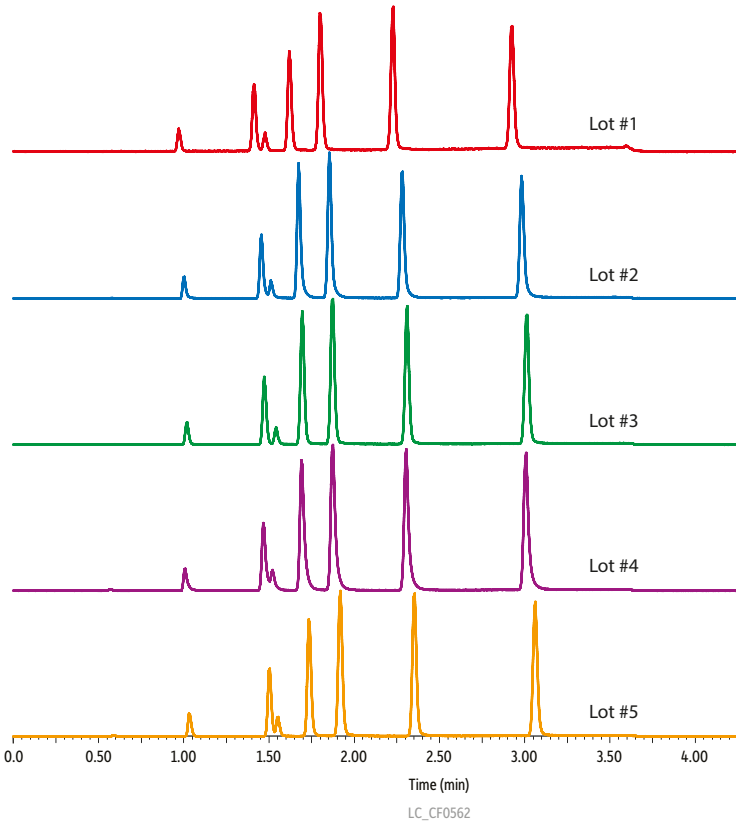


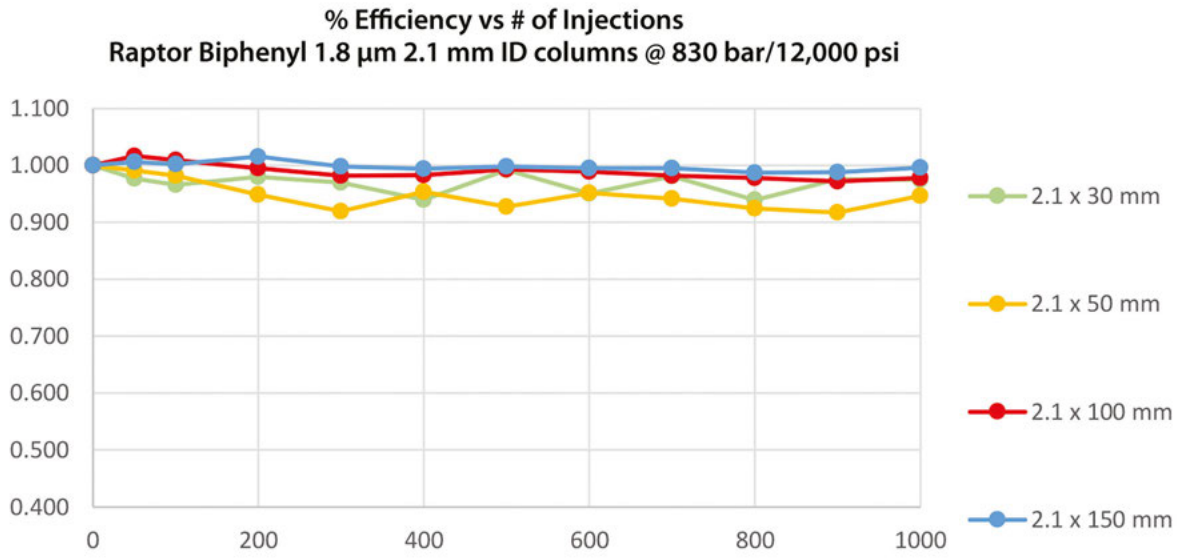
Figure 5: From one lot to the next, every Raptor Biphenyl column you purchase will perform the same.



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.



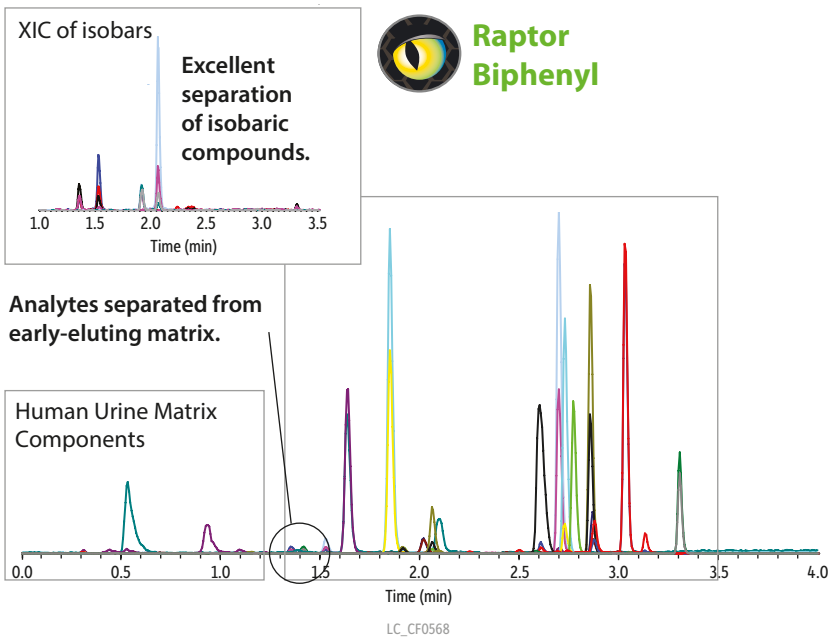
Clinically Proven to Optimize Your Bioanalytical Workflows

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!

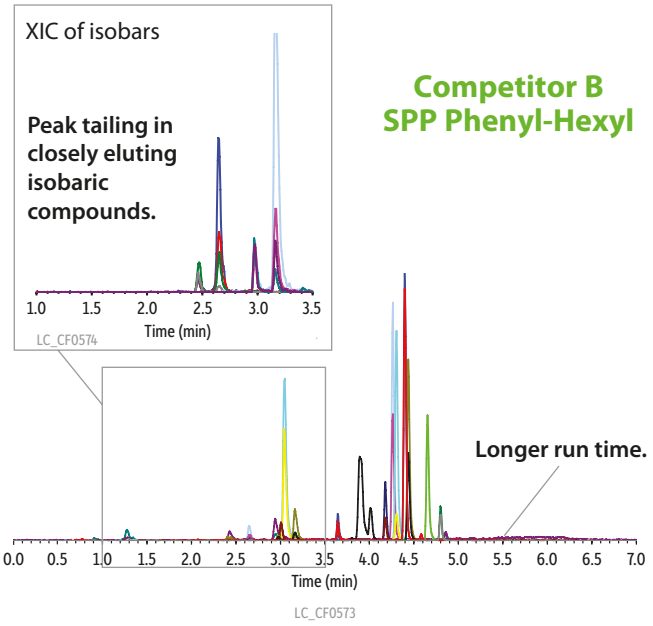


	Peaks	t_R (min)	Precursor ion	Product ion 1	Product ion 2
1.	Morphine*	1.34	286.2	152.3	165.3
2.	Oxymorphone	1.40	302.1	227.3	198.2
3.	Hydromorphone*	1.52	286.1	185.3	128.2
4.	Amphetamine	1.62	136.0	91.3	119.2
5.	Methamphetamine	1.84	150.0	91.2	119.3
6.	Codeine*	1.91	300.2	165.4	153.2
7.	Oxycodone	2.02	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

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

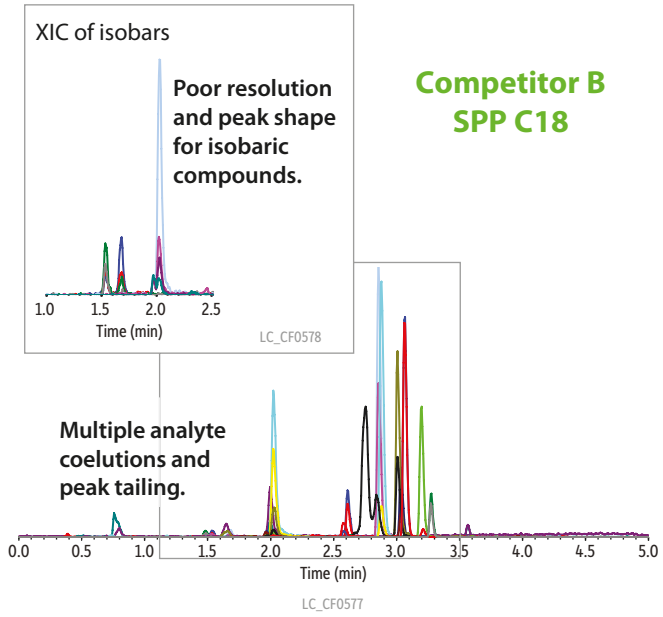
Column:	Raptor Biphenyl (cat.# 9309A5E)
Dimensions:	50 mm x 3.0 mm ID
Particle Size:	2.7 µm
Pore Size:	90 Å
Temp.:	30 °C
Sample:	
Diluent:	urine:mobile phase A:mobile phase B (17:76:7)
Conc.:	10-100 ng/mL
Inj. Vol.:	10 µL
Mobile Phase:	
A:	0.1% formic acid in water
B:	0.1% formic acid in methanol
Gradient (%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:	TurboIonSpray
Ion Mode:	ESI+
Instrument:	API LC-MS/MS
Notes:	Lorazepam was prepared at 100 ng/mL; all other analytes are 10 ng/mL.

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:mobile phase A:mobile 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: TurboIonSpray
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.



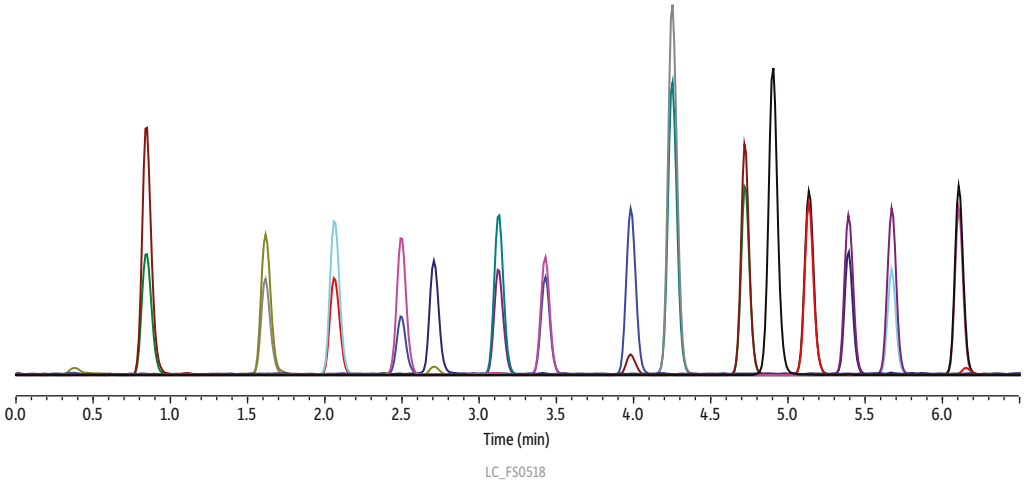
Column: Competitor B SPP C18
Dimensions: 50 mm x 3.0 mm ID
Particle Size: 2.6 µm
Pore Size: 100 Å
Temp.: 25 °C
Sample:
Diluent: urine:mobile phase A:mobile phase B (17:76:7)
Conc.: 10-100 ng/mL
Inj. Vol.: 10 µL
Mobile Phase:
A: 10 mM ammonium formate in water
B: 0.1% formic acid in methanol
Gradient (%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: TurboIonSpray
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.



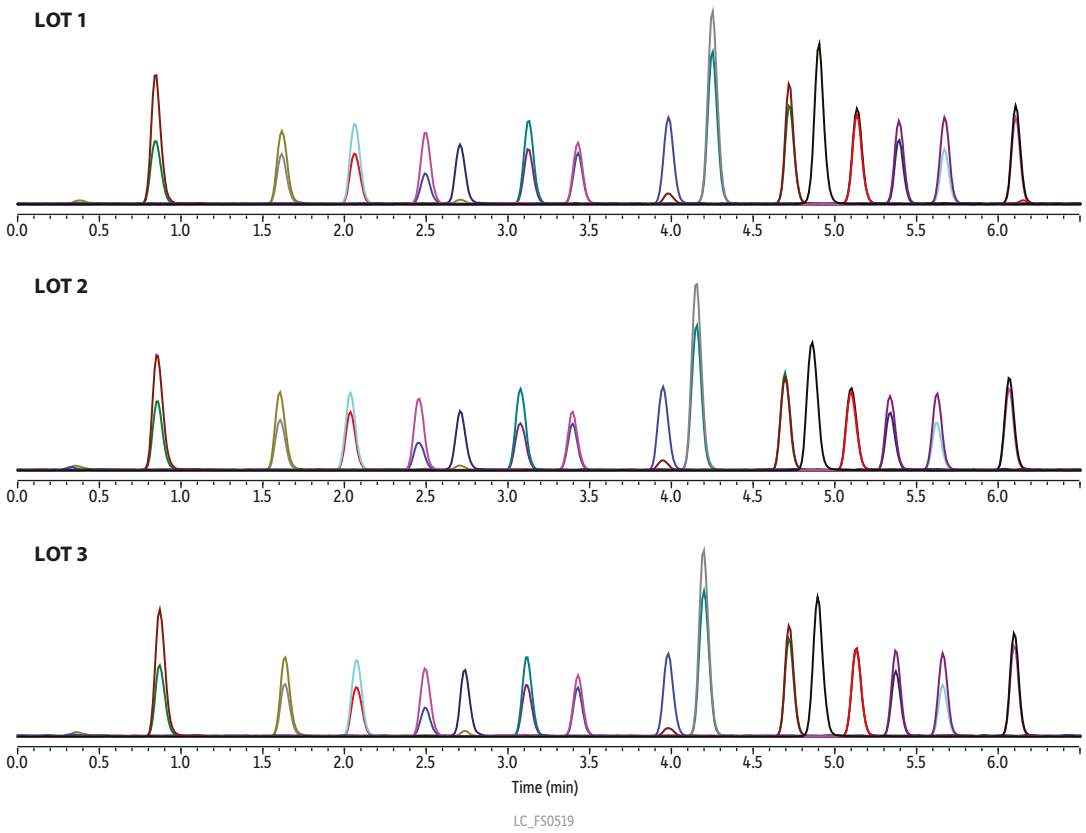
Peaks	tR (min)	Conc. (ng/mL)	Precursor Ion	Product Ion	Product Ion
1. Bisphenol S	0.84	5.00	249.2	108.1	92.1
2. Bisphenol F	1.62	350	199.3	93.1	105.1
3. Bisphenol E	2.06	100	213.3	198.3	197.4
4. Bisphenol A	2.50	100	227.3	212.3	133.1
5. Bisphenol AF	2.71	2.00	335.2	265.3	177.3
6. Bisphenol B	3.13	100	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.



Peaks	Conc. t_R (min)	(ng/mL)	Precursor Ion	Product Ion	Product Ion
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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

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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

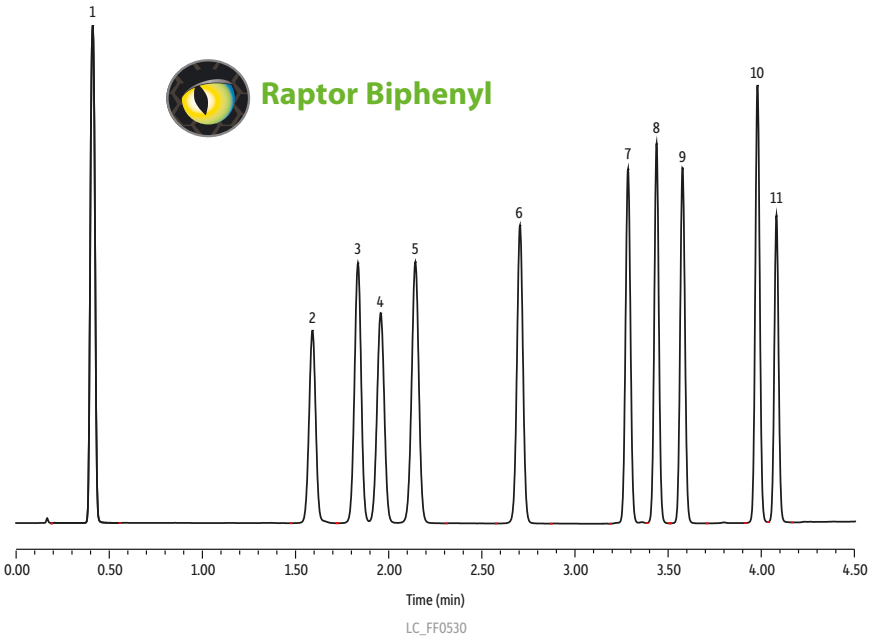
Time (min)	Flow (mL/min)	%A	%B
0.00	0.45	50	50
6.50	0.45	10	90
6.51	0.45	50	50
8.00	0.45	50	50

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

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.

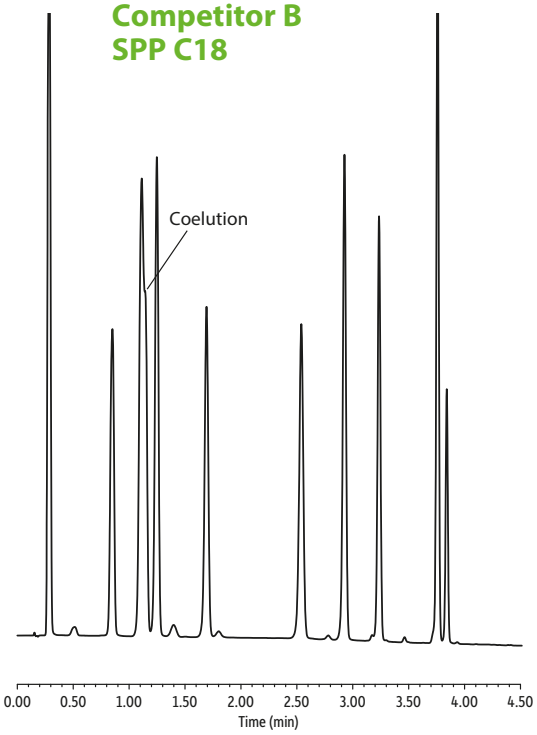


Peaks	t_R(min)
1. Sulfanilamide	0.41
2. Sulfadiazine	1.59
3. Sulfapyridine	1.84
4. Sulfathiazole	1.96
5. Sulfamerazine	2.14
6. Sulfamethazine	2.71
7. Sulfachlorpyridazine	3.29
8. Sulfadoxine	3.44
9. Sulfisoxazole	3.58
10. Sulfadimethoxine	3.98
11. Sulfaquinoxaline	4.08

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.)

Competitor B
SPP C18

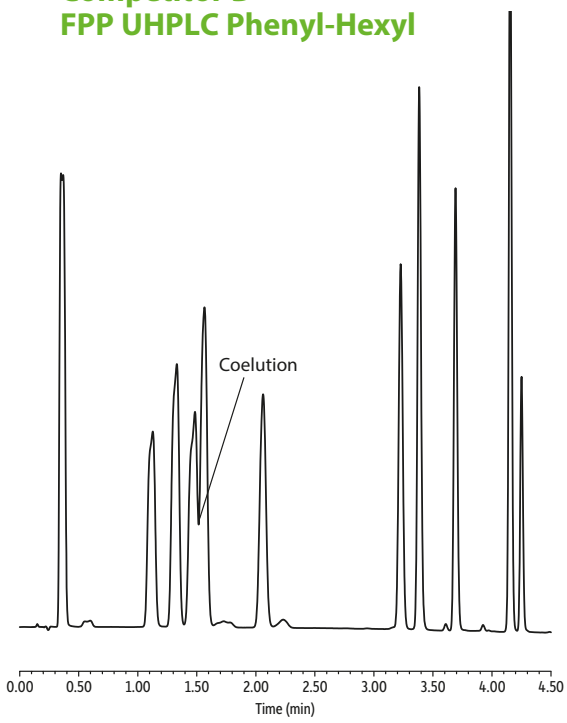


LC_FF0532

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 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



LC_FF0536

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.#
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

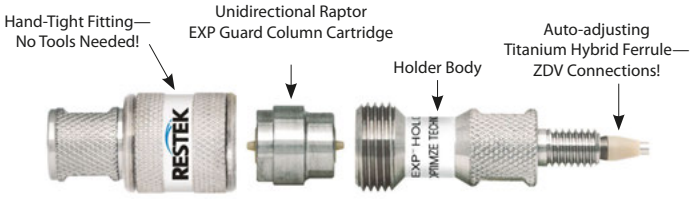
Effortlessly achieve 8,700+ psi HPLC seals by hand! (Wrench tighten to 20,000+ psi.) Hybrid titanium/PEEK seal can be installed repeatedly without compromising your seal.

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.bgb-shop.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.bgb-shop.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

BGB GC|LC MS|CE

DR-BGB-2014

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