

U.S. Patent No. 7, 563, 367

Setting the Standard for pH Method Development

Rugged reversed phase HPLC columns that offer extended lifetime at extreme pH conditions and excellent stability for reproducible, high efficiency separations.

- Take full advantage of high and low pH conditions (pH 1-12) to manipulate selectivity
- Expect longer column lifetime with patented TWIN-NX™ technology
- For analytical and preparative separations of basic and acidic compounds

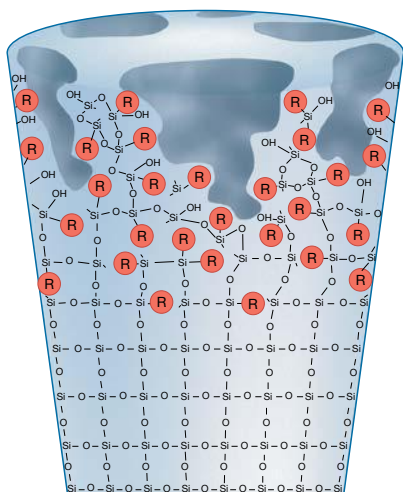
Phase	Description	USP Classification
NX-C18	The most rugged Gemini column, offering 5 times the durability of previous generation hybrid columns	L1
C6-Phenyl	A low bleed phenyl phase. For UV and MS detection, which offers an aromatic selectivity complementary to C18 phases	L11
C18	Selectivity, high structural integrity and increased loadability for preparative and purification applications in pre-packed columns and bulk media	L1



If Gemini analytical columns do not provide at least an equivalent separation as compared to a competing column of similar particle size, similar phase and dimensions, send in your comparative data within 45 days and keep the Gemini column for FREE.

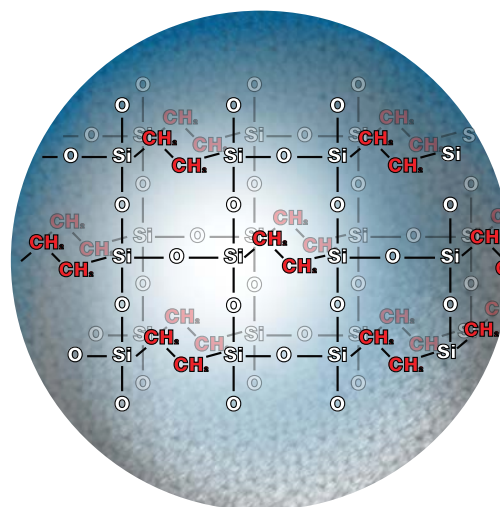
TWIN™ (Two-In-One) Technology™

During the final stage of silica manufacturing a unique silica-organic layer is grafted to create a completely new composite particle. Since the internal base silica is unaltered by this manufacturing process, the particle retains its mechanical strength and rigidity along with excellent efficiency, while the silica-organic shell protects the particle from chemical attack.



Second-Generation TWIN-NX™ Technology

TWIN-NX technology uses an improved patented organo-silica grafting process which incorporates highly stabilizing ethane cross-linking. These organic groups are evenly incorporated into the grafted layers on the silica surface while maintaining a pure silica core. This not only provides resistance to high pH attack, but also maintains the high efficiency and mechanical strength of a silica particle.



HPLC | GEMINI

Gemini NX-C18

- Control selectivity of ionizable compounds for optimized methods
- Consistent performance in both volatile and non-volatile buffers
- High sample loading capacity for metabolite identification and preparative purification
- pH stable 1-12 for durability

USP: L1

LC/MS
Certified

pH Stability: 1.0 – 12.0

Particle Size: 3 µm, 5 µm, and 10 µm

Phase: C18

Application: Small molecules, basic compounds

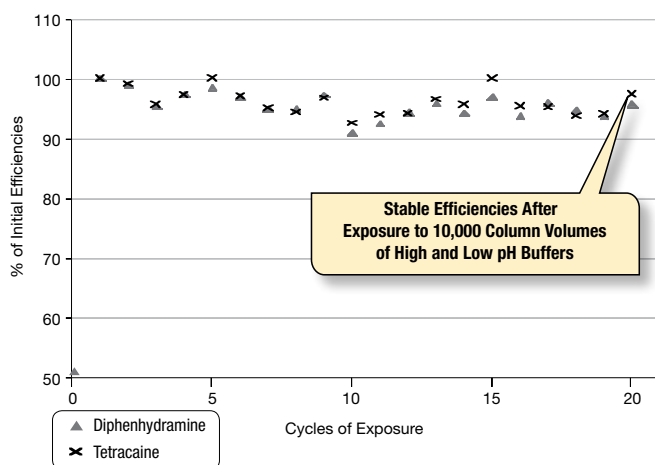
Strength: Most durable pH stable particle

Material Characteristics

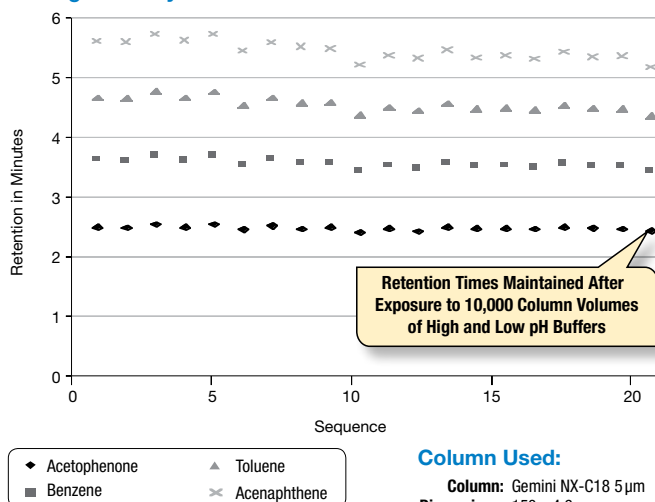
Packing Material	Particle Shape/Size (µm)	Pore Size (Å)	Surface Area (m ² /g)	Carbon Load %	End Capping
Gemini NX-C18	Spherical 3, 5, 10	110	375	14	TMS

Gemini NX-C18 Tested for Extreme Durability in Changing Mobile Phase pH

Column Efficiencies Maintained in High pH Testing for 20 Cycles



Retention Times of Four Probes Maintained in Neutral pH Testing for 20 Cycles



Column Used:

Column: Gemini NX-C18 5 µm
Dimensions: 150 x 4.6 mm
Part No.: 00F-4454-E0

Column Testing Cycle

Step 1

24x High pH Flush Procedures

Mobile Phase: A: 10 mM Ammonium Bicarbonate pH 10.5
B: Acetonitrile

Gradient: 5% to 95% B in 6 min Hold at 95% B for 2 min

Re-equilibrate: 5% B for 2 min

Flow Rate: 1.5 mL/min

Step 2

High pH Testing

Isocratic: 10 mM Ammonium Bicarbonate pH 10.5 / Acetonitrile (50:50)

Flow Rate: 1.5 mL/min

Detection: UV @ 230 nm

Samples: 1. Tetracaine
2. Diphenhydramine

Step 3

1x Neutral Flush Procedure

Mobile Phase: A: Water
B: Acetonitrile

Gradient: 5% B for 2 min

5% to 100% B in 3 min Hold at 100% B for 5 min

Flow Rate: 1.5 mL/min

Step 4

Neutral pH Testing

Isocratic: Water / Acetonitrile (35:65)

Flow Rate: 1.0 mL/min

Detection: UV @ 254 nm

Samples: 1. Acetophenone
2. Benzene
3. Toluene
4. Acenaphthene

Step 5

24x Low pH Flush Procedure

Mobile Phase: A: 0.5% Formic Acid in Water
B: 0.5% Formic Acid in Acetonitrile, pH 2.0

Gradient: 5% to 95% B in 6 min
Hold at 95% B for 2 min

Re-equilibrate: 5% B for 2 min

Flow Rate: 1.5 mL/min

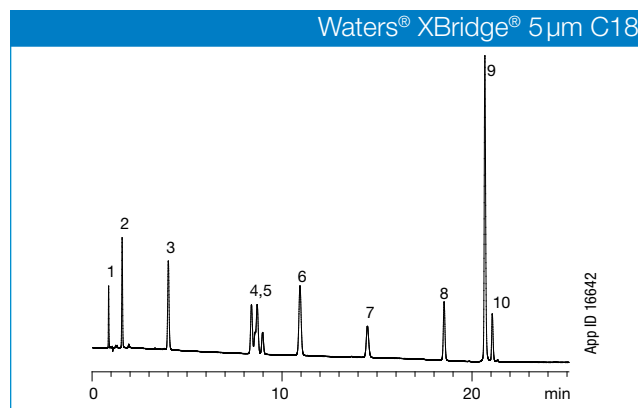
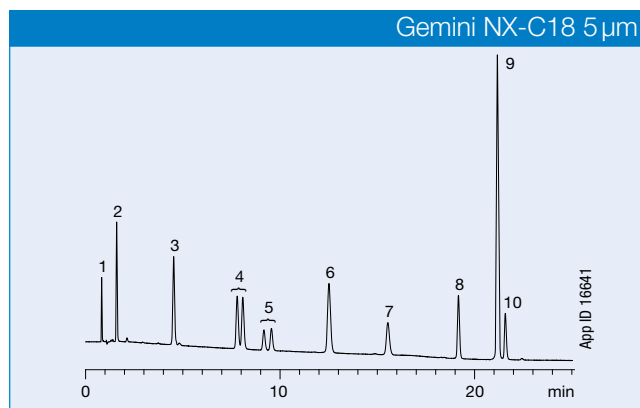
Step 6

Neutral pH Flush Repeats
Repeats for 20 Cycles



U.S. Patent No. 7, 563, 367

Polar Bases at High pH, pH 10.5



Y-axis normalized for all chromatograms.

Polar Bases (Beta Blockers) at High pH

Conditions for all columns:

Dimensions: 150 x 4.6 mm

Mobile Phase: A: 10 mM Ammonium Bicarbonate pH 10.5

B: Acetonitrile

Gradient: A/B (85:15) to (70:30) in 15 min to (50:50) in 5 min, Hold for 5 min

Flow Rate: 1.5 mL/min

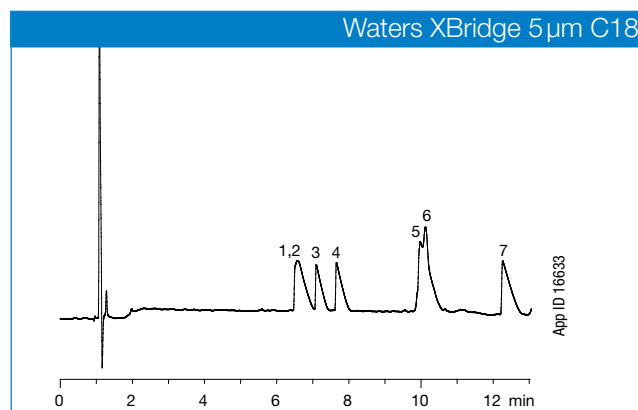
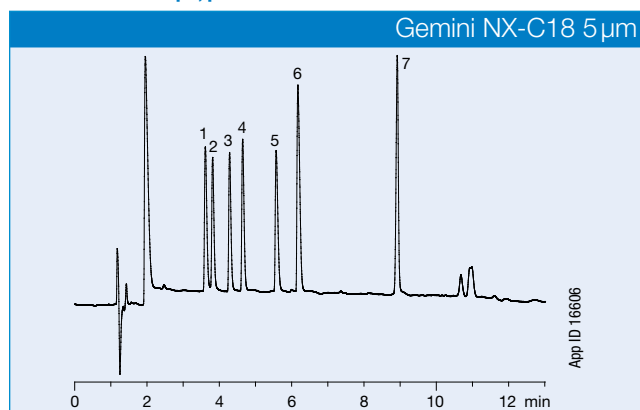
Temperature: Ambient

Detection: UV @ 230 nm

- Sample:**
1. Bisoprolol Contaminant
 2. Sotalol
 3. Atenolol
 4. Labetalol (Diastereoisomeric Pair)
 5. Nadolol (Diastereoisomeric Pair)
 6. Pindolol
 7. Metoprolol
 8. Bisoprolol
 9. Propranolol
 10. Alprenolol



Polar Bases at Low pH, pH 2.7



Y-axis normalized for all chromatograms.

Polar Bases (Antihistamines) in Formic Acid

Conditions for all columns:

Dimensions: 150 x 4.6 mm

Mobile Phase: A: 0.1 % Formic Acid in Water

B: 0.1 % Formic Acid in Acetonitrile

Gradient: A/B (90:10) to (50:50) in 10 min

Flow Rate: 1.5 mL/min

Temperature: Ambient

Detection: UV @ 210 nm

- Sample:**
1. Pyrilamine
 2. Triptelennamine
 3. Chlorpheniramine
 4. Brompheniramine
 5. Chloropyramine
 6. Diphenhydramine
 7. Loratadine

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Phenomenex is in no way affiliated with Waters Corporation.

Comparative chromatograms may not be representative of all applications.

Gemini®

U.S. Patent No. 7, 563, 367

Gemini C18

- Increased loading and retention of basic compounds
- Wide pH stability from 1-12
- Silica efficiency and mechanical strength
- Excellent media for process-scale purification

Gemini C18

USP: L1

LC/MS
Certified

pH Stability: 1.0 – 12.0

Particle Size: 3 µm, 5 µm, and 10 µm

Phase: C18

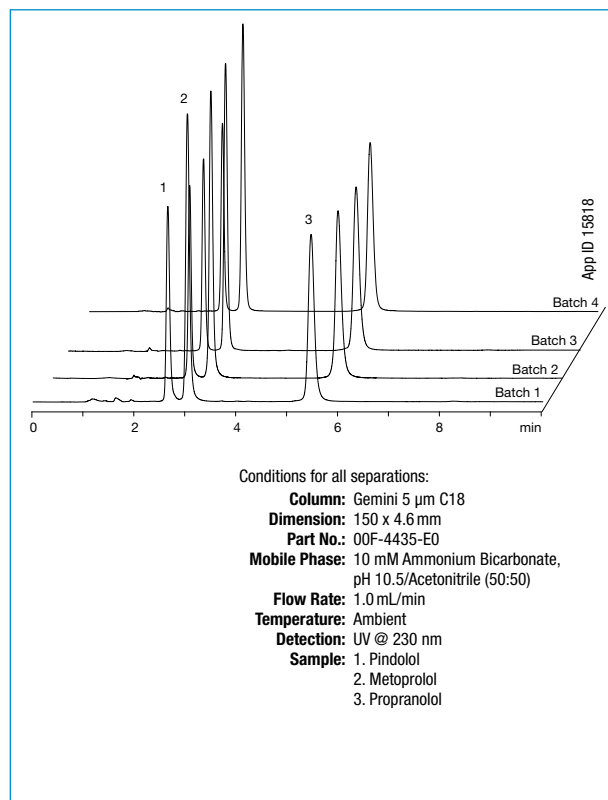
Application: Small molecules, basic compounds

Strength: Wide pH stability, high efficiency

Material Characteristics

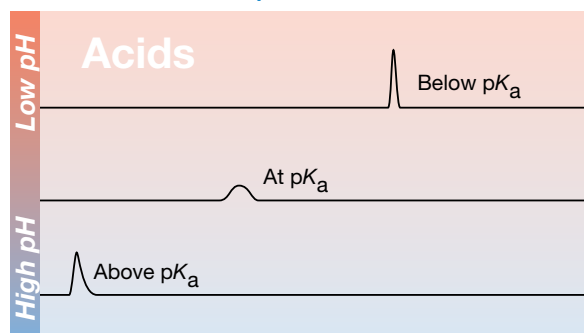
Packing Material	Particle Shape/Size (µm)	Pore Size (Å)	Surface Area (m ² /g)	Carbon Load %	End Capping
Gemini C18	Spherical 3, 5, 10	110	375	14	TMS

Batch-to-Batch Reproducibility

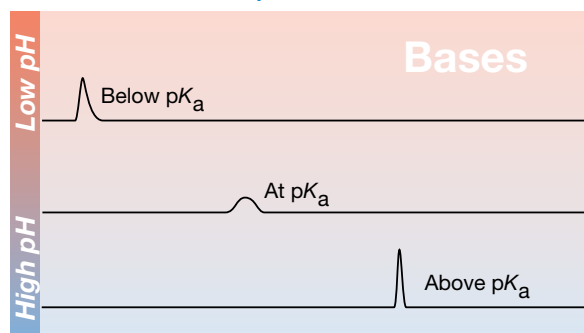


pH Quick Guide

Effects of Mobile Phase pH on Acids



Effects of Mobile Phase pH on Bases



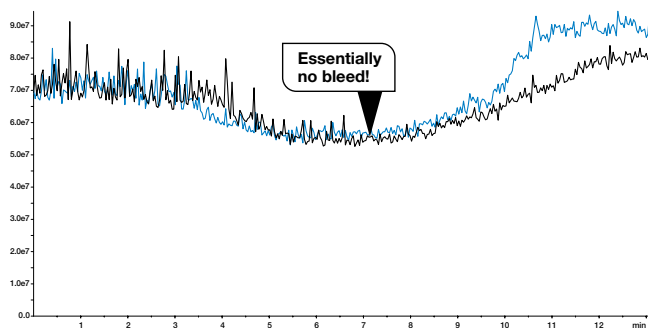
Gemini®

U.S. Patent No. 7, 563, 367

Virtually No LC/MS Bleed

The increased stability of Gemini columns provide the ultra-low bleed profile required for high sensitivity LC/MS applications. The advanced TWIN™ Technology used for Gemini columns limit phase cleavage and stabilizes the silica surface. When compared against a background MS profile, Gemini columns demonstrate virtually no column bleed across a wide mass range.

Total Ion Current



Conditions for all columns:

Column: Gemini 5 µm C18

Dimension: 150 x 3.0 mm

Part No.: 00F-4435-Y0

Mobile Phase: A: 0.1 % HCOOH in Acetonitrile
B: 0.1 % HCOOH in Water

Gradient: 5:95 (A/B) linear to 95:5 over 8 min,
Hold for 5 min

Flow Rate: 0.5 mL/min

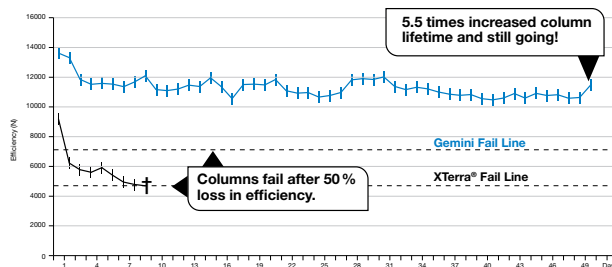
Detection: API 3000
Ion Source:ESI/PIM
Scan Rate:13000 m/z/s
Scan Range:60-1000

■ Gemini C18
■ Background MS Profile

Extended Column Lifetime

The TWIN™ Technology engineering of Gemini provide stability and increased column lifetime. Whether used under isocratic or gradient conditions, Gemini columns out-perform and outlasts pH stable columns. This is illustrated below.

Lifetime and Efficiency Comparison**



†Efficiency and lifetime comparison based on average of two columns each run in parallel.

Conditions for all columns:

Columns: Gemini 5 µm C18

Waters® XTerra® 5 µm MS C18

Dimensions: 150 x 4.6 mm

Mobile Phase: Acetonitrile/50 mM Methylpyrrolidine
Buffer, pH 11.5 (50:50)

Flow Rate: 1 mL/min

Temperature: Ambient

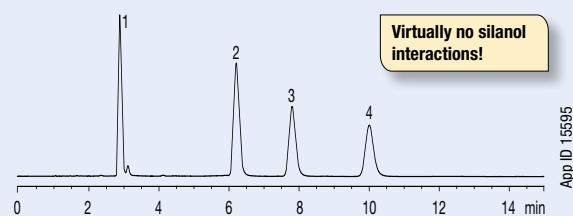
Detection: UV @ 254 nm

Sample: Diphenhydramine

■ Gemini C18
■ Waters® XTerra® MS C18

Chromatographic Comparisons**

Gemini 5 µm C18 110 Å



Tricyclic Antidepressants at Neutral pH

Conditions for all columns:

Dimensions: 150 x 4.6 mm

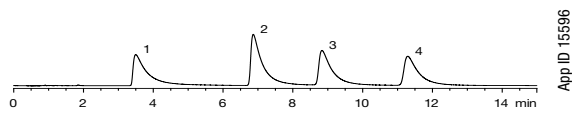
Mobile Phase: 20 mM Phosphate buffer pH 7.0/Acetonitrile/
Methanol (30:35:35)

Flow Rate: 1.5 mL/min

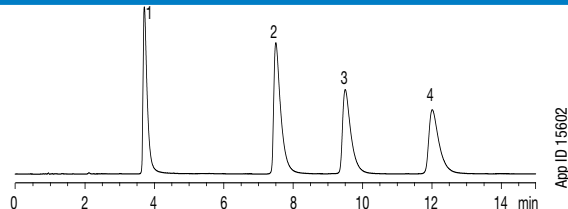
Detection: UV @ 254 nm

Sample: 1. Nortriptyline
2. Imipramine
3. Amitriptyline
4. Clomipramine

Agilent Technologies® ZORBAX® 5 µm Extend-C18 80 Å



Advanced Chromatography Technologies ACE® 5 µm C18 100 Å



**The comparative data presented here may not be representative for all applications.
Gemini is a registered trademark of Phenomenex.
TWIN and Two-In-One Technology are trademarks of Phenomenex.
Waters and XTerra are registered trademarks of Waters Corp.
ZORBAX is a registered trademark of Agilent Technologies.
ACE is a registered trademark of Advanced Chromatography Technologies Limited.
Phenomenex is not associated in any way with Waters Corp, Agilent Technologies or ACT.

Gemini C6-Phenyl

- Good selectivity for aromatic compounds
- Extremely low UV and MS bleed
- Wide pH stability from 1-12

Material Characteristics

Packing Material	Particle Shape/Size (µm)	Pore Size (Å)	Surface Area (m ² /g)	Carbon Load %	End Capping
Gemini C6-Phenyl	Spherical 3, 5	110	375	12	TMS

Gemini C6-Phenyl

USP: L11

LC/MS Certified

pH Stability: 1.0 – 12.0

Particle Size: 3 µm and 5 µm

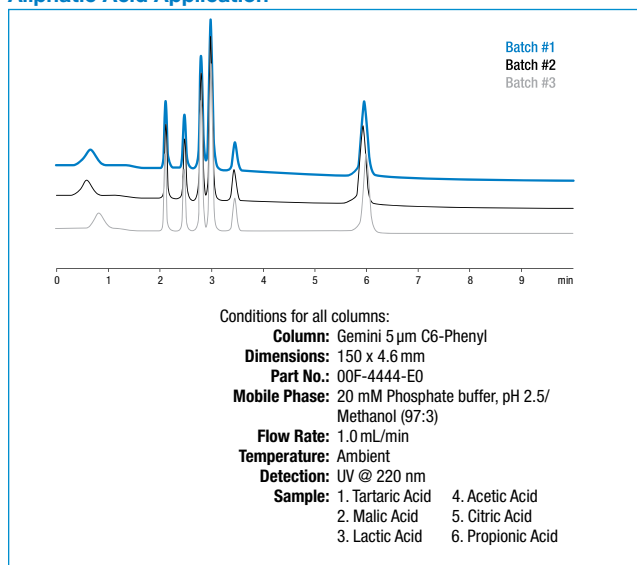
Phase: Phenyl with C6 linker

Application: Aromatic, polar, or basic compounds

Strength: High aromatic selectivity with exceptional peak shape even in neutral conditions. Extremely low bleed phenyl column.

Reproducible Phenyl Phase

Aliphatic Acid Application

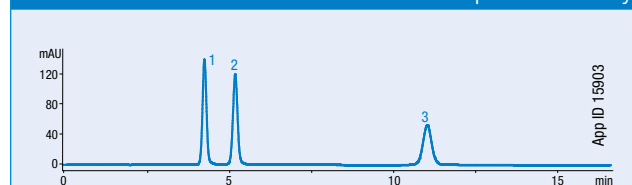


Enhanced Performance for Aromatic Compounds

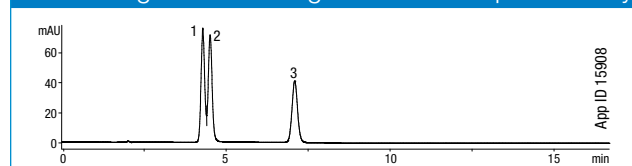
Sulfa Drug Application

Resolution	Pursuit® 5 µm DiPhenyl	Gemini 5 µm C6-Phenyl
Rs _{1,2}	1.0	4.0
Rs _{2,3}	9.8	16.0

Phenomenex Gemini 5 µm C6-Phenyl



Agilent Technologies® Pursuit® 5 µm DiPhenyl



Conditions for all columns:

Dimensions: 150 x 4.6 mm

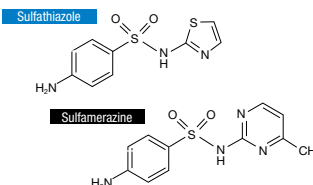
Mobile Phase: 0.1 % Formic Acid in Water/
Methanol (70:30)

Flow Rate: 1.0 mL/min

Temperature: Ambient

Detection: UV @ 254 nm

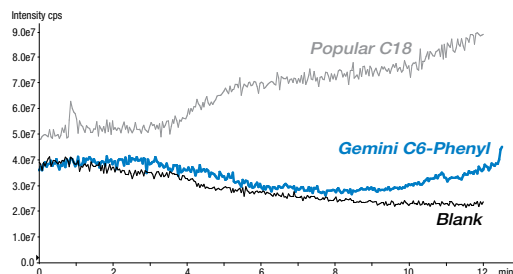
Sample: 1. Sulfathiazole
2. Sulfamerazine
3. Sulfamethoxazole



The comparative data presented here may not be representative for all applications. Agilent and Pursuit are registered trademarks of Agilent Technologies, Inc.

Low Bleed Phenyl Phase

One of the weaknesses of traditional phenyl phases has been excessive bleed in UV and MS. Gemini C6-Phenyl columns demonstrate far lower bleed than many other phenyl columns. Indeed, in this example the Gemini C6-Phenyl column shows lower bleed than a popular C18 column.



Conditions for all columns:

Dimensions: 150 x 3.0 mm

Mobile Phase: A: 0.1 % Formic acid in Water
B: 0.1 % Formic acid in Acetonitrile
Gradient: 5 % B to 95 % B in 10 min, then hold
95 % B for 2 min

Flow Rate: 0.6 mL/min

Temperature: Ambient

MS Detection: ESI + ion mode, M/Z 100-700

Applications

Mycotoxin Screening

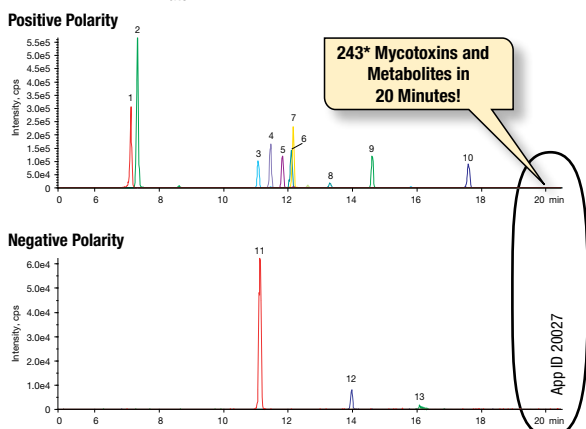
Column: Gemini 5 µm C18
Dimensions: 150 x 4.6 mm
Part No.: 00F-4435-E0
Mobile Phase: A: Water/Methanol (90:10) containing 5 mM Ammonium acetate and 1 % Acetic acid
 B: Water/Methanol (3:97) containing 5 mM Ammonium acetate and 1 % Acetic acid

Gradient	Time (min)	% B
	0	0
	14	100
	18.01	0
	20.5	0

Flow Rate: 1 mL/min
Temperature: 25 °C
Detection: Tandem Mass Spectrometer (MS/MS) (25 °C)
Detector: AB SCIEX API 4000™ System

Sample:

1. Lincromycin	8. Ergocryptinine
2. Ergometrine	9. Ochrotoxin A
3. Aflatoxin G2	10. Nigirin
4. Aflatoxin G1	11. Chloramphenicol
5. Aflatoxin B2	12. β-Zearalenol
6. Ergocryptine	13. Rapamycin
7. Aflatoxin B1	



Vitamin B3

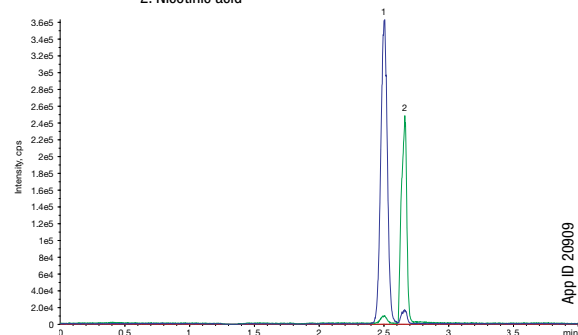
Column: Gemini 3 µm C18
Dimensions: 100 x 4.6 mm
Part No.: 00D-4439-E0
Mobile Phase: A: 0.1 % Formic acid in Water
 B: Methanol

Gradient	Time (min)	% B
	0	10
	2.5	90
	2.6	10
	4	10

Flow Rate: 0.6 mL/min
Temperature: 22 °C
Detection: Electrospray Mass Spec (ESMS) (22 °C)
Detector: AB SCIEX API 4000™ System

Sample:

1. Nicotinamide
2. Nicotinic acid



Hormones in Drinking Water: EPA Method 539

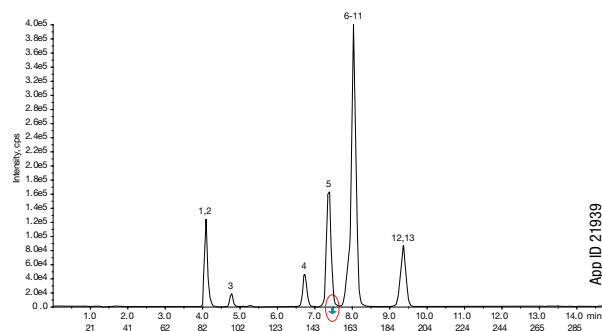
Column: Gemini 3 µm NX-C18
Dimensions: 100 x 2.0 mm
Part No.: 00D-4453-B0
Mobile Phase: A: 0.2 % NH₄OH in Water
 B: 0.2 % NH₄OH in Methanol

Gradient	Time (min)	% B	Time (min)	% B
	0.0	35	8.50	85
	0.1	35	13.0	85
	0.60	65	13.01	35
	7.50	65	15.0	35

Flow Rate: 0.2 mL/min
Temperature: 22 °C
Detection: Tandem Mass Spectrometer (MS/MS) (22 °C)
Detector: AB SCIEX API 4000™ System

Sample:

1. Estriol	8. Ethynylestradiol-d4
2. Estriol-d2 (IS)	9. 17α-Ethynylestradiol
3. Bisphenol A-d16	10. 13C2-Ethynylestradiol (IS)
4. Equilin	11. Androstenedione
5. Estrone	12. Testosterone-d3
6. Beta-estradiol	13. Testosterone
7. 13C6-estradiol (IS)	



TMP and Thiamine

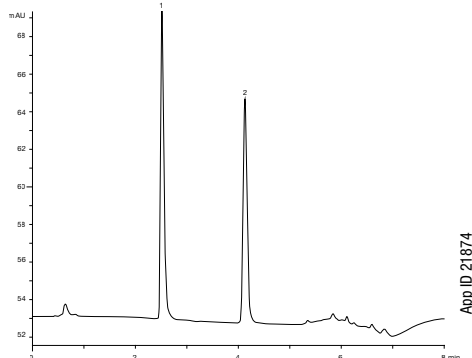
Column: Gemini 3 µm NX-C18
Dimensions: 100 x 3.0 mm
Part No.: 00D-4453-Y0
Mobile Phase: A: 25 mM Na₂HPO₄ with 10 % methanol (pH 7.0)
 B: 25 mM Na₂HPO₄ with 70 % methanol (pH 7.0)

Gradient	Time (min)	% B	Time (min)	% B
	0	97	4	0
	0.25	75	5	0
	0.75	75	5.1	97
	3	65	8	97

Flow Rate: 0.75 mL/min
Detection: Fluorescence (Excitation: 375 nm, Emission: 435 nm) (Ambient)
Temperature: 22 °C

Sample:

1. TMP
2. Thiamine



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Ordering Information

3 µm Microbore, Minibore and Narrow Bore Columns (mm)										SecurityGuard™ Cartridges (mm)
Phases	50 x 1.0	20 x 2.0	30 x 2.0	50 x 2.0	100 x 2.0	150 x 2.0	50 x 3.0	100 x 3.0	150 x 3.0	4 x 2.0*
C18	00B-4439-A0	00M-4439-B0	00A-4439-B0	00B-4439-B0	00D-4439-B0	00F-4439-B0	00B-4439-Y0	00D-4439-Y0	00F-4439-Y0	AJ0-7596
C6-Phenyl	00B-4443-A0	—	00A-4443-B0	00B-4443-B0	00D-4443-B0	00F-4443-B0	00B-4443-Y0	00D-4443-Y0	00F-4443-Y0	AJ0-7914
	—	—	—	—	—	—	—	—	—	/10pk
NX-C18	—	00M-4453-B0	00A-4453-B0	00B-4453-B0	00D-4453-B0	00F-4453-B0	00B-4453-Y0	00D-4453-Y0	00F-4453-Y0	AJ0-8367

for ID: 2.0-3.0 mm

3 µm Analytical Columns (mm)							SecurityGuard™ Cartridges (mm)
Phases	20 x 4.0	30 x 4.6	50 x 4.6	100 x 4.6	150 x 4.6	250 x 4.6	4 x 3.0*
C18	00M-4439-D0	00A-4439-E0	00B-4439-E0	00D-4439-E0	00F-4439-E0	00G-4439-E0	AJ0-7597
C6-Phenyl	—	00A-4443-E0	00B-4443-E0	00D-4443-E0	00F-4443-E0	00G-4443-E0	AJ0-7915
	—	—	—	—	—	—	/10pk
NX-C18	—	—	00B-4453-E0	00D-4453-E0	00F-4453-E0	00G-4453-E0	AJ0-8368

for ID: 3.2-8.0 mm



5 µm Minibore and Narrow Bore Columns (mm)									SecurityGuard™ Cartridges (mm)
Phases	30 x 2.0	50 x 2.0	150 x 2.0	250 x 2.0	50 x 3.0	100 x 3.0	150 x 3.0	250 x 3.0	4 x 2.0*
C18	00A-4435-B0	00B-4435-B0	00F-4435-B0	00G-4435-B0	00B-4435-Y0	00D-4435-Y0	00F-4435-Y0	00G-4435-Y0	/10pk
C6-Phenyl	00A-4444-B0	00B-4444-B0	00F-4444-B0	—	00B-4444-Y0	—	00F-4444-Y0	00G-4444-Y0	AJ0-7596
				—					AJ0-7914
									/10pk
NX-C18	00A-4454-B0	00B-4454-B0	00F-4454-B0	—	00B-4454-Y0	00D-4454-Y0	00F-4454-Y0	00G-4454-Y0	AJ0-8367

for ID: 2.0-3.0 mm

5 µm Analytical Columns (mm)						SecurityGuard™ Cartridges (mm)
Phases	30 x 4.6	50 x 4.6	100 x 4.6	150 x 4.6	250 x 4.6	4 x 3.0*
C18	00A-4435-E0	00B-4435-E0	00D-4435-E0	00F-4435-E0	00G-4435-E0	AJ0-7597
C6-Phenyl	00A-4444-E0	00B-4444-E0	00D-4444-E0	00F-4444-E0	00G-4444-E0	AJ0-7915
	—	—	—	—	—	/10pk
NX-C18	—	00B-4454-E0	00D-4454-E0	00F-4454-E0	00G-4454-E0	AJ0-8368

for ID: 3.2-8.0 mm



For Gemini Capillary HPLC Columns, Guards, and Adapter, contact your Phenomenex technical consultant or local distributor.



5 µm Semi-Prep Columns (mm)			SecurityGuard™ Cartridges (mm)
Phases	150 x 10	250 x 10	10 x 10†
C18	00F-4435-N0	00G-4435-N0	AJ0-7598
C6-Phenyl	—	00G-4444-N0	AJ0-9156
	—	—	/3pk
NX-C18	00F-4454-N0	00G-4454-N0	AJ0-8369

for ID: 9-16 mm

Axia™ Packed Preparative Columns (mm)							SecurityGuard™ Cartridges (mm)	
Phases	50 x 21.2	100 x 21.2	150 x 21.2	250 x 21.2	50 x 30	75 x 30	15 x 21.2**	15 x 30.0*
5 µm								
C18	00B-4435-P0-AX	00D-4435-P0-AX	00F-4435-P0-AX	00G-4435-P0-AX	00B-4435-U0-AX	00C-4435-U0-AX	AJ0-7846	AJ0-8308
C6-Phenyl	—	00D-4444-P0-AX	00F-4444-P0-AX	00G-4444-P0-AX	—	00C-4444-U0-AX	AJ0-9157	AJ0-9158
5 µm								
NX-C18	00B-4454-P0-AX	00D-4454-P0-AX	00F-4454-P0-AX	00G-4454-P0-AX	00B-4454-U0-AX	00C-4454-U0-AX	AJ0-8370	AJ0-8371
10 µm								
C18	00B-4436-P0-AX	00D-4436-P0-AX	00F-4436-P0-AX	00G-4436-P0-AX	00B-4436-U0-AX	—	AJ0-7846	AJ0-8308
10 µm								
NX-C18	00B-4455-P0-AX	00D-4455-P0-AX	00F-4455-P0-AX	00G-4455-P0-AX	—	—	AJ0-8370	AJ0-8371

for ID: 18-29 mm 30-49 mm

Axia™ Packed Preparative Columns (mm) continued							SecurityGuard™ Cartridges (mm)	
Phases	100 x 30	150 x 30	250 x 30	50 x 50	100 x 50	150 x 50	250 x 50	15 x 30.0*
5 µm								
C18	00D-4435-U0-AX	00F-4435-U0-AX	00G-4435-U0-AX	00B-4435-V0-AX	—	—	—	AJ0-8308
C6-Phenyl	00D-4444-U0-AX	—	—	—	—	—	—	AJ0-9158
5 µm								
NX-C18	00D-4454-U0-AX	00F-4454-U0-AX	00G-4454-U0-AX	—	—	—	—	AJ0-8371
10 µm								
C18	00D-4436-U0-AX	00F-4436-U0-AX	00G-4436-U0-AX	00B-4436-V0-AX	00D-4436-V0-AX	00F-4436-V0-AX	00G-4436-V0-AX	AJ0-8308
10 µm								
NX-C18	00D-4455-U0-AX	00F-4455-U0-AX	00G-4455-U0-AX	00B-4455-V0-AX	00D-4455-V0-AX	00F-4455-V0-AX	00G-4455-V0-AX	AJ0-8371

for ID: 30-49 mm



For PREP Columns & Bulk Media, see p. 345
For SecurityGuard Holders and Cartridges, see p. 254
For MercuryMS LC/MS Columns, Cartridges, and Cartridge Holders, Inquire.

*SecurityGuard™ Analytical Cartridges require holder, Part No.: KJ0-4282
†SemiPrep SecurityGuard™ Cartridges require holder, Part No.: AJ0-7220
**PREP SecurityGuard™ Cartridges require holder, Part No.: AJ0-8223
*PREP SecurityGuard™ Cartridges require holder, Part No.: AJ0-8277