



# The Standard for pH Method Development

High Efficiency • Excellent Lifetime • pH Stable 1-12



## Setting the Standard for pH Method Development

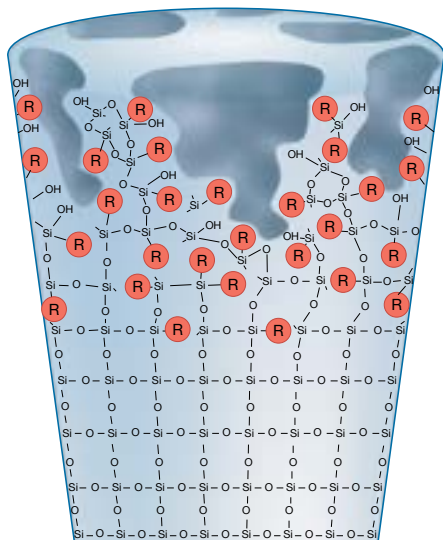
Gemini columns are rugged reversed phase HPLC columns that offer extended lifetime at extreme pH conditions and excellent stability for reproducible, high efficiency separations.

- 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

### TWIN (Two-In-One) Technology™

#### Gemini C18 and C6-Phenyl

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.

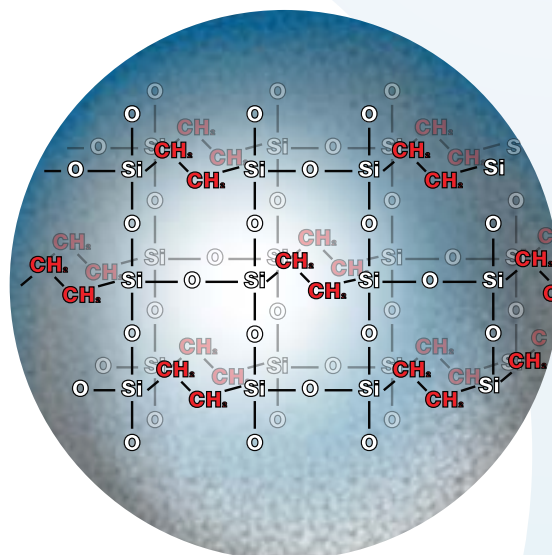


Phase	Description	USP Classification
NX-C18	The most rugged Gemini column, offering 5 times the durability of previous generation hybrid columns	L1
C6-Phenyl	A low bleed phenyl phase. For UV and MS detection, which offers an aromatic selectivity complementary to C18 phases	L11
C18	Selectivity, high structural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

### Second-Generation TWIN-NX™ Technology

#### Gemini NX-C18

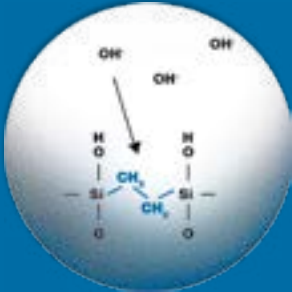
TWIN-NX technology uses an improved patented organo-silica grafting process which incorporates highly stabilizing ethane cross-linking. These organic groups are evenly incorporated into the grafted layers on the silica surface while maintaining a pure silica core. This not only provides resistance to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



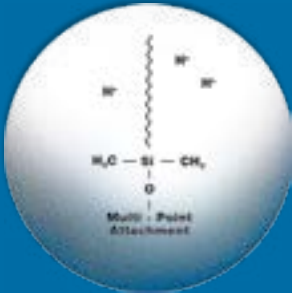
# How It Works

## Gemini NX-C18

Ethane Cross-Linking  
Resists High pH Attack



## Multi-Point Ligand Attachment Resists Low pH Ligand Cleavage



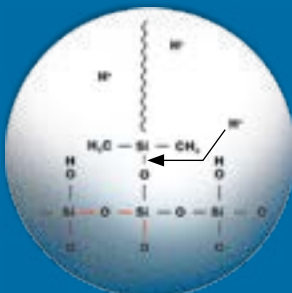
**Vs.**

## Standard Silica

Silica Dissolution



## Ligand Cleavage



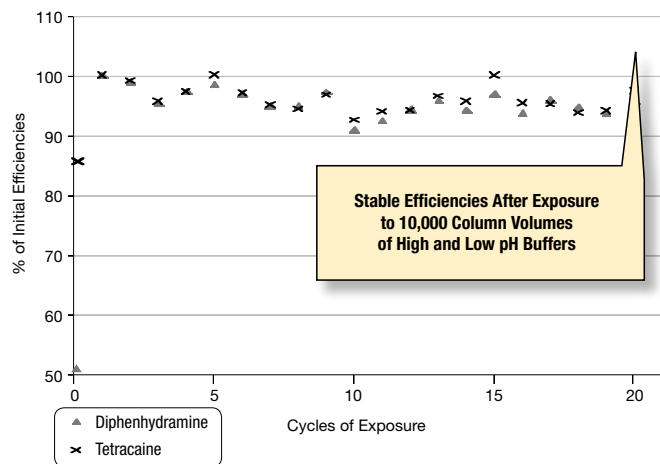
- pH stable 1-12 for durability
- Consistent performance in both volatile and non-volatile buffers
- High sample loading capacity for metabolite identification and preparative purification

## Gemini NX-C18

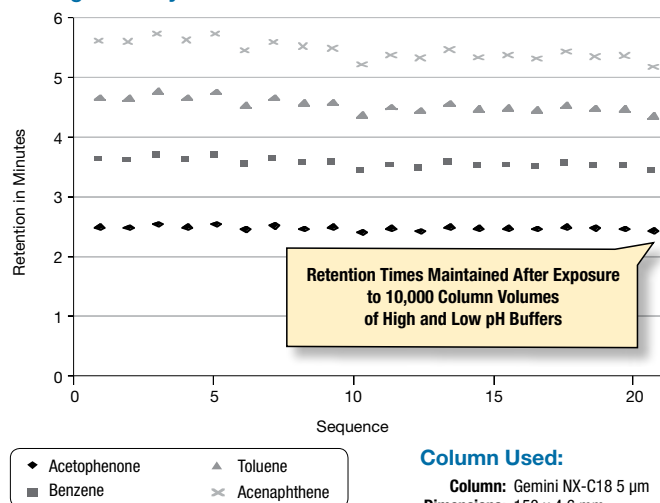
	USP: L1	LC/MS Certified
<b>pH Stability:</b>	1.0 – 12.0	
Particle Size:	3 μm, 5 μm, and 10 μm	
Phase:	C18	
Application:	Small molecules, basic compounds	
Strength:	Most durable pH stable particle	
Pore Size (Å):	110	
Surface Area (m <sup>2</sup> /g):	375	
Carbon Load %:	14	
End Capping:	TMS	

## 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



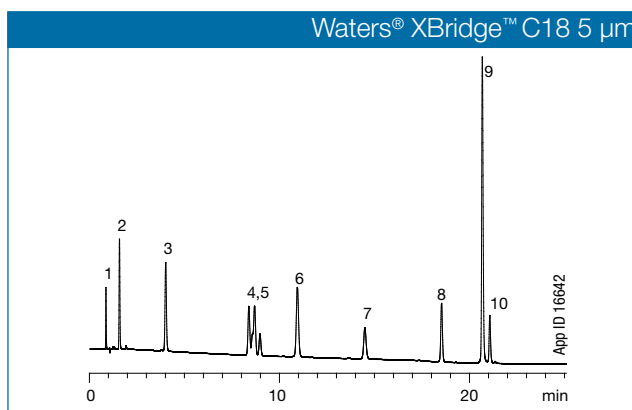
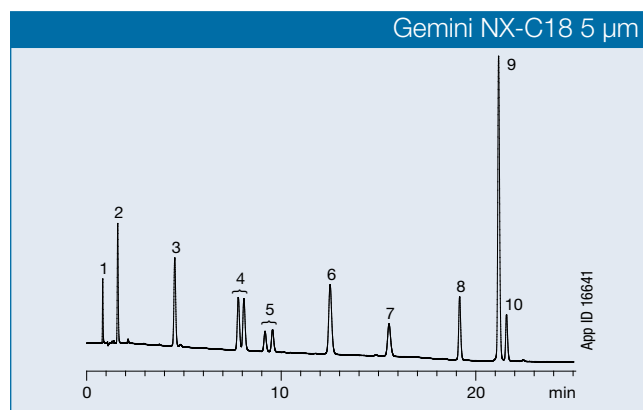
### Column Used:

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

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

The incredible durability across low and high pH ranges for Gemini NX-C18 analytical and preparative columns gives scientists the ability to get more performance from their "basic" separations.

### 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

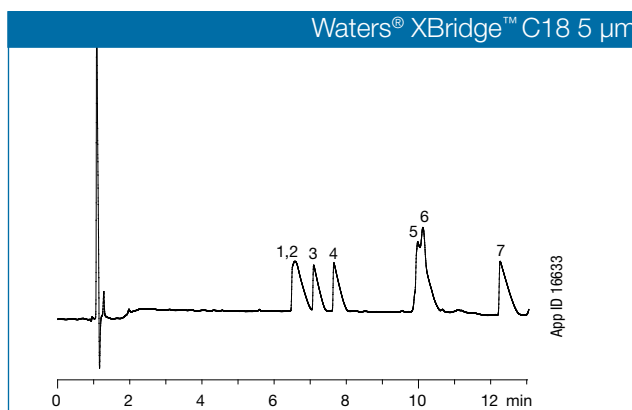
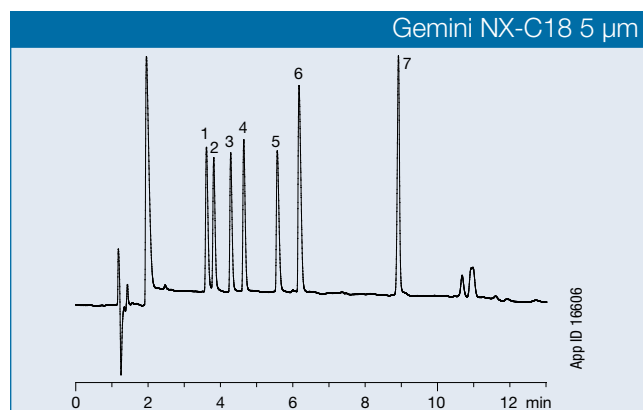
**Flow Rate:** 1.5 mL/min

**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

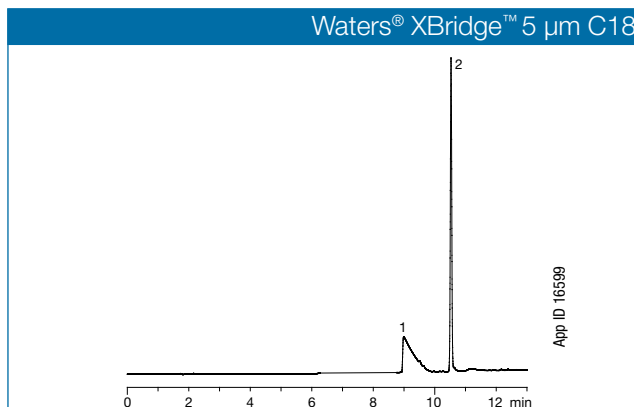
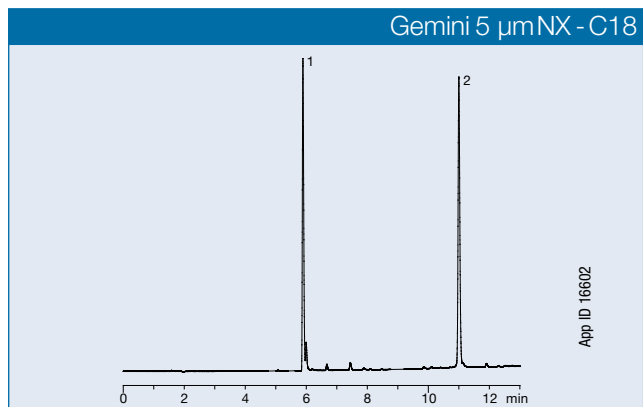
**Detection:** UV @ 210 nm

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

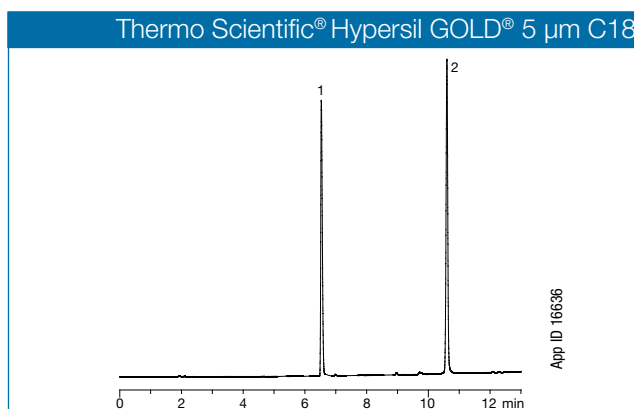
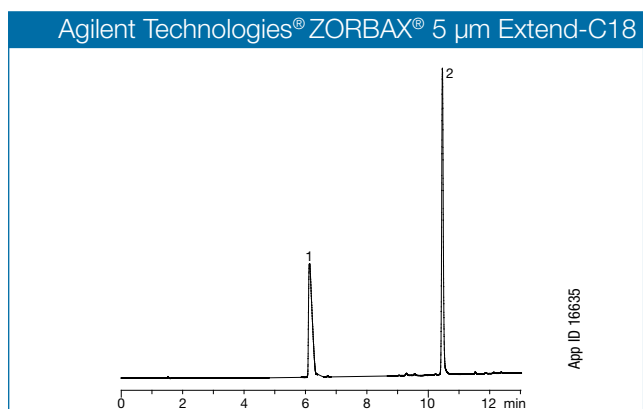
Comparative chromatograms may not be representative of all applications.  
XBridge is a trademark and Waters is a registered trademark of Waters Corporation.  
Phenomenex is in no way affiliated with Waters Corporation.

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

**Hydrophobic Basic Drugs at Low pH (pH 2.7)**



Y-axis normalized for all chromatograms.



Y-axis normalized for all chromatograms.

**Hydrophobic Bases (Diltiazem, Promethazine) in Formic Acid**

**Columns:** Gemini 5 µm NX-C18  
XBridge 5 µm C18  
Zorbax 5 µm Extend-C18  
Hypersil Gold 5 µm C18

**Sample:** 1. Diltiazem  
2. Promethazine

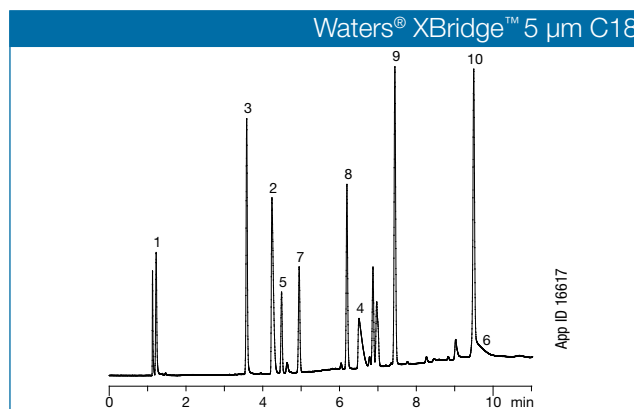
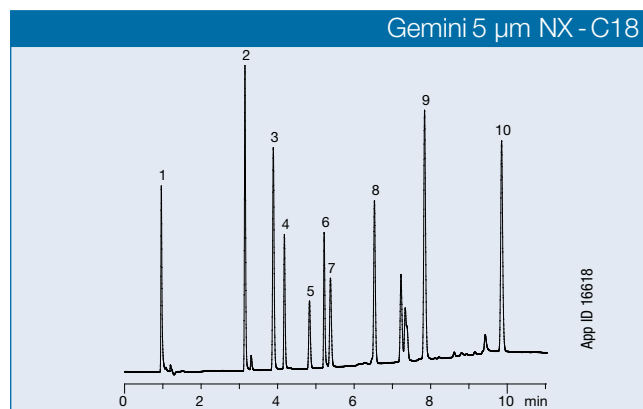
**Conditions for all columns:**

**Dimensions:** 150 x 4.6 mm  
**Mobile A:** 0.1 % Formic Acid in Water  
**Phase B:** 0.1 % Formic Acid in Acetonitrile  
**Gradient:** A/B (95:5) to (5:95) in 10 min  
**Flow Rate:** 1.0 mL/min  
**Temperature:** Ambient  
**Detection:** UV @ 254 nm

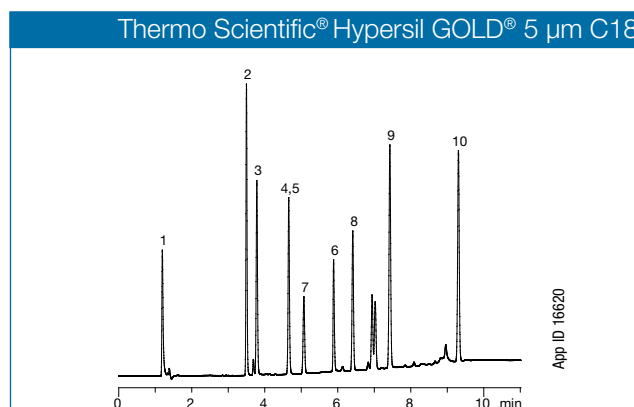
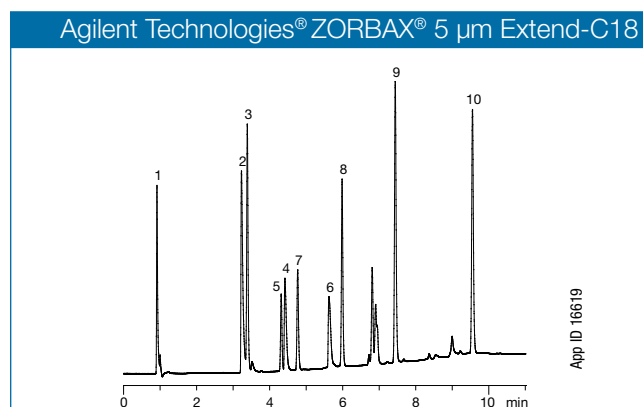
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## Performance in Volatile Buffers

With the widespread adoption of LC/MS and LC/MS/MS techniques, column performance in volatile buffers is critical.



Y-axis normalized for all chromatograms.



Y-axis normalized for all chromatograms.

### Mixtures of Acids, Neutrals, and Bases in Formic Acid pH 2.7

**Columns:** Gemini 5 µm NX-C18  
XBridge 5 µm C18  
Zorbax 5 µm Extend-C18  
Hypersil Gold 5 µm C18

**Conditions for all columns:**

**Dimensions:** 150 x 4.6 mm

**Mobile A:** 0.1 % Formic Acid in Water

**Phase B:** 0.1 % Formic Acid in Acetonitrile

**Gradient:** A/B (95:5) to (20:80) in 8 min,  
Hold for 2 min

**Flow Rate:** 1.5 mL/min

**Temperature:** Ambient

**Detection:** UV @ 254 nm

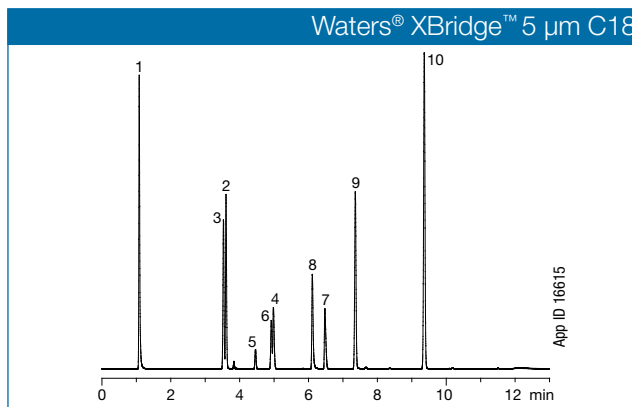
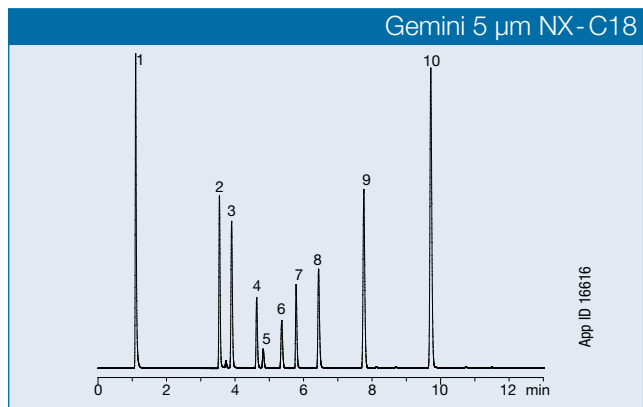
**Sample:**

1. Pyridine
2. Quinidine
3. Sulfathiazole
4. Triprolidine
5. Benzyl alcohol
6. Nortriptyline
7. Phenol
8. 3-Methyl-4-nitrobenzoic acid
9. Methylsalicylaldehyde
10. Hexanophenone

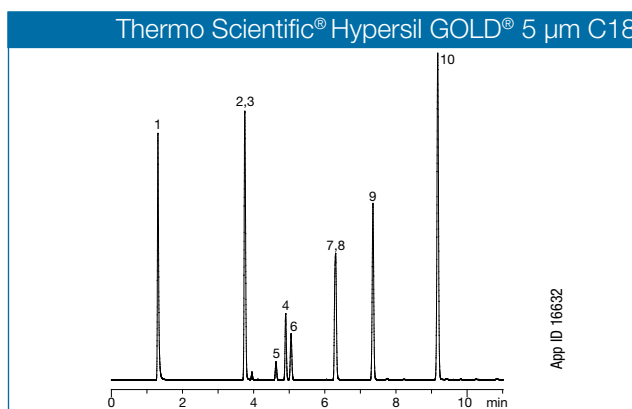
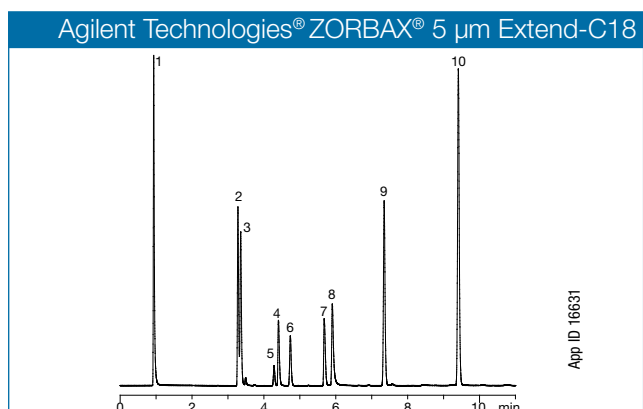
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Hypersil GOLD is a registered trademark of Thermo Hypersil-Keystone, Inc.  
Thermo Scientific is a registered trademark of Thermo Fisher Scientific Inc.  
ZORBAX and Agilent Technologies are registered trademarks of Agilent Technologies, Inc.  
Phenomenex is in no way affiliated with Waters Corp., Thermo Fisher Scientific, or Agilent.

## Performance in Non-Volatile Buffers

Gemini was engineered to be the column of choice for pharmaceutical scientists who work with difficult sample mixtures and harsh mobile phase conditions. The consistent performance and rugged phase will provide simplified method development and long column lifetimes.



Y-axis normalized for all chromatograms.



Y-axis normalized for all chromatograms.

### Mixtures of Acids, Neutrals, and Bases in Potassium Phosphate pH 2.5

**Columns:** Gemini 5 μm NX-C18  
XBridge 5 μm C18  
Zorbax 5 μm Extend-C18  
Hypersil Gold 5 μm C18

**Conditions for all columns:**

**Dimensions:** 150 x 4.6 mm

**Mobile:** A: 20 mM Potassium Phosphate pH 2.5

**Phase:** B: Acetonitrile

**Gradient:** A/B (95:5) to (20:80) in 8 min,  
Hold for 2 min

**Flow Rate:** 1.5 mL/min

**Temperature:** Ambient

**Detection:** UV @ 254 nm

**Sample:**

1. Pyridine
2. Quinidine
3. Sulfathiazole
4. Triprolidine
5. Benzyl alcohol
6. Phenol
7. Nortriptyline
8. 3-Methyl-4-nitrobenzoic acid
9. Methylsalicylaldehyde
10. Hexanophenone

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- Increased loading and retention of basic compounds
- Silica efficiency and mechanical strength
- pH stable 1 - 12 for durability

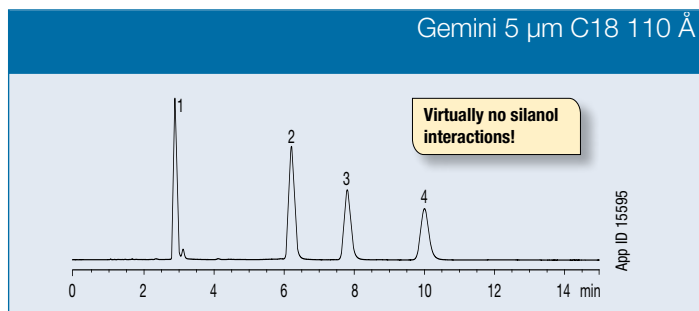
## Gemini C18

USP: L1

LC/MS Certified

<b>pH Stability:</b>	1.0 – 12.0
<b>Particle Size:</b>	3 µm, 5 µm, and 10 µm
<b>Phase:</b>	C18
<b>Application:</b>	Small molecules, basic compounds
<b>Strength:</b>	Wide pH stability, high efficiency
<b>Pore Size (Å):</b>	110
<b>Surface Area (m<sup>2</sup>/g):</b>	375
<b>Carbon Load %:</b>	14
<b>End Capping:</b>	TMS

## Chromatographic Comparisons



### Tricyclic Antidepressants at Neutral pH

Conditions for all columns:

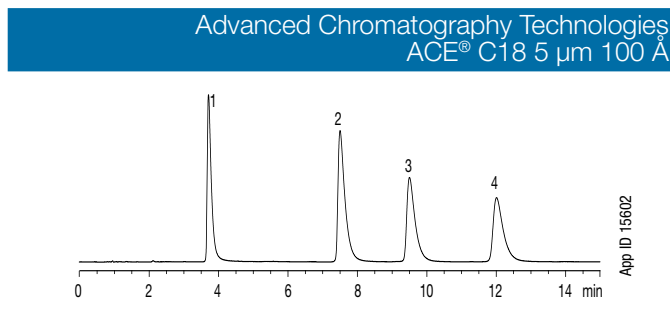
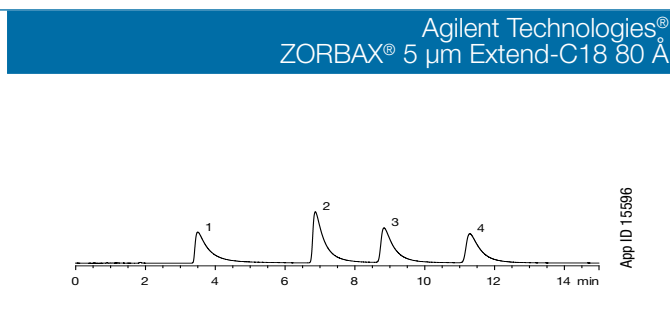
**Dimensions:** 150 x 4.6 mm

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

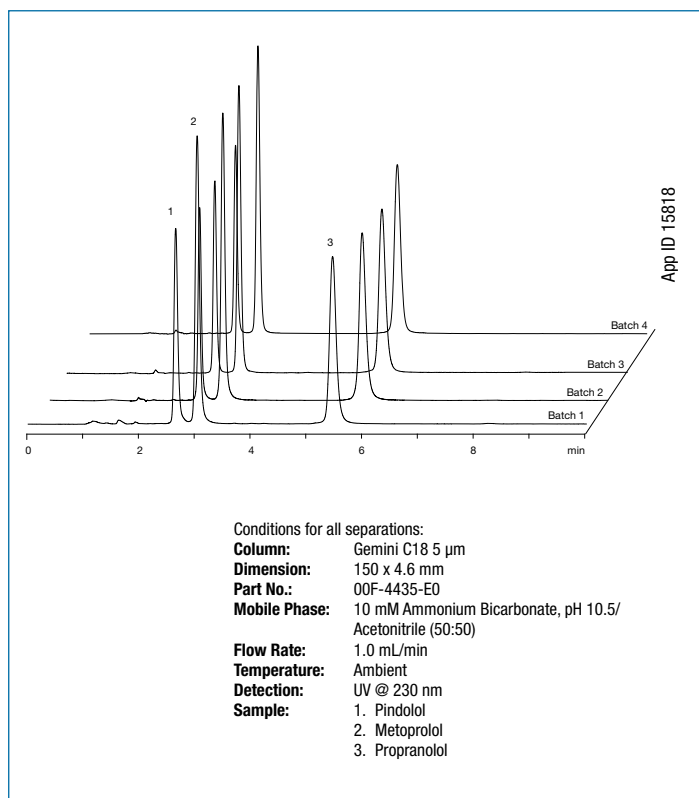
**Flow Rate:** 1.5 mL/min

**Detection:** UV @ 254 nm

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



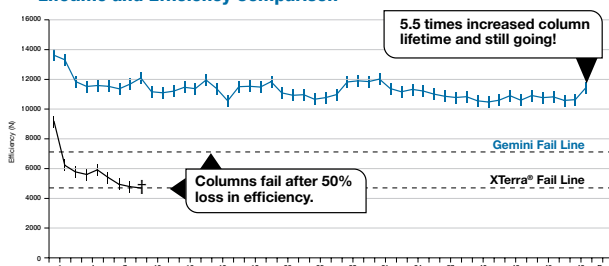
## Batch-to-Batch Reproducibility



## Extended Column Lifetime

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

### Lifetime and Efficiency Comparison<sup>‡</sup>



<sup>‡</sup>Efficiency and lifetime comparison based on average of two columns each run in parallel.

Conditions for all columns:

**Columns:** Gemini C18 5 µm  
Waters® Xterra® MS C18 5 µm  
**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 C6-Phenyl

USP: L11 LC/MS Certified

- pH stable 1-12 for durability
- Great aromatic selectivity
- Extremely low UV and MS bleed

### pH Stability: 1.0 – 12.0

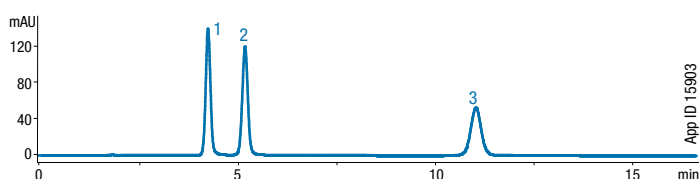
Particle Size: 3 µm and 5 µm  
Phase: Phenyl with C6 linker  
Application: Aromatic, polar or basic compounds  
Strength: High aromatic selectivity with exceptional peak shape even in neutral conditions. Extremely low bleed phenyl column.  
Pore Size (Å): 110  
Surface Area (m<sup>2</sup>/g): 375  
Carbon Load %: 12  
End Capping: TMS

## Enhanced Performance for Aromatic Compounds

### Sulfa Drug Application

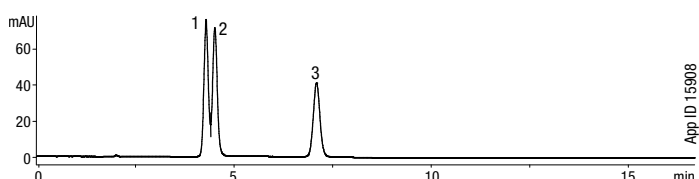
Resolution	Pursuit DiPhenyl 5 µm	Gemini C6-Phenyl 5 µm
Rs <sub>1,2</sub>	1.0	4.0
Rs <sub>2,3</sub>	9.8	16.0

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



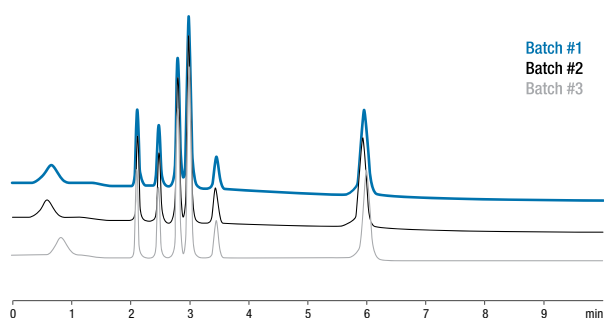
Phenomenex  
Gemini C6-Phenyl 5 µm

Agilent Technologies®  
Pursuit® 5 µm Di Phenyl



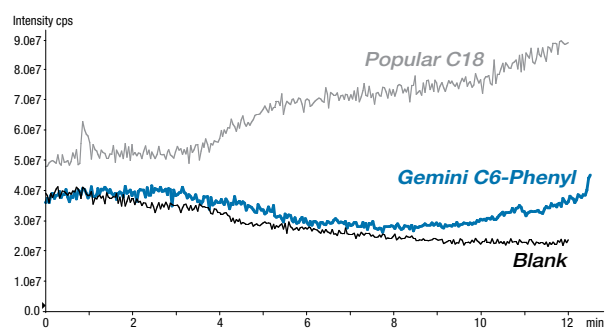
## Reproducible Phenyl Phase

### Aliphatic Acid Application



Conditions for all columns:  
**Column:** Gemini C6-Phenyl 5 µm  
**Dimensions:** 150 x 4.6 mm  
**Part No.:** 00F-4444-E0  
**Mobile Phase:** 20 mM Phosphate buffer, pH 2.5/Methanol (97:3)  
**Flow Rate:** 1.0 mL/min  
**Temperature:** Ambient  
**Detection:** UV @ 220 nm  
**Sample:**  
1. Tartaric Acid  
2. Malic Acid  
3. Lactic Acid  
4. Acetic Acid  
5. Citric Acid  
6. Propionic Acid

## Low Bleed Phenyl Phase



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



guarantee

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

## 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	/10pk	
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	AJ0-7596	
	—	—	—	—	—	—	—	—	—	AJ0-7914	
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	/10pk	
	—	—	—	—	—	—	—	—	—	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	/10pk	
C6-Phenyl	—	00A-4443-E0	00B-4443-E0	00D-4443-E0	00F-4443-E0	00G-4443-E0	AJ0-7597	
	—	—	—	—	—	—	AJ0-7915	
NX-C18	—	—	00B-4453-E0	00D-4453-E0	00F-4453-E0	00G-4453-E0	/10pk	
	—	—	—	—	—	—	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		
NX-C18	00A-4454-B0	00B-4454-B0	00F-4454-B0	—	00B-4454-Y0	00D-4454-Y0	00F-4454-Y0	00G-4454-Y0	/10pk		
	—	—	—	—	—	—	—	—	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	/10pk	
C6-Phenyl	00A-4444-E0	00B-4444-E0	00D-4444-E0	00F-4444-E0	00G-4444-E0	AJ0-7597	
	—	—	—	—	—	AJ0-7915	
NX-C18	—	00B-4454-E0	00D-4454-E0	00F-4454-E0	00G-4454-E0	/10pk	
	—	—	—	—	—	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	/3pk	
C6-Phenyl	—	00G-4444-N0	AJ0-7598	
	—	—	AJ0-9156	
NX-C18	00F-4454-N0	00G-4454-N0	/3pk	
	—	—	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*
<b>5 µm</b>							/ea	/ea
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
<b>5 µm</b>							/ea	/ea
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
<b>10 µm</b>							—	—
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
<b>10 µm</b>							/ea	/ea
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*
<b>5 µm</b>							—	/ea
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
<b>5 µm</b>							—	/ea
NX-C18	00D-4454-U0-AX	00F-4454-U0-AX	00G-4454-U0-AX	—	—	—	—	AJ0-8371
<b>10 µm</b>							—	/ea
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
<b>10 µm</b>							—	/ea
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

\*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

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