Kinetex™ Ultra-High Performance on Any LC System

Make any HPLC system perform like a UHPLC system with Kinetex™ core-shell technology columns
Ultra-High Performance on ANY LC System

Introducing Kinetex™- a leap in column particle technology that will change the way you think about UHPLC (Ultra-High Performance Liquid Chromatography). Prepare to transform the performance of every HPLC instrument in your laboratory into UHPLC results by harnessing the power of core-shell technology†. You can immediately improve resolution, throughput, and sensitivity as well as reduce solvent consumption. No longer restricted by the HPLC/UHPLC system divide, you can develop high performance LC methods on any instrument and transfer them anywhere.

† See page 33 for an overview of core-shell technology.

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Outperforms Traditional Fully Porous Columns

Wide Applicability

Complementary and Orthogonal Selectivities

Solvent Savings

Long Column Lifetime

Ultra-High Performance, Low Backpressure

Replace 3 µm and 5 µm Columns

Replace sub-2 µm Columns

Increase Resolution and Maximize Throughput

Easier Method Transfer

Increase Sensitivity
Low Backpressure
Sub-2 µm Efficiency

With the efficiency of a sub-2 µm column and typical operating backpressure less than 400 bar†, you can achieve the promise of ultra-high performance on any LC system.

N = 272,080 p/m
> 400 bar!
Method cannot transfer to a non-UHPLC instrument

N = 267,720 p/m
< 300 bar!
Easier method transfer to ANY system

Conditions for both columns:
Column: Kinetex 2.6 µm C18
Traditional 1.7 µm C18
Dimensions: 50 x 2.1 mm
Mobile Phase: Acetonitrile / Water (50:50)
Flow Rate: 0.6 mL/min
Temperature: 25 °C
Detection: UV @ 254 nm
Instrument: *Waters® ACQUITY® UPLC®
Sample: 0.5 µL test mixture
1. Acetophenone
2. Benzene
3. Toluene
4. Naphthalene

† Kinetex 2.6 µm columns are pressure rated to 600 bar use on both HPLC and UHPLC instrumentation.
* Waters, ACQUITY, and UPLC are registered trademarks of Waters Corporation. Phenomenex is not affiliated with Waters Corporation.
Comparative separations may not be representative of all applications.

PHENOMENEX | WEB: www.phenomenex.com
2x Efficiency of Traditional 3 µm Columns

Replace traditional 3 µm or 5 µm analytical columns with Kinetex™ 2.6 µm core-shell columns for immediate performance improvements in efficiency, speed, resolution, and sensitivity. Optimize methods for ultra-high performance and transfer them to any system.

**Conditions for both columns:**
- **Column:** Kinetex 2.6 µm C18
  - Traditional 3 µm C18
- **Dimensions:** 150 x 4.6 mm
- **Mobile Phase:** Acetonitrile / Water (70:30)
- **Flow Rate:** 1.8 mL/min
- **Temperature:** 25 °C
- **Backpressure:** 380 bar (Kinetex)
  - 250 bar (Traditional 3 µm)
- **Detection:** UV @ 254 nm
- **Instrument:** Agilent 1200SL
- **Sample:**
  1. Uracil
  2. Acetophenone
  3. Toluene
  4. Naphthalene

Comparative separations may not be representative of all applications.
Replace 3 µm and 5 µm Columns
For Improved Speed, Resolution, and Sensitivity

Unlike traditionally fully porous particles, higher-pressure capable instruments are not required with Kinetex™ 2.6 µm core-shell technology to achieve ultra-high performance chromatography. Generating much lower backpressure (< 400 bar) at optimal linear velocities, you can now achieve 2-3x the column efficiencies of traditional fully porous 3 µm and 5 µm columns on any LC instrument. Use that extra efficiency to improve the resolution of a critical pair or consider decreasing your column length for higher throughput.

Optimization of Atenolol EP Method
This EP (European Pharmacopoeia [Ph. Eur.]) monograph is an impurity profile that uses an isocratic method. As shown to the right, Kinetex™ core-shell technology columns allow you to shorten the run time to less than 11 minutes and still maintain the resolution of all impurities.

EP Specified 5 µm C18 Column

| Dimensions: | 150 x 3.9 mm |
| Mobile Phase: | 12.5 mM Phosphoric acid in Water, pH 3.0 + 2.0 g Sodium Octanesulfonate + 0.8 g Tetrabutyl Ammonium Hydrogen Sulfate / Methanol / THF (80:18:2) |
| Flow Rate: | 0.6 mL/min |
| Temperature: | 22 ºC |
| Detection: | UV @ 226 nm |
| Sample: | Atenolol Related Substance |

1. Impurity B
2. Impurity A
3. Impurity J
4. Impurity I
5. Impurities D and E
6. Impurity F
7. Impurity G
8. Impurity H

*Waters® Symmetry® 5 µm C18

* Waters and Symmetry are registered trademarks of Waters Corporation. Phenomenex is not affiliated with Waters Corporation. Comparative separations may not be representative of all applications.
Substitute* with Kinetex™ C18

Improved Resolution and Higher Sensitivity

Column: Kinetex 2.6 µm C18
Dimensions: 150 x 4.6 mm
Part No.: 00F-4462-E0
Flow Rate: 0.6 mL/min

30 % Faster Analysis

Column: Kinetex 2.6 µm C18
Dimensions: 150 x 4.6 mm
Part No.: 00F-4462-E0
Flow Rate: 0.8 mL/min

Decrease Column Length‡

66 % Higher Throughput than Original EP Method

Column: Kinetex 2.6 µm C18
Dimensions: 100 x 4.6 mm
Part No.: 00D-4462-E0
Flow Rate: 1.0 mL/min

* Decrease in column particle within allowable EP and USP Pharma particles size change (+/- 50 %)
‡ Decrease in column particle within allowable EP and USP column length change (+/- 50 %)

Conditions are same except as noted:
Mobile Phase: 12.5 mM Phosphoric acid in Water, pH 3.0 + 2.0 g Sodium Octanesulfonate + 0.8 g Tetrabutyl Ammonium Hydrogen Sulfate / Methanol / THF (80:18:2)
Temperature: 22 ºC
Detection: UV @ 226 nm
Sample: Atenolol Related Substance
1. Impurity B
2. Impurity A
3. Impurity J
4. Impurity I
5. Impurities D and E
6. Impurity F
7. Impurity G
8. Impurity H

PHENOMENEX | WEB: www.phenomenex.com
Replace Sub-2 μm Columns For Higher Efficiency

For users of higher pressure capable instruments who want the highest level of efficiency, we introduce the Kinetex™ 1.7 μm column - the first sub-2 μm core-shell particle available on the market.

Traditional 1.7 μm

Kinetex™ 1.7 μm

The most efficient sub-2 μm column on the planet.

Conditions for both columns:
- Column: Kinetex 1.7 μm C18
  - Traditional 1.7 μm C18
- Dimensions: 50 x 2.1 mm
- Mobile Phase: Acetonitrile / Water (50:50)
- Flow Rate: 0.6 mL/min
- Temperature: 25 °C
- Detection: UV @ 254 nm
- Instrument: *Waters® ACQUITY® UPLC®
- Sample: 1. Acetophenone
  2. Benzene
  3. Toluene
  4. Naphthalene

* Waters, ACQUITY, and UPLC are registered trademarks of Waters Corporation. Phenomenex is not affiliated with Waters Corporation. Comparative separations may not be representative of all applications.
Replace Sub-2 µm Columns
For Increased Peak Capacity

Kinetex™ 1.7 µm core-shell columns can instantly boost the performance of your existing sub-2 µm methods as shown below.

**Conditions for both columns:**
- **Column:** Kinetex 1.7 µm C18
- **Traditional 1.7 µm**
- **Dimension:** 50 x 2.1 mm
- **Mobile Phase:**
  - A: 0.1 % Formic acid in Water
  - B: 0.1 % Formic acid in Acetonitrile
- **Gradient:**
  - Time (min) % B Time (min) % B
  - 0 5 2.33 95
  - 5 95 3.37 5
- **Flow Rate:** 0.6 mL/min
- **Temperature:** 45 °C
- **Detection:** UV @ 260 nm
- **Backpressure:** 475 bar (Kinetex) 390 bar (Traditional)
- **Instrument:** *Waters® ACQUITY® UPLC®
- **Sample:**
  - 1. Sulfathiazole
  - 2. Sulfamerazine
  - 3. Sulfamethoxazole
  - 4. Sulfaquinoxaline

*Waters, ACQUITY, and UPLC are registered trademarks of Waters Corporation. Phenomenex is not affiliated with Waters Corporation. Comparative separations may not be representative of all applications.

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**Average Peak Capacity**
- *Traditional 1.7 µm:* 137
- *Kinetex™ 1.7 µm:* 148

**Use Kinetex™ 2.6 µm for ultra-high performance on any LC system.**
Decrease Run Time
Increase Resolution

In the past, the options for fast LC were limited to costly system upgrades, compromises in column performance or only modest improvements in throughput. Now, Kinetex™ core-shell technology delivers on the promise of UHPLC performance via dramatically faster analysis with similar or better resolution on any LC system.

### 5 µm Kinetex™ Column

**Traditional 5 µm C18**
- **Dimensions:** 250 x 4.6 mm
- **Mobile Phase:** A: Water, B: Acetonitrile
- **Gradient:**
  - Time (min) % B
    - 0 5
    - 4.78 5
    - 51.52 95
    - 66 95
    - 66.01 5
    - 86.38 5
- **Flow Rate:** 0.714 mL/min
- **Temperature:** 45 °C
- **Detection:** UV @ 258 nm
- **Sample:**
  1. Acetone
  2. 2-Butanone
  3. 2-Pentanone
  4. Acetophenone
  5. 2-Heptanone
  6. Butyrophenone
  7. 2-Nonanone

\[ R_s^{10,11} = 3.11 \]

### Kinetex™ Column

**Kinetex 2.6 µm C18**
- **Dimensions:** 100 x 4.6 mm
- **Part No.:** 00D-4462-E0
- **Mobile Phase:** A: Water, B: Acetonitrile
- **Gradient:**
  - Time (min) % B
    - 0 5
    - 0.65 5
    - 7.01 95
    - 8.2 95
    - 8.21 5
    - 10.97 5
- **Flow Rate:** 2.1 mL/min
- **Temperature:** 45 °C
- **Detection:** UV @ 258 nm
- **Backpressure:** 360 bar
- **Sample:**
  1. Acetone
  2. 2-Butanone
  3. 2-Pentanone
  4. Acetophenone
  5. 2-Heptanone
  6. Butyrophenone
  7. 2-Nonanone
  8. Hexanophenone
  9. Octanophenone
  10. 2-Tridecanone
  11. Decanophenone
  12. 2-Pentadecanone
  13. 2-Hexadecanone

\[ R_s^{10,11} = 4.96 \]
Decrease Run Time
Maximize Throughput

For the ultimate sample throughput demands, Kinetex™ columns provide the efficiency needed to significantly reduce run times. In this separation of 13 ketones, a 20-fold increase in productivity is accomplished while still maintaining resolution.

<table>
<thead>
<tr>
<th>Column:</th>
<th>Traditional 5 µm C18</th>
<th>Kinetex™ 2.6 µm C18</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions:</td>
<td>250 x 4.6 mm</td>
<td>50 x 4.6 mm</td>
</tr>
<tr>
<td>Mobile Phase:</td>
<td>A: Water</td>
<td>B: Acetonitrile</td>
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<tr>
<td>Gradient:</td>
<td>Time (min)</td>
<td>% B</td>
</tr>
<tr>
<td>A</td>
<td>4.78</td>
<td>5</td>
</tr>
<tr>
<td>B</td>
<td>51.52</td>
<td>95</td>
</tr>
<tr>
<td>Flow Rate:</td>
<td>0.714 mL/min</td>
<td>3.4 mL/min</td>
</tr>
<tr>
<td>Temperature:</td>
<td>45 °C</td>
<td>45 °C</td>
</tr>
<tr>
<td>Detection:</td>
<td>UV @ 258 nm</td>
<td>UV @ 258 nm</td>
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<tr>
<td>Sample:</td>
<td>Acetone</td>
<td>Acetone</td>
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<tr>
<td>1</td>
<td>2-Butanone</td>
<td>2-Butanone</td>
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<tr>
<td>2</td>
<td>2-Pentanone</td>
<td>2-Pentanone</td>
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<td>3</td>
<td>Acetophenone</td>
<td>Acetophenone</td>
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<td>4</td>
<td>2-Heptanone</td>
<td>2-Heptanone</td>
</tr>
<tr>
<td>5</td>
<td>Butyrophenone</td>
<td>Butyrophenone</td>
</tr>
<tr>
<td>6</td>
<td>2-Nonanone</td>
<td>2-Nonanone</td>
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<td>7</td>
<td>2-Octanone</td>
<td>2-Octanone</td>
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<tr>
<td>8</td>
<td>Hexanophenone</td>
<td>Hexanophenone</td>
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<tr>
<td>9</td>
<td>Octanophenone</td>
<td>Octanophenone</td>
</tr>
<tr>
<td>10</td>
<td>2-Tridecanone</td>
<td>2-Tridecanone</td>
</tr>
<tr>
<td>11</td>
<td>Decanophenone</td>
<td>Decanophenone</td>
</tr>
<tr>
<td>12</td>
<td>2-Pentadecanone</td>
<td>2-Pentadecanone</td>
</tr>
<tr>
<td>13</td>
<td>2-Hexadecanone</td>
<td>2-Hexadecanone</td>
</tr>
</tbody>
</table>

Comparative separations may not be representative of all applications.
**Easier Method Transfer to ANY LC System**

UHPLC methods developed with fully porous sub-2 µm columns often generate backpressure higher than HPLC system limitations. With Kinetex™ 2.6 µm core-shell technology, you are no longer restricted from developing high performance LC methods on any system and transferring them anywhere.

**Kinetex™ 4.6 mm ID on Agilent 1100**
- **Column:** Kinetex 2.6 µm C18
- **Dimensions:** 50 x 4.6 mm
- **Part No.:** 00B-4462-E0
- **Mobile Phase:** Acetonitrile / Water (50:50)
- **Flow Rate:** 2.35 mL/min
- **Temperature:** Ambient
- **Detection:** UV @ 254 nm
- **Sample:** 1. Uracil
  2. Acetophenone
  3. Toluene
  4. Naphthalene

**Kinetex™ 2.1 mm ID on Agilent 1200SL**
- **Column:** Kinetex 2.6 µm C18
- **Dimensions:** 50 x 2.1 mm
- **Part No.:** 00B-4462-AN
- **Mobile Phase:** Acetonitrile / Water (50:50)
- **Flow Rate:** 0.49 mL/min
- **Temperature:** Ambient
- **Detection:** UV @ 254 nm
- **Sample:** 1. Uracil
  2. Acetophenone
  3. Toluene
  4. Naphthalene
In these examples different internal diameters of Kinetex™ columns are used on various systems to illustrate the versatility of Kinetex™ core-shell technology. Please note the flow rates are scaled to maintain the same linear velocity.

**Kinetex™ 3.0 mm ID on *Shimadzu Prominence™ UFLCXR™**

- **Column:** Kinetex 2.6 µm C18
- **Dimensions:** 50 x 3.0 mm
- **Part No.:** 00B-4462-Y0
- **Mobile Phase:** Acetonitrile / Water (50:50)
- **Flow Rate:** 1.0 mL/min
- **Temperature:** Ambient
- **Detection:** UV @ 254 nm
- **Sample:** 1. Uracil
  2. Acetophenone
  3. Toluene
  4. Naphthalene

**Kinetex™ 2.1 mm ID on *Waters® ACQUITY® UPLC®**

- **Column:** Kinetex 2.6 µm C18
- **Dimensions:** 50 x 2.1 mm
- **Part No.:** 00B-4462-AN
- **Mobile Phase:** Acetonitrile / Water (50:50)
- **Flow Rate:** 0.49 mL/min
- **Temperature:** Ambient
- **Detection:** UV @ 254 nm
- **Sample:** 1. Uracil
  2. Acetophenone
  3. Toluene
  4. Naphthalene

* Waters, ACQUITY, and UPLC are registered trademarks of Waters Corporation. Prominence and UFLC are trademarks of Shimadzu Corporation. Phenomenex is not affiliated with Agilent Technologies or the above companies.
Increase Sensitivity

The combination of the small particle size, narrow particle size distribution, and the significantly shorter diffusion path results in much higher column efficiencies and increased chromatographic resolution. The increased efficiencies provide an immediate benefit on sensitivity since higher chromatographic efficiencies translate into significantly narrower and taller peaks, making it easier to detect low level impurities.

**Conditions same except where noted:**
- **Dimensions:** 50 x 2.1 mm (Kinetex)
  50 x 2.0 mm (Traditional)
- **Mobile Phase:** Acetonitrile / Water (50:50)
- **Flow Rate:** 0.5 mL/min
- **Temperature:** 25 °C
- **Instrument:** Waters® ACQUITY® UPLC®
- **Detection:** UV @ 254 nm
- **Sample:**
  1. Acetophenone
  2. Benzene
  3. Toluene
  4. Naphthalene

* Waters, ACQUITY, and UPLC are registered trademarks of Waters Corporation. Phenomenex is not affiliated with Waters Corporation. Comparative separations may not be representative of all applications.
**Improved Resolution and Sensitivity Comparison**

*ZORBAX® 3.5 µm SB-C18*

- **Dimensions**: 150 x 4.6 mm
- **Mobile Phase**: A: Water; B: Acetonitrile
- **Gradient**: (95:5) A/B for 1.16 min, then to (5:95) A/B
- **Flow Rate**: 1.5 mL/min
- **Temperature**: 45 ºC
- **Detection**: UV @ 254 nm
- **Instrument**: Agilent 1200
- **Backpressure**: 190 bar
- **Sample**:
  1. Pyridine
  2. Acetaminophen
  3. Pindolol
  4. Quinine
  5. Acebutolol
  6. Chlorpheniramine
  7. Triprolidine
  8. Prednisolone
  9. Nortriptyline
  10. 4-Chlorobenzoic acid
  11. 5-Methyl-2-hydroxy benzaldehyde
  12. 4-Chlorocinnamic acid
  13. Diazepam
  14. Diflunisal
  15. Niflumic acid
  16. Hexanophenone

* ZORBAX is registered trademark of Agilent Technologies. Comparative separations may not be representative of all applications. Phenomenex is not affiliated with Agilent Technologies.

**Kinetex™ 2.6 µm C18**

- **Dimensions**: 150 x 4.6 mm
- **Part No.**: 00F-4462-E0
- **Mobile Phase**: A: Water; B: Acetonitrile
- **Gradient**: (95:5) A/B for 1.16 min, then to (5:95) A/B
- **Flow Rate**: 1.5 mL/min
- **Temperature**: 45 ºC
- **Detection**: UV @ 254 nm
- **Instrument**: Agilent 1200
- **Backpressure**: 300 bar
- **Sample**:
  1. Pyridine
  2. Acetaminophen
  3. Pindolol
  4. Quinine
  5. Acebutolol
  6. Chlorpheniramine
  7. Triprolidine
  8. Prednisolone
  9. Nortriptyline
  10. 4-Chlorobenzoic acid
  11. 5-Methyl-2-hydroxy benzaldehyde
  12. 4-Chlorocinnamic acid
  13. Diazepam
  14. Diflunisal
  15. Niflumic acid
  16. Hexanophenone

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Have you experienced short lifetime with your sub-2 µm columns?

Even with complex sample mixtures, Kinetex™ columns maintain consistent results over normal use. In this example, β-blockers in human plasma were extracted after protein crash over the course of 1000 injections in both a Kinetex™ 2.6 µm core-shell column and a traditional sub-2 µm fully porous column intended for UHPLC performance. Virtually no degradation of the column performance is seen with the Kinetex™ column.

**Conditions for both columns:**
- Dimensions: 50 x 2.1 mm
- Mobile Phase: A: 0.1 % Formic acid in Water
  - B: 0.1 % Formic acid in Acetonitrile
- Gradient: A/B (95:5) for 1.2 min to (0:100) for 0.01 min, hold at (95:5)
- Flow Rate: 0.6 mL/min
- Temperature: 25 °C
- Instrument: Waters® ACQUITY® UPLC®
- Detection: UV @ 254 nm
- Sample: 1. Metoprolol
  2. Alprenolol
  3. Endogenous

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Further Extend Kinetex™ Column Lifetime

**KrudKatcher™ Ultra In-line Filter**

Protect your valuable UHPLC/HPLC column with a reliable and easy-to-use, disposable KrudKatcher™ Ultra pre-column filter. Pressure-rated to 20,000 psi (1,375 bar), the stainless steel filter body houses an integrated 0.5 µm 316 stainless steel filter element that efficiently removes microparticulates from the flow stream without contributing to system backpressure or dead volume (< 0.2 µL).

**Reproducible Performance with KrudKatcher™ Ultra In-Line Filter**

<table>
<thead>
<tr>
<th>Substance</th>
<th>Change in t&lt;sub&gt;R&lt;/sub&gt; (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uracil</td>
<td>0.2</td>
</tr>
<tr>
<td>Acetophenone</td>
<td>0.5</td>
</tr>
<tr>
<td>Toluene</td>
<td>0.7</td>
</tr>
<tr>
<td>Naphthalene</td>
<td>0.8</td>
</tr>
</tbody>
</table>

n=15

**Column:** Kinetex 2.6 µm C18 100 Å

- with and without KrudKatcher Ultra In-Line filter as noted

**Dimensions:** 50 x 2.1 mm

**Part No.:** 008-4462-KU (Kinetex column)

**A0-8497 (KrudKatcher Ultra)**

**Mobile Phase:** Acetonitrile / Water (65:35)

**Flow Rate:** 0.5 mL/min

**Temperature:** 22 °C

**Injection Volume:** 0.2 µL

**Detection:** UV @ 254 nm

**Backpressure:** approx. 248 bar

**Sample:** Prodigy Test Mix (AL0-3045)

1. Uracil
2. Acetophenone
3. Toluene
4. Naphthalene

*For more details on the test methodology and results, contact Phenomenex.*

*See p. 43 for KrudKatcher ordering information.*
Improve Performance

When chromatographic column performance improves you can not only decrease your analysis time but also decrease your overall solvent consumption without compromising your separations. Use Kinetex™ core-shell technology to dramatically decrease the solvent consumption in your laboratory and increase sample throughput.

Typical Method Consumption

- **Column**: Traditional 5 µm C18
- **Dimensions**: 250 x 4.6 mm
- **Mobile Phase**:
  - A: 20 mM Potassium phosphate pH 7
  - B: Methanol / Acetonitrile (50:50)
  - A/B (48:52)
- **Flow Rate**: 1.0 mL/min
- **Temperature**: 40 °C
- **Detection**: UV @ 254 nm

**Sample**:
1. Tianeptine
2. Desmethyldoxepin
3. Protriptyline
4. Desipramine
5. Imipramine
6. Amoxapine
7. Doxepin
8. Nortriptyline
9. Amitriptyline
10. Clomipramine

**Typical Method Consumption**

110 mL solvent per run!
Substitute specified column with Kinetex™ column to reduce solvent consumption

**Only 26 mL solvent per run!**

Further reduce column ID for even greater solvent savings!

**< 4 mL solvent per run!**

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**Column:** Kinetex 2.6 µm C18  
**Dimensions:** 100 x 4.6 mm  
**Part No.:** 00D-4462-E0  
**Mobile Phase:** A: 20 mM Potassium phosphate pH 7  
B: Methanol / Acetonitrile (50:50)  
A/B (48:52)  
**Flow Rate:** 2.9 mL/min  
**Temperature:** 40 ºC  
**Detection:** UV @ 254 nm  
**Sample:**  
1. Tianeptine  
2. Desmethyldoxepin  
3. Protriptyline  
4. Desipramine  
5. Imipramine  
6. Amoxapine  
7. Doxepin  
8. Nortriptyline  
9. Amitriptyline  
10. Clomipramine

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**Column:** Kinetex 2.6 µm C18  
**Dimensions:** 50 x 2.1 mm  
**Part No.:** 00B-4462-AN  
**Mobile Phase:** A: 20 mM Potassium phosphate pH 7  
B: Methanol / Acetonitrile (50:50)  
A/B (48:52)  
**Flow Rate:** 0.6 mL/min  
**Temperature:** 40 ºC  
**Detection:** UV @ 254 nm  
**Sample:**  
1. Tianeptine  
2. Desmethyldoxepin  
3. Protriptyline  
4. Desipramine  
5. Imipramine  
6. Amoxapine  
7. Doxepin  
8. Nortriptyline  
9. Amitriptyline  
10. Clomipramine

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How much could this save you...annually?
Complementary and Orthogonal Selectivities
C18, PFP, and HILIC

Even more than efficiency, selectivity is the most important parameter for obtaining high performance separations. Notice in the resolution equation below that selectivity ($\alpha$) is more influential than efficiency ($N$).

$$R_s = \frac{\sqrt{N}}{4} \left( \frac{\alpha-1}{\alpha} \right) \left( \frac{k}{k+1} \right)$$

where $k$ is the average value for the two peaks.

The selectivity parameter, $\alpha$, is a measure of the spacing between two peaks and is expressed as:

$$\alpha = \frac{k_2}{k_1}$$

To provide alternative and orthogonal selectivity phases, Kinetex™ columns are available in 3 selectivities: C18, PFP (Pentafluorophenyl), and HILIC* (Hydrophilic Interaction Liquid Chromatography), for resolution of a wide range of compounds from polar to hydrophobic, aromatic, and isomers.

Kinetex™ Phase Selectivities

<table>
<thead>
<tr>
<th>Phase</th>
<th>Mechanism</th>
<th>Recommended for</th>
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</thead>
<tbody>
<tr>
<td>C18</td>
<td>Hydrophobic</td>
<td>L1 methods</td>
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<tr>
<td></td>
<td></td>
<td>Most reversed phase applications</td>
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<tr>
<td>PFP</td>
<td>Hydrogen bonding</td>
<td>Positional isomers</td>
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<td>Dipole-dipole</td>
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<td>Aromatic pi-pi</td>
<td>Conjugated compounds</td>
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<td>Hydrophobic</td>
<td>L43 methods</td>
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<td>HILIC*</td>
<td>Hydrophilic</td>
<td>Very polar compounds</td>
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<td>Improved MS sensitivity</td>
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</table>

* HILIC available October 2009.
### Positional Isomers

#### Steroids

- **Columns:**
  - Kinetex 2.6 µm PFP
  - Kinetex 2.6 µm C18
- **Dimensions:**
  - 50 x 2.1 mm
- **Mobile Phase:**
  - 0.1 % Formic acid in Water
  - 0.1 % Formic acid in Acetonitrile (70:30)
- **Flow Rate:** 0.8 mL/min
- **Temperature:** 25 °C
- **Detection:** UV @ 254 nm

#### Conditions for both columns:

1. **Sample:**
   - 1. 2,3-dimethylphenol
   - 2. 2,5-dimethylphenol
   - 3. 2,6-dimethylphenol
   - 4. 3,4-dimethylphenol
   - 5. 3,5-dimethylphenol
   - 6. 2,5-dimethylphenol
   - 7. 2,6-dimethylphenol
   - 8. 3,4-dimethylphenol
   - 9. 3,5-dimethylphenol
   - 10. 2,4-dibromophenol

---

### Steroids

- **Columns:**
  - Kinetex 2.6 µm PFP
  - Kinetex 2.6 µm C18
- **Dimensions:**
  - 150 x 4.6 mm
- **Mobile Phase:**
  - A: Water
  - B: Acetonitrile
- **Gradient:**
  - A/B (75:25) to (35:65) in 12 min to (75:25) in 0.01 min, hold for 4 min
- **Flow Rate:** 1.2 mL/min
- **Temperature:** 22 °C
- **Detection:** UV @ 230 nm

#### Conditions for both columns:

1. **Sample:**
   - 1. 11-α-Hydroxyprogesterone
   - 2. Cortisone Acetate
   - 3. Estradiol
   - 4. 21-Hydroxyprogesterone
   - 5. 11-Ketoprogesterone
   - 6. Estrone

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**Thank you**

- **Nice separation**

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**PHENOMENEX** | WEB: www.phenomenex.com
Complementary Selectivities
C18 and PFP

Conditions for both columns:
- Columns: Kinetex 2.6 µm PFP, Kinetex 2.6 µm C18
- Dimensions: 100 x 4.6mm
- Mobile Phase:
  - A: Water
  - B: Methanol
- Gradient: (45:55) A/B to (35:65) A/B over 6 min
- Flow Rate: 1.2 mL/min
- Temperature: 22 °C
- Detection: UV @ 254 nm
- Sample:
  1. HMx
  2. RDx
  3. 1,3,5-Trinitrobenzene
  4. 1,3-Dinitrobenzene
  5. Nitrobenzene
  6. 2,4,6-Trinitrotoluene
  7. 2,4-Dinitrotoluene

Resorcinol
- Columns: Kinetex 2.6 µm PFP, Kinetex 2.6 µm C18
- Dimensions: 50 x 2.1 mm
- Mobile Phase:
  - 0.1 % Formic acid in Water
  - 0.1 % Formic acid in Acetonitrile (85:15)
- Flow Rate: 0.5 mL/min
- Temperature: 25 °C
- Detection: UV @ 270 nm
- Sample:
  1. Resorcinol
  2. 2-Methylresorcinol
  3. Catechol
  4. 2,5-Dimethylresorcinol
  5. 4-Methylcatechol
  6. 4-Nitrocatechol

Explosives
Orthogonal Selectivities
C18 and HILIC

Norepinephrine and Epinephrine

Conditions for both columns:
- **Columns:** Kinetex 2.6 µm HILIC
  Kinetex 2.6 µm C18
- **Dimensions:** 50 x 2.1 mm
- **Mobile Phase (HILIC):** Acetonitrile / 100 mM Ammonium formate pH 3.2 (92:8)
- **Mobile Phase (C18):** 5 mM Ammonium formate pH 3.2 / Methanol (97:3)
- **Flow Rate:** 0.4 mL/min
- **Temperature:** 30 °C
- **Detection:** UV @ 210 nm
- **Sample:**
  1. Norepinephrine
  2. Epinephrine
Wide Applicability Across Many Industries
For Food and Beverage

From complex applications such as carbamate pesticides to applications requiring low level detection such as pharmaceutical impurity profiling, Kinetex™ core-shell technology delivers exceptionally high performance results. For a comprehensive list of Kinetex™ applications, please visit: www.phenomenex.com/kinetex

Soft Drink Additives

- Column: Kinetex 2.6 µm C18
- Dimensions: 100 x 4.6 mm
- Part No.: 00D-4462-E0
- Mobile Phase: A: 0.1 % Phosphoric acid in Water
  B: 0.1 % Phosphoric acid in Acetonitrile
- Gradient:
  - Time (min) % B
  - 0 5
  - 0.67 5
  - 2.67 40
- Flow Rate: 1.8 mL/min
- Temperature: 30 ºC
- Detection: UV @ 215 nm
- Instrument: Agilent 1100
- Sample:
  1. Ascorbic acid
  2. Acesulfame K
  3. Saccharin
  4. Quinine
  5. Caffeine
  6. Aspartame
  7. Sorbic acid
  8. Benzoic acid

Green Tea

- Column: Kinetex 2.6 µm C18
- Dimensions: 100 x 4.6 mm
- Part No.: 00D-4462-E0
- Mobile Phase: A: 0.1 % Phosphoric acid in Water
  B: 0.1 % Phosphoric acid in Acetonitrile
- Gradient:
  - Time (min) % B
  - 0 15
  - 0.44 15
  - 2.67 35
- Flow Rate: 1.8 mL/min
- Temperature: 30 ºC
- Detection: UV @ 215 nm
- Instrument: Agilent 1100
- Backpressure: 240 bar
- Sample:
  1. Epigallocatechin
  2. Catechin
  3. Epicatechin
  4. Epigallocatechin gallate
  5. Epicatechin gallate

App ID 18529

App ID 18549
Wide Applicability Across Many Industries
For Food Safety

Antibiotics from Meat

Column: Kinetex 2.6 µm C18
Dimensions: 50 x 2.1 mm
Part No.: 008-4462-AN
Mobile Phase: A: 0.1 % Formic acid in Water
B: 0.1 % Formic acid in Methanol

Gradient: Time (min) % B
0 2
0.3 2
7.27 80
7.37 99
8.27 99
13 2

Flow Rate: 0.5 mL/min
Temperature: 40 ºC
Detection: API MS (22 ºC)
Instrument: Agilent 1100

Sample:
1. Sulfanilamide  Positive 173.1 to 92.1
2. Amoxicillin  Positive 366.1 to 349.1
3. Lincomycin  Positive 407.4 to 156.1
4. Sulfadiazine  Positive 251.1 to 156.1
5. Sulfathiazole  Positive 256.1 to 156.1
6. Ampicillin  Negative 348 to 207
7. Thiamphenicol  Negative 384 to 207
8. Sulfamerazine  Positive 265.1 to 155.9
9. Tetracycline  Positive 445.2 to 155.9
10. Ciprofloxacin  Positive 332.2 to 314.2
11. Enrofloxacin  Positive 358.2 to 340.2
12. Sulfamethazine  Positive 279.2 to 92.1
13. Sulfamethazine  Positive 279.2 to 92.1
14. Sarafloxacin  Positive 386.3 to 368.1
15. Sulfamethoxydiazine  Positive 281.1 to 155.9
16. Florfenicol  Negative 356.1 to 185
17. Spiramycin  Positive 422.5 to 174.1
18. Chlorotetraacycline  Positive 479.3 to 444
19. Sulfadiazine  Positive 311.2 to 156.2
20. Clindamycin  Positive 425.4 to 174.1
21. Tilmicosin  Positive 435.6 to 174.1
22. Chloramphenicol  Negative 321.1 to 152
23. Sulfamethoxazole  Positive 311.2 to 156.2
24. Sulfadoxine  Positive 358.2 to 340.2
25. Ampicillin  Negative 348 to 207
26. Tylosin  Negative 384 to 207
27. Sarafloxacin  Positive 386.3 to 368.1
28. Penicillin G  Negative 333 to 192.4
29. Cefoxitin  Negative 434.1 to 207.9
30. Flunixin  Negative 295.1 to 191

App ID 18555

PHENOMENEX | WEB: www.phenomenex.com
Wide Applicability Across Many Industries
For Food Safety

Azo Dyes

Melamine and Cyanuric Acid

Aflatoxin from Peanut Butter

Column: Kinetex 2.6 µm C18
Dimensions: 150 x 4.6 mm
Part No.: 00F-4462-50
Mobile Phase: A: 0.1% Phosphoric acid in Water
B: 0.1% Phosphoric acid in Acetonitrile
Gradient: Time (min) % B
0 25
15 95
17 95
Flow Rate: 1.8 mL/min
Temperature: 50 ºC
Detection: UV @ 215 nm
Backpressure: 380 bar
Sample:
1. Orange II
2. Sudan Orange G
3. Fast Garnet GBC
4. Dimethyl yellow
5. Sudan Red G

Column: Kinetex 2.6 µm HILIC
Dimensions: 50 x 2.1 mm
Part No.: 00B-4461-AN
Mobile Phase: Acetonitrile / 100 mM Ammonium acetate, pH 5.8 (90:10)
Flow Rate: 1.0 mL/min
Temperature: 25 ºC
Detection: API 3000™ MS
Backpressure: 190 bar
Instrument: Waters® ACQUITY® UPLC® MS/MS
Sample:
1. Cyanuric acid 128-85.0 (quant ion), 128.0-42.0 (qualifier ion)
2. Cyanuric acid-13C3 ISTD 131.1-87.0
3. Melamine 127.1-85.0 (quant ion), 127.1-68.0 (qualifier ion)
4. Melamine-13C3.15N3 ISTD 133.2-89.1

Column: Kinetex 2.6 µm PFP
Dimensions: 50 x 2.1 mm
Part No.: 00B-4477-AN
Mobile Phase: Acetonitrile / 100 mM Ammonium Acetate, pH 5.8 (90:10)
Flow Rate: 400 µL/min
Temperature: 25 ºC
Detection: MS
Backpressure: 190 bar
Instrument: Waters® ACQUITY® UPLC® MS/MS
Sample:
1. Aflatoxin IS
2. Aflatoxin G2
3. Aflatoxin G1
4. Aflatoxin B2
5. Aflatoxin B1

SPE Method: Strata® Florisil® (FL-PR) cartridge, 500 mg/3 mL,
(Part No.: 8B-S013-HBJ)
Matrix: Peanut Butter
Condition: 3 mL of Methanol twice for conditioning, vacuuming at any rate.
Load: Sample loaded at 1-2 drops per second
Waste: 3 mL of Methanol/Water (60:40) twice at 1-2 drops per second
Elute: 3 mL Acetone / Water / Formic acid (98.3.5.0:5) twice at 1 drop per second
Blow all elution fractions down under nitrogen to dryness and reconstitute in 1 mL mobile phase

* API 3000 is a trademark of Life Technologies Corporation and its affiliated companies.
† Waters, ACQUITY, and UPLC are registered trademarks of Waters Corporation.
Phenomenex is not affiliated with Life Technologies Corporation or Waters Corporation.
Comparative separations may not be representative of all applications.
Wide Applicability Across Many Industries
For Environmental

Explosives:
EPA Method 8330

SPE Method: Strata™-XL 100 µm Polymeric Reversed Phase cartridge, 500 mg/6 mL, (Part No.: 8B-S046-TBJ)
Condition: 10 mL of Acetonitrile conditioning at any speed rate
Load: Sample loaded at 5-10 mL/min; do not let the cartridge go dry
Wash: 1-2 column volume of 5:95 Methanol / Water
Dry: 3-5 minutes at 10 mm Hg vacuum
Elute: Elute with 5 mL of 85:15 Acetonitrile / Water at 1-2 drops per second

Mobile Phase: A: Water B: Methanol
Gradient: (45:55) A/B to (35:65) A/B over 5 min
Flow Rate: 1.4 mL/min
Temperature: 22 ºC
Detection: UV @ 254 nm
Sample: 1. HMx 2. RDx 3. 1,3,5-Trinitrobenzene 4. 1,3-Dinitrobenzene 5. Tetryl 6. Nitrobenzene 7. 2,4,6-Trinitrotoluene 8. 2-Amino-2,4-Dinitrotoluene 9. 2-Amino-2,6-Dinitrotoluene 10. 2,6-Dinitrotoluene 11. 2,4-Dinitrotoluene 12. 2-Nitrotoluene 13. 4-Nitrotoluene 14. 3-Nitrotoluene

Carbamate Pesticides:
EPA Method 531.1

Mobile Phase: A: 0.1 % Phosphoric acid in Water B: 0.1 % Phosphoric acid in Acetonitrile
Gradient: (95:5) A/B to (5:95) A/B over 3 min
Flow Rate: 1.0 mL/min
Temperature: 40 ºC
Detection: UV @ 210 nm

Polyaromatic Hydrocarbons (PAHs):
EPA Method 610

SPE Method: Strata™-X 33 µm Polymeric Reversed Phase cartridge, 30 mg/3 mL, (Part No.: 8B-S046-TBJ)
Condition: 1 mL of Methanol for conditioning at any speed rate
Load: Sample loaded at 1-2 drops per second
Wash: 1 mL of sample load buffer at 1-2 drops per second
Dry: 2 minutes at 10 mm Hg vacuum
Elute: 0.5 mL of 5 % Formic acid / Methanol twice at 1 drop per second

Mobile Phase: A: Water B: Acetonitrile
Gradient: (30:70) A/B to (0:100) A/B over 10 min
Flow Rate: 1.5 mL/min
Temperature: 30 °C
Detection: UV @ 254 nm
**Wide Applicability Across Many Industries**

**For Pharmaceutical**

**Paracetamol Impurity Profile**

- **Column:** Kinetex 2.6 µm C18
- **Dimensions:** 150 x 4.6 mm
- **Part No.:** 00F-4462-E0
- **Mobile Phase:** 100 mM NaH₂PO₄ / 50 mM Na₂HPO₄ / 4 g/L (Bu₄)NOH (37.5 : 37.5 : 25)
- **Flow Rate:** 0.9 mL/min
- **Temperature:** 35 ºC
- **Detection:** UV @ 245 nm (22 ºC)
- **Sample:**
  1. Impurity K
  2. Paracetamol
  3. Impurity A
  4. Impurity F
  5. Impurity J

**Tricyclic Antidepressants**

- **Column:** Kinetex 2.6 µm C18
- **Dimensions:** 50 x 4.6 mm
- **Part No.:** 00B-4462-E0
- **Mobile Phase:** A: 20 mM Potassium Phosphate pH 7.0 / B: Methanol / Acetonitrile (50:50) / A/B (48:52)
- **Flow Rate:** 2.9 mL/min
- **Temperature:** 40 ºC
- **Detection:** UV @ 254 nm (22 ºC)
- **Sample:**
  1. Tianeptine
  2. Desmethyldoxepin
  3. Protriptyline
  4. Desipramine
  5. Imipramine
  6. Amoxapine
  7. Doxepin
  8. Nortriptyline
  9. Amitriptyline
  10. Clomipramine

**Forced Degradation of Ranitidine**

- **Column:** Kinetex 2.6 µm C18
- **Dimensions:** 150 x 4.6 mm
- **Part No.:** 00F-4462-E0
- **Mobile Phase:** A: 0.1 % Formic acid in Water / B: 0.1 % Formic acid in Acetonitrile
- **Gradient:** 5 % to 20 % B in 7 min 20 % to 95 % in 2 min
- **Flow Rate:** 1.4 mL/min
- **Temperature:** 30 ºC
- **Detection:** UV @ 230 nm (22 ºC)
- **Sample:** Ranitidine 1 mg/mL in Methanol. Heated at 65 ºC for 4 days.
**Wide Applicability Across Many Industries**

For Biopharmaceutical

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**Peptide Map of unreduced Human Ig-G2**

- **Column:** Kinetex 2.6 µm C18
- **Dimensions:** 150 x 4.6 mm
- **Part No.:** 00F-4462-E0
- **Mobile Phase:**
  - A: 0.1 % Trifluoroacetic acid / 2 % Acetonitrile / Water
  - B: 0.9 % Trifluoroacetic acid / 98 % Acetonitrile / Water
- **Gradient:**
  - Time (min) | % B
  - 0 | 2
  - 2 | 2
  - 41 | 48
- **Flow Rate:** 1.0 mL/min
- **Temperature:** 40 ºC
- **Detection:** UV @ 214 nm
- **Sample:** 1. Hu-Ig-G2 Lys-C+Asn-N Digest

---

**Peptide Map of reduced and alkylated Ig-G1**

- **Column:** Kinetex 2.6 µm C18
- **Dimensions:** 150 x 4.6 mm
- **Part No.:** 00F-4462-E0
- **Mobile Phase:**
  - A: 0.1 % Trifluoroacetic acid / 2 % Acetonitrile / Water
  - B: 0.085 % Trifluoroacetic acid in Acetonitrile
- **Gradient:**
  - Time (min) | % B
  - 0 | 1
  - 40 | 56
  - 41 | 56
- **Flow Rate:** 1.0 mL/min
- **Temperature:** 40 ºC
- **Detection:** UV @ 214 nm
- **Sample:** 1. Hu-Ig-G1 Reduced and Alkylated Tryptic Digest

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**Peptide Map of biogeneric α-Interferon (unreduced)**

- **Column:** Kinetex 2.6 µm C18
- **Dimensions:** 150 x 4.6 mm
- **Part No.:** 00F-4462-E0
- **Mobile Phase:**
  - A: 0.1 % Trifluoroacetic acid / 2 % Acetonitrile / Water
  - B: 0.9 % Trifluoroacetic acid / 98 % Acetonitrile / Water
- **Gradient:**
  - Time (min) | % B
  - 0 | 1
  - 40 | 56
  - 41 | 56
- **Flow Rate:** 1.0 mL/min
- **Temperature:** 25 ºC
- **Detection:** UV @ 214 nm
- **Sample:** 1. Human α-Interferon tryptic digest
Wide Applicability Across Many Industries
For Toxicology

**Opiates**

- **Column:** Kinetex 2.6 µm PFP
- **Dimensions:** 50 x 2.1 mm
- **Part No.:** 00B-4477-AN
- **Mobile Phase:**
  - A: 0.1 % Formic acid and 5 mM Ammonium Acetate in Water
  - B: 0.1 % Formic acid and 5 mM Ammonium Acetate in (50:50) Acetonitrile / Methanol
- **Gradient:**
  - Time (min) % B
  - 0 20
  - 2.5 95
  - 3 95
  - 3.1 20
  - 4.9 20
- **Flow Rate:** 450 µL/min
- **Temperature:** 25 ºC
- **Detection:** MS

**Sample:**
1. Normorphine
2. Morphine
3. d3-Morphine
4. Dymorphine
5. Hydromorphone
6. d6-Hydromorphone
7. d6-Codine
8. Codine
9. d-Desmethytramadol
10. d6-Oxycodone
11. Oxycodeone
12. Hydrocodone
13. N-Desmethytramadol
14. Tramadol
15. Normeperidine
16. d4-Normeperidine
17. d4-Meperidine
18. Meperidine

**Metabolomics**

- **Column:** Kinetex 2.6 µm C18
- **Dimensions:** 150 x 4.6 mm
- **Part No.:** 00F-4462-E0
- **Mobile Phase:**
  - A: 0.1% Formic acid in Water
  - B: 0.1% Formic acid in Acetonitrile
- **Gradient:**
  - Time (min) % B
  - 0 5
  - 1.40 5
  - 14.75 95
  - 14.76 5
  - 20.75 5
- **Flow Rate:** 1.5 mL/min
- **Temperature:** 45 ºC
- **Detection:** UV @ 220 nm (25 ºC)
- **Backpressure:** 380 bar
- **Instrument:** Agilent 1100

**Sample:**
1. 6-MAM (328.3-152.3)
2. d3-6-MAM (331.3-211.3)
3. PCP (244.3-91.2)
4. d5-PCP (249.3-164.4)
5. Methadone (310.2-265.2)
6. d9-Methadone (319.2-268.2)

**Illicit Drugs**

- **Column:** Kinetex 2.6 µm C18
- **Dimensions:** 50 x 2.1 mm
- **Part No.:** 00B-4462-AN
- **Mobile Phase:**
  - A: 0.1 % Formic acid in Water
  - B: 0.1 % Formic acid in Acetonitrile
- **Gradient:**
  - Time (min) % B
  - 0 10
  - 1 95
  - 1.4 95
  - 1.41 95
  - 2 10
- **Flow Rate:** 1.0 mL/min
- **Temperature:** 25 ºC
- **Detection:** MS, ESI (110 ºC)
- **Backpressure:** 520 bar
- **Instrument:** Agilent 1100

**Sample:**
1. 1,2 3,4 5,6

Note: Please request App ID 18621 for method below 400 bar
Kinetex™ Core-Shell Particles vs. Traditional Fully Porous Particles

In the example outlined below, a Kinetex™ 150 mm length column is compared to 250 mm length traditional 5 µm columns. Notice the improvement in resolution and shorter run time with the Kinetex™ column.

Pharmaceutical Drug Screen

Conditions same for all columns except where noted:
- **Columns**:
  - Kinetex 2.6 µm C18 100 Å
  - *Inertsil® 5 µm ODS-3 100 Å
  - *ZORBAX® 5 µm SB-C18 300 Å
- **Dimensions**: Kinetex: 150 x 4.6 mm
  - *Inertsil® and *ZORBAX®: 250 x 4.6 mm
- **Mobile Phase**: A: 0.1 % Phosphoric acid in Water
  - B: 0.1 % Phosphoric acid in Acetonitrile
- **Gradient**: 5 % to 95 % B in 9 min (150 x 4.6 mm)
  - 5 % to 95 % B in 15 min (250 x 4.6 mm)
- **Flow Rate**: 1.8 mL/min
- **Temperature**: 50 °C
- **Detection**: UV @ 215 nm (22 °C)

**Sample**: 1. Procainamide
2. Acetaminophen
3. Folic acid
4. Sulfathiazole
5. Acebutolol
6. Dextromethorphan
7. Diphenhydramine
8. Propafenone
9. Amitriptyline
10. Fluoxetine
11. Naproxen
12. Diflunisal
13. Indomethacin

**Chromatographic Performance Compared Kinetex™ Core-Shell vs. Traditional Fully Porous Columns**

<table>
<thead>
<tr>
<th></th>
<th>Dimensions (mm)</th>
<th>Peak Capacity</th>
<th>Average Peak Width</th>
<th>Minimum Resolution</th>
<th>Average Resolution</th>
<th>Back Pressure (bar)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kinetex™ 2.6 µm C18</td>
<td>150 x 4.6</td>
<td>271.8</td>
<td>0.0211</td>
<td>3.3</td>
<td>14.0</td>
<td>378</td>
</tr>
<tr>
<td>*Inertsil® 5 µm ODS-3</td>
<td>250 x 4.6</td>
<td>238.4</td>
<td>0.0446</td>
<td>0.5</td>
<td>11.4</td>
<td>144</td>
</tr>
<tr>
<td>*ZORBAX® 5 µm SB-C18</td>
<td>250 x 4.6</td>
<td>242.4</td>
<td>0.0376</td>
<td>1.2</td>
<td>12.0</td>
<td>149</td>
</tr>
</tbody>
</table>

* Inertsil is a registered trademark of GL Sciences, Inc., Japan. ZORBAx is a registered trademark of Agilent Technologies. Comparative separations may not be representative of all applications. Phenomenex is not affiliated with the above companies.
Kinetex™ Core-Shell Particles vs. Traditional Fully Porous Particles

Explosives: EPA Method 8330

**Conditions same for all columns except where noted:**
- **Columns:**
  - Kinetex: 2.6 µm C18 100 Å
  - *HYPERSIL® 5 µm C18 120 Å
  - *Inertsil® 5 µm ODS-3 100 Å
  - *ZORBAX® 5 µm SB-C18 300 Å
- **Dimensions:** Kinetex: 150 x 4.6 mm
  - Other columns: 250 x 4.6 mm
- **Mobile Phase:** A: Water B: Methanol
- **Gradient:** A/B (45:55) to (35:65) in 6 min
- **Flow Rate:** 1.2 mL/min
- **Temperature:** 22 ºC
- **Detection:** UV @ 254 nm (22 ºC)

*HYPERSIL is a registered trademark of Thermo Hypersil-Keystone. Inertsil is a registered trademark of GL Sciences, Inc. ZORBAX is a registered trademark of Agilent Technologies. Comparative separations may not be representative of all applications. Phenomenex is not affiliated with the above companies.
Kinetex™ Core-Shell Particles

vs. Traditional Fully Porous Particles

Phenols: EPA Method 604

Sample:
1. Phenol
2. 4-Nitrophenol
3. 2-Chlorophenol
4. 2-Nitrophenol
5. 2,4-Dimethylphenol
6. 2,4-Dinitrophenol
7. 4-Chloro-3-Methylphenol
8. 2,4-Dichlorophenol
9. 2-Methyl-4,6-Dichlorophenol
10. 2,4,6-Trichlorophenol
11. Pentachlorophenol

Conditions same for all columns:
- Columns: Kinetex 2.6 µm C18
  *ACE® 3.5 µm C18
  *XBridge® 3.5 µm C18
  *YMC-Pack™ PRO™ 3 µm C18
- Dimensions: 150 x 4.6 mm
- Mobile Phase: A: 0.1 % Phosphoric acid in Water
  B: 0.1 % Phosphoric acid in Acetonitrile
- Gradient: (80:20) A/B to (5:95) over 5 min
- Flow Rate: 1.0 mL/min
- Temperature: 22 ºC
- Detection: UV @ 254 nm (22 ºC)

Baseline resolution of all compounds

* ACE is a registered trademark of Advanced Chromatography Technologies. YMC-Pack, Pro C18, and YMC are trademarks of YMC Co., Ltd. xBridge is a registered trademark of Waters Corp. Comparative separations may not be representative of all applications. Phenomenex is not affiliated with the above companies.
Optimized for Ultra-High Performance

Innovations in LC particle technology are driven by the demand for better chromatographic performance and higher productivity. To achieve performance improvements of greater sensitivity, higher resolution, and to enable faster analysis times, a column requires lower plate height (higher efficiency) at high linear velocities. With traditional fully porous 3 µm and 5 µm particles, efficiency decreases significantly as flow rate increases. In most cases, loss of resolution and sensitivity prevents faster analysis times. Smaller fully porous particles (< 2 µm) provide faster chromatographic separations at low plate heights (HETP) but require higher pressure capable instrumentation. Kinetex™ core-shell technology offers the ultra-high efficiency of sub-2 µm particles over an extended range of linear velocity without generating excessive column backpressure by reducing Eddy Diffusion (multi-path effect) and allowing for faster mass transfer. As a result of this innovative design, Kinetex™ columns provide roughly 3x the efficiency of 5 µm fully porous particles and 2x the efficiency of 3 µm fully porous particles without the need for specialized high pressure instrumentation.

Functional Diagrams

van Deemter Equation

\[
H = \frac{2\lambda d_p}{u} + 2GD_m/\mu + \frac{w(d_e)^2\mu/D_m}{\mu} + \frac{Rd_e^2\mu/D_s}{\mu}
\]

Traditional Chromatography

Ultra-High Performance

* \(d_e\) refers to the effective particle size. For Kinetex 1.7 µm particles, \(d_e = 1.5 \mu m\) and for Kinetex 2.6 µm particles, \(d_e = 1.7 \mu m\). For fully porous particles, \(d_e = d_p\).

Kinetex™ core-shell technology allows you to go faster without losing efficiency on any LC instrument.
Innovation in Particle Technology

The Kinetex™ core-shell particle is not fully porous. Using sol-gel processing techniques that incorporate nano structuring technology, a durable, homogeneous porous shell is grown on a solid silica core. This highly optimized process combined with uniform particle size distribution produces a column that generates extremely high plate counts. When using Kinetex™ 2.6 µm, less column backpressure is generated, allowing it to be used on any LC system.

**Traditional Fully Porous Particle**
- Diffusion path limits efficiencies
- Ultra-high performance limited to UHPLC systems with traditional fully porous sub-2 µm columns

**Kinetex™ 2.6 µm Core-Shell Particle**
- Reduced diffusion path maximizes efficiency
- Ultra-high performance on any system with Kinetex™ 2.6 µm columns

**Kinetex™ 1.7 µm Core-Shell Particle**
- Reduced diffusion path maximizes efficiency
- Increased efficiencies compared to traditional fully porous sub-2 µm columns. Typical operating backpressures > 400 bar

**When using Kinetex™ 1.7 µm, increased performance can be achieved, however higher pressure-capable instrumentation is required.**
Since the Kinetex™ particle is not fully porous, analytes spend less time diffusing into and out of the pores as they travel through the column. This shorter diffusion path allows for faster mass transfer. The result is less band broadening for higher peak efficiency comparable to or better than sub-2 µm fully porous particles.

**Performance of Kinetex™ Core-Shell Particles**
Compared to Fully Porous Sub-2 µm and 3 µm Particles

![Graph showing performance comparison]

- **Sub-2 µm Fully Porous**
- **2.6 µm Kinetex™ Core-Shell**
- **3 µm Fully Porous**
- **5 µm Fully Porous**

*Illustration - not actual test data.*
Kinetex™ particles are nearly monodispersed. This extremely narrow particle size distribution reduces the effects of Eddy Diffusion (multi-path effect- the A term of the van Deemter equation) since the interstitial space between the particles is virtually homogeneous. This results in ultra-high column efficiency and excellent reproducibility.

**Uniform Particle Size Distribution**

![Uniform Particle Size Distribution Graph](image)

**Illustration of Eddy Diffusion Effects**

![Eddy Diffusion Illustration](image)
A Superior Quality Product

In order to ensure reproducible, robust, and reliable results, Kinetex™ columns are manufactured with high quality standards. Every step in the manufacturing process of Kinetex™ columns is tightly controlled for:

- Particle size distribution
- Surface and bonding homogeneity
- Quality control testing
- Inertness of the base silica
- Packing quality

Surface and Bonding Homogeneity

Using sol-gel processing techniques that incorporate nano-structuring technology, a durable, homogeneous porous shell is grown on a solid silica core. This highly optimized process combined with uniform particle size distribution produces a column that generates extraordinary plate counts.

“Kinetex™ core-shell particles are synthesized from first principles using ultra-pure starting materials in a rigorously controlled process at our manufacturing plant in Torrance, CA, USA.”

- Phenomenex R&D Scientist
Kinetex™ core-shell particles exhibit virtually no silanol activity as evidenced in the example below. At low pH, nortriptyline is charged and likely to interact with residual silanols available on the surface of the stationary phase after bonding. Less retention of nortriptyline indicates lower silanol activity and less ionic interactions.

Inert Stationary Phase

Kinetex™ core-shell particles exhibit virtually no silanol activity as evidenced in the example below. At low pH, nortriptyline is charged and likely to interact with residual silanols available on the surface of the stationary phase after bonding. Less retention of nortriptyline indicates lower silanol activity and less ionic interactions.

Conditions for all columns:
Dimensions: 50 x 2.1 mm
Mobile Phase: 0.1% Phosphoric acid in Water / Acetonitrile (70:30)
Flow Rate: 0.42 mL/min
Temperature: 40 °C
Detection: UV @ 254 nm (22 °C)
Instrument: Agilent 1200SL
Sample: 1. 3-Methyl-4-nitrobenzoic acid (acid)
2. Nortriptyline (base)
3. 5-Methylsalicylaldehyde (neutral)

* HALO is a registered trademark of Advanced Materials Technology, Inc. ZORBAX is a registered trademark of Agilent Technologies. ACQUITY is a registered trademark of Waters Corp. Comparative separations may not be representative of all applications. Phenomenex is not affiliated with the above companies.
With Kinetex™ core-shell technology, analytical loading is comparable to or better than competitive columns. In the study below, the change in peak width was measured with increased loading on column. Kinetex™ exhibited excellent analytical loading capacity.

Analytical Loading - Ethyl paraben in formic acid buffer

Each individual Kinetex™ column and batch of media undergoes a battery of quality assurance tests for particle size distribution (both solid core and shell thickness), surface coverage, carbon load, pore diameter distribution, and many other parameters to ensure exceptional reproducibility.

Batch-to-Batch Overlay

Conditions for both columns:
- Mobile Phase: 0.1 % Formic acid in Water / Acetonitrile (65:35)
- Flow Rate: 1.85 mL/min
- Temperature: 30 °C
- Instrument: Agilent 1200SL

Conditions same for all batches:
- Columns: Kinetex 2.6 µm C18
- Dimensions: 50 x 4.6 mm
- Part No.: 008-4462-60
- Mobile Phase: Water / Acetonitrile (65:35)
- Flow Rate: 1.0 mL/min
- Detection: UV @ 254 nm
- Sample: 1. Uracil
  2. Hydroxycortisone
  3. Cortisone
  4. Cortisone acetate
  5. 17-Hydroxyprogesterone

* XBridge™ is a trademark of Waters Corporation. Comparative separations may not be representative of all applications. Phenomenex is not affiliated with Waters Corporation.
Scalable

Across Particle Sizes

Kinetex™ 1.7 µm columns are completely scalable to Kinetex™ 2.6 µm columns. If your method developed on Kinetex™ 1.7 µm needs to transfer to a traditional HPLC system, simply switch the method over to Kinetex™ 2.6 µm for reproducible selectivity at lower backpressure.

Comparative separations may not be representative of all applications.
## Ordering Information

### Kinetex™ 2.6 μm Minibore Columns (mm)

<table>
<thead>
<tr>
<th>Material</th>
<th>50 x 2.1</th>
<th>100 x 2.1</th>
<th>150 x 2.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>C18</td>
<td>00B-4462-AN</td>
<td>00D-4462-AN</td>
<td>00F-4462-AN</td>
</tr>
<tr>
<td>PFP</td>
<td>00B-4477-AN</td>
<td>00D-4477-AN</td>
<td>00F-4477-AN</td>
</tr>
<tr>
<td>HILIC*</td>
<td>00B-4461-AN</td>
<td>—</td>
<td>00F-4461-AN</td>
</tr>
</tbody>
</table>

### Kinetex™ 2.6 μm Solvent Saver Midbore Columns (mm)

<table>
<thead>
<tr>
<th>Material</th>
<th>50 x 3.0</th>
<th>100 x 3.0</th>
<th>150 x 3.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>C18</td>
<td>00B-4462-Y0</td>
<td>00D-4462-Y0</td>
<td>00F-4462-Y0</td>
</tr>
<tr>
<td>PFP</td>
<td>00B-4477-Y0</td>
<td>00D-4477-Y0</td>
<td>00F-4477-Y0</td>
</tr>
<tr>
<td>HILIC*</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

### Kinetex™ 2.6 μm Analytical Columns (mm)

<table>
<thead>
<tr>
<th>Material</th>
<th>50 x 4.6</th>
<th>100 x 4.6</th>
<th>150 x 4.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>C18</td>
<td>00B-4462-E0</td>
<td>00D-4462-E0</td>
<td>00F-4462-E0</td>
</tr>
<tr>
<td>PFP</td>
<td>00B-4477-E0</td>
<td>00D-4477-E0</td>
<td>00F-4477-E0</td>
</tr>
<tr>
<td>HILIC*</td>
<td>00B-4461-E0</td>
<td>—</td>
<td>00F-4461-E0</td>
</tr>
</tbody>
</table>

### Kinetex™ 1.7 μm Minibore Columns (mm)

<table>
<thead>
<tr>
<th>Material</th>
<th>50 x 2.1</th>
<th>100 x 2.1</th>
<th>150 x 2.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>C18</td>
<td>00B-4475-AN</td>
<td>00D-4475-AN</td>
<td>00F-4475-AN</td>
</tr>
<tr>
<td>PFP</td>
<td>00B-4476-AN</td>
<td>00D-4476-AN</td>
<td>00F-4476-AN</td>
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<tr>
<td>HILIC*</td>
<td>00B-4474-AN</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

### Material Characteristics**

<table>
<thead>
<tr>
<th>Packing Material</th>
<th>Total Particle Size (µm)</th>
<th>Porous Shell (µm)</th>
<th>Solid Core (µm)</th>
<th>Pore Size (Å)</th>
<th>Effective Surface Area (m²/g)</th>
<th>Effective Carbon Load %</th>
<th>pH Stability</th>
<th>Pressure Stability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kinetex™ C18</td>
<td>2.6 0.35</td>
<td>1.9</td>
<td>100</td>
<td>100</td>
<td>200</td>
<td>12</td>
<td>1.5 - 10</td>
<td>600 bar</td>
</tr>
<tr>
<td>Kinetex™ PFP</td>
<td>2.6 0.35</td>
<td>1.9</td>
<td>100</td>
<td>100</td>
<td>200</td>
<td>9</td>
<td>1.5 - 8.0</td>
<td>600 bar</td>
</tr>
<tr>
<td>Kinetex™ HILIC*</td>
<td>2.6 0.35</td>
<td>1.9</td>
<td>100</td>
<td>100</td>
<td>200</td>
<td>0</td>
<td>2.0 - 7.5</td>
<td>600 bar</td>
</tr>
<tr>
<td>Kinetex™ C18</td>
<td>1.7 0.23</td>
<td>1.25</td>
<td>100</td>
<td>100</td>
<td>200</td>
<td>12</td>
<td>1.5 - 10</td>
<td>1000 bar</td>
</tr>
<tr>
<td>Kinetex™ PFP</td>
<td>1.7 0.23</td>
<td>1.25</td>
<td>100</td>
<td>100</td>
<td>200</td>
<td>9</td>
<td>1.5 - 8.0</td>
<td>1000 bar</td>
</tr>
<tr>
<td>Kinetex™ HILIC*</td>
<td>1.7 0.23</td>
<td>1.25</td>
<td>100</td>
<td>100</td>
<td>200</td>
<td>0</td>
<td>2.0 - 7.5</td>
<td>1000 bar</td>
</tr>
</tbody>
</table>

**For the evaluation of effective surface area and carbon load, please request TN-1064.
Selecting the Right Kinetex™ 2.6 µm Column and Flow Rate

<table>
<thead>
<tr>
<th>Length (mm)</th>
<th>ID (mm)</th>
<th>Flow Rate (mL/min)</th>
<th>Pressure (Bar) **</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum</td>
<td>4.6</td>
<td>0.8 - 2.5</td>
<td>165 - 600</td>
</tr>
<tr>
<td>Resolving</td>
<td>3.0</td>
<td>0.3 - 1.2</td>
<td>170 - 600</td>
</tr>
<tr>
<td>Power</td>
<td>2.1</td>
<td>0.1 - 0.5</td>
<td>180 - 600</td>
</tr>
<tr>
<td>Resolving</td>
<td>4.6</td>
<td>0.8 - 3.0</td>
<td>&lt; 100 - 600</td>
</tr>
<tr>
<td>Power + Speed</td>
<td>3.0</td>
<td>0.3 - 2.0</td>
<td>&lt; 100 - 600</td>
</tr>
<tr>
<td>Maximum</td>
<td>2.1</td>
<td>0.1 - 0.75</td>
<td>&lt; 100 - 600</td>
</tr>
<tr>
<td>Speed</td>
<td>4.6</td>
<td>0.8 - 4.5</td>
<td>&lt; 100 - 600</td>
</tr>
<tr>
<td></td>
<td>3.0</td>
<td>0.3 - 2.5</td>
<td>&lt; 100 - 600</td>
</tr>
<tr>
<td></td>
<td>2.1</td>
<td>0.1 - 1.0</td>
<td>&lt; 100 - 600</td>
</tr>
</tbody>
</table>

** Dependent on mobile phase composition and temperature.

Selecting the Right Kinetex™ 1.7 µm Column and Flow Rate

<table>
<thead>
<tr>
<th>Length (mm)</th>
<th>ID (mm)</th>
<th>Flow Rate (mL/min)</th>
<th>Pressure (Bar) **</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum</td>
<td>2.1</td>
<td>0.1 - 0.5</td>
<td>Up to 1000</td>
</tr>
<tr>
<td>Resolving</td>
<td>2.1</td>
<td>0.1 - 0.75</td>
<td>Up to 1000</td>
</tr>
<tr>
<td>Power</td>
<td>100</td>
<td>0.1 - 0.75</td>
<td>Up to 1000</td>
</tr>
<tr>
<td>Resolving</td>
<td>2.1</td>
<td>0.1 - 1.0</td>
<td>Up to 1000</td>
</tr>
<tr>
<td>Power + Speed</td>
<td>50</td>
<td>0.1 - 1.0</td>
<td>Up to 1000</td>
</tr>
</tbody>
</table>

** Dependent on mobile phase composition and temperature.

KrudKatcher™ Ultra In-line Filter (NEW)

Disposable in-line filter fits all UHPLC / HPLC columns 1.0 to 4.6 mm. Extremely low dead volume minimizes sample peak dispersion (see p. 15 for more information). Pressure rated to 1375 bar (20,000 psi).

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>Unit Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>AFO-8497</td>
<td>KrudKatcher Ultra In-Line Filter, 0.5 µm Porosity x 0.004 in. ID</td>
<td>3/pk</td>
</tr>
</tbody>
</table>

Wrenches not provided. KrudKatcher Ultra requires 5/16 in. wrench.

UHPLC / HPLC Sure-Lok™ High Pressure PEEK® Male Nut Fittings

UHPLC / HPLC Sure-Lok High Pressure PEEK male nut fittings are recommended for installation of Kinetex™ columns. The convenient one-piece design (AQ0-8503) is pressure rated to 12,000 psi (827 bar). A handy fitting tightening tool (AQ0-8530) is available to facilitate achievement of a leak-free connection.

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>Unit Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>AQ0-8503</td>
<td>Sure-Lok High Pressure PEEK 1-Pc Nut, 10-32, for 1/8 in. Tubing, 12,000 psi (827 bar)</td>
<td>10/pk</td>
</tr>
<tr>
<td>AQ0-8530</td>
<td>Sure-Lok Fitting Tightening Tool, Aluminum</td>
<td>ea</td>
</tr>
</tbody>
</table>

Sure-Lok Fitting Tightening Tool is required for AQ0-8503

Column Heater

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>Unit Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>EHO-7057</td>
<td>ThermaSphere™ TS-130 HPLC Column Heater 25-90 °C, 95 to 265 VAC, 50/60 Hz</td>
<td>ea</td>
</tr>
<tr>
<td>EHO-7058</td>
<td>Stand for ThermaSphere TS-130 HPLC Column Heater</td>
<td>ea</td>
</tr>
</tbody>
</table>
The Story of Kinetex™: From Project to Phenomenon

Over the past few years we’ve heard from customers like you, facing the pressure to be more productive while coping with reduced resources. We asked ourselves what it would take to create a true evolution in HPLC – one that would benefit all chromatographers with ultra-high performance.

We recognized the full potential of core-shell technology and evolved our chemistry and manufacturing process to create the most homogeneous porous shell and spherical particle. A team of sol-gel scientists, experienced organic chemists, and production engineers then invested over three years to optimize the surface chemistry and column manufacturing process for the most efficiently packed column bed we’ve ever seen. The result: Kinetex™ core-shell columns reach speeds and efficiencies previously thought to be impossible.

It seems easy, standing at the end of an elegant solution, yet, it was only possible through the insightful minds and especially determined spirits of our passionate employees. We can’t overstate the contributions from all quarters. Long hours, extensive travel, weekend shifts, debates and sometimes even arguments – nothing was spared to bring the industry the breakthrough it needed.

Everyone at Phenomenex is thrilled to introduce this new technology. We are confident that you will find Kinetex™ core-shell HPLC/UHPLC columns to be the best combination of performance and versatility yet!
Ultra-High Performance on ANY LC System

<table>
<thead>
<tr>
<th></th>
<th>Core-Shell Particles</th>
<th>Traditional Fully Porous Particles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Kinetex™ 1.7 µm</td>
<td>Kinetex™ 2.6 µm</td>
</tr>
<tr>
<td>Multiple Column Selectivities</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Highest Efficiencies</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Highest Sensitivity</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Easy Method Transfer across LC systems</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

Provides sub-2 µm Performance on:

<table>
<thead>
<tr>
<th></th>
<th>400 Bar LC Instruments</th>
<th>600 Bar LC Instruments</th>
<th>1000 Bar LC Instruments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core-Shell Particles</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Traditional Fully Porous Particles</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

If you are not completely satisfied with Kinetex™ core-shell columns, send in your comparative data to a similar product within 45 days and KEEP THE COLUMN FOR FREE.

*Most traditional fully porous sub-2 µm columns > 50 mm length, operate at pressures higher than 600 bar for optimal linear velocities.
Advanced in Every Way