

# Grace® HPLC Column Solutions

## Address Today's Separation Challenges

This catalog features Grace's leading HPLC column technologies. You will find innovative chemistries, unsurpassed reliability, and hardware configurations that optimize your method requirements for speed, sensitivity, resolution or sample loading. Discover how our select range of small molecule columns, biomolecule-based offerings and ion chromatography technologies address your toughest separation challenges.

### Grace® Featured Column Families:

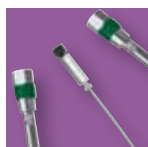
**VisionHT™** — Unique chemistries in sub2 to 10µm particles maximize performance and speed for UHPLC and HPLC.



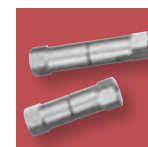
**Everest®** — High capacity for complex peptide mapping and proteomics applications.



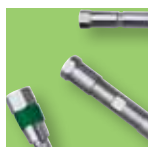
**Alltima™ HP** — Premium quality, exceptionally stable columns, without phase bleed.



**ProZap™** — High-speed protein and peptide separations.



**Prevail™** — Compatible with 100% aqueous to 100% organic mobile phases.



**Vydac® TP** — Popular, industry-standard bioseparations columns.



**GraceSmart™** — High quality HPLC columns at an exceptional value.



**Alltech® IC** — Wide variety for the separation of organic and inorganic anions and cations.



**Vydac® MS** — Unique selectivity and recovery for protein isolation and characterization.



### Grace Expertise and Product Ownership

Grace has been manufacturing silica and bonding it with unique chemistries for more than three decades. Our combined media production, column packing, and sub2µm particle expertise uniquely positions us to solve the challenges of modern chromatography laboratories. Partner with Grace and be assured our consistent, reliable chromatography products adhere to strict quality standards.























- Certified in ISO 9001, 14000 and 13485 procedures
- FDA 21 CFR 820 for medical devices
- Full traceability from base silica to final product
- Extensive process control to ensure highest reproducibility
- Experienced global technical support and sales teams

### Additional Column Brands Available

While this catalog focuses on Grace leading HPLC columns, other popular brands are still available. **Visit our website for a comprehensive listing.**

- |                       |                       |
|-----------------------|-----------------------|
| <b>Alltima™</b>       | <b>Genesis®</b>       |
| <b>Adsorbosphere™</b> | <b>Grom™ Sil</b>      |
| <b>Allsphere™</b>     | <b>Grom™ Sapphire</b> |
| <b>Apex™</b>          | <b>Macrosphere™</b>   |
| <b>Apollo™</b>        | <b>Platinum™</b>      |
| <b>Brava™</b>         | <b>ProSphere™</b>     |
| <b>Denali®</b>        | <b>Vydac® SP</b>      |
| <b>Econosphere™</b>   |                       |

## HPLC Column Hardware Formats

| HPLC Column Hardware Formats |   |   |                                  |                                     |   |  |   |   |
|------------------------------|---|---|----------------------------------|-------------------------------------|---|--|---|---|
| Format                       |   | i.d. (mm)   | Length (mm)                      | System Compatibility                | Description                               | Advantage  | Brand Availability  |   |
| UHPLC                        |    |    | 1<br>2                           | 20<br>30<br>50<br>100<br>150<br>250 | UHPLC system, LC/MS                       | Ultra-low dead volume hardware, pressure rated to 18,000psig, allows 2–7X faster linear velocities.                  | Packed with sub2µm media, this hardware delivers the fastest separations with maximum efficiency. Extremely low sample dispersion offers best sensitivity.  | VisionHT™   |
| Capillary                    |    |    | 0.075<br>0.150<br>0.300<br>0.500 | 50<br>100<br>150<br>250             | Capillary systems, LC/MS                  | Highly specialized columns packed in small diameter fused silica tubing.   | High-sensitivity and sample-limited applications.   | Alltima™ HP<br>Vydac® MS<br>Everest®  |
| Expedite™                    |    |    | 2.1<br>4.6                       | 10<br>20                            | Low volume, high-throughput (HTP) systems | Extremely short, low-volume columns that prevent sample diffusion.   | High-throughput and rapid resolution LC/MS applications packed with highly efficient 1.5µm media.   | VisionHT™<br>Alltima™ HP<br>Prevail™<br>ProZap™   |
| Microbore                    |    |    | 2.1                              | 50<br>100<br>150                    | Standard HPLC optimized for low volume    | 2.1mm diameter analytical columns requiring low volume systems.  | Low solvent consumption and improved sensitivity compared to traditional 4.6mm columns.   | VisionHT™<br>Alltima™ HP<br>Prevail™<br>GraceSmart™<br>Vydac® MS<br>Everest®<br>IC              |
| Solvent Reducer              |    |    | 3                                | 100<br>150<br>250                   | Standard HPLC                             | 3mm diameter analytical columns suitable for use on conventional HPLC.   | 50% solvent savings compared to traditional 4.6mm columns. No need to optimize system for low volume.   | VisionHT™<br>Alltima™ HP<br>Prevail™<br>Vydac® MS<br>Vydac® TP                                  |
| Analytical                   |  |  | 4.6                              | 50<br>100<br>150<br>250             | Standard HPLC                             | Conventional 4.6mm i.d. with industry standard port configurations.  | Most common, traditional hardware format.   | VisionHT™<br>Alltima™ HP<br>Prevail™<br>GraceSmart™<br>Vydac® MS<br>Everest®<br>Vydac® TP<br>IC |
| Rocket™                      |  |  | 7                                | 33<br>53                            | Standard HPLC                             | Large 7mm i.d. balances column volume with conventional LC system volume, and allows faster mobile phase flow rates. | Ultra-fast separations on conventional HPLC systems. Unique hardware geometry reduces peak broadening and delivers excellent peak shapes. 5mL/min max flow rate reduces analysis time up to 80% compared to traditional analytical columns. | VisionHT™<br>Alltima™ HP<br>Prevail™  |
| Preparative                  |  |  | 10<br>22                         | 50<br>100<br>150<br>250             | Preparative LC                            | Large i.d. increases loading.  | Packed under high pressure for high efficiency LC purifications.  | VisionHT™<br>Vydac® MS<br>Vydac® TP   |
| Capillary Guard              |  |  | 0.150<br>0.300                   | 10                                  |   | Guard system with reusable holder and disposable cartridges.   | Protects capillary columns and prolongs life.   | Alltima™ HP<br>Vydac® MS<br>Everest®  |
| UHPLC Guard                  |  |  | 1<br>2                           | 5                                   |   | Integral and stand-alone options.  | Protects UHPLC column investment, and prolongs life.  | VisionHT™   |
| All-Guard™                   |  |  | 2.1<br>4.6                       | 7.5                                 |   | Guard system with reusable holder and disposable cartridges.   | Protects analytical and microbore columns and prolongs life.  | VisionHT™<br>Alltima™ HP<br>Prevail™<br>Vydac® MS<br>Everest®<br>Vydac® TP                      |

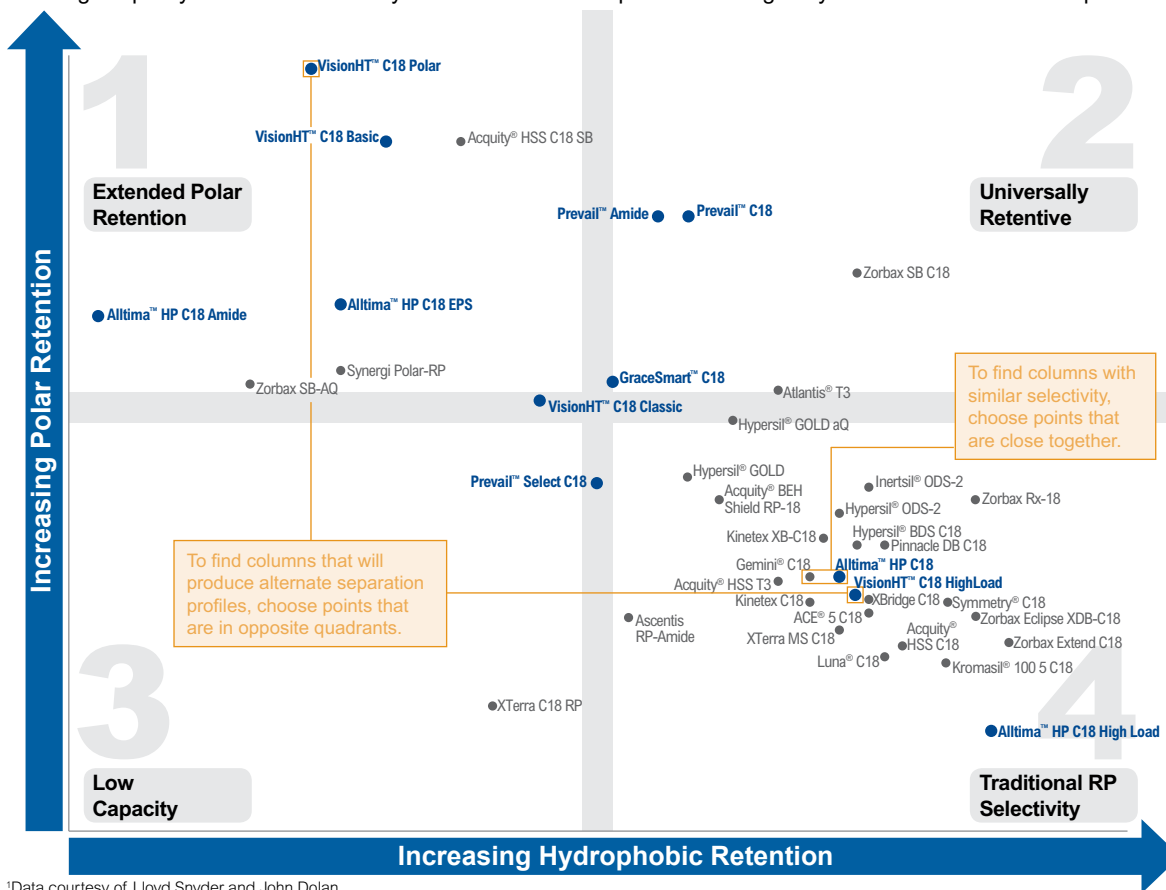
## HPLC Phase Specifications and Usage

| Columns for Small Molecules |                 |               |                                  |                 |             |  |   |            |
|-----------------------------|-----------------|---------------|----------------------------------|-----------------|-------------|--|---|------------|
| Brand                       | Phase           | Pore Size (Å) | Surface Area (m <sup>2</sup> /g) | Carbon Load (%) | Endcapped   | Chromatographic Properties   | Application/Benefit   | USP L-code |
| VisionHT™                   | C18 HighLoad    | 120           | 220                              | 11              | Yes         | Ultra high-purity silica, fully bonded.  | General purpose for broad range compounds, classic selectivity, high-capacity for hydrophobic compounds.  | L1         |
|                             | C18 Basic       | 120           | 220                              | 5               | Proprietary | Ultra-high purity silica. Controlled silica surface exposure gives dual mode separation with polar and non-polar analytes. | Alternate reversed-phase selectivity. High polar retention especially with compounds having two or more polar groups. Excellent sensitivity and peak shape for basic compounds, without the need for acidified mobile phases. | L1         |
|                             | C18 Classic     | 100           | 200                              | 6               | Yes         | Lower carbon load. Slight silica exposure.   | Reversed-phase separations with reduced bonding optimized for speed. Some additional polar retention.   | L1         |
|                             | C18 Polar       | 100           | 200                              | 5               | No          | High silica exposure, low carbon load. Uniform coverage of inert vicinal silanols.   | Unique polar selectivity. Low carbon load gives fastest reversed-phase elution times while retaining polar compounds longer.  | L1         |
|                             | HILIC           | 120           | 220                              | —               | No          | Polar phase with shorter equilibration times. Shipped in ACN/Water.  | Peak reversal compared to reversed-phase. Ideal for very polar compounds with high organic mobile phases for improved sensitivity by MS.  | L3         |
|                             | Silica          | 120           | 220                              | —               | No          | Traditional normal phase for use in 100% organic mobile phases.  | For isomeric separation of non-aqueous compatible compounds by absorption chromatography.   | L3         |
| Alltima™ HP                 | C18             | 190           | 200                              | 12              | Yes         | Classic reversed-phase retention and selectivity.  | Routine applications.   | L1         |
|                             | C18 EPS         | 190           | 200                              | 4               | Yes         | Greater retention and enhanced peak symmetry for polar compounds. Alternate selectivity to traditional reversed-phases.    | Reversed-phase applications where C18 is too retentive.   | L1         |
|                             | C18 Hi-Load     | 100           | 450                              | 24              | Yes         | Highest carbon load for superior retention and loadability.  | High resolution for complex samples.  | L1         |
|                             | C18 AQ          | 100           | 450                              | 20              | Yes         | 100% water wetttable.  | Applications requiring high aqueous mobile phases.  | L1         |
|                             | C18 Amide       | 190           | 200                              | 12              | Yes         | Polar-embedded phase with extremely low bleed. Compatible with microbore.  | Basic compounds in neutral to alkaline pH, MS applications.   | L1         |
|                             | C8              | 190           | 200                              | 8               | Yes         | Lower capacity compared to C18 phases.   | Reversed-phase applications where C18 is too retentive.   | L7         |
|                             | Cyano           | 190           | 200                              | 4               | Yes         | Extremely stable, long life and reproducible.  | Ideal for basic drug analysis.  | L10        |
|                             | Silica          | 100           | 450                              | —               | No          | Highly polar phase.  | General purpose normal phase applications.  | L3         |
|                             | HILIC           | 120           | 230                              | —               | No          | Hydrophilic interaction chromatography uses small amounts of water for increased sensitivity with microbore applications.  | Very polar analytes that cannot be retained by reversed-phase.  | L3         |
| Prevail™                    | C18 Select      | 110           | 350                              | 17              | Yes         | Stable in 100% aqueous to 100% organic mobile phases.  | Same benefits as Prevail™ C18, but less retentive for polar compounds.  | L1         |
|                             | C18             | 110           | 350                              | 15              | Yes         | Stable in 100% aqueous to 100% organic mobile phases.  | Flexibility to switch between varied mobile phase conditions to suit a variety of applications. Excellent sensitivity for microbore applications.   | L1         |
|                             | C8              | 110           | 350                              | 8               | Yes         | Stable C8 phase.   | Use for highly hydrophobic compounds that retain too strongly on C18.   | L7         |
|                             | Phenyl          | 110           | 350                              | 7               | Yes         | Lowest hydrophobic capacity.   | Selective for aromatic compounds in a variety of mobile phase conditions.   | L11        |
|                             | Cyano           | 110           | 350                              | —               | Yes         | General purpose cyano suitable for normal or reversed-phase use.   | Rugged normal phase applications.   | L10        |
|                             | Amino           | 110           | 350                              | —               | No          | Stable in 100% aqueous to 100% organic mobile phases.  | Use for carbohydrates or as a weak anion exchanger.   | L8         |
|                             | Silica          | 110           | 350                              | —               | No          | Highly polar phase.  | General purpose normal phase applications.  | L3         |
|                             | Organic Acid    | 110           | 350                              | —               | Yes         | Highly efficient silica-based, acid-stable.  | Separate common organic acids with unsurpassed resolution, speed and sensitivity. Lower cost than polymeric columns.  | —          |
|                             | Carbohydrate ES | —             | —                                | —               | No          | Extremely stable hybrid phase.   | Excellent for mono- and oligosaccharides and sugar alcohols.  | —          |
| GraceSmart™                 | C18             | 120           | 220                              | 10              | Yes         | High purity silica with monomeric C18 bonding offers classical reversed-phase selectivity.                                 | Excellent value for general purpose, routine applications.  | L1         |

| Columns for Large Molecules / Life Science |                |               |                                  |                 |            |  |  |            |
|--|----------------|---------------|----------------------------------|-----------------|------------|--|--|------------|
| Brand                                      | Phase          | Pore Size (Å) | Surface Area (m <sup>2</sup> /g) | Carbon Load (%) | End-capped | Chromatographic Properties   | Application/Benefit  | USP L-code |
| Vydac <sup>®</sup> MS                      | 218MS C18      | 300           | 60–110                           | 8               | Yes        | Polymeric bonding, highest hydrophobic interaction and unique geometric selectivity.                 | Use for simple enzymatic digests (<12 proteins) or biomolecules 0–5K MW.   | L1         |
|  | 238MS C18      | 300           | 70                               | 4               | Yes        | Monomeric bonding offers increased peptide interaction and generally yields higher peak counts.      | Use for same applications as 218MS, but offers different C18 selectivity.  | L1         |
|  | 208MS C8       | 300           | 70                               | 5               | Yes        | Lower hydrophobicity is better for larger biomolecules.  | Ideal for biomolecules 5–10K MW.   | L7         |
|  | 214MS C4       | 300           | 70–110                           | 3               | Yes        | Lower capacity than C18 or C8, suitable for hydrophobic proteins or when minimal organic is desired. | Ideal for biomolecules >10K MW, undenatured intact proteins, antibodies, oligonucleotides, human growth hormone.                                       | L26        |
|  | 219MS Diphenyl | 300           | 70                               | 4               | Yes        | Lowest capacity, aromatic functional groups.   | Highly selective for proteins with aromatic side chains.   | L11        |
| Everest <sup>®</sup>                       | 238EV C18      | 300           | 70–110                           | 6               | Yes        | Maximum surface coverage for highest resolution of complex samples.                                  | Complex enzymatic digests (>12 proteins).  | L1         |
| ProZap <sup>™</sup>                        | C18            | 500           | 59                               | 3               | Yes        | Sub2µm, 500Å wide pore.  | Ideal for fast, intact protein or peptide analysis.  | L1         |
| Vydac <sup>®</sup> TP                      | 218TP C18      | 300           | 60–110                           | 8               | Yes        | First generation polymeric C18 media with unique selectivity.  | Small polypeptides 4–5K MW, enzymatic digest fragments, natural and synthetic peptides, multi-ring compounds.  | L1         |
|  | 238TP C18      | 300           | 60–110                           | 4               | Yes        | First generation monomeric C18 media.  | Use for same applications at 218TP, but offers different C18 selectivity.  | L1         |
|  | 208TP C8       | 300           | 60–110                           | 5               | Yes        | Less hydrophobic than C18TP media.   | Polypeptides 10–20K MW.  | L7         |
|  | 214TP C4       | 300           | 60–110                           | 3               | Yes        | First generation C4 media.   | Glycoproteins, hemoglobin variants, histones, insulin variants, membrane proteins.   | L26        |
|  | 219TP Diphenyl | 300           | 60–110                           | 4               | Yes        | Lowest capacity first generation diphenyl media.   | Polypeptides with aromatic side chains, large hydrophobic proteins, membrane-spanning peptides, lipid peptides, fusion proteins from inclusion bodies. | L11        |

## Reversed-Phase Column Comparisons

Based on the widely accepted work and test procedures of Drs Lloyd Snyder and John Dolan<sup>1,2,3</sup>, Grace developed this tool to show relative selectivity comparisons for commercially available columns. This graph plots the indicators for hydrophobicity versus the cation exchange capacity at pH 7. Hydrophobicity is often the primary analyte interaction and indicates overall capacity. The cation exchange capacity measures secondary interactions that take place and can greatly influence the retention of polar analytes.



<sup>1</sup>Data courtesy of Lloyd Snyder and John Dolan.

<sup>2</sup>The "Hydrophobic-subtraction" Model of Reversed-phase Column Selectivity", L.R. Snyder, J.W. Dolan and P.W. Carr, *J. Chromatogr. A*, 1060 (2004) 77–116.

<sup>3</sup>A New Look at the Selectivity of Reversed-phase HPLC Columns", L.R. Snyder, J.W. Dolan and P.W. Carr, *Anal. Chem.*, 79 (2007) 3255–3262.

# Application-Based Column Selection

Use this chart to identify a suitable column for your application. Traditional choice columns are well matched to the application. Alternative choice columns can provide different selectivity when the traditional choice column does not work.

For specific application chromatograms, please see our website.

**Legend:**

- Traditional Choice
- Alternative Choice

hplc columns

| Application-Based Column Selection |                |       |         |                                   |          |                    |                 |        |               |             |                        |                      |   |  |                                  |          |         |                              |            |                  |   |
|------------------------------------|----------------|-------|---------|-----------------------------------|----------|--------------------|-----------------|--------|---------------|-------------|------------------------|----------------------|---|--|----------------------------------|----------|---------|------------------------------|------------|------------------|---|
| Column                             | Pharmaceutical |       |         | Neutraceutical / Natural Products |          |                    | Food & Beverage |        |               |             | Environmental          |                      | Biopharmaceutical/ Life Science         |  |                                  |          |         |                              |            |                  |   |
|                                    | Acidic         | Basic | Neutral | Herbal Medicines                  | Vitamins | Dietary Supplement | Carbohydrates   | Lipids | Organic Acids | Food Safety | Agricultural Chemicals | Industrial/Aromatics | Simple Enzymatic Digests (<12 proteins) | Complex Enzymatic Digests (>12 proteins) | Proteins, Peptides, Biomolecules |          |         | Undenatured, Intact Proteins | Antibodies | Oligonucleotides |   |
|                                    |                |       |         |                                   |          |                    |                 |        |               |             |                        |                      |   |  | 0-5K MW                          | 5-10K MW | >10K MW |                              |            |                  |   |
| VisionHT™ C18 HighLoad             | ●              | ●     | ■       | ■                                 | ■        | ■                  |                 |        | ●             | ■           |                        | ●                    | ■                                       | ■  | ■                                |          |         |                              |            |                  |   |
| VisionHT™ C18 Basic                |                | ■     | ●       | ●                                 |          | ●                  |                 |        | ●             |             |                        |                      | ●*                                      | ●*                                       | ●*                               |          |         |                              |            |                  |   |
| VisionHT™ C18 Classic              |                |       |         |                                   |          |                    |                 |        |               |             | ■                      |                      |   |  |                                  |          |         |                              |            |                  |   |
| VisionHT™ C18 Polar                | ■              | ■     | ●       | ●                                 | ●        | ●                  |                 |        | ●             | ■           | ■                      |                      |   |  |                                  |          |         |                              |            |                  |   |
| VisionHT™ Silica                   |                |       |         |                                   |          |                    |                 | ●      |               |             |                        |                      |   |  |                                  |          |         |                              |            |                  |   |
| Alltima™ HP C18                    |                |       | ■       | ■                                 | ■        |                    |                 | ■      | ■             |             |                        |                      |   |  |                                  |          |         |                              |            |                  |   |
| Alltima™ HP C18 EPS                | ■              |       | ●       | ●                                 | ●        | ●                  |                 |        | ●             | ■           |                        |                      |   |  |                                  |          |         |                              |            |                  |   |
| Alltima™ HP C18 Hi-Load            | ●              | ●     | ■       | ■                                 | ■        | ■                  |                 | ■      | ●             |             |                        | ●                    |   |  |                                  |          |         |                              |            |                  |   |
| Alltima™ HP C18 AQ                 | ■              |       |         |                                   |          |                    |                 |        | ■             |             |                        |                      |   |  |                                  |          |         |                              |            |                  |   |
| Alltima™ HP C18 Amide              |                | ■     |         |                                   |          | ●                  |                 |        |               |             |                        |                      |   |  |                                  |          |         |                              |            |                  |   |
| Alltima™ HP C18 Cyano              |                | ●     |         |                                   |          |                    |                 |        |               |             | ●                      |                      |   |  |                                  |          |         |                              |            |                  |   |
| Prevail™ C18 Select                |                |       |         |                                   | ■        |                    |                 |        |               |             |                        |                      |   |  |                                  |          |         |                              |            |                  |   |
| Prevail™ C18                       |                |       | ■       | ■                                 | ■        |                    |                 |        |               |             |                        | ●                    |   |  |                                  |          |         |                              |            |                  |   |
| Prevail™ Phenyl                    |                |       |         |                                   |          |                    |                 |        |               |             | ■                      |                      |   |  |                                  |          |         |                              |            |                  |   |
| Prevail™ Organic Acid              |                |       |         |                                   |          |                    |                 | ■      |               |             |                        |                      |   |  |                                  |          |         |                              |            |                  |   |
| Prevail™ Carbohydrate ES           |                |       |         |                                   |          |                    | ■               |        |               |             |                        |                      |   |  |                                  |          |         |                              |            |                  |   |
| GraceSmart™ C18                    | ■              |       | ■       | ■                                 | ■        |                    |                 |        | ■             | ■           |                        |                      |   |  |                                  |          |         |                              |            |                  |   |
| Vydac® 218MS C18                   |                |       |         |                                   |          |                    |                 |        |               |             |                        | ■                    |   | ■  |                                  |          |         |                              |            |                  |   |
| Vydac® 238MS C18                   |                |       |         |                                   |          |                    |                 |        |               |             |                        | ●                    |   | ■  |                                  |          |         |                              |            |                  |   |
| Vydac® 208MS C8                    |                |       |         |                                   |          |                    |                 |        |               |             |                        |                      |   |  | ■                                |          |         |                              |            |                  |   |
| Vydac® 214MS C4                    |                |       |         |                                   |          |                    |                 |        |               |             |                        |                      |   |  |                                  |          | ■       | ■                            | ■          | ■                | ■ |
| Vydac® 219MS Diphenyl              |                |       |         |                                   |          |                    |                 |        |               |             |                        |                      |   |  | ●                                | ●        | ●       |                              | ●          |                  |   |
| Everest® 238EV C18                 |                |       |         |                                   |          |                    |                 |        |               |             |                        |                      | ■                                       |  |                                  |          |         |                              |            |                  | ■ |
| ProZap™ C18                        |                |       |         |                                   |          |                    |                 |        |               |             |                        |                      |   |  | ■                                | ■        | ■       | ■                            | ■          | ■                | ■ |
| Vydac® 218TP C18                   |                |       |         |                                   |          |                    |                 |        |               |             |                        | ■                    |   | ■  |                                  |          |         |                              |            |                  |   |
| Vydac® 214TP C4                    |                |       |         |                                   |          |                    |                 |        |               |             |                        |                      |   |  |                                  |          | ■       | ■                            |            |                  | ■ |

\*For UHPLC applications.