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# Designing Safer, More Effective Drugs

Pharmaceutical formulations has a growing need for better analytical performance as the excipients (or “non-active” ingredients) along with the active ingredients are becoming more scrutinized by regulatory agencies. Scientists are now looking for ways to more easily qualify and quantitate a large variety of ingredients. Take a quick look at our solutions for ways you can improve your formulations analysis, today.

## What and Why?

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# What are excipients?

Excipients are the inactive ingredients within a pharmaceutical formulation that hold the active pharmaceutical ingredient (API) and ensure the conveniently sized dose is delivered efficiently and effectively to the targeted area. Excipients are typically inert substances, but sometimes they can result in adverse side effects. Modern pharmaceutical regulations require formulation analysis for all ingredients within a pharmaceutical drug to identify all excipient components and guarantee safety of the end product.

Formulation analysis can be achieved through several modes of chromatography including reversed phase, ion-exclusion, size exclusion chromatography (SEC), which includes gel permeation chromatography (GPC) and gel filtration chromatography (GFC), and gas chromatography (GC). Phenomenex offers a wide breadth of products for reliable and reproducible excipient analysis.

## Recommended Chromatography Technique by Excipient Category

| Excipient                  | Technique                                                                                        |
|----------------------------|--------------------------------------------------------------------------------------------------|
| Binders                    | Size Exclusion Chromatography (SEC)<br>Reversed Phase<br>Ion-Exchange<br>Gas Chromatography (GC) |
| Coatings                   | Size Exclusion Chromatography (SEC)<br>Reversed Phase                                            |
| Fillers / Sweeteners       | Ion-Exclusion/Ligand Exchange<br>Reversed Phase                                                  |
| Solubilizers / Surfactants | Size Exclusion Chromatography (SEC)<br>Gas Chromatography (GC)                                   |
| Residual Solvents          | Gas Chromatography (GC)                                                                          |



## Phenomenex Premier Solutions by Technique

| HPLC/UHPLC                                 | Recommended                                                                                                |
|--------------------------------------------|------------------------------------------------------------------------------------------------------------|
| <b>Size Exclusion Chromatography (SEC)</b> |                                                                                                            |
| Gel Permeation Chromatography (GPC)        |                                                                                                            |
| • Polymer-Based Non-Aqueous GPC/SEC        | Phenogel™                                                                                                  |
| Gel Filtration Chromatography (GFC)        |                                                                                                            |
| • Silica-Based Aqueous GFC/SEC             | Yarra™ (1.8 µm, 3 µm), BioSep™ (5 µm)                                                                      |
| • Polymer-Based Aqueous GFC/SEC            | PolySep™                                                                                                   |
| <b>Ion-Exclusion/Ligand Exchange</b>       | Rezex™                                                                                                     |
| <b>Reversed Phase</b>                      | Kinetex® (1.3 µm, 1.7 µm, 2.6 µm, 3.5 µm, 5 µm)<br>Luna® (1.6 µm, 2.5 µm, 3 µm, 5 µm)                      |
| <b>Ion-Exchange</b>                        | Luna SCX                                                                                                   |
| GC                                         | Recommended                                                                                                |
| <b>Gas Chromatography</b>                  | Zebtron™ ZB-1ms, ZB-5ms, ZB-5MS <sub>PLUS</sub> ™, ZB-35, ZB-50, ZB-624, ZB-WAX <sub>PLUS</sub> ™, ZB-FFAP |

# Pharmacopoeia Classifications

## Ph. Eur. Recommendations

Column recommendations provided by the European Pharmacopoeia (Ph. Eur.) are generally given as a description of the media along with the column dimensions. For instance, a monograph may call for “a stainless steel column 0.3 m long and 7.8 mm in internal diameter packed with strong cation-exchange resin (calcium form) R (9 µm) and maintained at a temperature of  $85 \pm 1$  °C.” This would be the precise description of our Rezex™ RCM-Monosaccharide 300 x 7.8 mm column (P/N 00H-0130-K0).

| Description According to Pharm. Eur. 8.6<br>4.1.1. Reagents 2016                                       | Number  | Recommended<br>Phenomenex Column                                                                                           | Indicated Particle Size<br>(µm) |
|--------------------------------------------------------------------------------------------------------|---------|----------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| Silica gel for chromatography.                                                                         | 1076900 | Kinetex® HILIC<br>Luna® Silica(2)                                                                                          | 3 to 10                         |
| Silica gel for chromatography, alkyl bonded for use with highly aqueous mobile phases.                 | 1160200 | Synergi™ Hydro-RP<br>Synergi Fusion-RP<br>Gemini® C18<br>Gemini NX-C18<br>Kinetex C18<br>Kinetex EVO C18<br>Kinetex XB-C18 |                                 |
| Silica gel for chromatography, alkyl bonded for use with highly aqueous mobile phases, endcapped.      | 1176900 | Synergi Hydro-RP<br>Synergi Fusion-RP<br>Gemini C18<br>Gemini NX-C18<br>Kinetex C18<br>Kinetex EVO C18<br>Kinetex XB-C18   |                                 |
| Silica gel for chromatography, butylsilyl.<br>Spheroidal 300 Å; pore volume: 0.6 cm³/g; area: 80 m²/g. | 1076200 | Aeris™ WIDEPORE C4                                                                                                         | 3 to 10                         |
| Silica gel for chromatography, butylsilyl, endcapped.                                                  | 1170500 | Aeris WIDEPORE C4<br>Jupiter® 300 C4                                                                                       | 3 to 10                         |
| Silica gel for chromatography, cyanosilyl.                                                             | 1109900 | Luna CN (Cyano)                                                                                                            | 3 to 10                         |
| Silica gel for chromatography, di-isobutyloctadecylsilyl.                                              | 1140000 | Kinetex XB-C18                                                                                                             |                                 |
| Silica gel for chromatography, diol dihydroxypropyl, 100 Å.                                            | 1110000 | Luna HILIC                                                                                                                 | 5                               |
| Silica gel for chromatography, dodecylsilyl, endcapped.                                                | 1179700 | Synergi Max-RP                                                                                                             |                                 |

[See More >](#)



# Pharmacopoeia Classifications

| Description According to Pharm. Eur. 8.6<br>4.1.1. Reagents 2016                                                                                                                                                                                                                                                                                      | Number  | Recommended<br>Phenomenex Column                                                                                                                       | Indicated Particle Size<br>(µm) |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| Silica gel for chromatography, hydrophilic surface has been modified to provide hydrophilic characteristics.                                                                                                                                                                                                                                          | 1077200 | Luna® HILIC                                                                                                                                            | 3 to 10                         |
| Silica gel for chromatography, nitrile cyanopropylsilyl.                                                                                                                                                                                                                                                                                              | 1077300 | Luna CN (Cyano)                                                                                                                                        | 3 to 10                         |
| Silica gel for chromatography, nitrile R1 chemically bonded nitrile groups.                                                                                                                                                                                                                                                                           | 1077400 | Luna CN (Cyano)                                                                                                                                        | 3 to 10                         |
| Silica gel for chromatography, nitrile R2 ultrapure silica (<20 ppm metal) with cyanopropylsilyl groups.                                                                                                                                                                                                                                              | 1119500 | Luna CN (Cyano)                                                                                                                                        | 3 to 10                         |
| Silica gel for chromatography, nitrile, endcapped with cyanopropylsilyl groups.                                                                                                                                                                                                                                                                       | 1174500 | Luna CN (Cyano)                                                                                                                                        | 3 to 10                         |
| Silica gel for chromatography, octadecylsilyl.                                                                                                                                                                                                                                                                                                        | 1077500 | Luna C18(2)<br>Synergi™ Hydro-RP<br>Synergi Fusion-RP<br>Gemini® C18<br>Gemini NX-C18<br>Kinetex® C18<br>Kinetex EVO C18<br>Kinetex XB-C18             | 3 to 10                         |
| Silica gel for chromatography, octadecylsilyl R1 ultrapure silica (<20 ppm metals), pore size and C-load are indicated in the method.                                                                                                                                                                                                                 | 1110100 | Luna C18(2)<br>Synergi Hydro-RP<br>Synergi Fusion-RP<br>Gemini C18<br>Gemini NX-C18<br>Jupiter C18<br>Kinetex C18<br>Kinetex EVO C18<br>Kinetex XB-C18 | 3 to 10                         |
| Silica gel for chromatography, octadecylsilyl, base-deactivated pretreated before the bonding by careful washing and hydrolyzing most of the superficial siloxane bridges to minimize the interaction with basic components.                                                                                                                          | 1077600 | Luna C18(2)<br>Gemini C18<br>Gemini NX-C18<br>Kinetex C18<br>Kinetex EVO C18<br>Kinetex XB-C18                                                         | 3 to 10                         |
| Silica gel for chromatography, octadecylsilyl, endcapped. To minimize any interaction with basic compounds it's carefully endcapped to cover most of the remaining silanol groups.                                                                                                                                                                    | 1115400 | Luna C18(2)<br>Gemini C18<br>Gemini NX-C18<br>Kinetex C18<br>Kinetex EVO C18<br>Kinetex XB-C18                                                         | 3 to 10                         |
| Silica gel for chromatography, octadecylsilyl, endcapped R1 ultrapure silica (<20 ppm metal), 19 % C-load. To minimize any interaction with basic compounds it's carefully endcapped to cover most of the remaining silanol groups.                                                                                                                   | 1115401 | Luna C18<br>Synergi Hydro-RP                                                                                                                           |                                 |
| Silica gel for chromatography, octadecylsilyl, endcapped, base-deactivated; pore size 100 Å, C-load:16 %, pretreated before the bonding by careful washing and hydrolyzing most of the superficial siloxane bridges. To further minimize any interaction with basic compounds it's carefully endcapped to cover most of the remaining silanol groups. | 1108600 | Luna C18(2)<br>Gemini C18<br>Gemini NX-C18                                                                                                             | 3 to 10                         |
| Silica gel for chromatography, octadecylsilyl, endcapped, base-deactivated R1; pretreated before the bonding by careful washing and hydrolyzing most of the superficial siloxane bridges. To further minimize any interaction with basic compounds it's carefully endcapped to cover most of the remaining silanol groups.                            | 1162600 | Luna C18(2)<br>Gemini C18<br>Gemini NX-C18<br>Kinetex C18<br>Kinetex EVO C18<br>Kinetex XB-C18                                                         | 3 to 10                         |

# Pharmacopoeia Classifications

| Description According to Pharm. Eur. 8.6<br>4.1.1. Reagents 2016                                                                                                                                                                                                                                                                                               | Number  | Recommended Phenomenex Column                                                                         | Indicated Particle Size (µm) |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|-------------------------------------------------------------------------------------------------------|------------------------------|
| Silica gel for chromatography, octadecylsilyl, monolithic.                                                                                                                                                                                                                                                                                                     | 1154500 | Onyx™ C18                                                                                             |                              |
| Silica gel for chromatography, octadecylsilyl, with polar embedded groups, endcapped; the particles are based on a mixture of silica chemically modified at the surface by the bonding of octadecylsilyl groups and silica chemically modified with a reagent providing a surface with chains having embedded polar groups.                                    | 1177900 | Synergi™ Fusion-RP                                                                                    | 3 to 10                      |
| Silica gel for chromatography, octadecylsilyl, with polar incorporated groups, endcapped; the particles are based on silica, chemically modified with a reagent providing a surface with chains having polar incorporated groups and terminating octadecyl groups.                                                                                             | 1165100 | Synergi Fusion-RP                                                                                     | 3 to 10                      |
| Silica gel for chromatography, octadecylsilyl, ethylene-bridged (hybrid material). Synthetic, spherical ethylene-bridged particles, containing both organic and inorganic (silica) components.                                                                                                                                                                 | 1190500 | Kinetex® EVO C18<br>Gemini® NX-C18                                                                    |                              |
| Silica gel for chromatography compatible with 100 % aqueous mobile phase, octadecylsilyl, endcapped.                                                                                                                                                                                                                                                           | 1188400 | Kinetex EVO C18<br>Synergi Hydro-RP<br>Synergi Fusion-RP                                              |                              |
| Silica gel for chromatography, octadecylsilyl, extra-dense bonded, endcapped.                                                                                                                                                                                                                                                                                  | 1188500 | Luna® C18(2)<br>Gemini C18<br>Gemini NX-C18<br>Kinetex C18<br>Kinetex EVO C18<br>Kinetex XB-C18       |                              |
| Silica gel for chromatography, octadecylsilyl, solid core, endcapped with spherical silica particles containing a non-porous solid silica core surrounded by a thin outer porous silica coating with octadecylsilyl groups. To minimize any interaction with basic compounds it is carefully endcapped to cover most of the remaining silanol groups.          | 1193900 | Kinetex C18<br>Kinetex XB-C18<br>Kinetex EVO C18<br>Aeris™ PEPTIDE XB-C18<br>Aeris WIDEPORE XB-C18    |                              |
| Silica gel for chromatography, octylsilyl.                                                                                                                                                                                                                                                                                                                     | 1077700 | Kinetex C8<br>Luna C8(2)                                                                              | 3 to 10                      |
| Silica gel for chromatography, octylsilyl R1. Bonding of octylsilyl and methyl groups (double bonded phase).                                                                                                                                                                                                                                                   | 1077701 | Kinetex C8<br>Luna C8(2)                                                                              | 3 to 10                      |
| Silica gel for chromatography, octylsilyl, base-deactivated pretreated before the bonding by careful washing and hydrolyzing most of the superficial siloxane bridges to minimize the interaction with basic components.                                                                                                                                       | 1131600 | Kinetex C8<br>Luna C8(2)                                                                              | 3 to 10                      |
| Silica gel for chromatography, octylsilyl, endcapped. To minimize any interaction with basic compounds it's carefully endcapped to cover most of the remaining silanol groups.                                                                                                                                                                                 | 1119600 | Kinetex C8<br>Luna C8(2)                                                                              | 3 to 10                      |
| Silica gel for chromatography, octylsilyl, endcapped, base-deactivated pretreated before the bonding by careful washing and hydrolyzing most of the superficial siloxane bridges to minimize the interaction with basic components. To further minimize any interaction with basic compounds it's carefully endcapped to cover most of the remaining silanols. | 1148800 | Kinetex C8<br>Luna C8(2)                                                                              | 3 to 10                      |
| Silica gel for chromatography, phenylhexylsilyl.                                                                                                                                                                                                                                                                                                               | 1153900 | Kinetex Phenyl-Hexyl<br>Luna Phenyl-Hexyl<br>Gemini C6-Phenyl                                         | 3 to 10                      |
| Silica gel for chromatography, phenylhexylsilyl, endcapped 3 µm. To minimize any interaction with basic compounds it's carefully endcapped to cover most of the remaining silanol groups.                                                                                                                                                                      | 1170600 | Kinetex Phenyl-Hexyl<br>Luna Phenyl-Hexyl<br>Gemini C6-Phenyl                                         | 3                            |
| Silica gel for chromatography, phenylsilyl.                                                                                                                                                                                                                                                                                                                    | 1110200 | Synergi Polar-RP<br>Luna Phenyl-Hexyl<br>Gemini C6-Phenyl<br>Kinetex Biphenyl<br>Kinetex Phenyl-Hexyl | 5 to 10                      |

[See More](#)

# Pharmacopoeia Classifications

| Description According to Pharm. Eur. 8.6<br>4.1.1. Reagents 2016                                                                                                                                                                                                                                                                                                                              | Number  | Recommended<br>Phenomenex Column                                                                          | Indicated Particle Size<br>(µm) |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|-----------------------------------------------------------------------------------------------------------|---------------------------------|
| Silica gel for chromatography, phenylsilyl, endcapped. To minimize any interaction with basic compounds it's carefully endcapped to cover most of the remaining silanol groups.                                                                                                                                                                                                               | 1154900 | Synergi™ Polar-RP<br>Luna® Phenyl-Hexyl<br>Gemini® C6-Phenyl<br>Kinetex® Biphenyl<br>Kinetex Phenyl-Hexyl | 5 to 10                         |
| Silica gel for chromatography, propoxybenzene, endcapped.                                                                                                                                                                                                                                                                                                                                     | 1174600 | Synergi Polar-RP                                                                                          | 3 to 10                         |
| Silica gel for chromatography, strong cation-exchange bonding of sulfonic acid groups.                                                                                                                                                                                                                                                                                                        | 1161400 | Luna SCX                                                                                                  | 5 to 10                         |
| Silica for size-exclusion chromatography. 10 µm silica with a very hydrophilic surface. Pore size average: 30 nm; pH stability 2 to 8; exclusion range for proteins: $1 \times 10^3$ to $3 \times 10^5$ .                                                                                                                                                                                     | 1077900 | BioSep™-SEC-S3000                                                                                         | 10                              |
| Organosilica polymer, amorphous, octadecylsilyl. Synthetic, spherical hybrid particles containing both inorganic (silica) and organic (organosiloxanes) components, chemically modified at the surface by trifunctionally bonded octadecylsilyl groups.                                                                                                                                       | 1144200 | Kinetex EVO C18<br>Gemini C18<br>Gemini NX-C18                                                            |                                 |
| Organosilica polymer, amorphous, octadecylsilyl, endcapped. Synthetic, spherical hybrid particles containing both inorganic (silica) and organic (organosiloxanes) components, chemically modified at the surface by trifunctionally bonded octadecylsilyl groups. To minimize any interaction with basic compounds, it is carefully endcapped to cover most of the remaining silanol groups. | 1178600 | Kinetex EVO C18<br>Gemini C18<br>Gemini NX-C18                                                            |                                 |
| Organosilica polymer for mass spectrometry, amorphous, octadecylsilyl, endcapped. Synthetic, spherical hybrid particles containing both inorganic (silica) and organic (organosiloxanes) components. To minimize any interaction with basic compounds, it is carefully endcapped to cover most of the remaining silanol groups.                                                               | 1164900 | Kinetex EVO C18<br>Gemini C18<br>Gemini NX-C18                                                            |                                 |
| Ion-exclusion resin for chromatography. A resin with sulfonic acid groups attached to a polymer lattice consisting of polystyrene cross-linked with divinylbenzene.                                                                                                                                                                                                                           | 1131000 | Rezex™ ROA-Organic Acid<br>Rezex RHM-Monosaccharide                                                       |                                 |
| Cation-exchange resin, strong. Strong cation-exchange resin in protonated form with sulfonic acid groups attached to a polymer lattice consisting of polystyrene cross-linked with divinylbenzene.                                                                                                                                                                                            | 1156800 | Rezex ROA-Organic Acid<br>Rezex RHM-Monosaccharide                                                        |                                 |
| Cation-exchange resin (Calcium form), strong. Resin in calcium form with sulfonic acid groups attached to a polymer lattice consisting of polystyrene cross-linked with 8 % divinylbenzene                                                                                                                                                                                                    | 1104600 | Rezex RCM-Monosaccharide<br>Rezex RCU-USP Sugar Alcohols                                                  |                                 |
| Cation-exchange resin (Sodium form), strong. Resin in sodium form with sulfonic acid groups attached to a polymer lattice consisting of polystyrene cross-linked with divinylbenzene.                                                                                                                                                                                                         | 1176100 | Rezex RNM-Carbohydrate                                                                                    |                                 |



# Pharmacopoeia Classifications

## USP Packings (L classifications)

| USP Column Classification                                                                                                                                                        | Recommended Phenomenex Column                                                                                                               | Particle Shape                                                                                          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|
| <b>L1</b> Octadecyl silane chemically bonded to porous or non-porous silica or ceramic microparticles, 1.5 to 10 µm in diameter, or a monolithic rod.                            | Gemini® NX-C18<br>Kinetex® C18<br>Kinetex EVO C18<br>Kinetex XB-C18<br>Luna® C18(2)<br>Gemini C18<br>Synergi™ Hydro-RP<br>Synergi Fusion-RP | Spherical<br>Core-Shell<br>Core-Shell<br>Core-Shell<br>Spherical<br>Spherical<br>Spherical<br>Spherical |
| <b>L3</b> Porous silica particles, 1.5 to 10 µm in diameter, or a monolithic silica rod.                                                                                         | Kinetex HILIC<br>Luna Silica(2)<br>Onyx™ Silica                                                                                             | Core-Shell<br>Spherical<br>Monolith                                                                     |
| <b>L7</b> Octyl silane chemically bonded to totally or superficially porous silica particles, 1.5 to 10 µm in diameter, or a monolithic silica rod.                              | Kinetex C8<br>Luna C8(2)<br>Onyx C8                                                                                                         | Core-Shell<br>Spherical<br>Monolith                                                                     |
| <b>L8</b> An essentially monomolecular layer of aminopropyl-silane chemically bonded to totally porous silica gel support, 1.5 to 10 µm in diameter, or a monolithic silica rod. | Luna NH <sub>2</sub>                                                                                                                        | Spherical                                                                                               |
| <b>L9</b> Irregular or spherical, totally porous silica gel having a chemically bonded, strongly acidic cation-exchange coating, 3 to 10 µm in diameter.                         | Luna SCX<br>Aeris™ WIDEPORE XB-C8                                                                                                           | Spherical<br>Core-Shell                                                                                 |
| <b>L10</b> Nitrile groups chemically bonded to porous silica particles, 1.5 to 10 µm in diameter, or a monolithic silica rod.                                                    | Luna CN 100 Å                                                                                                                               | Spherical                                                                                               |
| <b>L11</b> Phenyl groups chemically bonded to porous silica particles, 1.5 to 10 µm in diameter, or a monolithic silica rod.                                                     | Kinetex Biphenyl<br>Kinetex Phenyl-Hexyl<br>Synergi Polar-RP<br>Luna Phenyl-Hexyl<br>Gemini C6-Phenyl<br>Prodigy™ PH-3                      | Core-Shell<br>Core-Shell<br>Spherical<br>Spherical<br>Spherical<br>Spherical                            |
| <b>L17</b> Strong cation-exchange resin consisting of sulfonated cross-linked styrene-divinylbenzene copolymer in the hydrogen form, 6 to 12 µm in diameter.                     | Rezex™ RHM-Monosaccharide<br>Rezex ROA-Organic Acid                                                                                         | Spherical<br>Spherical                                                                                  |
| <b>L19</b> Strong cation-exchange resin consisting of sulfonated cross-linked styrene-divinylbenzene copolymer in the calcium form, 5 to 15 µm in diameter.                      | Rezex RCM-Monosaccharide<br>Rezex RCU-Sugar Alcohols                                                                                        | Spherical<br>Spherical                                                                                  |
| <b>L20</b> Dihydroxypropane groups chemically bonded to porous silica or hybrid particles, 1.5 to 10 µm in diameter, or a monolithic silica rod.                                 | Luna HILIC<br>BioSep™-SEC-S                                                                                                                 | Spherical<br>Spherical                                                                                  |
| <b>L21</b> A rigid, spherical styrene-divinylbenzene copolymer, 3 to 30 µm in diameter.                                                                                          | PolymerX™ RP-1<br>Phenogel™ 100 Å                                                                                                           | Spherical<br>Spherical                                                                                  |
| <b>L22</b> A cation-exchange resin made of porous polystyrene gel with sulfonic acid groups, 5 to 15 µm in diameter.                                                             | Rezex ROA-Organic Acid<br>Yarra™ SEC                                                                                                        | Spherical<br>Spherical                                                                                  |
| <b>L26</b> Butyl silane chemically bonded to totally porous silica particles, 1.5 to 10 µm in diameter.                                                                          | Jupiter® 300 C4<br>Aeris WIDEPORE C4                                                                                                        | Spherical<br>Core-Shell                                                                                 |

# Pharmacopoeia Classifications

## USP Packings (L classifications cont'd)

| USP Column Classification                                                                                                                                                                          | Recommended Phenomenex Column                                              | Particle Shape                                   |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|--------------------------------------------------|
| <b>L33</b> Packing having the capacity to separate dextrans by molecular size over a range of 4,000 to 500,000 daltons. It is spherical, silica-based and processed to provide pH stability.       | Yarra™ SEC-2000<br>BioSep™-SEC-S2000<br>Yarra SEC-3000<br>BioSep-SEC-S3000 | Spherical<br>Spherical<br>Spherical<br>Spherical |
| <b>L34</b> Strong cation-exchange resin consisting of sulfonated cross-linked styrene-divinylbenzene copolymer in the lead form, 7 to 9 µm in diameter.                                            | Rezex™ RPM-Monosaccharide                                                  | Spherical                                        |
| <b>L35</b> A zirconium-stabilized spherical silica packing with a hydrophilic (diol-type) molecular monolayer bonded phase having a pore size of 150Å.                                             | (BioSep-SEC-S2000 or Yarra SEC-2000 may be used)                           | Spherical<br>Spherical                           |
| <b>L37</b> Polymethacrylate gel packing having the capacity to separate proteins by molecular size over a range of 2,000 to 40,000 daltons.                                                        | PolySep™-GFC-P3000                                                         | Spherical                                        |
| <b>L38</b> Methacrylate-based size-exclusion packing for water-soluble samples.                                                                                                                    | PolySep-GFC-P series                                                       | Spherical                                        |
| <b>L39</b> Hydrophilic polyhydroxymethacrylate gel of totally porous spherical resin.                                                                                                              | PolySep-GFC-P series                                                       | Spherical                                        |
| <b>L43</b> Pentafluorophenyl groups chemically bonded to silica particles by a propyl spacer, 1.5 to 10 µm in diameter.                                                                            | Kinetex® F5<br>Luna® PFP(2)                                                | Core-Shell<br>Spherical                          |
| <b>L58</b> Strong cation-exchange resin consisting of sulfonated cross-linked styrene-divinylbenzene copolymer in the sodium form, about 6 to 30 µm in diameter.                                   | Rezex RNM-Carbohydrate                                                     | Spherical                                        |
| <b>L59</b> Size-exclusion separations of proteins (separation by molecular weight) over the range of 5 to 7000 kDa. Spherical (1.5 to 10 µm), silica or hybrid packing with a hydrophilic coating. | Yarra SEC-2000<br>BioSep-SEC-S2000<br>Yarra SEC-3000<br>BioSep-SEC-S3000   | Spherical<br>Spherical<br>Spherical<br>Spherical |

## USP Phase Designation (G classifications)

| Phase Type | Phase Description                                                      | Recommended Zebron™ GC Columns                    |
|------------|------------------------------------------------------------------------|---------------------------------------------------|
| <b>G1</b>  | Dimethylpolysiloxane Oil                                               | ZB-1, ZB-1ms, ZB-1HT Inferno™                     |
| <b>G2</b>  | Dimethylpolysiloxane Gum                                               | ZB-1, ZB-1ms, ZB-1HT                              |
| <b>G3</b>  | 50 % Phenyl 50 % Methylpolysiloxane                                    | ZB-50                                             |
| <b>G9</b>  | Methylvinylpolysiloxane                                                | ZB-1ms, ZB-1HT Inferno, ZB-1                      |
| <b>G14</b> | Polyethylene Glycol (Average MW 950 - 1,050)                           | ZB-WAX, ZB-WAX <sub>PLUS</sub> ™                  |
| <b>G15</b> | Polyethylene Glycol (Average MW 3,000 - 3,700)                         | ZB-WAX, ZB-WAX <sub>PLUS</sub>                    |
| <b>G16</b> | Polyethylene Glycol (Average MW 15,000)                                | ZB-WAX, ZB-WAX <sub>PLUS</sub>                    |
| <b>G17</b> | 75 % Phenyl 25 % Methylpolysiloxane                                    | ZB-50                                             |
| <b>G20</b> | Polyethylene Glycol (Average MW 380 - 420)                             | ZB-WAX, ZB-WAX <sub>PLUS</sub>                    |
| <b>G25</b> | Polyethylene Glycol TPA (Carbowax 20M Terephthalic Acid)               | ZB-FFAP                                           |
| <b>G27</b> | 5 % Phenyl 95 % Methylpolysiloxane                                     | ZB-5, ZB-5MSi, ZB-5HT Inferno                     |
|            | 5 % Phenyl-Arylene 95 % Methylpolysiloxane                             | ZB-5ms, ZB-5MS <sub>PLUS</sub> , ZB-SemiVolatiles |
| <b>G28</b> | 25 % Phenyl 75 % Methylpolysiloxane                                    | ZB-35, ZB-35HT Inferno                            |
| <b>G32</b> | 20 % Phenylmethyl 80 % Dimethylpolysiloxane                            | ZB-35, ZB-35HT Inferno                            |
| <b>G35</b> | Polyethylene Glycol / Diepoxide Esterified with Nitroterephthalic Acid | ZB-FFAP                                           |
| <b>G36</b> | 1 % Vinyl 5 % Phenylmethylpolysiloxane                                 | ZB-5, ZB-5MSi, ZB-5HT Inferno                     |
| <b>G38</b> | Phase G1 / Small % Tailing Inhibitor                                   | ZB-1, ZB-1ms, ZB-1HT Inferno                      |
| <b>G39</b> | Polyethylene Glycol (Average MW 1,500)                                 | ZB-WAX, ZB-WAX <sub>PLUS</sub>                    |
| <b>G41</b> | Phenylmethyldimethylsilicone (10 % Phenyl Substituted)                 | ZB-5, ZB-5MSi, ZB-5HT Inferno                     |
| <b>G42</b> | 35 % Phenyl 65 % Dimethylpolysiloxane                                  | ZB-35, ZB-35HT Inferno                            |
| <b>G43</b> | 6 % Cyanopropylphenyl 94 % Dimethylpolysiloxane                        | ZB-624                                            |
| <b>G46</b> | 14 % Cyanopropylphenyl 86 % Methylpolysiloxane                         | ZB-1701, ZB-1701P                                 |
| <b>G47</b> | Polyethylene Glycol (Average MW 8,000)                                 | ZB-WAX <sub>PLUS</sub> , ZB-WAX                   |

# Allowable Adjustments

Recent revisions of both the USP and Ph. Eur. have better defined the “allowable adjustments” one can make to an existing monograph without requiring revalidation. Below are the isocratic and gradient summaries for the ranges of these parameter changes, or prohibition thereof.

## Allowable Adjustments to Pharmacopoeia Methods for Isocratic Separations

| Component                                                    | United States Pharmacopoeia (USP)                                                                    | European Pharmacopoeia (Ph. Eur.)                                                                               |
|--------------------------------------------------------------|------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|
| <b>Mobile phase minor component (<math>\leq 50\%</math>)</b> | $\pm 30\%$ Relative; Cannot exceed<br>$\pm 10\%$ Absolute change; Cannot be reduced to zero          | $\pm 30\%$ Relative or $\pm 2\%$ absolute, whichever is the larger;<br>Cannot exceed $\pm 10\%$ Absolute change |
| <b>Mobile phase pH</b>                                       | $\pm 0.2$ pH units                                                                                   | $\pm 0.2$ pH units; $\pm 1.0$ for non-ionizable substances                                                      |
| <b>Buffer concentration</b>                                  | $\pm 10\%$                                                                                           | $\pm 10\%$                                                                                                      |
| <b>Column temperature</b>                                    | $\pm 10^\circ\text{C}$                                                                               | $\pm 10^\circ\text{C}$                                                                                          |
| <b>Injection volume</b>                                      | Can be adjusted as much as needed; must be consistent with linearity, precision, and detection reqs. | Can be reduced so long as precision and detection limits are met                                                |
| <b>Detector wavelength</b>                                   | Cannot be modified                                                                                   | Cannot be modified                                                                                              |
| <b>Flow rate</b>                                             | $\pm 50\%$ (at given ID)                                                                             | $\pm 50\%$ (at given ID; flow rates may be adjusted more when changing inner diameter)                          |
| <b>Column inner diameter</b>                                 | Can be adjusted so long as linear velocity is maintained                                             | $\pm 25\%$                                                                                                      |
| <b>Column length</b>                                         | Column length (L) to particle size diameter (dp) ratio can be adjusted between $-25\%$ and $+50\%$ * | Column length may be adjusted $\pm 70\%$                                                                        |
| <b>Particle size</b>                                         | Column length (L) to particle size diameter (dp) ratio can be adjusted between $-25\%$ and $+50\%$ * | Particle diameter may be reduced as much as $50\%$                                                              |
| <b>Stationary phase</b>                                      | No change of the identity of the substituent permitted                                               | No change of the identity of the substituent permitted                                                          |
| <b>Guards</b>                                                | Same stationary phase as column; guard ID $\leq$ column ID; guard length $\leq 15\%$ column length   | There is no statement not allowing guard columns as long as it has same material as the column                  |

\*Alternatively (as for the application of particle size adjustment to superficially porous particles), other L/dp combinations can be used provided that the number of theoretical plates (N) is within  $-25\%$  to  $+50\%$

## Allowable Adjustments to Pharmacopoeia Methods for Gradient Separations

| Component                                                    | United States Pharmacopoeia (USP)                                                                    | European Pharmacopoeia (Ph. Eur.)                                                                                                                                                                                                                                                            |
|--------------------------------------------------------------|------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Mobile phase minor component (<math>\leq 50\%</math>)</b> | Changes to gradient composition are not recommended                                                  | Minor adjustments of the composition of the mobile phase and the gradient are acceptable, if the system suitability requirements are met, the principle peak(s) elute(s) within $\pm 15\%$ of the indicated retention time(s) and the final elution power of the mobile phase is not weaker. |
| <b>Mobile phase pH</b>                                       | $\pm 0.2$ pH units                                                                                   | No adjustment permitted                                                                                                                                                                                                                                                                      |
| <b>Buffer concentration</b>                                  | $\pm 10\%$                                                                                           | No adjustment permitted                                                                                                                                                                                                                                                                      |
| <b>Column temperature</b>                                    | $\pm 10^\circ\text{C}$                                                                               | $\pm 5^\circ\text{C}$                                                                                                                                                                                                                                                                        |
| <b>Injection volume</b>                                      | Can be adjusted as much as needed; must be consistent with linearity, precision, and detection reqs. | Can be reduced so long as precision and detection limits are met                                                                                                                                                                                                                             |
| <b>Detector wavelength</b>                                   | Cannot be modified                                                                                   | Cannot be modified                                                                                                                                                                                                                                                                           |
| <b>Flow rate</b>                                             | Changes to flow rate are not allowed                                                                 | Adjustment is permitted to maintain linear velocity when changing column dimensions                                                                                                                                                                                                          |
| <b>Column inner diameter</b>                                 | Changes to column length, particle size, or inner diameter are not allowed                           | $\pm 25\%$                                                                                                                                                                                                                                                                                   |
| <b>Column length</b>                                         | Changes to column length, particle size, or inner diameter are not allowed                           | $\pm 70\%$                                                                                                                                                                                                                                                                                   |
| <b>Particle size</b>                                         | Changes to column length, particle size, or inner diameter are not allowed                           | No change permitted                                                                                                                                                                                                                                                                          |
| <b>Stationary phase</b>                                      | No change of the identity of the substituent permitted                                               | No change of the identity of the substituent permitted                                                                                                                                                                                                                                       |
| <b>Guards</b>                                                | Same stationary phase as column; guard ID $\leq$ column ID; guard length $\leq 15\%$ column length   | There is no statement not allowing guard columns as long as it has same material as the column                                                                                                                                                                                               |

To view the latest updates, please visit:

[www.phenomenex.com/allowable](http://www.phenomenex.com/allowable)

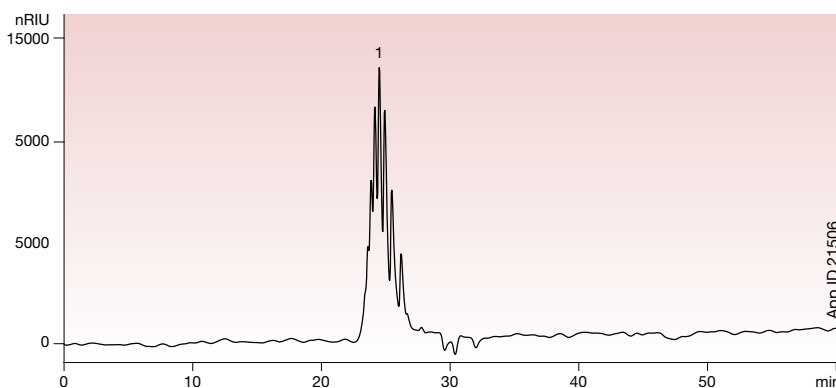
# Binders

Binders are the most extensively used excipient and are typically polymers that hold all of the ingredients together. A major benefit of binders is the addition of mechanical strength to the tablet to ensure rigid shape, high stability, and long storage lifetimes. Binders can also be considered fillers when adding bulk to a tablet.

## Polyethylene Glycol (PEG)

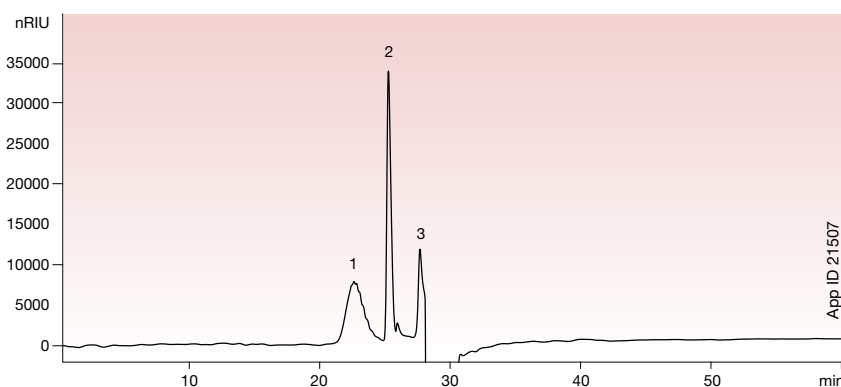
GPC separation of a polyethylene glycol (PEG) standard using 3 fixed pore size Phenogel™ columns (50 Å, 100 Å, and 500 Å) and THF mobile phase at 1 mL/min. Fixed pore size columns can provide increased resolution of narrower MW ranges compared to the mixed bed linear phases. Note that discrete MW species can be resolved.

**Column:** Phenogel 5 µm 50 Å,  
100 Å, 500 Å  
**Dimensions:** 300 x 7.8 mm  
**Mobile Phase:** THF  
**Flow Rate:** 1 mL/min  
**Detection:** Refractive Index (RI)  
**Temperature:** 40 °C  
**Sample:** 1. PEG 300



GPC separation of an Advil® Cold & Sinus LIQUI-GELS® sample. Note the corresponding peaks to API as peak 3, PEG as peak 2, and a larger disperse polymer (i.e., gelatin) as peak 1. The combination of the 3 fixed pore size Phenogel columns (50 Å, 100 Å, and 500 Å) in series can give a slightly wider range than one specific fixed pore size column.

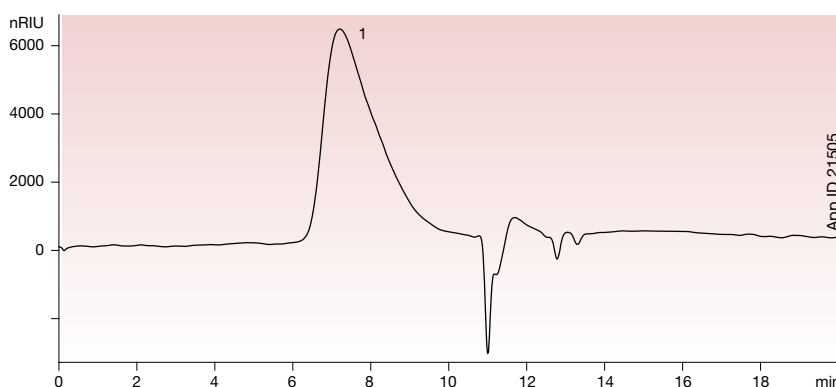
**Column:** Phenogel 5 µm 50 Å,  
100 Å, 500 Å  
**Dimensions:** 300 x 7.8 mm  
**Mobile Phase:** THF  
**Flow Rate:** 1 mL/min  
**Detection:** Refractive Index (RI)  
**Temperature:** 40 °C  
**Sample:** 1. API Unknown Peak A  
2. PEG 106  
3. API Unknown Peak B



## Polyvinylpyrrolidone (PVP, Povidone)

Separation of polyvinylpyrrolidone (povidone) on 2x Phenogel Linear(2) column using DMF as mobile phase. Povidone is a common binder and filler agent used in tablet formulations. Note the wide MW distribution on a GPC column.

**Column:** Phenogel 5 µm Linear(2) x2  
**Dimensions:** 300 x 7.8 mm  
**Part No.:** 00H-3259-K0-DF  
**Mobile Phase:** 10 mM Lithium Bromide  
in DMF  
**Flow Rate:** 2 mL/min  
**Detection:** Refractive Index (RI)  
**Temperature:** 40 °C  
**Sample:** 1. Polyvinylpyrrolidone (PVP)

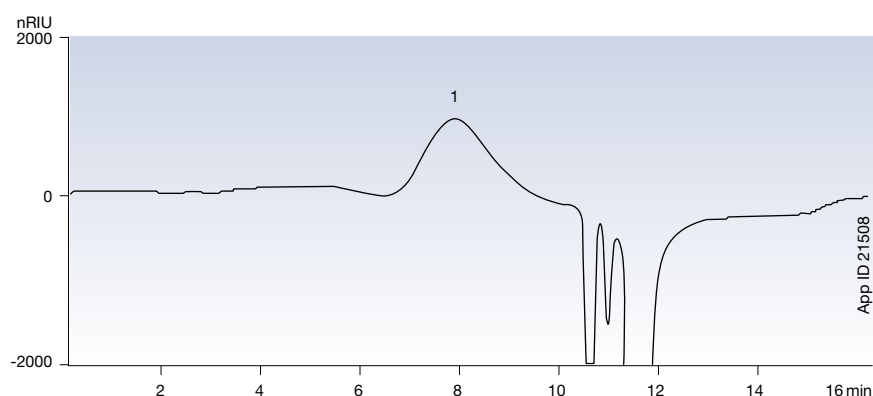


# Coatings

Polymer coatings on pharmaceuticals help seal the drug, prevent dissolution, and enable drug targeting. Some coatings can also facilitate a delayed dosage for an accurately timed release of the active ingredient.

## Cellulose Acetate

GPC separation of cellulose acetate using 2x Phenogel™ Linear(2) columns. Cellulose acetate is also used as a binder for tablets and is very polydisperse leading to a very broad peak. Mixed bed linear phases are well suited for wide MW distribution separations.



**Column:** Phenogel 5  $\mu$ m Linear(2) x2  
**Dimensions:** 300 x 7.8 mm  
**Part No.:** 00H-3259-K0-DF  
**Mobile Phase:** 10 mM Lithium Bromide in DMF  
**Flow Rate:** 2 mL/min  
**Detection:** Refractive Index (RI)  
**Temperature:** 40 °C  
**Sample:** 1. Cellulose acetate





# Fillers/Sweeteners

As the name implies, fillers bulk up a tablet or capsule in order to make it a suitable size for manufacturing, packaging, and ingestion. Many fillers are coupled as sweeteners to combat the bitter taste of other active and non-active ingredients.

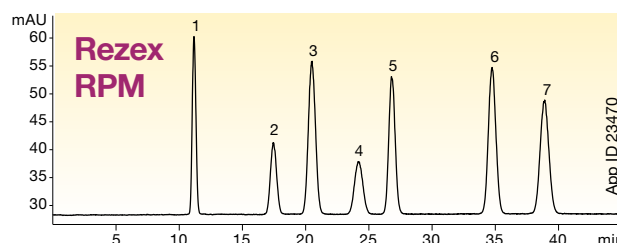
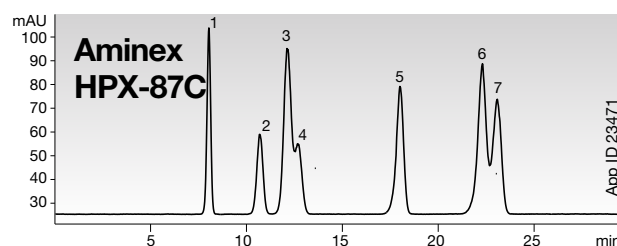
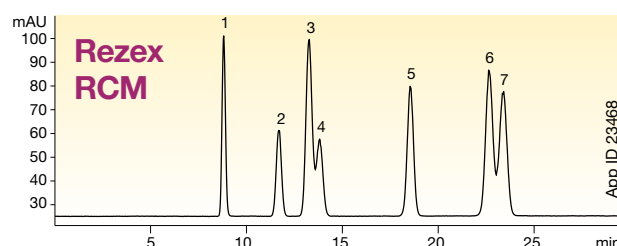
## Sugar Alcohols

### Optimizing Pharmacopoeia (Ph. Eur. & USP) Monographs of Sugar Alcohol Excipients Using Rezex™ Ion-Exclusion HPLC Columns

Rezex ion-exclusion HPLC columns are the solution for several published European Pharmacopoeia (Ph. Eur.) and United States Pharmacopoeia (USP) methodologies, particularly for excipients like sugar alcohols such as sorbitol, mannitol, isomalt, maltitol, lactitol, xylitol, trehalose, erythritol, etc. The Rezex RCM/RCU phases contain the strong cation-exchange resin (calcium form), or L19 USP packing, that is recommended by most pharmacopoeia monographs for sugar alcohols, while the Rezex RPM (lead form), or L34 USP packing, will provide stronger separation power.

In this example, we study a mixture of 7 sugar alcohols whose monographs typically call for a column with calcium form, or L19 packing. A Bio-Rad® Aminex HPX-87C is commonly recommended, however, the direct replacement, Rezex RCM, provides sharper peak shape and higher resolution as shown by the comparison below. As an excellent alternative, Rezex RPM provides stronger retention and higher resolution of the more closely eluting peaks compared to Rezex RCM.

### Rezex RCM vs. Aminex™ HPX-87C



### Column Cross Reference Chart

| Phenomenex Rezex       | Bio-Rad Aminex          |
|------------------------|-------------------------|
| RCM-Monosaccharide     | HPX-87C 125-0095        |
| RHM-Monosaccharide     | HPX-87H 125-0140        |
| RPM-Monosaccharide     | HPX-87P 125-0098        |
| RNM-Carbohydrate       | HPX-87N 125-0143        |
| RSO-Oligosaccharide    | HPX-42A 125-0097        |
| ROA-Organic Acid       | HPX-87H 125-0140        |
| RFQ-Fast Acid          | Fast Acid 125-0100      |
| RKP-Potassium          | HPX-87K 125-0142        |
| RCU-USP Sugar Alcohols | Sugar Alcohols 125-0094 |

#### Conditions for all columns:

**Dimensions:** 300 x 7.8 mm

**Mobile Phase:** Water

**Flow Rate:** 0.6 mL/min

**Detection:** ELSD

**Temperature:** 85 °C

**Sample:** 1. Trehalose

2. Isomalt

3. Maltitol

4. Isomaltitol

5. Mannitol

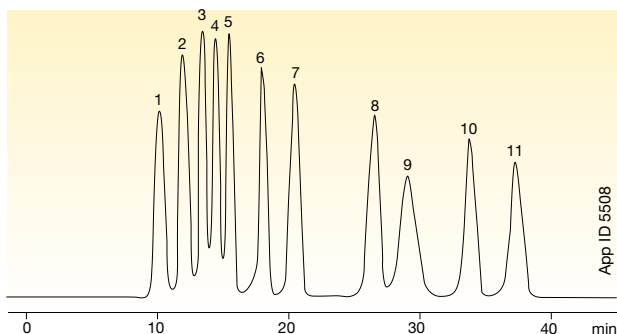
6. Xylitol

7. Sorbitol

Comparative separations may not be representative of all applications.

## Separation of a Complex Mixture of Sugar Alcohols on Rezex™ RPM-Monosaccharide

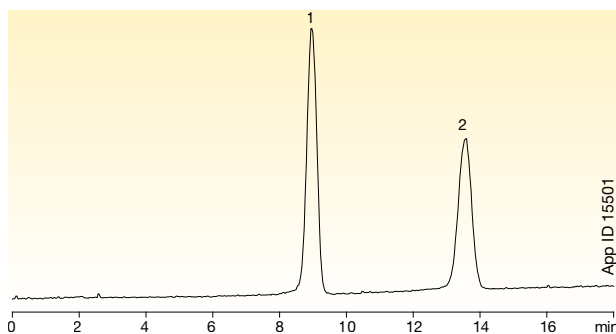
A mixture of sugars and sugar alcohols run on a Rezex RPM 300 x 7.8mm column. Note the wide separation between Mannitol (8), Xylitol (10) and Sorbitol (11).



**Column:** Rezex RPM-Monosaccharide  
**Dimensions:** 300 x 7.8mm  
**Part No.:** 00H-0135-K0  
**Mobile Phase:** Water  
**Flow Rate:** 0.6 mL/min  
**Detection:** RI (Ambient)  
**Column Temperature:** 75 °C  
**Sample:** 1. Stachyose 8. Mannitol  
 2. Maltose 9. Salicin  
 3. Glucose 10. Xylitol  
 4. Xylose 11. Sorbitol  
 5. Galactose  
 6. Fructose  
 7. Meso-Erythritol

## Reduce Analysis Times Using Shorter Rezex RPM-Monosaccharide

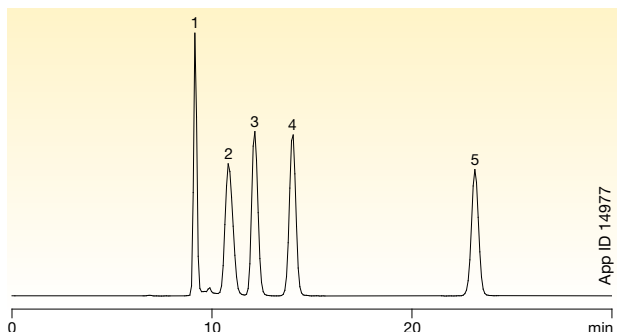
A mixture of mannitol (1) and sorbitol (2) run on a Rezex RPM-Monosaccharide 100 x 7.8mm column using similar conditions to the USP method. Note the reduced run time of 15 minutes for separating the two excipients.



**Column:** Rezex RPM-Monosaccharide  
**Dimensions:** 100 x 7.8mm  
**Part No.:** 00D-0135-K0  
**Mobile Phase:** Water  
**Flow Rate:** 0.6 mL/min  
**Detection:** ELSD (Ambient)  
**Column Temperature:** 80 °C  
**Sample:** 1. Mannitol  
 2. Sorbitol

## Alternative Selectivity of Rezex RCM-Monosaccharide Phase Offers

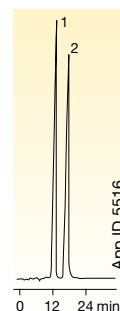
A mixture of sugars and sugar alcohols run on a Rezex RCM-Monosaccharide 300 x 7.8mm column. Note the different retention times for compounds, despite using similar column dimensions and flow rates. Rezex RCM offers different selectivity versus the Rezex RPM column.



**Column:** Rezex RCM-Monosaccharide  
**Dimensions:** 300 x 7.8mm  
**Part No.:** 00H-0130-K0  
**Mobile Phase:** Water  
**Flow Rate:** 0.6 mL/min  
**Detection:** ELSD (Ambient)  
**Column Temperature:** 80 °C  
**Sample:** 1. Sucrose 4. Fructose  
 2. Glucose 5. Sorbitol  
 3. Galactose

## Rezex RCU-USP Sugar Alcohols: Well Suited for Published USP Methodologies

A mixture of (1) mannitol and (2) sorbitol run on a Rezex RCU-USP Sugar Alcohols 250 x 4.0mm column using a method similar to the published USP method. The Rezex RCU offers a different option for the Mannitol and Sorbitol application.



**Column:** Rezex RCU-USP Sugar Alcohols  
**Dimensions:** 250 x 4.0mm  
**Part No.:** 00G-0130-D0  
**Mobile Phase:** Water  
**Flow Rate:** 0.2 mL/min  
**Detection:** RI (Ambient)  
**Column Temperature:** 85 °C  
**Sample:** 1. Mannitol  
 2. Sorbitol

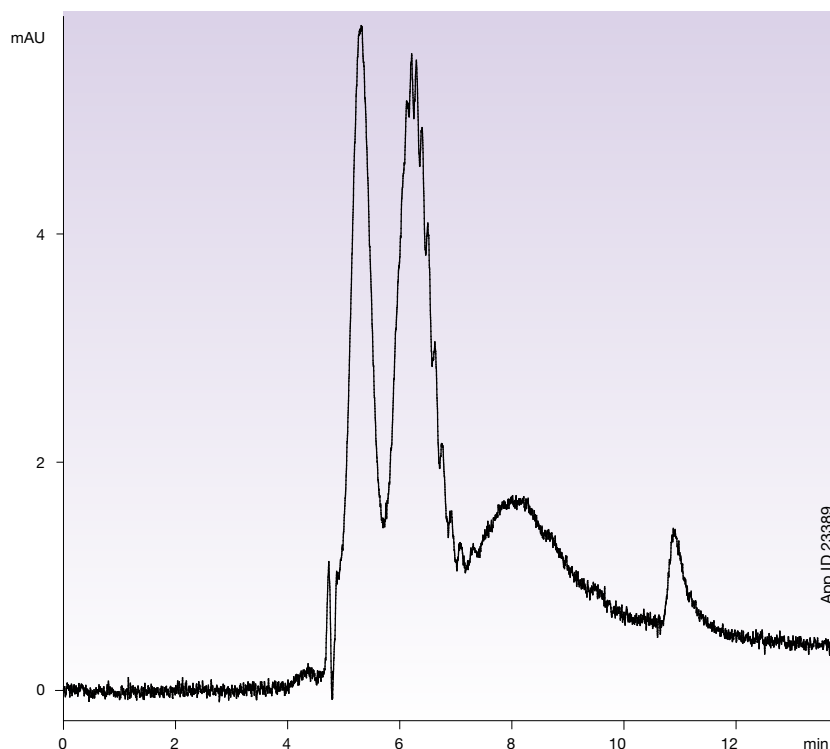
# Solubilizers/Surfactants

In order to ensure solubility of an API in various forms such as tablets, vaccines, and intravenous preparations, solubilizers are added to the excipient formulation. They can also be helpful for the dissolution of a tablet after ingestion.

## Polysorbate 80 (TWEEN® 80)

### HPLC-UV Analysis on a Yarra™ 1.8µm SEC-X150 Aqueous GFC/SEC Column

Polysorbate 80, also known as TWEEN 80, is very popular in the pharmaceutical, food, and cosmetic industries as an excipient, or inactive ingredient, in products such as tablets, vaccines, intravenous preparations, lotions, and soaps. The primary role of this pharmaceutical excipient is a solubilizing agent acting as a surfactant to assist with the solubility of all other pharmaceutical ingredients and also dissolution of the tablet. In this application, TWEEN 80 is analyzed by HPLC-UV using a Yarra 1.8µm SEC-X150 150 x 4.6mm aqueous size exclusion (SEC), or gel filtration chromatography (GFC), column in under 12 minutes.



#### LC/UV Conditions

**Column:** Yarra 1.8µm SEC-X150  
**Dimensions:** 150 x 4.6mm  
**Part No.:** 00F-4631-E0  
**Mobile Phase:** Water/Acetonitrile (65:35)  
**Flow Rate:** 0.4 mL/min  
**Temperature:** Ambient  
**Detection:** UV @ 245 nm  
**Sample:** TWEEN 80

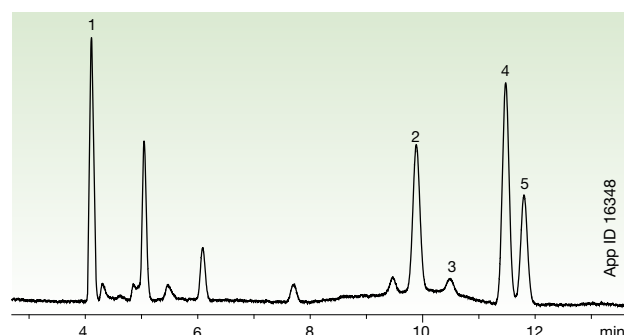
# Residual Solvents

Residual solvents are trace-level chemical residues in drug substances and drug products that are byproducts of manufacturing, or that form during packaging and storage. It is the responsibility of the drug manufacturers to ensure that these residues are removed, or are present only in limited concentrations.

## USP Monograph <467>

In 2008, the United States Pharmacopoeia (USP) revised the general chapter on residual solvent analysis, USP <467>, to reflect the International European Pharmacopoeia (Ph. Eur.) guidelines for the identification, control and quantification of residual solvents. This revision significantly increased the requirements a pharmaceutical company must meet in order to demonstrate that all drug products (not just new) are compliant with Chapter <467> limits.

### Procedure A – Class 1

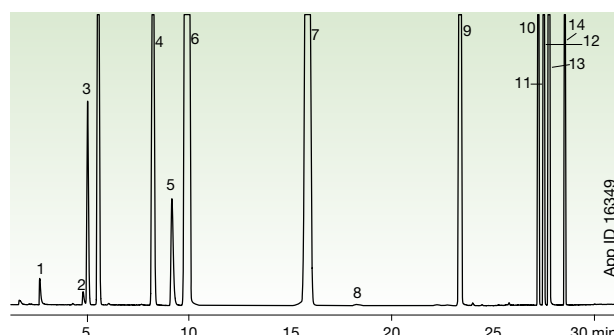


#### GC/FID Conditions

**Column:** Zebtron™ ZB-624  
**Dimensions:** 30 meter x 0.32 mm x 1.80 μm  
**Part No.:** 7HM-G005-31  
**Injection:** Headspace 5:1 @ 140 °C, 1 mL  
**Carrier Gas:** Helium @ 35 cm/sec (constant flow)  
**Oven Program:** 40 °C for 20 min to 240 °C @ 10 °C/min for 20 min  
**Detector:** FID @ 250 °C  
**Sample:** Sample prepared as per USP guidelines

|                          |                       |
|--------------------------|-----------------------|
| 1. 1,1-Dichloroethene    | 4. Benzene            |
| 2. 1,1,1-Trichloroethane | 5. 1,2-Dichloroethane |
| 3. Carbon tetrachloride  |                       |

### Procedure A – Class 2 Mix A

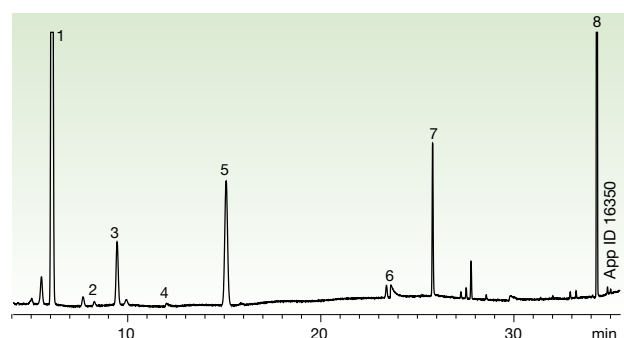


#### GC/FID Conditions

**Column:** Zebtron ZB-624  
**Dimensions:** 30 meter x 0.32 mm x 1.80 μm  
**Part No.:** 7HM-G005-31  
**Injection:** Headspace 5:1 @ 140 °C, 1 mL  
**Carrier Gas:** Helium @ 35 cm/sec (constant flow)  
**Oven Program:** 40 °C for 20 min to 240 °C @ 10 °C/min for 20 min  
**Detector:** FID @ 250 °C  
**Sample:** Sample prepared as per USP guidelines

|                           |                   |
|---------------------------|-------------------|
| 1. Methanol               | 8. 1,4-Dioxane    |
| 2. Acetonitrile           | 9. Toluene        |
| 3. Dichloromethane        | 10. Chlorobenzene |
| 4. cis-1,2-Dichloroethene | 11. Ethylbenzene  |
| 5. THF                    | 12. m-Xylene      |
| 6. Cyclohexane            | 13. p-Xylene      |
| 7. Methylcyclohexane      | 14. o-Xylene      |

### Procedure A – Class 2 Mix B



#### GC/FID Conditions

**Column:** Zebtron ZB-624  
**Dimensions:** 30 meter x 0.32 mm x 1.80 μm  
**Part No.:** 7HM-G005-31  
**Injection:** Headspace 5:1 @ 140 °C, 1 mL  
**Carrier Gas:** Helium @ 35 cm/sec (constant flow)  
**Oven Program:** 40 °C for 20 min to 240 °C @ 10 °C/min for 20 min  
**Detector:** FID @ 250 °C  
**Sample:** Sample prepared as per USP guidelines

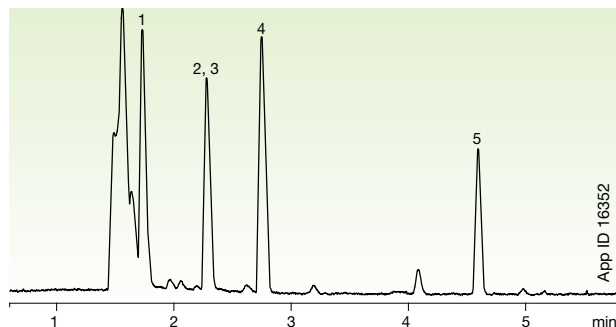
|                        |                      |
|------------------------|----------------------|
| 1. Hexane              | 5. Trichloroethylene |
| 2. Nitromethane        | 6. Pyridine          |
| 3. Chloroform          | 7. Methylbutylketone |
| 4. 1,2-Dimethoxyethane | 8. Tetralin          |



# Residual Solvents

## USP Monograph <467>

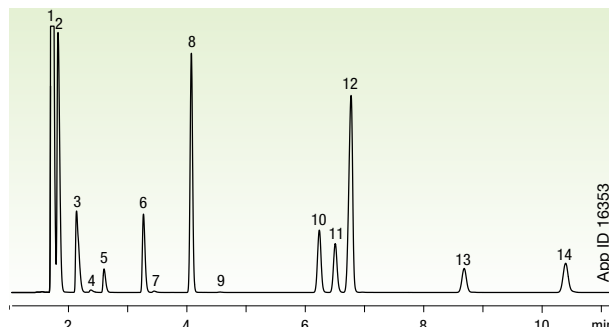
### Procedure B – Class 1



#### GC/FID Conditions

**Column:** Zebron™ ZB-WAX<sub>PLUS</sub><sup>™</sup>  
**Dimensions:** 30 meter x 0.32 mm x 0.25 μm  
**Part No.:** 7HM-G013-11  
**Injection:** Headspace 5:1 @ 140 °C, 1 mL  
**Carrier Gas:** Helium @ 35 cm/sec (constant flow)  
**Oven Program:** 50 °C hold 20 min to 165 °C @ 6 °C/min hold 20 min  
**Detector:** FID @ 250 °C  
**Sample:** Sample prepared as per USP method  
 1. 1,1-Dichloroethene  
 2. Carbon tetrachloride  
 3. 1,1,1-Trichloroethane  
 4. Benzene  
 5. 1,2-Dichloroethane

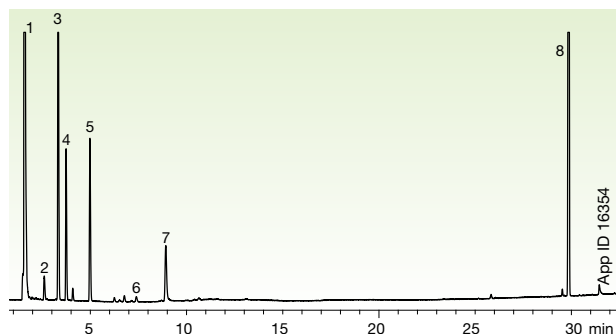
### Procedure B – Class 2 Mix A



#### GC/FID Conditions

**Column:** Zebron ZB-WAX<sub>PLUS</sub>  
**Dimensions:** 30 meter x 0.32 mm x 0.25 μm  
**Part No.:** 7HM-G013-11  
**Injection:** Headspace 5:1 @ 140 °C, 1 mL  
**Carrier Gas:** Helium @ 35 cm/sec (constant flow)  
**Oven Program:** 50 °C hold 20 min to 165 °C @ 6 °C/min hold 20 min  
**Detector:** FID @ 250 °C  
**Sample:** Sample prepared as per USP method  
 1. Cyclohexane  
 2. Methylcyclohexane  
 3. THF  
 4. Methanol  
 5. Dichloromethane  
 6. cis-1,2-Dichloroethene  
 7. Acetonitrile  
 8. Toluene  
 9. 1,4-Dioxane  
 10. Ethylbenzene  
 11. p-Xylene  
 12. m-Xylene  
 13. o-Xylene  
 14. Chlorobenzene

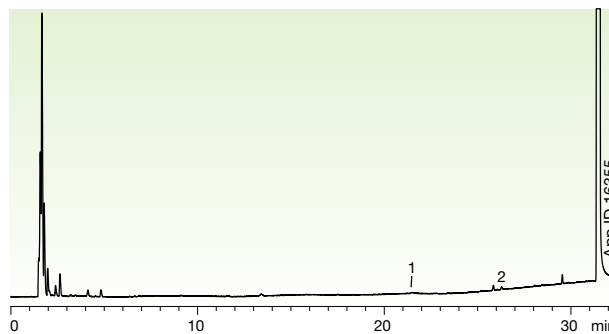
### Procedure B – Class 2 Mix B



#### GC/FID Conditions

**Column:** Zebron ZB-WAX<sub>PLUS</sub>  
**Dimensions:** 30 meter x 0.32 mm x 0.25 μm  
**Part No.:** 7HM-G013-11  
**Injection:** Headspace 5:1 @ 140 °C, 1 mL  
**Carrier Gas:** Helium @ 35 cm/sec (constant flow)  
**Oven Program:** 50 °C hold 20 min to 165 °C @ 6 °C/min hold 20 min  
**Detector:** FID @ 250 °C  
**Sample:** Sample prepared as per USP method  
 1. Hexane  
 2. 1,2-Dimethoxyethane  
 3. Trichloroethylene  
 4. Chloroform  
 5. Methylbutylketone  
 6. Nitromethane  
 7. Pyridine  
 8. Tetralin

### Procedure B – Class 2 Mix C



#### GC/FID Conditions

**Column:** Zebron ZB-WAX<sub>PLUS</sub>  
**Dimensions:** 30 meter x 0.32 mm x 0.25 μm  
**Part No.:** 7HM-G013-11  
**Injection:** Headspace 5:1 @ 140 °C, 1 mL  
**Carrier Gas:** Helium @ 35 cm/sec (constant flow)  
**Oven Program:** 50 °C hold 20 min to 165 °C @ 6 °C/min hold 20 min  
**Detector:** FID @ 250 °C  
**Sample:** Sample prepared as per USP method  
 1. N,N-Dimethylformamide  
 2. N,N-Dimethylacetamide

# GC (Gas Chromatography)



| Zebron Phase                                                                                                                                                                                | ID (mm) | df (µm) | 10 meter    | 15 meter    | 30 meter    | 60 meter    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|---------|-------------|-------------|-------------|-------------|
| <b>ZB-1ms</b><br>Very low bleed for GC/MS analyses; recommended for active compounds and boiling point separations                                                                          | 0.10    | 0.10    | 7CB-G011-02 |             |             |             |
|                                                                                                                                                                                             | 0.18    | 0.18    | 7CD-G011-08 |             |             |             |
|                                                                                                                                                                                             | 0.25    | 0.10    |             |             | 7HG-G011-02 |             |
|                                                                                                                                                                                             | 0.25    | 0.25    |             | 7EG-G011-11 | 7HG-G011-11 | 7KG-G011-11 |
|                                                                                                                                                                                             | 0.25    | 0.50    |             |             | 7HG-G011-17 |             |
|                                                                                                                                                                                             | 0.25    | 1.00    |             |             | 7HG-G011-22 | 7KG-G011-22 |
|                                                                                                                                                                                             | 0.32    | 0.25    | 7EM-G011-11 |             | 7HM-G011-11 |             |
|                                                                                                                                                                                             | 0.32    | 1.00    |             |             | 7HM-G011-22 | 7KM-G011-22 |
|                                                                                                                                                                                             | 0.53    | 1.00    |             |             | 7HK-G011-22 |             |
| <b>ZB-5ms</b><br>Stable, low bleed 5% phenyl-arylene phase for GC and GC/MS; recommended for a variety of pharmaceutical applications                                                       | 0.10    | 0.10    | 7CB-G010-02 |             |             |             |
|                                                                                                                                                                                             | 0.18    | 0.18    | 7CD-G010-08 |             |             |             |
|                                                                                                                                                                                             | 0.25    | 0.25    |             | 7EG-G010-11 | 7HG-G010-11 | 7KG-G010-11 |
|                                                                                                                                                                                             | 0.25    | 0.50    |             |             | 7HG-G010-17 |             |
|                                                                                                                                                                                             | 0.25    | 1.00    |             |             | 7HG-G010-22 |             |
|                                                                                                                                                                                             | 0.32    | 0.25    |             |             | 7HM-G010-11 | 7KM-G010-11 |
|                                                                                                                                                                                             | 0.32    | 0.50    |             |             | 7HM-G010-17 |             |
|                                                                                                                                                                                             | 0.32    | 1.00    |             |             | 7HM-G010-22 |             |
| <b>ZB-5MS<sup>PLUS</sup></b><br>Highly inert 5% phenyl-arylene phase for chemical, biological, and other pharmaceutical testing                                                             | 0.25    | 0.25    |             | 7EG-G030-11 | 7HG-G030-11 | 7KG-G030-11 |
|                                                                                                                                                                                             | 0.25    | 0.50    |             |             | 7HG-G030-17 |             |
|                                                                                                                                                                                             | 0.25    | 1.00    |             |             | 7HG-G030-22 |             |
|                                                                                                                                                                                             | 0.32    | 0.25    |             |             | 7HM-G030-11 |             |
|                                                                                                                                                                                             | 0.32    | 1.00    |             |             | 7HM-G030-22 |             |
| <b>ZB-35</b><br>Rugged, inert, intermediate polarity phase for versatile separations                                                                                                        | 0.25    | 0.25    |             | 7EG-G003-11 | 7HG-G003-11 | 7KG-G003-11 |
|                                                                                                                                                                                             | 0.25    | 0.50    |             | 7EG-G003-17 | 7HG-G003-17 |             |
|                                                                                                                                                                                             | 0.32    | 0.25    |             |             | 7HM-G003-11 | 7KM-G003-11 |
|                                                                                                                                                                                             | 0.53    | 0.50    |             |             | 7HK-G003-17 |             |
|                                                                                                                                                                                             | 0.53    | 1.00    |             | 7EK-G003-22 | 7HK-G003-22 |             |
| <b>ZB-50</b><br>Recommended for phenolic antioxidants and amino acids                                                                                                                       | 0.25    | 0.15    |             | 7EG-G004-05 |             |             |
|                                                                                                                                                                                             | 0.25    | 0.25    |             | 7EG-G004-11 | 7HG-G004-11 | 7KG-G004-11 |
|                                                                                                                                                                                             | 0.25    | 0.50    |             |             | 7HG-G004-17 | 7KG-G004-17 |
|                                                                                                                                                                                             | 0.32    | 0.25    |             | 7EM-G004-11 | 7HM-G004-11 |             |
|                                                                                                                                                                                             | 0.32    | 0.50    |             | 7EM-G004-17 | 7HM-G004-17 |             |
|                                                                                                                                                                                             | 0.53    | 1.00    |             | 7EK-G004-22 | 7HK-G004-22 |             |
| <b>ZB-624</b><br>Specifically designed for VOC separations, including OVIs and residual solvents                                                                                            | 0.25    | 1.40    |             |             | 7HG-G005-27 | 7KG-G005-27 |
|                                                                                                                                                                                             | 0.32    | 1.80    |             |             | 7HM-G005-31 | 7KM-G005-31 |
|                                                                                                                                                                                             | 0.53    | 3.00    |             |             | 7HK-G005-36 | 7KK-G005-36 |
| <b>ZB-WAX<sup>PLUS</sup></b><br>100% aqueous stable with high retention of alcohols and chlorinated solvents; recommended for alcohols, flavors, and residual solvent applications          | 0.10    | 0.10    | 7CB-G013-02 |             |             |             |
|                                                                                                                                                                                             | 0.25    | 0.25    |             | 7EG-G013-11 | 7HG-G013-11 | 7KG-G013-11 |
|                                                                                                                                                                                             | 0.32    | 0.25    |             |             | 7HM-G013-11 | 7KM-G013-11 |
|                                                                                                                                                                                             | 0.32    | 0.50    |             |             | 7HM-G013-17 | 7KM-G013-17 |
|                                                                                                                                                                                             | 0.53    | 1.00    |             | 7EK-G013-22 | 7HK-G013-22 | 7KK-G013-22 |
| <b>ZB-FFAP</b><br>High polarity nitroterephthalic acid modified PEG phase with good peak shape for underivatized acids; especially suited for organic acids, free fatty acids, and alcohols | 0.25    | 0.25    |             | 7EG-G009-11 | 7HG-G009-11 | 7KG-G009-11 |
|                                                                                                                                                                                             | 0.32    | 0.25    |             | 7EM-G009-11 | 7HM-G009-11 |             |
|                                                                                                                                                                                             | 0.32    | 0.50    |             | 7EM-G009-17 | 7HM-G009-17 |             |
|                                                                                                                                                                                             | 0.32    | 1.00    |             |             | 7HM-G009-22 |             |
|                                                                                                                                                                                             | 0.53    | 1.00    |             | 7EK-G009-22 | 7HK-G009-22 |             |



Explore Tips and Tools Online:  
[www.phenomenex.com/GC](http://www.phenomenex.com/GC)



# Gel Filtration (GFC)

## Yarra

### Column Specifications

|                            | SEC-X150                   | SEC-2000                 | SEC-3000                 | SEC-4000                 |
|----------------------------|----------------------------|--------------------------|--------------------------|--------------------------|
| Resin Type                 | Silica                     | Silica                   | Silica                   | Silica                   |
| Particle Size (µm)         | 1.8                        | 3                        | 3                        | 3                        |
| Pore Size (Å)              | 150                        | 145                      | 290                      | 500                      |
| MW Range (Da)              | 1K-450K                    | 1K-300K                  | 5K-700K                  | 15K-1500K                |
| pH Range                   | 1.5 - 8.5                  | 2.5 - 7.5                | 2.5 - 7.5                | 2.5 - 7.5                |
| Typical Backpressure (psi) | 3,250                      | 1,300                    | 1,300                    | 1,000                    |
| Max Backpressure (psi)     | 7,000                      | 3,000                    | 3,000                    | 1,700                    |
| Typical Efficiency         | > 30,000<br>(150 x 4.6 mm) | 48,000<br>(300 x 7.8 mm) | 48,000<br>(300 x 7.8 mm) | 38,000<br>(300 x 7.8 mm) |
| Max. Flow Rate (mL/min)    | 0.4                        | 1.5                      | 1.5                      | 1.2                      |

### Yarra 1.8µm SEC Column (mm)

|                | Analytical  |
|----------------|-------------|
| Phase          | 150 x 4.6   |
| 1.8µm SEC-X150 | 00F-4631-E0 |



### Yarra 3µm SEC Columns (mm)

|                    | Narrow Bore | Analytical  | Analytical  | SecurityGuard™ Cartridges (mm) |
|--------------------|-------------|-------------|-------------|--------------------------------|
| Phases             | 300 x 4.6   | 150 x 7.8   | 300 x 7.8   | 4 x 3.0*                       |
|                    |             |             |             | /10pk                          |
| Yarra 3µm SEC-2000 | 00H-4512-E0 | 00F-4512-K0 | 00H-4512-K0 | AJ0-4487                       |
| Yarra 3µm SEC-3000 | 00H-4513-E0 | 00F-4513-K0 | 00H-4513-K0 | AJ0-4488                       |
| Yarra 3µm SEC-4000 | 00H-4514-E0 | —           | 00H-4514-K0 | AJ0-4489                       |

for ID 4.6–7.8 mm

\*SecurityGuard Analytical cartridges require holder, Part No.: KJ0-4282

# Polymeric Gel Filtration (GFC)

## PolySep

**PolySep™**  
Polymeric Aqueous GFC/SEC

### Technical Data and Specifications

| Phase                           | 1000                                                                                                                       | 2000                | 3000                | 4000                  | 5000                | 6000                | Linear              |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------|---------------------|---------------------|-----------------------|---------------------|---------------------|---------------------|
| Exclusion Limits in Daltons:    |                                                                                                                            |                     |                     |                       |                     |                     |                     |
| PEG                             | 2 x 10 <sup>3</sup>                                                                                                        | 9 x 10 <sup>3</sup> | 5 x 10 <sup>4</sup> | 2 x 10 <sup>5</sup>   | 2 x 10 <sup>6</sup> | 1 x 10 <sup>7</sup> | 1 x 10 <sup>7</sup> |
| Pullulans                       | 3.5 x 10 <sup>3</sup>                                                                                                      | 1 x 10 <sup>4</sup> | 1 x 10 <sup>5</sup> | 3.5 x 10 <sup>5</sup> | 4 x 10 <sup>6</sup> | 2 x 10 <sup>7</sup> | 2 x 10 <sup>7</sup> |
| Separation Range (Da)           | 20 - 3 K                                                                                                                   | 100 - 10 K          | 250 - 75 K          | 3 K - 400 K           | 50 K - 2 M          | 100 K - 15 M        | 1 K - 10 M          |
| Typical Efficiency Plates/meter | 22,000                                                                                                                     | 50,000              | 32,000              | 32,000                | 32,000              | 32,000              | 32,000              |
| Maximum Organic Modifier:       |                                                                                                                            |                     |                     |                       |                     |                     |                     |
| Methanol                        | 20 %                                                                                                                       | 95 %                | 70 %                | 70 %                  | 70 %                | 70 %                | 70 %                |
| Acetonitrile                    | 20 %                                                                                                                       | 70 %                | 70 %                | 70 %                  | 70 %                | 70 %                | 70 %                |
| pH Range                        | 3.0 to 12.0                                                                                                                |                     |                     |                       |                     |                     |                     |
| Maximum Flow Rate               | Depends on backpressure, do not exceed 1000 psi                                                                            |                     |                     |                       |                     |                     |                     |
| Column Hardware                 | Stainless steel or PEEK (Biocompatible hardware available upon request)                                                    |                     |                     |                       |                     |                     |                     |
| Temperature                     | 4 to 60 °C                                                                                                                 |                     |                     |                       |                     |                     |                     |
| Maximum Salt                    | Maximum allowed 0.5 M with a flow rate not to exceed 0.5 mL/min                                                            |                     |                     |                       |                     |                     |                     |
| Storage                         | For overnight, pump water at 0.2 mL/min, for longer storage use 0.05 % NaN <sub>3</sub> in water or 10 % methanol in water |                     |                     |                       |                     |                     |                     |
| General                         | A guard column is recommended to improve column life                                                                       |                     |                     |                       |                     |                     |                     |

### PolySep Columns (mm)

|        | Analytical | Guards   |
|--------|------------|----------|
| Phases | 300 x 7.8  | 35 x 7.8 |
| 1000   | CH0-9226   | CH0-9225 |
| 2000   | CH0-9227   | CH0-9225 |
| 3000   | CH0-9228   | CH0-9225 |
| 4000   | CH0-9229   | CH0-9225 |
| 5000   | CH0-9230   | CH0-9225 |
| 6000   | CH0-9231   | CH0-9225 |
| Linear | CH0-9232   | CH0-9225 |

# Ion-Exclusion/Ligand Exchange

Rezex

**REZEX™**  
Ion Exclusion LC

## Columns

| Part No.    | Description            | Size (mm) | Cross Linkage | Ionic Form | USP Packing | Price |
|-------------|------------------------|-----------|---------------|------------|-------------|-------|
| 00H-0130-K0 | RCM-Monosaccharide     | 300 x 7.8 | 8 %           | Calcium    | L19         |       |
| 00F-0130-K0 | RCM-Monosaccharide     | 150 x 7.8 | 8 %           | Calcium    | L19         |       |
| 00G-0130-D0 | RCU-USP Sugar Alcohols | 250 x 4.0 | 8 %           | Calcium    | L19         |       |
| 00H-0135-K0 | RPM-Monosaccharide     | 300 x 7.8 | 8 %           | Lead       | L34         |       |
| 00D-0135-K0 | RPM-Monosaccharide     | 100 X 7.8 | 8 %           | Lead       | L34         |       |

## Guards

| Part No.    | Size (mm) | Price | SecurityGuard™ Cartridges (mm) | Price |
|-------------|-----------|-------|--------------------------------|-------|
| 03B-0130-K0 | 50 x 7.8  |       | AJ0-4493                       |       |
| 03B-0130-K0 | 50 x 7.8  |       | AJ0-4493                       |       |
| 03A-0130-D0 | 30 x 4.0  |       | AJ0-4493                       |       |
| 03B-0135-K0 | 50 x 7.8  |       | AJ0-4492                       |       |
| 03B-0135-K0 | 50 x 7.8  |       | AJ0-4492                       |       |

for ID: 3.2-8.0 mm

\*SecurityGuard Analytical Cartridges require universal holder Part No. KJ0-4282

# Gel Permeation (GPC)

Phenogel

**Phenogel™**  
Organic GPC/SEC

| 5 µm Analytical Columns (mm) |               | THF         | Shipping Solvent<br>Chloroform | DMF            | SecurityGuard™ Cartridges (mm) |
|------------------------------|---------------|-------------|--------------------------------|----------------|--------------------------------|
| Pore Size                    | MW Range      | 300 x 7.8   | 300 x 7.8                      | 300 x 7.8      | 4 x 3.0"                       |
|                              |               |             |                                |                | /3pk                           |
| 50 Å                         | 100-3 K       | 00H-0441-K0 | 00H-0441-K0-CL                 | 00H-0441-K0-DF | AJ0-9292                       |
| 100 Å                        | 500-6 K       | 00H-0442-K0 | 00H-0442-K0-CL                 | 00H-0442-K0-DF | AJ0-9292                       |
| 500 Å                        | 1 K-15 K      | 00H-0443-K0 | 00H-0443-K0-CL                 | 00H-0443-K0-DF | AJ0-9292                       |
| 10 <sup>3</sup> Å            | 1 K-75 K      | 00H-0444-K0 | 00H-0444-K0-CL                 | 00H-0444-K0-DF | AJ0-9292                       |
| 10 <sup>4</sup> Å            | 5 K-500 K     | 00H-0445-K0 | 00H-0445-K0-CL                 | 00H-0445-K0-DF | AJ0-9292                       |
| 10 <sup>5</sup> Å            | 10 K-1,000 K  | 00H-0446-K0 | 00H-0446-K0-CL                 | 00H-0446-K0-DF | AJ0-9292                       |
| 10 <sup>6</sup> Å            | 60 K-10,000 K | 00H-0447-K0 | 00H-0447-K0-CL                 | 00H-0447-K0-DF | AJ0-9292                       |
|                              |               | 300 x 7.8   | 300 x 7.8                      | 300 x 7.8      | 4 x 3.0"                       |
| Mixed Beds                   |               |             |                                |                | /3pk                           |
| Linear(2)                    | 100-10,000 K  | 00H-3259-K0 | 00H-3259-K0-CL                 | 00H-3259-K0-DF | AJ0-9292                       |

for 3.2–8.0 mm ID

| 5 µm Narrow Bore (NB) Columns (mm) |               |             | SecurityGuard™ Cartridges (mm) |
|------------------------------------|---------------|-------------|--------------------------------|
| Pore Size                          | MW Range      | 300 x 4.6   | 4 x 3.0"                       |
|                                    |               |             | /3pk                           |
| 50 Å                               | 100-3 K       | 00H-0441-E0 | AJ0-9292                       |
| 100 Å                              | 500-6 K       | 00H-0442-E0 | AJ0-9292                       |
| 500 Å                              | 1 K-15 K      | 00H-0443-E0 | AJ0-9292                       |
| 10 <sup>3</sup> Å                  | 1 K-75 K      | 00H-0444-E0 | AJ0-9292                       |
| 10 <sup>4</sup> Å                  | 5 K-500 K     | 00H-0445-E0 | AJ0-9292                       |
| 10 <sup>5</sup> Å                  | 10 K-1,000 K  | 00H-0446-E0 | AJ0-9292                       |
| 10 <sup>6</sup> Å                  | 60 K-10,000 K | 00H-0447-E0 | AJ0-9292                       |
|                                    |               | 300 x 4.6   | 4 x 3.0"                       |
| Mixed Beds                         |               |             | /3pk                           |
| Linear(2)                          | 100-10,000 K  | 00H-3259-E0 | AJ0-9292                       |

for 3.2–8.0 mm ID

| 10 µm Analytical Columns (mm) |               |             | SecurityGuard™ Cartridges (mm) |
|-------------------------------|---------------|-------------|--------------------------------|
| Pore Size                     | MW Range      | 300 x 7.8   | 4 x 3.0"                       |
|                               |               |             | /3pk                           |
| 50 Å                          | 100-3 K       | 00H-0641-K0 | AJ0-9292                       |
| 100 Å                         | 500-6 K       | 00H-0642-K0 | AJ0-9292                       |
| 500 Å                         | 1 K-15 K      | 00H-0643-K0 | AJ0-9292                       |
| 10 <sup>3</sup> Å             | 1 K-75 K      | 00H-0644-K0 | AJ0-9292                       |
| 10 <sup>4</sup> Å             | 5 K-500 K     | 00H-0645-K0 | AJ0-9292                       |
| 10 <sup>5</sup> Å             | 10 K-1,000 K  | 00H-0646-K0 | AJ0-9292                       |
| 10 <sup>6</sup> Å             | 60 K-10,000 K | 00H-0647-K0 | AJ0-9292                       |
|                               |               | 300 x 7.8   | 4 x 3.0"                       |
| Mixed Beds                    |               |             | /3pk                           |
| Linear(2)                     | 100-10,000 K  | 00H-3260-K0 | AJ0-9292                       |

for 3.2–8.0 mm ID

\*SecurityGuard Analytical Cartridges require holder, Part No.: KJ0-4282

## Guard Cartridge Holder

| Part No. | Description                         | Price |
|----------|-------------------------------------|-------|
| KJ0-4282 | Reusable Holder (SecurityGuard Kit) |       |



## Column Union

| Part No. | Description                              | Unit | Price |
|----------|------------------------------------------|------|-------|
| AQ0-8507 | Zero Dead Union, SS, with 10-32 fittings | ea   |       |

Note: Additional union (AQ0-8507) may be necessary for SecurityGuard to fit in column oven with less than 30 cm length capacity.

Phenogel columns are routinely shipped in THF. However, columns are also available in commonly used solvents, Chloroform and DMF, for an additional charge. Please specify shipping solvent when ordering.

## UHPLC/HPLC: Core-Shell



## Kinetex

| 5 µm Analytical Columns (mm) |             |             |             |             | SecurityGuard<br>ULTRA Cartridges <sup>‡</sup> |
|------------------------------|-------------|-------------|-------------|-------------|------------------------------------------------|
| Phases                       | 50 x 4.6    | 100 x 4.6   | 150 x 4.6   | 250 x 4.6   | 3/pk                                           |
| <b>EVO C18</b>               | 00B-4633-E0 | 00D-4633-E0 | 00F-4633-E0 | 00G-4633-E0 | AJ0-9296                                       |
| <b>Biphenyl</b>              | 00B-4627-E0 | 00D-4627-E0 | 00F-4627-E0 | 00G-4627-E0 | AJ0-9207                                       |
| <b>XB-C18</b>                | 00B-4605-E0 | 00D-4605-E0 | 00F-4605-E0 | 00G-4605-E0 | AJ0-8768                                       |
| <b>C18</b>                   | 00B-4601-E0 | 00D-4601-E0 | 00F-4601-E0 | 00G-4601-E0 | AJ0-8768                                       |
| <b>C8</b>                    | 00B-4608-E0 | 00D-4608-E0 | 00F-4608-E0 | 00G-4608-E0 | AJ0-8770                                       |
| <b>Phenyl-Hexyl</b>          | 00B-4603-E0 | 00D-4603-E0 | 00F-4603-E0 | 00G-4603-E0 | AJ0-8774                                       |

for 4.6 mm ID

| 3.5 µm Analytical Columns (mm) |             |             | SecurityGuard<br>ULTRA Cartridges <sup>‡</sup> |
|--------------------------------|-------------|-------------|------------------------------------------------|
| Phases                         | 100 x 4.6   | 250 x 4.6   | 3/pk                                           |
| <b>XB-C18</b>                  | 00D-4744-E0 | 00F-4744-E0 | AJ0-8768                                       |

for 4.6 mm ID

| 2.6 µm Analytical Columns (mm) |             |             |             |             |             | SecurityGuard<br>ULTRA Cartridges <sup>‡</sup> |
|--------------------------------|-------------|-------------|-------------|-------------|-------------|------------------------------------------------|
| Phases                         | 30 x 4.6    | 50 x 4.6    | 75 x 4.6    | 100 x 4.6   | 150 x 4.6   | 3/pk                                           |
| <b>EVO C18</b>                 | —           | 00B-4725-E0 | —           | 00D-4725-E0 | 00F-4725-E0 | AJ0-9296                                       |
| <b>F5</b>                      | —           | 00B-4723-E0 | —           | 00D-4723-E0 | 00F-4723-E0 | AJ0-9320                                       |
| <b>Biphenyl</b>                | —           | 00B-4622-E0 | —           | 00D-4622-E0 | 00F-4622-E0 | AJ0-9207                                       |
| <b>XB-C18</b>                  | —           | 00B-4496-E0 | 00C-4496-E0 | 00D-4496-E0 | 00F-4496-E0 | AJ0-8768                                       |
| <b>C18</b>                     | 00A-4462-E0 | 00B-4462-E0 | 00C-4462-E0 | 00D-4462-E0 | 00F-4462-E0 | AJ0-8768                                       |
| <b>C8</b>                      | —           | 00B-4497-E0 | 00C-4497-E0 | 00D-4497-E0 | 00F-4497-E0 | AJ0-8770                                       |
| <b>HILIC</b>                   | —           | 00B-4461-E0 | 00C-4461-E0 | 00D-4461-E0 | 00F-4461-E0 | AJ0-8772                                       |
| <b>Phenyl-Hexyl</b>            | —           | 00B-4495-E0 | 00C-4495-E0 | 00D-4495-E0 | 00F-4495-E0 | AJ0-8774                                       |

for 4.6 mm ID

| 1.7 µm Minibore Columns (mm) |             |             |             |             | SecurityGuard<br>ULTRA Cartridges <sup>‡</sup> |
|------------------------------|-------------|-------------|-------------|-------------|------------------------------------------------|
| Phases                       | 30 x 2.1    | 50 x 2.1    | 100 x 2.1   | 150 x 2.1   | 3/pk                                           |
| <b>EVO C18</b>               | —           | 00B-4726-AN | 00D-4726-AN | 00F-4726-AN | AJ0-9298                                       |
| <b>F5</b>                    | —           | 00B-4722-AN | 00D-4722-AN | 00F-4722-AN | AJ0-9322                                       |
| <b>Biphenyl</b>              | 00A-4628-AN | 00B-4628-AN | 00D-4628-AN | 00F-4628-AN | AJ0-9209                                       |
| <b>XB-C18</b>                | 00A-4498-AN | 00B-4498-AN | 00D-4498-AN | 00F-4498-AN | AJ0-8782                                       |
| <b>C18</b>                   | 00A-4475-AN | 00B-4475-AN | 00D-4475-AN | 00F-4475-AN | AJ0-8782                                       |
| <b>C8</b>                    | 00A-4499-AN | 00B-4499-AN | 00D-4499-AN | 00F-4499-AN | AJ0-8784                                       |
| <b>HILIC</b>                 | 00A-4474-AN | 00B-4474-AN | 00D-4474-AN | —           | AJ0-8786                                       |
| <b>Phenyl-Hexyl</b>          | —           | 00B-4500-AN | 00D-4500-AN | 00F-4500-AN | AJ0-8788                                       |

for 2.1 mm ID

<sup>‡</sup>SecurityGuard ULTRA Cartridges require holder, Part No.: AJ0-9000

| 1.3 µm Minibore Columns (mm) |             |             |
|------------------------------|-------------|-------------|
| Phases                       | 30 x 2.1    | 50 x 2.1    |
| <b>C18</b>                   | 00A-4515-AN | 00B-4515-AN |

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# UHPLC/HPLC: Fully Porous



## Luna

| Omega 1.6 µm Minibore Columns (mm) |             |             |             | SecurityGuard™ ULTRA Cartridges† |
|------------------------------------|-------------|-------------|-------------|----------------------------------|
|                                    | 50 x 2.1    | 100 x 2.1   | 150 x 2.1   | 3/pk                             |
| <b>C18</b>                         | 00B-4742-AN | 00D-4742-AN | 00F-4742-AN | AJ0-9502                         |
| <b>Polar C18</b>                   | 00B-4748-AN | 00D-4748-AN | 00F-4748-AN | AJ0-9505                         |

for 2.1 mm ID

† SecurityGuard ULTRA Cartridges require holder, Part No.: AJ0-9000



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| 2.5 µm High Speed Technology (HST) Columns (mm) |          |          |          |           |          |
|-------------------------------------------------|----------|----------|----------|-----------|----------|
|                                                 | 50 x 1.0 | 30 x 2.0 | 50 x 2.0 | 100 x 2.0 | 50 x 3.0 |

|            |             |             |             |             |             |             |
|------------|-------------|-------------|-------------|-------------|-------------|-------------|
| <b>C18</b> | 00B-4446-A0 | 00A-4446-B0 | 00B-4446-B0 | 00D-4446-B0 | 00B-4446-Y0 | 00D-4446-Y0 |
|------------|-------------|-------------|-------------|-------------|-------------|-------------|

| 3 µm Analytical Columns (mm) |             |             |             |             |             | SecurityGuard Cartridges (mm) |
|------------------------------|-------------|-------------|-------------|-------------|-------------|-------------------------------|
| Phases                       | 30 x 4.6    | 50 x 4.6    | 75 x 4.6    | 100 x 4.6   | 150 x 4.6   | 4 x 3.0*                      |
|                              |             |             |             |             |             | /10pk                         |
| <b>Silica(2)</b>             | 00A-4162-E0 | 00B-4162-E0 | 00C-4162-E0 | 00D-4162-E0 | 00F-4162-E0 | AJ0-4348                      |
| <b>C8(2)</b>                 | 00A-4248-E0 | 00B-4248-E0 | 00C-4248-E0 | 00D-4248-E0 | 00F-4248-E0 | AJ0-4290                      |
| <b>C18(2)</b>                | 00A-4251-E0 | 00B-4251-E0 | 00C-4251-E0 | 00D-4251-E0 | 00F-4251-E0 | AJ0-4287                      |
| <b>CN</b>                    | 00A-4254-E0 | 00B-4254-E0 | 00C-4254-E0 | 00D-4254-E0 | 00F-4254-E0 | AJ0-4305                      |
| <b>Phenyl-Hexyl</b>          | 00A-4256-E0 | 00B-4256-E0 | 00C-4256-E0 | 00D-4256-E0 | 00F-4256-E0 | AJ0-4351                      |
| <b>NH<sub>2</sub></b>        | —           | 00B-4377-E0 | —           | 00D-4377-E0 | 00F-4377-E0 | AJ0-4302                      |
| <b>HILIC</b>                 | —           | —           | —           | 00D-4449-E0 | 00F-4449-E0 | AJ0-8329                      |
| <b>PFP(2)</b>                | —           | 00B-4447-E0 | —           | 00D-4447-E0 | 00F-4447-E0 | AJ0-8327                      |

for ID: 3.2-8.0 mm

| 5 µm Analytical Columns (mm) |             |             |             |             |             |             | SecurityGuard Cartridges (mm) |
|------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------------------------|
| Phases                       | 30 x 4.6    | 50 x 4.6    | 75 x 4.6    | 100 x 4.6   | 150 x 4.6   | 200 x 4.6   | 4 x 3.0*                      |
|                              |             |             |             |             |             |             | /10pk                         |
| <b>Silica(2)</b>             | —           | 00B-4274-E0 | —           | 00D-4274-E0 | 00F-4274-E0 | 00G-4274-E0 | AJ0-4348                      |
| <b>C5</b>                    | —           | 00B-4043-E0 | —           | 00D-4043-E0 | 00F-4043-E0 | 00G-4043-E0 | AJ0-4293                      |
| <b>C8(2)</b>                 | 00A-4249-E0 | 00B-4249-E0 | 00C-4249-E0 | 00D-4249-E0 | 00F-4249-E0 | 00G-4249-E0 | AJ0-4290                      |
| <b>C18(2)</b>                | 00A-4252-E0 | 00B-4252-E0 | 00C-4252-E0 | 00D-4252-E0 | 00F-4252-E0 | 00G-4252-E0 | AJ0-4287                      |
| <b>CN</b>                    | 00A-4255-E0 | 00B-4255-E0 | 00C-4255-E0 | 00D-4255-E0 | 00F-4255-E0 | 00G-4255-E0 | AJ0-4305                      |
| <b>Phenyl-Hexyl</b>          | 00A-4257-E0 | 00B-4257-E0 | —           | 00D-4257-E0 | 00F-4257-E0 | 00G-4257-E0 | AJ0-4351                      |
| <b>NH<sub>2</sub></b>        | 00A-4378-E0 | 00B-4378-E0 | —           | 00D-4378-E0 | 00F-4378-E0 | 00G-4378-E0 | AJ0-4302                      |
| <b>SCX</b>                   | —           | 00B-4398-E0 | —           | 00D-4398-E0 | 00F-4398-E0 | 00G-4398-E0 | AJ0-4308                      |
| <b>HILIC</b>                 | —           | —           | —           | 00D-4450-E0 | 00F-4450-E0 | 00G-4450-E0 | AJ0-8329                      |
| <b>PFP(2)</b>                | —           | 00B-4448-E0 | —           | 00D-4448-E0 | 00F-4448-E0 | 00G-4448-E0 | AJ0-8327                      |

3.2-8.0 mm

SecurityGuard™ Analytical Cartridges require universal holder, Part No.: KJ0-4282

guarantee

If Phenomenex products in this brochure do not provide at least an equivalent separation as compared to other products of the same phase and dimensions, return the product with comparative data within 45 days for a FULL REFUND

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