Enhance Resolution
FOR POLYMER ANALYSIS,
Guaranteed*

- Remarkable Reproducibility
- Exceptional Efficiency
- Long Lifetimes
- Economically Priced

www.phenomenex.com/Phenogel
Phenogel™ Non-Aqueous GPC/SEC Columns

- 5 and 10 µm particle sizes
- Narrow bore (4.6 mm ID) solvent-saver columns available
- Highly cross-linked for mechanical and chemical stability
- Temperature stable to 140 °C

Phenogel packing materials are made from styrene-divinylbenzene by emulsion polymerization under conditions to optimize pore size, total pore volume, particle size, and degree of cross-linking. The results yield Gel Permeation Chromatography (GPC) materials that provide very high resolution, rugged durability, and wide solvent compatibility.

Phenogel is available in seven different pore sizes ranging from 50 Å to 10⁶ Å, and a unique Linear(2) configuration. Pore size distribution and pore volume are closely controlled parameters in the manufacturing process; attention to these details accounts for the high resolution and tight linear calibration curves associated with Phenogel, as well as the excellent column-to-column reproducibility.

Phenogel Columns are a Recommended Alternative to:

<table>
<thead>
<tr>
<th>Company</th>
<th>Column</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jordi Associates</td>
<td>PLgel®</td>
</tr>
<tr>
<td>Agilent Technologies</td>
<td>PLgel®</td>
</tr>
<tr>
<td>Waters®</td>
<td>Styragel®</td>
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<td></td>
<td>Styragel® HR</td>
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<td>Shodex®</td>
<td>GPC XP-800 series</td>
</tr>
<tr>
<td>PSS®</td>
<td>SUD</td>
</tr>
<tr>
<td>Tosoh Bioscience®</td>
<td>TSKgel® H-type</td>
</tr>
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</table>

If Phenogel analytical columns do not provide at least equivalent separation as compared to a competing column of the similar particle size, phase, and dimensions, return the column with comparative data within 45 days for a FULL REFUND.

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</tr>
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<td>Tosoh Bioscience®</td>
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Solvent and Temperature Compatibility

- Phenogel™ columns are packed in tetrahydrofuran (THF).
- Columns can also be shipped in solvents such as DMF, Methylene Chloride, NMP, and Methanol to help minimize equilibration time.

Although styrene-divinylbenzene materials are exceptionally inert, interaction between the column packing and sample materials (especially very polar solutes) occasionally occurs and the mobile phase must be modified to eliminate this effect. Phenogel columns can tolerate up to 0.1 % by weight amines, 0.5 % glacial acetic acid, or up to 1 % water in the mobile phase as modifiers.

Phenogel columns are temperature stable to 140 °C which is important for applications involving solutes with limited solubility at ambient temperatures, or where solubility considerations demand the use of viscous solvents such as DMF or DMSO. At higher temperatures, eluent viscosity is decreased and mass transfer is enhanced, with the effect of increasing sample resolution. This temperature stability is particularly useful when analyzing polymers such as polyethylene and polypropylene which require higher temperatures.

Solvent Selection Table

<table>
<thead>
<tr>
<th>Recommended GPC Solvent</th>
<th>Sample</th>
<th>Suggested Temp.</th>
</tr>
</thead>
<tbody>
<tr>
<td>THF</td>
<td>Polyethylene Polyvinyl Alcohol Polyethylene Glycol</td>
<td>Ambient</td>
</tr>
<tr>
<td>DMF</td>
<td>Phenolic Resin Polyethylene Glycol</td>
<td>50 °C</td>
</tr>
<tr>
<td>Water</td>
<td>Polyethylene Polypropylene Glycol</td>
<td>Ambient</td>
</tr>
<tr>
<td>DMF</td>
<td>Polyethylene Glycol</td>
<td>60 °C</td>
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Solvent Compatibility Table

<table>
<thead>
<tr>
<th>Mobile Phase Solvent</th>
<th>Phenygel Pore Size</th>
<th>50 Å</th>
<th>100 Å</th>
<th>500 Å</th>
<th>105 Å</th>
<th>106 Å</th>
<th>107 Å</th>
<th>108 Å</th>
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<tr>
<td>Acetone</td>
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<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
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<td>Benzene</td>
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<td>Y</td>
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<tr>
<td>Methylene Chloride</td>
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<td>O-Dichlorobenzene</td>
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<td>Polyethylene Glycol</td>
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<td>Toluene</td>
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</table>

Solvent Miscibility Table

<table>
<thead>
<tr>
<th>Solvent</th>
<th>70-80 % SWELL</th>
<th>50 % SWELL</th>
<th>60 % SWELL</th>
<th>30 % SWELL</th>
</tr>
</thead>
<tbody>
<tr>
<td>THF</td>
<td>A</td>
<td>B</td>
<td>D</td>
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<tr>
<td>M-Cresol</td>
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<tr>
<td>MF</td>
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<tr>
<td>Methylene Chloride</td>
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</tr>
<tr>
<td>Chloroform</td>
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<tr>
<td>Dioxane</td>
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<tr>
<td>Water</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Solvent Switching

Solvent Switching Considerations

Although Phenogel™ columns are rugged and can withstand strong solvent changes, care should be exercised when switching from high-solvability solvents (A) to low-solvability solvents (B, C, and D), see diagram below right. Improper solvent switches can result in a void. Best results are attained when an intermediate-swell solvent is used, and column lifetime is improved. Contact Phenomenex regarding solvents not listed below.

Column life can be maximized by dedicating certain columns to certain solvents. This will also minimize solvent switches. If care is not taken, a void may occur.

- Reduce flow rate to 0.2 mL/min
- Backpressure must NEVER exceed 1500 psi
- Always check solvent miscibility in a beaker or follow the solvent miscibility table below before proceeding with ANY solvent switch
- Compare the swell characteristics of solvent 1 (old solvent) to solvent 2 (new solvent) and follow the guidelines below

- If solvent 1 and solvent 2 belong to the same swell category (see table below right), check the solvent miscibility and proceed with the switch
- If solvent 1 and solvent 2 belong to successive swell categories as indicated by the arrows in the table below right, check the miscibility and proceed with the switch
- If solvent 1 and solvent 2 DO NOT belong to the same OR successive swell categories, switch to an intermediate solvent FIRST, as indicated by the arrows in the table below

**HFIP (hexafluoroisopropanol) allows polymers such as polyethylene and polypropylene which require higher temperatures.**

Solvent Switching Guidelines

1. Compare the swell characteristics of solvent 1 (old solvent) to solvent 2 (new solvent).
2. If solvent 1 and solvent 2 do not belong to the same OR successive swell categories, switch to an intermediate solvent FIRST.
3. Always check solvent miscibility in a beaker or follow the solvent miscibility table below before proceeding with ANY solvent switch.
4. Reduce flow rate to 0.2 mL/min.
5. Backpressure must NEVER exceed 1500 psi.
6. If care is not taken, a void may occur.

**Phenogel™ columns maintain excellent solvent compatibility and high efficiency during sequential solvent switches from:**

THF → DMF → Toluene → CHCl₃ → DMF (ambient temp) → DMF (50 °C) → THF → NMP → DMSO → THF → DMSO → Methanol

Phenogel columns are temperature stable to 140 °C which is important for applications involving solutes with limited solubility at ambient temperatures, or where solubility considerations demand the use of viscous solvents such as DMF or DMSO. At higher temperatures, eluent viscosity is decreased and mass transfer is enhanced, with the effect of increasing sample resolution. This temperature stability is particularly useful when analyzing polymers such as polyethylene and polypropylene which require higher temperatures.

Phenogel columns are packed in tetrahydrofuran (THF) to maintain excellent solvent compatibility and high efficiency during sequential solvent switches from THF → DMF → Toluene → CHCl₃ → DMF (ambient temp) → DMF (50 °C) → THF → NMP → DMSO → THF → DMSO → Methanol.
Applications on Phenogel™ Linear Non-Aqueous GPC/SEC Columns

Linear Columns
- Linear calibration to 10 million daltons
- Long column lifetime
- Excellent mechanical stability
- Excellent for analyzing a wide range of molecular weights

Nylon 6 in HFIP
Column: Phenogel 10 µm Linear(2) x 2
Dimensions: 300 x 7.8 mm
Part No.: 00H-3260-K0
Mobile Phase: HFIP (0.01 M NATFAT)
Flow Rate: 1.0 mL/min
Detection: Differential Refractometer
Injection Volume: 100 µL 0.025 % w/v
Temperature: 30 °C
Sample: 14,500 MW

Mixed Polystyrene Standard on Linear(2) Column
Column: Phenogel 5 µm Linear(2)
Dimensions: 300 x 7.8 mm
Part No.: 00H-3219-K0
Mobile Phase: THF
Flow Rate: 1.0 mL/min
Detection: RI
Injection Volume: 5 µL
Temperature: 50 °C
Sample: Phenolic Aldehyde Resin, MW 500 to 470 K

Applications on Phenogel™ Fixed Pore Non-Aqueous GPC/SEC Columns

50 Å - 106 Å Fixed Pore Columns
- High resolution at low cost
- Customize your analysis by coupling different pore-size columns
- Wide range of solvent compatibility

Polyethylene Oxide (PEO)
Column: Phenogel 10 µm 105 Å, 104 Å, 103 Å
Dimensions: 300 x 7.8 mm
Part No.: 00H-0446-K0 (105 Å)
00H-0445-K0 (104 Å)
00H-0444-K0 (103 Å)
Mobile Phase: DMF (0.1M LiBr)
Flow Rate: 1.0 mL/min
Detection: Differential Refractometer
Injection Volume: 100 µL 0.125 % w/v
Temperature: 50 °C
Sample: 400,000 MW

Phenolic Resins
Column: Phenogel 5 µm 500 Å x 2, 103 Å, 104 Å
Dimensions: 300 x 7.8 mm
Part No.: 00H-0443-K0 (500 Å)
00H-0444-K0 (103 Å)
00H-0445-K0 (104 Å)
Solvent: THF
Flow Rate: 1.0 mL/min
Detection: RI
Injection Volume: 5 µL
Temperature: 25 °C
Sample: Phenolic Aldehyde Resin, MW 500 to 470 K

Closely Related Hydrocarbons
Column: Phenogel 5 µm 50 Å, 100 Å, 500 Å
Dimensions: 300 x 7.8 mm
Part No.: 00H-0441-K0 (50 Å)
00H-0442-K0 (100 Å)
00H-0443-K0 (500 Å)
Solvent: THF
Flow Rate: 1.0 mL/min
Detection: Differential Refractometer
Injection Volume: 100 µL 0.25 % w/v
Temperature: Ambient
Sample:
1. C40   562 MW
2. C32   450 MW
3. C24   338 MW
4. C20   282 MW
5. C16   226 MW
6. C13   184 MW
7. C10   147 MW

Polyvinyl Butyral
Column: Phenogel 5 µm 5,000 A, 10,000 A, 20,000 A
Dimensions: 300 x 7.8 mm
Part No.: 00H-0449-K0 (5000 Å)
00H-0448-K0 (10,000 Å)
00H-0447-K0 (20,000 Å)
Mobile Phase: DME (1.15M L/L)
Flow Rate: 1.0 mL/min
Detection: Differential Refractometer
Injection Volume: 100 µL 0.25 % w/v
Temperature: 50 °C
Sample: 483,000 MW
Poly-α-(Methyl Styrene) (Wide MW Range)

Column: Phenogel 5 µm 105 Å, 104 Å, 103 Å, 500 Å
Dimensions: 300 x 7.8 mm
Part No.: 00H-0446-K0 (105 Å)
00H-0445-K0 (104 Å)
00H-0444-K0 (103 Å)
00H-0443-K0 (500 Å)
Solvent: THF
Flow Rate: 1.0 mL/min
Detection: Differential Refractometer
Injection Volume: 100 µL 0.25 % w/v
Sample:
1. 680,000 MW
2. 90,000 MW
3. 30,000 MW
4. 6,000 MW

Isoprenes from In Vitro Translation on Products

Column: Phenogel 5 µm 50 Å, 100 Å in series
Dimensions: 300 x 7.8 mm
Part No.: 00H-0441-K0 (50 Å)
00H-0442-K0 (100 Å)
Mobile Phase: THF
Flow Rate: 0.25 mL/min
Detection: Differential Refractometer
Sample:
1. Squalene C30 (2, 6, 10, 15, 19, 23-Hexamethyltetracosane)
2. Phytane C20 (2, 6, 10, 14-Tetramethylhexadane)
3. Farnesene C15 (2, 6, 10-Trimethyldodecane)

The columns were used in tandem to characterize isoprene chain lengths removed from labeled in vitro translation products or cell proteins. The isoprenoids were removed by treatment with Raney nickel and extracted into pentane. The pentane extractable material was hydrogenated over platinum catalyst and injected onto the column. Fractions were collected at 0.5 minute intervals and radioactivity was monitored by liquid scintillation. These saturated hydrocarbon chains were characterized by comparing radioactive peaks to standard retention times.

Phenogel-Narrow Bore Columns: An Improved Dimension in GPC Analysis

- Decrease solvent consumption
- Retain same elution profile
- Reduce solvent disposal costs

Phenogel-NB (Narrow Bore) columns are optimized to reduce solvent consumption. The Phenogel-NB columns have a 4.6 mm column ID and run at 0.35 mL/minute, reducing solvent consumption and disposal costs up to 65%!

Loading

With narrow bore GPC/SEC columns, the volume in which the sample elutes is significantly decreased, thus increasing the effective concentration of the sample. This increase in sensitivity is exploited in HPLC, but in GPC it leads to overloading effects and proportionally lower sample loadings must be used.
Polymer Calibration Standards Kits

- Low, medium and high molecular weights available
- Narrow molecular weight distribution

Organic SEC (GPC) Calibration Kits
All calibration kits contain standards that are uniformly separated logarithmically to give equally distributed data points on a calibration curve over the Mw (peak molecular weight) range stated.

Ordering Information

For Sample and Solvent Filtration Prior to Chromatography!

Organic SEC (GPC) Calibration Kits

- Increased column lifetime
- Consistent, reproducible results

Phenex Syringe Filters
For Sample and Solvent Filtration Prior to Chromatography!

- Consistent, reproducible results
- Increased column lifetime

Ordering Information

Phenex Syringe Filter

- 0.2µm, 0.45µm, 1.2µm, 5µm
- Polyvinylidene fluoride (PVDF) and glass fiber
- 28mm diameter: instrument grade, hydrophobic PVDF
- 4.7mm diameter: medical grade, hydrophilic PVDF
- 300 x 7.8, 300 x 25, 300 x 4.6
- 10, 25, 50, 100, 250, 500 µm

Ordering Information

Phenogel Columns are a Recommended Alternative to:

- Tosoh Bioscience® TSKgel® H-type
- PSS SDV
- Shodex® GPC KF-800 series
- Waters® Styragel®
- Agilent Technologies® PLgel™
- Jordi Associates Jordi GPC-DVB
- UltraStyragel™
- Styragel® HT
- Styragel® HR
- TSKgel® H-type

Phenogel Columns are a Recommended Alternative to:

- TSV
- TSV-HP
- TSKgel® H-type

Ordering Information

Please specify shipping solvent when ordering

Other column dimensions available. Phenogel columns are routinely shipped in THF. However, columns are also available in commonly used solvents such as Toluene and Chloroform as well as DMF, NMP, and other solvents.

Ordering Information

If Phenogel analytical columns do not provide at least equivalent separation as compared to a competing column of the similar particle size, phase, and dimensions, return the column with comparative data within 45 days for a FULL REFUND.