

Phenogel™ GPC/SEC Columns

- 5 and 10 μm particle sizes
- Narrow bore (4.6 mm ID) solvent-saver to preparative columns available
- Very good alternative to Polymer Labs PLgel and Waters Styragel, Ultrastyrigel, Styragel HT, and Styragel HR columns
- Highly cross-linked for mechanical and chemical stability
- Temperature stable to 140 °C

Phenogel is available in seven different pore sizes ranging from 50 Å to 10⁶ Å†, and a linear bed configuration. Pore size distribution and pore volume are closely controlled parameters in the manufacturing process; accounting for the high resolution, tight linear calibration curves and excellent column-to-column reproducibility.

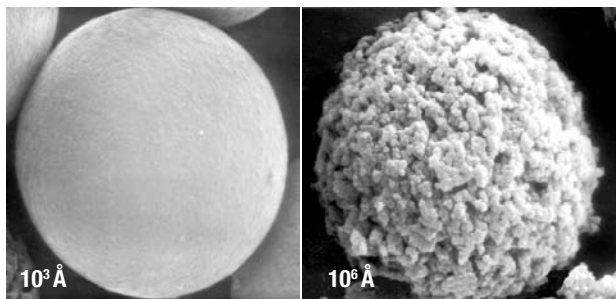
Sample Elution

Each standard dimension Phenogel column (300 x 7.8 mm) has an internal volume of 15 mL that is distributed as follows:

- 3 mL is occupied by the solid portions of the gel particles (20 % of total column volume)
- 6 mL is the pore volume of the packing material (40 % of total column volume)
- 6 mL is the interstitial volume or volume between the gel particles (40 % of total column volume)

Thus, about 6 mL of solvent must elute through each column before even the largest molecules can emerge, while the smallest molecules emerge with the total column volume of 12 mL. This constant distribution of volume makes it possible to predict the amount of solvent and time necessary to complete any analysis.

SEM Photos of Phenogel Polymer Beads



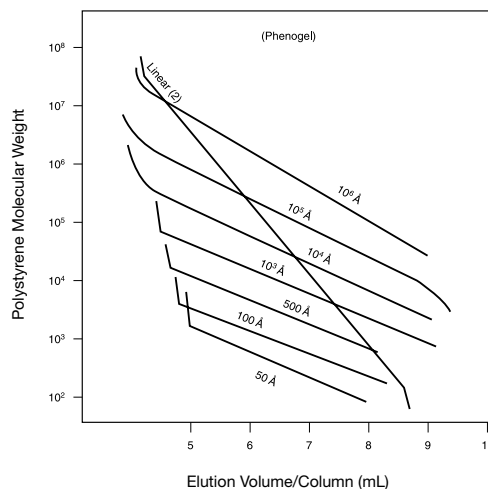
Technical Specifications

Material:	SDVB
Particle Size:	5, 10 μm
Porosities:	50 Å to 10 ⁶ Å†, and mixed beds
Typical Pressure:	5 μm: 350 psi 10 μm: 200 psi
Maximum Pressure:	650 psi
Maximum Temperature:	140 °C
Minimum Efficiency*:	5 μm: 45,000 p/m** 10 μm: 35,000 p/m**
Typical Flow Rates:	4.6 mm ID: 0.35 mL/min 7.8 mm ID: 1.0 mL/min 21.2 mm ID: 8.0 mL/min
End Fittings:	Valco Compatible

* Tested in THF ** For 300 x 7.8 mm ID columns

† See note on p. 381 regarding pore sizes and exclusion limits

Column Molecular Weight Calibration Curves



Column Selection by Molecular Weight

Sample Type	Molecular Weight	Phenogel Column
Small Organics	100 - 3 K	50 Å
	500 - 6 K	100 Å
	1 K - 15 K	500 Å
Resins	1 K - 75 K	10 ³ Å
	5 K - 500 K	10 ⁴ Å
	10 K - 1,000 K	10 ⁵ Å
High MW Polymers	60 K - 10,000 K	10 ⁶ Å
	100 - 10,000 K	Linear(2)

Phenogel™ GPC/SEC Columns

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 *o*-CP, to help minimize equilibration time

Solvent Compatibility Table

Mobile Phase Solvent	Phenogel Pore Size:							Linear & Mixed	Suggested Operating Temp.
	50 (Å)	100	500	10 ³	10 ⁴	10 ⁵	10 ⁶		
Acetone	Y	Y	Y	Y	Y	Y	Y	Y	
Benzene	Y	Y	Y	Y	Y	Y	Y	Y	
Carbon Tetrachloride	Y	Y	Y	Y	Y	Y	Y	Y	
Chloroform	Y	Y	Y	Y	Y	Y	Y	Y	
30 % HFIP/Chloroform	Y	Y	Y	Y	Y	Y	Y	Y	
Diethyl Ether	Y	Y	Y	Y	Y	Y	Y	Y	
Dimethylacetamide (DMAC)	Y*	Y	Y	Y	Y	Y	Y	Y	60 °C
Dimethylformamide (DMF)	Y*	Y	Y	Y	Y	Y	Y	Y	60 °C
Dioxane	Y	Y	Y	Y	Y	Y	Y	Y	
DMSO	Y*	Y	Y	Y	Y	Y	Y	Y	60 °C
Ethyl Acetate	Y	Y	Y	Y	Y	Y	Y	Y	
Hexafluoroisopropanol (HFIP)	Y	Y	Y	Y	Y	Y	Y	Y	
Hexane	Y	Y	Y	Y	Y	Y	Y	Y	
M-Cresol	Y*	Y	Y	Y	Y	Y	Y	Y	100 °C
Methyl Ethyl Ketone	Y	Y	Y	Y	Y	Y	Y	Y	
Methylene Chloride	Y	Y	Y	Y	Y	Y	Y	Y	
<i>o</i> -Chlorophenol	Y*	Y	Y	Y	Y	Y	Y	Y	100 °C
<i>o</i> -Dichlorobenzene	Y*	Y	Y	Y	Y	Y	Y	Y	135 °C
Quinolin	Y*	Y	Y	Y	Y	Y	Y	Y	60 °C
Tetrahydrofuran	Y	Y	Y	Y	Y	Y	Y	Y	
Toluene	Y	Y	Y	Y	Y	Y	Y	Y	
Trichlorobenzene	Y*	Y	Y	Y	Y	Y	Y	Y	135 °C
Water	N	N	N	N	N	N	N	N	
Xylene	Y	Y	Y	Y	Y	Y	Y	Y	

*Not recommended on 5 μm 50 Å columns.

N = Not Compatible
Y = Compatible

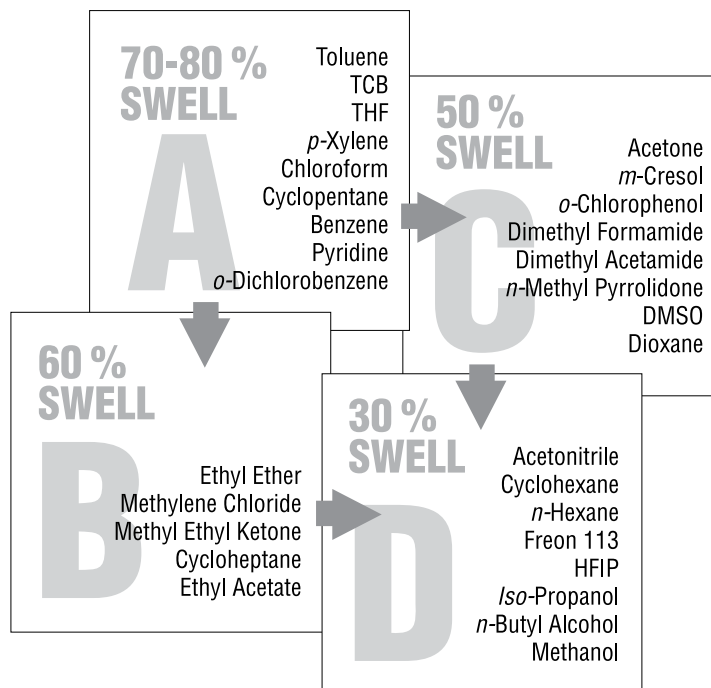


Solvent Switching Considerations

Although Phenogel columns are rugged and can withstand strong solvent changes, care should be exercised when switching from high-swell solvents (A) to low-swell solvents (B, C, and D). 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 650 psi
- Always check solvent miscibility in a beaker or follow the solvent miscibility table on page 379 before proceeding with ANY solvent switch.
- Compare the swell characteristics of solvent 1 (old solvent) to solvent 2 (new solvent) and use the following guidelines:
 - If solvent 1 and solvent 2 belong to the same swell category (see table below), 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, 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.



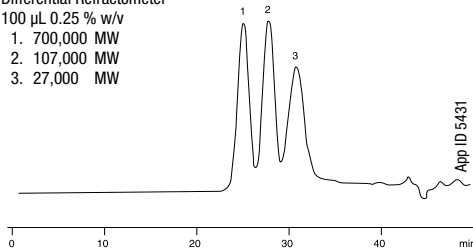
Phenogel™ GPC/SEC Columns

50 Å - 10⁶ Å Columns

- High resolution at low cost
- Customize your analysis by coupling different pore-size columns
- Wide range of solvent compatibility

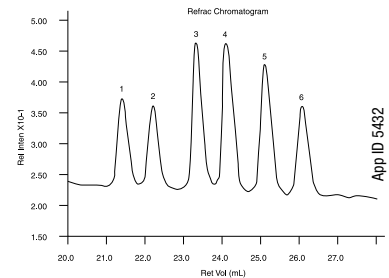
Polymethyl Methacrylates (Wide MW Range)

Column: Phenogel 5 µm 10⁵ Å, 10⁴ Å, 10³ Å, 500 Å
Dimensions: 300 x 7.8 mm
Solvent: THF
Flow Rate: 1.0 mL/min
Detection: Differential Refractometer
Injection Volume: 100 µL 0.25 % w/v
Sample:



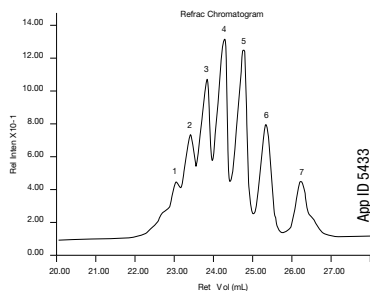
Closely Related Hydrocarbons

Column: Phenogel 5 µm 50 Å, 100 Å, 500 Å
Dimensions: 300 x 7.8 mm
Solvent: THF
Flow Rate: 1.0 mL/min
Detection: Differential Refractometer
Injection Volume: 100 µL 0.25 % w/v
Temperature: Ambient
Sample:



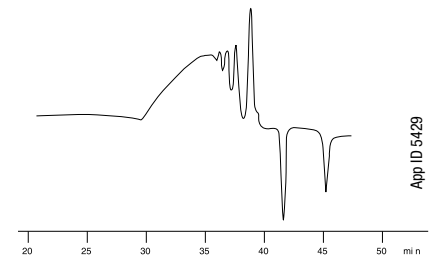
Polyethylene Glycol 330

Column: Phenogel 5 µm 50 Å, 100 Å, 500 Å
Dimensions: 300 x 7.8 mm
Solvent: THF
Flow Rate: 1.0 mL/min
Detection: Differential Refractometer
Injection Volume: 100 µL 0.25 % w/v
Temperature: Ambient
Sample:



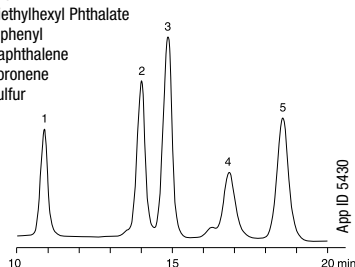
Phenolic Resins

Column: Phenogel 5 µm 500 Å x 2, 10³ Å, 10⁴ Å
Dimensions: 300 x 7.8 mm
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



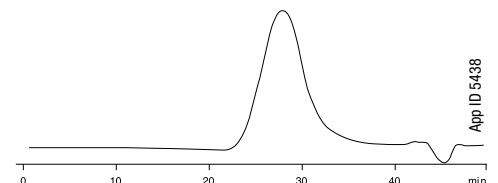
Organic Compounds

Column: Phenogel 10 µm 100 Å
Dimensions: 250 x 21.2 mm
Part No: 00G-0642-P0
Mobile Phase: Dichloromethane
Flow Rate: 4.0 mL/min
Detection: UV @ 254 nm
Temperature: Ambient
Sample:



Polyvinyl Butyral

Column: Phenogel 5 µm 500, 10³, 10⁴, 10⁵ Å
Dimensions: 300 x 7.8 mm
Solvent: THF
Flow Rate: 1.0 mL/min
Detection: Differential Refractometer
Injection Volume: 100 µL 0.25 % w/v
Temperature: 25 °C
Sample: 300,000 MW

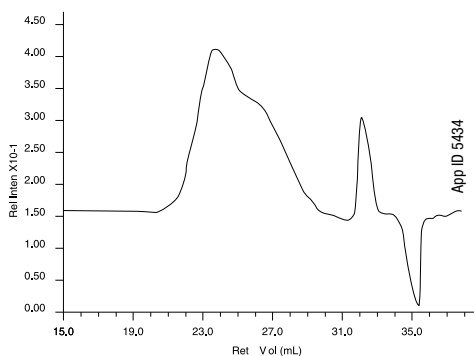


Phenogel™ GPC/SEC Columns

50 Å - 10⁶ Å Columns (cont'd)

Polyethylene Oxide (PEO)

Column: Phenogel 10 μm 10⁵, 10⁴, 10³ Å
Dimensions: 300 x 7.8 mm
Mobile Phase: DMF (0.1 M LiBr)
Flow Rate: 1.0 mL/min
Detection: Differential Refractometer
Injection Volume: 100 μL 0.125 % w/v
Temperature: 50 °C
Sample: 1. 400,000 MW

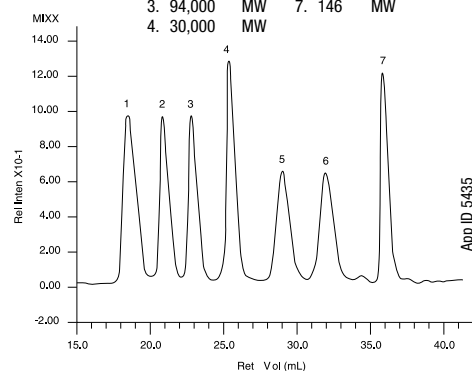


Polystyrenes (Wide MW Range)

Column: Phenogel 10 μm 10⁵, 10⁴, 10³ Å
Dimensions: 300 x 7.8 mm
Mobile Phase: THF
Flow Rate: 1.0 mL/min
Detection: Differential Refractometer
Injection Volume: 100 μL 0.125 % w/v
Temperature: Ambient

Sample:

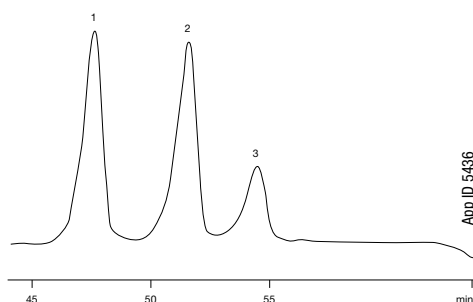
1. 1,560,000 MW	5. 6,100 MW
2. 260,000 MW	6. 845 MW
3. 94,000 MW	7. 146 MW
4. 30,000 MW	



Isoprenes from In Vitro Translation on Products

Column: Phenogel 5 μm 50 Å, 100 Å in series
Dimensions: 300 x 7.8 mm
Mobile Phase: THF
Flow Rate: 0.25 mL/min
Detection: Differential Refractometer
Sample:

- Squalene C30 (2, 6, 10, 15, 19, 23-Hexamethyltetracosane)
- Phytane C20 (2, 6, 10, 14-Tetramethylhexadane)
- Farnesane C15 (2, 6, 10-Trimethyldecane)

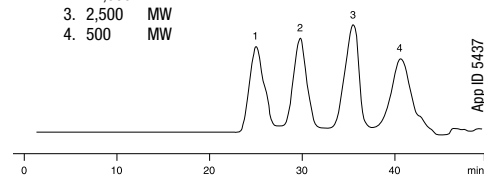


Polybutadienes (Wide MW Range)

Column: Phenogel 5 μm 10⁵, 10⁴, 10³, 500 Å
Dimensions: 300 x 7.8 mm
Solvent: THF
Flow Rate: 1.0 mL/min
Detection: Differential Refractometer

Injection Volume: 100 μL 0.25 % w/v
Sample:

- 420,000 MW
- 24,000 MW
- 2,500 MW
- 500 MW

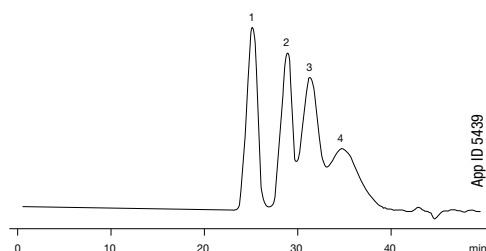


Poly-(α-Methyl Styrene) (Wide MW Range)

Column: Phenogel 5 μm 10⁵, 10⁴, 10³, 500 Å
Dimensions: 300 x 7.8 mm
Solvent: THF
Flow Rate: 1.0 mL/min
Detection: Differential Refractometer

Injection Volume: 100 μL 0.25 % w/v
Sample:

- 680,000 MW
- 90,000 MW
- 30,000 MW
- 6,000 MW



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.

Chromatogram courtesy of W. Maltese and R. Erdman, Weis Center for Research, Geisinger Clinic.

Phenogel™ GPC/SEC Columns

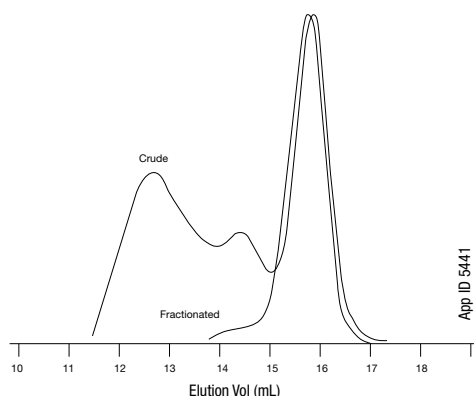
Linear Columns

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

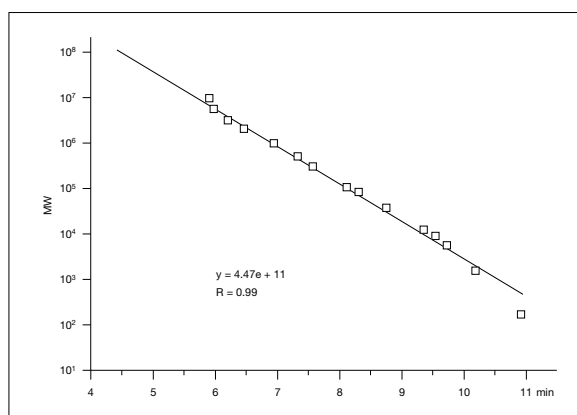


Cyclic Polymer Characterization

Column: Phenogel 10 µm Linear(2)
Dimensions: 600 x 7.8 mm
Part No.: 00K-3260-K0
Mobile Phase: THF with 1 % TEA
Flow Rate: 1.3 mL/min
Detection: UV @ 268 nm
Injection Volume: 40 µL 0.2 % w/v
Temperature: Ambient
Sample: Poly-(2-Vinylpyridine) [0.05 % - 0.25 % (w/v)]



Calibration Curve: Linear (2) - Phenogel 5 µm 300 x 7.8 mm



Narrow Bore Columns

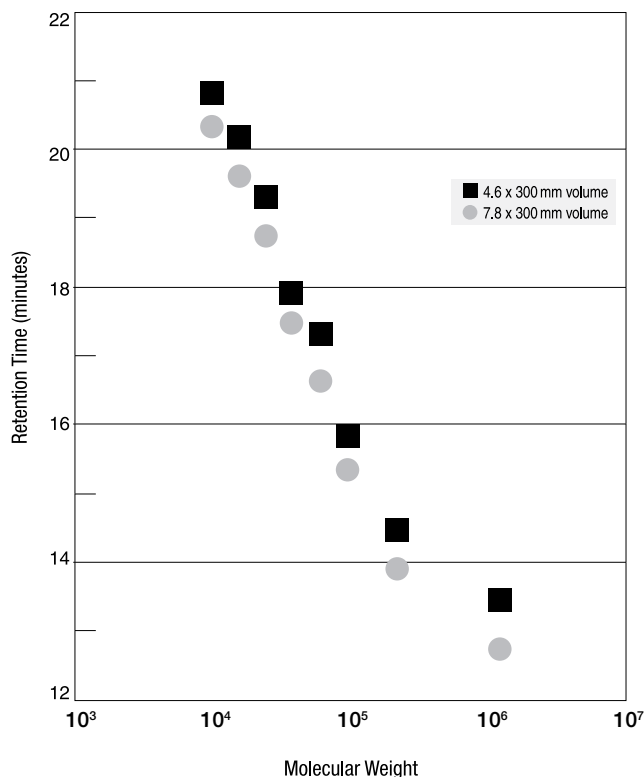
An Improved Dimension in GPC Analysis

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

Phenogel-NB (NarrowBore) columns are optimized to reduce solvent consumption. The Phenogel-NB columns have a 4.6 mm column ID and run at 0.35 mL/min, 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.



Phenogel™ GPC/SEC Columns



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, send in your comparative data within 45 days and keep the column for FREE.

Ordering Information

5 µm Columns (mm)		300 x 7.8	600 x 7.8	300 x 21.2	Guards
Pore Size	MW Range				50 x 7.8
50 Å	100-3 K	00H-0441-KO	—	—	03B-2088-KO
100 Å	500-6 K	00H-0442-KO	00K-0442-KO	—	03B-2088-KO
500 Å	1K-15 K	00H-0443-KO	—	—	03B-2088-KO
10 ³ Å	1K-75 K	00H-0444-KO	—	—	03B-2088-KO
10 ⁴ Å	5K-500 K	00H-0445-KO	00K-0445-KO	00H-0445-PO	03B-2088-KO
10 ⁵ Å	10K-1,000 K	00H-0446-KO	00K-0446-KO	00H-0446-PO	03B-2088-KO
10 ⁶ Å	60K-10,000 K	00H-0447-KO	—	00H-0447-PO	03B-2088-KO
		300 x 7.8	600 x 7.8	—	50 x 7.8
Mixed Beds					
Linear(2)	100-10,000 K	00H-3259-KO	00K-3259-KO	—	03B-2088-KO

Other Shipping Solvents:
Methanol, Methylene Chloride, Cyclohexane, Ethyl Acetate, NMP, DMAC, DMF

Size (mm)	Price
30 x 4.6	
50 x 4.6	
300 x 4.6	
300 x 7.8	
600 x 7.8	
300 x 21.2	
600 x 21.2	

NOTE: Phenogel columns are routinely shipped in THF. Columns can be shipped in Toluene and Chloroform upon request at no additional charge.

5 µm Narrow Bore (NB) Columns (mm)		300 x 4.6	Guards
Pore Size	MW Range		30 x 4.6
50 Å	100-3 K	00H-0441-E0	03A-2088-E0
100 Å	500-6 K	00H-0442-E0	03A-2088-E0
500 Å	1K-15 K	00H-0443-E0	03A-2088-E0
10 ³ Å	1K-75 K	00H-0444-E0	03A-2088-E0
10 ⁴ Å	5K-500 K	00H-0445-E0	03A-2088-E0

Phenogel Columns are a Recommended Alternative to:

Manufacturer	Columns
Jordi Associates	Jordi GPC-DVB
Polymer Labs	PLgel™
Waters	Styragel® µStyragel™ UltraStyragel™ Styragel® HT Styragel® HR

10 µm Columns (mm)		300 x 7.8	600 x 7.8	300 x 21.2	600 x 21.2	Guards
Pore Size	MW Range					50 x 7.8
50 Å	100-3 K	00H-0641-KO	00K-0641-KO	00H-0641-PO	00K-0641-PO	03B-2090-KO
100 Å	500-6 K	00H-0642-KO	00K-0642-KO	00H-0642-PO	00K-0642-PO	03B-2090-KO
500 Å	1K-15 K	00H-0643-KO	00K-0643-KO	—	00K-0643-PO	03B-2090-KO
10 ³ Å	1K-75 K	00H-0644-KO	00K-0644-KO	00H-0644-PO	00K-0644-PO	03B-2090-KO
10 ⁴ Å	5K-500 K	00H-0645-KO	00K-0645-KO	00H-0645-PO	00K-0645-PO	03B-2090-KO
10 ⁵ Å	10K-1,000 K	00H-0646-KO	00K-0646-KO	00H-0646-PO	00K-0646-PO	03B-2090-KO
10 ⁶ Å	60K-10,000 K	00H-0647-KO	00K-0647-KO	00H-0647-PO	00K-0647-PO	03B-2090-KO
		300 x 7.8	600 x 7.8	300 x 21.2	—	50 x 7.8
Mixed Beds						
Linear(2)	100-10,000 K	00H-3260-KO	00K-3260-KO	00H-3260-PO	—	03B-2090-KO



For full line of Polymer Calibration Standards, see p. 358



For Column Heaters, see p. 343



All 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. Refer to the chart above for the additional charge for these shipping solvents. Please specify shipping solvent when ordering.