

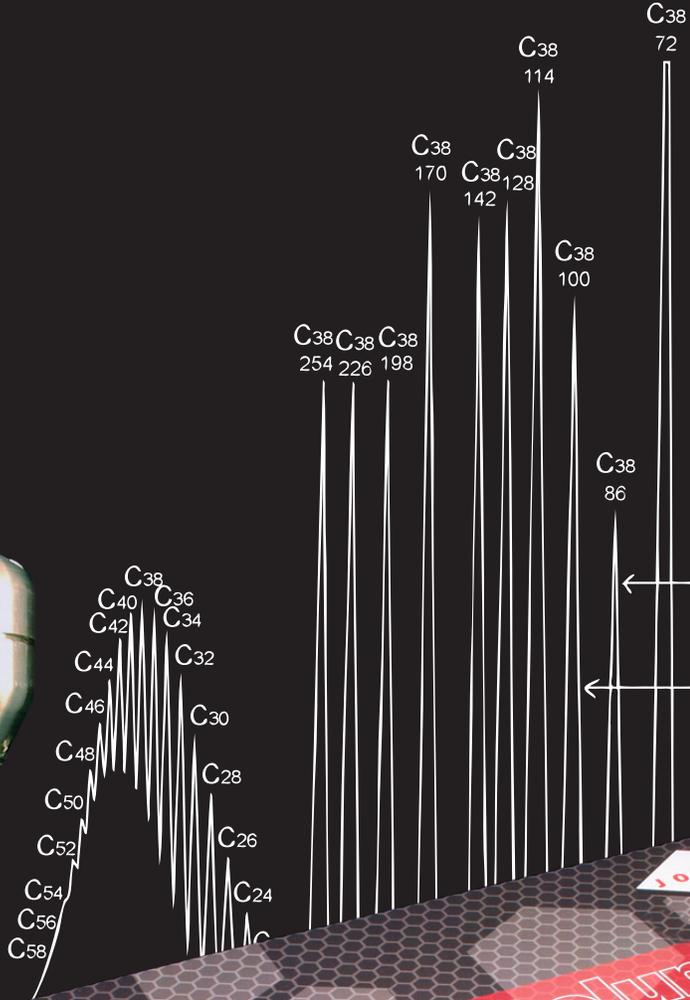
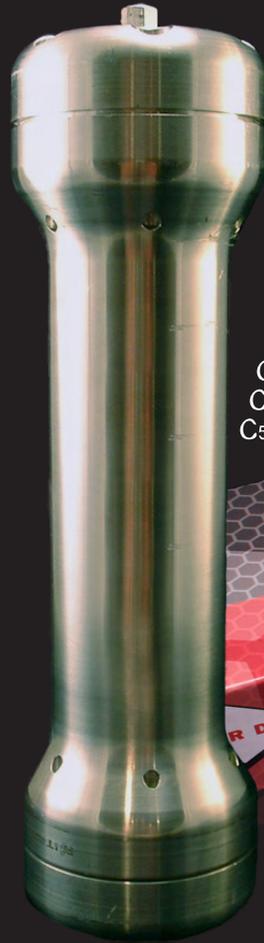
# GPC COLUMNS

Material Solutions. Uncompromising Integrity.

# GPC



## Gel Permeation Chromatography



$$N_{1/2} = 5.54 \left( \frac{211.2\text{mm}}{1.1\text{mm}} \right)^2 = 204,227$$

$$N_{50} = 25 \left( \frac{207.5\text{mm}}{2.3\text{mm}} \right)^2 = 203,485$$



## Introduction

Jordi Labs specializes in the production of innovative polymeric media for Gel Permeation (GPC) and Gel Filtration (GFC) Chromatography. Our GPC and GFC columns represent over 25 years of continuous research and development efforts. Jordi resins are always crafted using high quality 100% divinylbenzene (DVB) or other crosslinkable packings, with 8 unique surface chemistries available. Jordi also operates one of the largest premier GPC service laboratories in the country. Our team's recognized analytical expertise and dedication to customer satisfaction has significantly influenced the development of our revolutionary column media. Jordi's unwavering commitment to quality and integrity is a promise that you are getting the finest GPC and GFC columns on the market today. We pride ourselves on delivering the best chromatography products and services, and offering expert support and advice to ensure your success.

## Background of SEC

Size exclusion chromatography (SEC) is a broad term which refers to size-based separation techniques, including GPC and GFC. The basis of these techniques is the separation of molecules by differences in hydrodynamic volume, or molecular size in solution. GPC and GFC offer molecular weight determination for polymeric solutions, as well as a method for the separation of components with significant size differences.

GFC is applicable to separations performed in aqueous mobile phases, typically for the analysis of proteins or water soluble polymers. GPC is performed in organic mobile phases and is a common choice for the separation of synthetic polymers. Jordi offers a wide selection of GPC and GFC columns for all modes of SEC.

SEC consists of passing a sample solution through a porous media. Larger molecules that cannot access some of the pores within the media exit the column more rapidly, since they are excluded from some of the pores. Smaller molecules are able to penetrate into more of the porous structure, resulting in higher retention and later elution times. **Figure I** shows the path of two different-sized molecules passing through an SEC column. The porous media cannot accommodate the red (larger) molecules, thus the red molecules elute more easily and at faster times. The yellow (smaller) molecules fit into all the pores of the gel increasing the time required to pass through the column.

SEC is unique in that GPC and GFC separations do not depend on interactions between the stationary phase and the sample, unlike common reversed-phase (RP) chromatography techniques. RP separations rely on differences in the hydrophobic interactions between the column and sample components. In SEC, sample-column interactions are undesirable because they prevent purely size-based separations.

## Jordi SEC

Choosing the right Jordi column for your application is easy.

Our extensive application database contains hundreds of methods for the analysis of nearly all commercially available polymers. You can search by polymer name and method through Jordi's complete database, available at [www.jordilabs.com/applications.php](http://www.jordilabs.com/applications.php). Alternatively, our team of chemists is available at any time by phone or by email to help you custom design your SEC method, and to select the Jordi column set that is right for you. Please call or write to us today to receive your free copy of the Jordi method database on CD or in print.

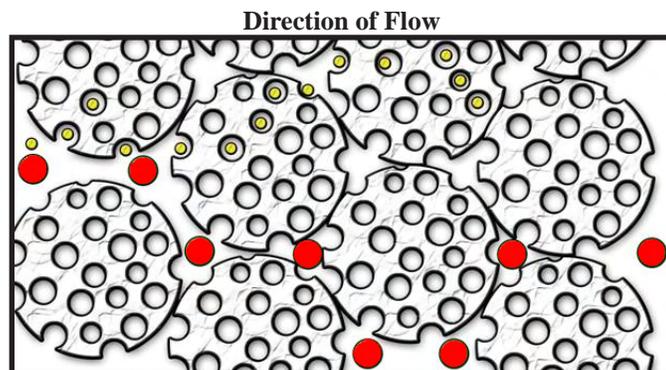


Fig. I

## Optimizing Your SEC Separation

The first goal in any SEC separation is to prevent column-sample interactions. Typically, mobile phase selection and column chemistry are among the most important factors to consider in designing a successful SEC method. In general, hydrophilic samples separate best on polar phases, while hydrophobic polymers perform best on non-polar phases. Below is a list of the most important parameters in designing your SEC separation.

1. Column Chemistry (sample-column interaction)
2. Mobile Phase (sample-column interaction, solubility of sample)
3. Pore Size (applicable size range of the separation)
4. Resolution (separating power)

**Column Chemistry**—Jordi offers the broadest selection of polymer packing chemistries available from any single SEC column manufacturer. Our diverse GPC product line provides the solution to optimizing your separations.

**Solvent Compatibility**—All Jordi columns are designed to accommodate an extremely broad range of solvents. Most Jordi columns can be used in nearly any solvent system, from water to hexanes. Jordi columns exhibit incredible ruggedness, allowing the application of mobile phases that would dissolve competitors' columns, including strong acids and bases. Jordi columns are stable across the entire pH range, offering the freedom to access excellent separating power, even for samples with limited solubility. Jordi columns are a smart choice, whether you are using a conventional mobile phase (THF, Water) or developing a unique method.

JORDI PORE SIZE SPECIFICATIONS

Description	MW Range
GPC Solid Bead	2,000-400,000,000
GPC 100Å	<100-5,000
GPC 500Å	<100-10,000
GPC 10 <sup>3</sup> Å	<100-50,000
GPC 10 <sup>4</sup> Å	100-100,000
GPC 10 <sup>5</sup> Å	10,000-10,000,000
GPC Mixed Bed	100-10,000,000

Table I

**Pore Size**—Jordi Labs offers unsurpassed pore size selection that covers the entire molecular weight range. The diversity of pore sizes in Jordi resins allows for the separation of molecules ranging from 100-400,000,000 molecular weight. **Table I** presents Jordi’s pore size options and the molecular weight ranges which they separate. This table excludes xStream. Please see last page for pore size selection for this item.

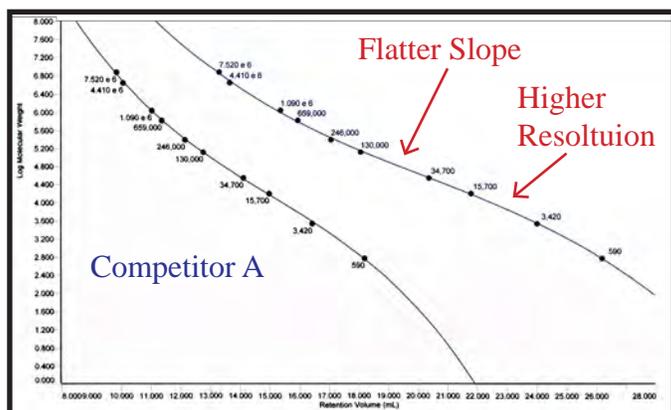


Fig. II

**Resolution**— The resolution of an SEC separation is directly related to the pore volume of the column. Greater pore volume of the correct pore size results in greater resolution. Jordi builds high resolution into all our column packings by optimizing our pore size distributions and pore volumes (up to 730 m<sup>2</sup>/g). We are also the only SEC column manufacturer who offers standard 10cm ID columns. This dimension provides 33% greater gel volume for our 10 x 250mm columns as compared to the 7.8 x 300mm size used by other manufacturers. Jordi provides these advantages at an equal or lower cost. **Figure II** features a comparison of the resolving power of two Jordi Mixed Beds (250x10mm) versus two competitor Mixed Beds (300x7.8mm).

Jordi recommends the Mixed Bed column if your sample molecular weight is unknown or if the sample has a broad molecular weight distribution, as this column covers a vast molecular weight range. **Figure III** shows the separation of a series of narrow molecular weight standards on a single Jordi Mixed Bed (10 x 250mm) column, as compared to a competitor’s 10<sup>6</sup> high molecular weight column.

The Jordi Mixed Bed provides superior resolution to the competitor’s column, even at high molecular weight.

Specific pore size columns are most useful for samples with narrow or well-defined molecular weight ranges. Jordi Solid Bead columns apply well to the separation of ultra-high molecular weight compounds (>2 million molecular weight). Low molecular weight samples (oligomers and small molecules) separate well on high resolution Jordi 500Å columns.

A complete list of all Jordi SEC columns is easily accessible on our website: [www.jordilabs.com](http://www.jordilabs.com). Our website also features a full portfolio of approved methods for each Jordi column. To locate these methods, simply click on the links at the bottom of each column page.

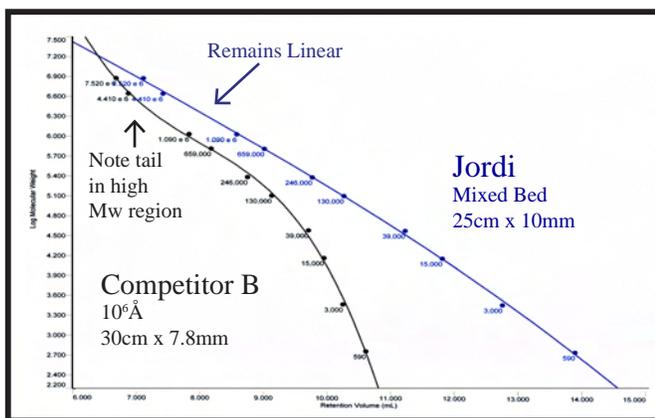


Fig. III

**Jordi GPC – Organic Solvents**

Jordi offers four column chemistries for analyses in organic mobile phases including:

1. Jordi Gel DVB
2. Jordi Gel DVB Fluorinated\*
3. Jordi Gel DVB Hydroxylated
4. Jordi Gel DVB Glucose

Traditional polymeric GPC products feature poly(styrene-co-divinylbenzene) (PS-DVB) packings. These resins provide a generally non-interacting surface for many organic polymers in common organic solvents, such as tetrahydrofuran (THF). Jordi GPC packings boast 100% divinylbenzene (DVB), offering superior separation characteristics, with the added advantage of improved column life and increased solvent compatibility.

Jordi DVB Columns are our best selling GPC product, backed by hundreds of published applications. This superb GPC column is trusted worldwide for providing high resolution, excellent plate counts and unsurpassed durability, coupled with over fifteen years of production.

Jordi Gel DVB Fluorinated\* resins represent one of the most advanced breakthroughs in GPC technology. This patented technology provides a non-stick surface chemistry that greatly reduces sample-column interactions for a variety of polar polymers.

\*Patented



JORDI LABS

Example applications include the analysis of phenolic resins, polyacrylamides and novel drug delivery polymers in polar solvents, including hexafluoroisopropanol (HFIP).

Jordi Gel DVB Fluorinated\* resin also applies where PS-DVB columns fail, allowing the use of more convenient mobile phases, such as THF. Reduced column back pressure on Jordi Fluorinated DVB columns allows for higher flow rates and decreased analysis time. This unique property also applies to ultra-high resolution GPC column sets, featuring over 250,000 plates per meter.

Jordi Glucose and Hydroxylated columns bridge the gap between aqueous and organic SEC columns. Both columns are compatible with 100% organic mobile phases, while our Glucose column also offers compatibility with 100% aqueous solvent. Typical applications for these columns include the analysis of polysaccharides and other polar polymers. Jordi Hydroxylated DVB columns are applicable to the analysis of hydroxypropyl methylcellulose (HMPC) and its derivatives. The more polar Jordi Glucose columns are a common choice for use in water/polar organic mixtures. Although Jordi Glucose columns withstand 100% aqueous solvent, they are more commonly used in polar organic solvents such as dimethylsulfoxide (DMSO), dimethylacetamide (DMAC), dimethylformamide (DMF).

#### Jordi GFC – Aqueous Solvents

Jordi offers four column chemistries for GFC in aqueous mobile phases including:

1. Jordi Gel DVB Glucose (neutral)
2. Jordi Gel xStream H<sub>2</sub>O™ Polyamide\* (Neutral) - New Product
3. Jordi Gel DVB Sulfonated (negatively charged)
4. Jordi Gel DVB Polar Pack WAX (neutral or positively charged)

Aqueous applications present a significant challenge in the field of size-based separations, due to the difficulty in preventing sample-column interactions. Jordi offers the widest selection of column packings to ensure success in your aqueous SEC separation. Jordi Gel DVB Glucose and the new Jordi Gel xStream H<sub>2</sub>O™ allow for the separation of a wide range of samples in 100% aqueous, 100% organic or aqueous/organic mobile phases. Our Sulfonated and Polar Pack WAX columns separate cationic and anionic samples based on charge-charge repulsions, without the need for high salt concentrations.

Jordi Gel DVB Glucose and Jordi Gel xStream H<sub>2</sub>O™ columns apply to a wide range of neutral, polar synthetic polymers and polysaccharides in mixed mobile phases, such as DMSO/H<sub>2</sub>O.

\*Patented

Jordi has the GPC columns to meet all your application needs, please visit our extensive application database for approved and established methods for the analysis of your polymeric materials.

Our expert team of chemists is always available to help custom design your SEC method. Please call or email us today to find the columns that are right for you.

The extreme inertness of these packings extends their use to strongly basic mobile phases, including 1M NaOH, that would destroy the competitors methacrylate-based products.

The new Jordi Gel xStream H<sub>2</sub>O™ column packing is an exciting breakthrough technology, which has increased hydrophilicity to reduce sample-column interactions. This novel resin features 100% polymeric polyamide chemistry. The Jordi Gel xStream H<sub>2</sub>O™, unlike typical GPC columns, performs well in any range of mobile phases, including 100% aqueous, 100% organic or any mixture of solvents. This new column is optimized for use in aqueous-based mobile phases and has the unique ability to separate a variety of cationic and polar polymers. Dextrans, polysaccharides and vinyl ether/maleic acid copolymers prove to separate well on the Jordi Gel xStream H<sub>2</sub>O™ in pure water. Separations in THF include, but are not limited to, phenoxy resins, poly(n-butyl methacrylate), polycaprolactone, several styrenic polymers, PMMA and other methacrylic polymers.

The Jordi Gel xStream H<sub>2</sub>O™ is also appropriate for analysis in HFIP, eliminating sample-column interactions and providing excellent resolution in the separation of nylons and PET. Other organic mobile phases applicable to separations on the Jordi Gel xStream H<sub>2</sub>O™ include chloroform, DMSO, DMAC and DMF. **Table II** contains the typical MW ranges for Jordi Gel xStream H<sub>2</sub>O. The range is dependent on sample and mobile phase.

JORDI xSTREAM PORE SIZE SPECIFICATIONS	
Description	MW Range
xStream Solid Bead	<10,000,000
xStream 1000Å	<10,000-50,000
xStream 10000Å	<200,000
xStream Mixed Bed	<10,000-700,000

Table II

Jordi Sulfonated and Polar Pack DVB columns apply to the separation of charged polymers without the need for high salt concentrations. These columns are an excellent choice for light scattering analyses, where high salt concentrations compromise system performance. Jordi Sulfonated columns have a negatively charged surface for the separation of anionic polymers, such as poly(styrene sulfonate). Typical solvents for this phase include aqueous/organic mixtures, such as water/methanol. Jordi Polar Pack Wax columns have a tertiary amine group, which in weakly acidic mobile phases converts to the positively charged quaternary amine. Common applications include the separation of amine polymers, such as poly(ethyleneimine) in water/acetic acid solutions.



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