

The TSK-GEL column line for gel filtration chromatography consists of two column types: TSK-GEL SW and TSK-GEL PW columns. TSK-GEL SW and TSK-GEL SW_{XL} columns contain silica-based, hydrophilic bonded phase packings that permit minimal interaction with protein samples. Polymer-based

TSK-GEL PW and TSK-GEL PW_{XL} columns are most suitable for analyzing water-soluble polymers, including oligosaccharides and many synthetic polymers. The table shows how to select the appropriate column for your sample.

TSK-GEL Column Selection Guide for High Performance GFC

Sample	Recommended TSK-GEL Column		Point in Selection	
	First Choice	Second Choice		
Carbohydrates	polysaccharides	GMPW _{XL}	G5000PW _{XL} + G3000PW _{XL}	large pore size linear calibration curve
	oligosaccharides	G-Oligo-PW	G2000PW	resolving power
Nucleic acids	large DNA fragments	G-DNA-PW G5000PW _{XL}		large pore size resolving power
	medium & small DNA fragments	G4000SW _{XL} G3000SW _{XL}		suitable pore size resolving power
	RNA	G4000SW _{XL} G3000SW	G3000PW _{XL}	suitable pore size resolving power
	oligonucleotides	G2500PW _{XL}		small pore size ionic interaction
Proteins	normal size	G3000SW _{XL} G4000SW _{XL} G2000SW _{XL}	G3000PW _{XL} G4000PW _{XL}	resolving power
	large (low density lipoprotein)	G6000PW _{XL} G5000PW _{XL}		large pore size resolving power
	large (gelatin)	G5000PW _{XL} + G3000PW _{XL}	GMPW _{XL}	large pore size linear calibration curve
Peptides	large	G3000SW _{XL} G2000SW _{XL}	G3000PW _{XL}	
	small	G2500PW _{XL}	G2000SW _{XL}	linear calibration curve resolving power
Virus		G6000PW _{XL} G5000PW _{XL}	G4000SW _{XL}	large pore size resolving power
Synthetic polymers		GMPW _{XL}	G5000PW _{XL} + G3000PW _{XL}	large pore size linear calibration curve low adsorption
Synthetic oligomers	nonionic, cationic	G-Oligo-PW	G2500PW _{XL}	small pore size
	anionic	G2500PW _{XL}		resolving power ionic interaction

TSK-GEL PW and TSK-GEL PW_{XL} columns are employed in high performance gel filtration separations of industrial water-soluble polymers. Characteristics of these columns are listed in Table 1. The hydrophilic polymer matrix has excellent chemical and mechanical stability. Although commonly used with aqueous solvents, the polymer is compatible with up to 50% organic solvent. Figures A and B show calibration curves for TSK-GEL PW and TSK-GEL PW_{XL} columns, using polyethylene glycols and oxides as molecular weight markers.

Table 2 lists mobile phases recommended for analyses of various water-soluble polymers. Although hydrophilic, PW-type resin is not as hydrophilic as polysaccharide gels. Thus, addition of organic modifier or a decrease in salt concentration can help to reduce hydrophobic interaction. With the exception of G-Oligo-PW and G2000PW, TSK-GEL PW-type resins have a small residual negative charge. Figures C, D, and E clarify how various mobile phase parameters influence the elution of anionic and cationic polymers on PW-type columns.

TSKgel GMPW and TSKgel GMPW_{XL} columns are mixed bed columns with calibration curves that are linear over a wide range of molecular weights. Because the pore volume of a mixed-bed column is the same as that for a narrow pore size column, the slope of the calibration curve is much steeper, which limits

resolution. Mixed bed columns are ideal for preliminary investigations, when the molecular weight composition of a sample is unknown. Then, unless the molecular weight distribution of the sample is very broad, one selects a second column (or series of columns) with a pore size (or range of pore sizes) that can provide optimum resolution.

TSKgel G-Oligo-PW columns are specially prepared for separating noncharged or cationic oligomers. A small residual positive charge makes G-Oligo-PW and G2000PW columns unsuitable for analyses of anionic oligomers.

Another specialty column, the TSKgel G-DNA-PW column, differs from G6000PW columns in that the particle size is smaller, to offer higher efficiency for separating nucleic acids.

TSK-GEL PW and PW_{XL} columns are chemically stable between pH 2 and 12. Detailed operating conditions are described in the information accompanying the columns. We recommend using a TSKgel PMH guard column with G2500PW through G6000PW columns, and with GMPW columns. TSK-GEL PW_{XL} guard columns should be used with all PW_{XL} columns, and with G-DNA-PW columns. We recommend using the Oligo guard column to protect G-Oligo-PW and TSKgel G2000PW columns.

Table 1. Characteristics of TSK-GEL PW and TSK-GEL PW_{XL} Columns

Column	Particle Size (µm)	Pore Size (Å)	PEGs/PEOs	Sample MW	Dextrans
G-Oligo-PW	6	125	<2000		—
G2000PW	10	125	<2000		—
G2500PW _{XL}	6	<200	<3000		—
G2500PW	10	<200	<3000		—
G3000PW _{XL}	6	200	<50,000		<60,000
G3000PW	10	200	<50,000		<60,000
G4000PW _{XL}	10	500	2000-300,000		1000-700,000
G4000PW	17	500	2000-300,000		1000-700,000
G5000PW _{XL}	10	1000	4000-1,000,000		50,000-7,000,000
G5000PW	17	1000	4000-1,000,000		50,000-7,000,000
G6000PW _{XL}	13	>1000	40,000-8,000,000		500,000-50,000,000
G6000PW	17	>1000	40,000-8,000,000		500,000-50,000,000
G-DNA-PW	10	4000	40,000-8,000,000		—
GMPW _{XL}	13	<100-1000	500-8,000,000		<50,000,000
GMPW	17	<100-1000	500-8,000,000		<50,000,000

Mobile Phase: polyethylene glycols/polyethylene oxides - distilled water, dextrans - 0.2M phosphate buffer, pH 6.8

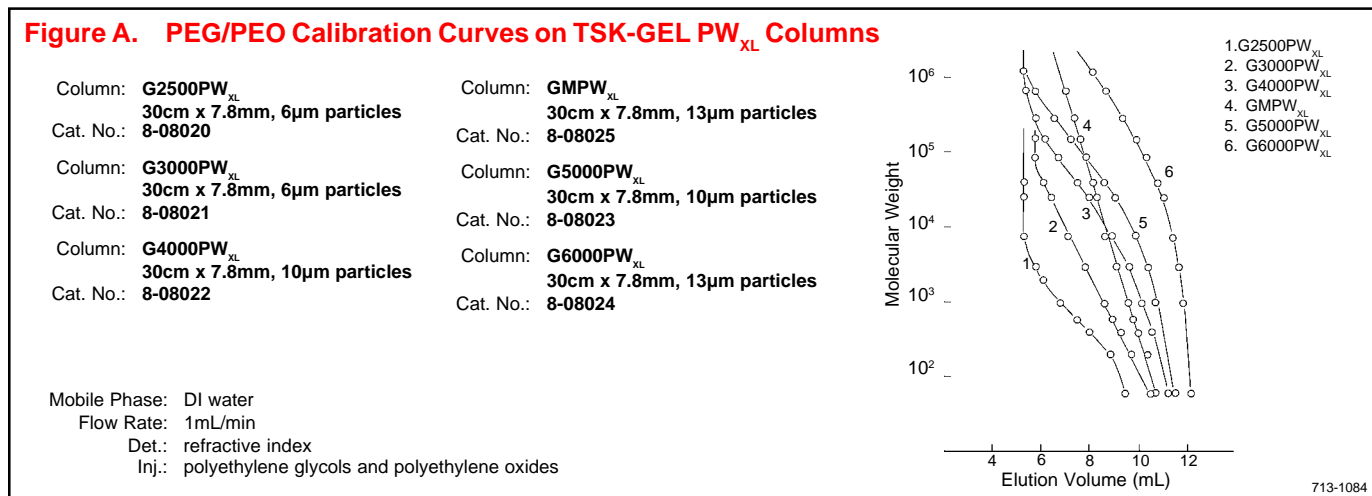


Figure B. PEG/PEO Calibration Curves on TSK-GEL PW Columns

Column: two G2000PW, 30cm x 7.5mm, 10µm particles
Cat.No.: 8-05761

Column: two G2500PW, 30cm x 7.5mm, 10µm particles
Cat. No.: 8-08028

Column: two G3000PW, 30cm x 7.5mm, 10µm particles
Cat. No.: 8-05762

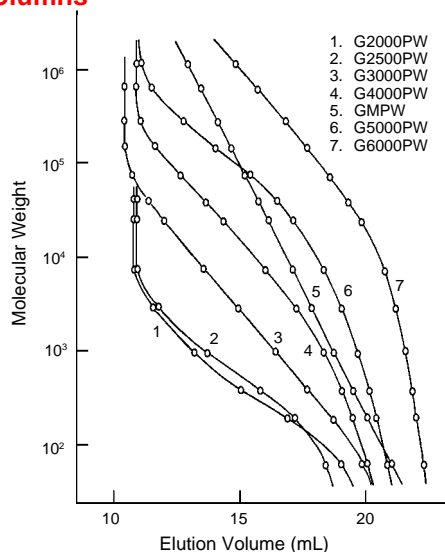
Column: two G4000PW, 30cm x 7.5mm, 17µm particles
Cat. No.: 8-05763

Column: two GMPW, 30cm x 7.5mm, 17µm particles
Cat. No.: 8-08026

Column: two G5000PW, 30cm x 7.5mm, 17µm particles
Cat. No.: 8-05764

Column: two G6000PW, 30cm x 7.5mm, 17µm particles
Cat. No.: 8-05765

Mobile Phase: DI water
Flow Rate: 1mL/min
Det.: refractive index
Inj.: polyethylene glycols and polyethylene oxides



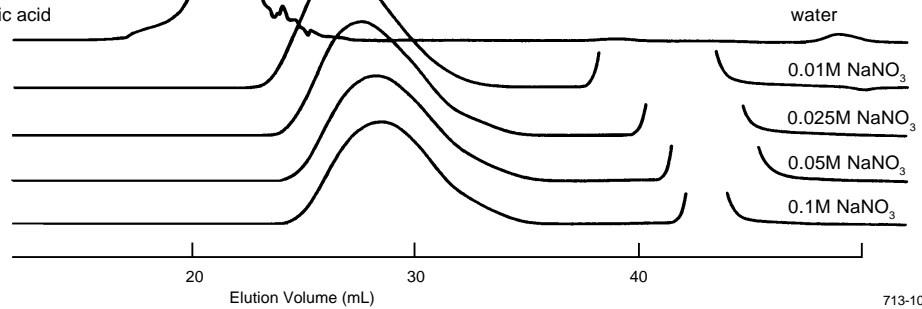
713-1085

Table 2. Mobile Phases for GFC of Water-Soluble Polymers on TSK-GEL PW-Type Columns

Type of Polymer	Typical Sample	Mobile Phase
Nonionic hydrophilic	polyethylene glycol soluble starch, methyl cellulose, pullulan dextran above samples, plus hydroxyethyl cellulose, polyvinyl alcohol, polyacrylamide	distilled water 0.01N NaOH DMSO buffer or salt solution (e.g., 0.1-0.5M NaNO ₃)
Nonionic hydrophobic	polyvinylpyrrolidone	buffer or salt solution with organic solvent (e.g., 20% CH ₃ CN in 0.1M NaNO ₃)
Anionic hydrophilic	sodium chondroitinsulfate, sodium alginate, carboxymethyl cellulose, sodium polyacrylate, sodium hyaluronate	buffer or salt solution (e.g., 0.1M NaNO ₃)
Anionic hydrophobic	sulfonated lignin (sodium salt), sodium polystyrenesulfonate	buffer or salt solution with organic solvent (e.g., 20% CH ₃ CN in 0.1M NaNO ₃)
Cationic hydrophilic	glycol chitosan, DEAE-dextran, poly(ethyleneimine), poly(trimethylaminoethylmethacrylate)iodide	0.5M acetic acid with 0.3M Na ₂ SO ₄ or 0.8M NaNO ₃
Cationic hydrophobic	poly(4-vinylbenzyltrimethylammonium chloride), poly(N-methyl-2-vinylpyridinium)iodide	0.5M acetic acid with 0.3M Na ₂ SO ₄
Amphoteric hydrophilic	peptides, proteins, polysaccharides, oligosaccharides, DNA, RNA	buffer or salt solution (e.g., 0.1M NaNO ₃)
Amphoteric hydrophobic	blue dextran, collagen, gelatin, hydrophobic proteins, hydrophobic peptides	buffer or salt solution with organic solvent (e.g., 20% CH ₃ CN in 0.1M NaNO ₃) 35-45% CH ₃ CN in 0.1% TFA

Figure C. Eluant Ionic Strength Affects Separation of an Anionic Polymer

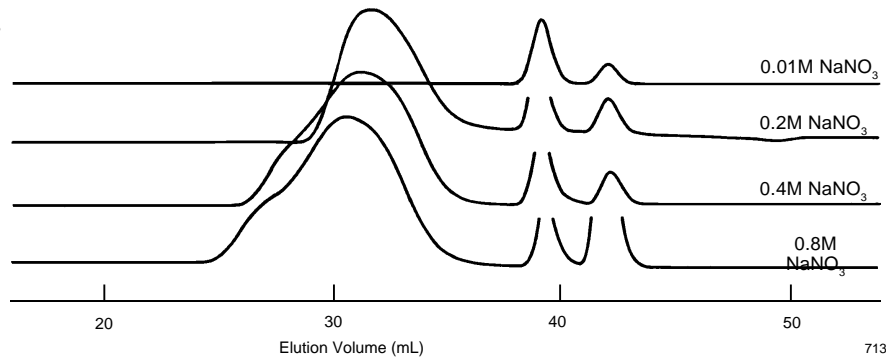
Columns: **Two GMPW,**
30cm x 7.5mm, 17µm particles
 Cat. No.: **8-08026**
 Mobile Phase: see figure
 Flow Rate: 0.5mL/min
 Det.: refractive index
 Inj.: 0.5mL of 0.05-0.1% polyacrylic acid
 (sodium salt)



713-1086

Figure D. Eluant Ionic Strength Affects Separation of a Cationic Polymer

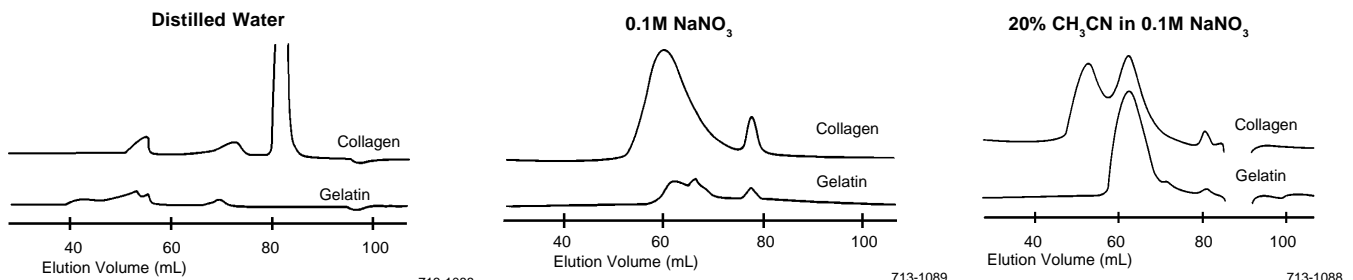
Columns: **Two GMPW,**
30cm x 7.5mm, 17µm particles
 Cat. No.: **8-08026**
 Mobile Phase: see figure
 Flow Rate: 0.5mL/min
 Det.: refractive index
 Inj.: 0.5mL of 0.05-0.1%
 DEAE-dextran



713-1086

Figure E. Mobile Phase Additives Improve Separation of an Amphoteric Polymer

Columns: **Two GMPW,**
30cm x 7.5mm, 17µm particles
 Cat. No.: **8-08026**
 Mobile Phase: see figure
 Flow Rate: 0.5mL/min
 Det.: refractive index
 Inj.: 0.5mL of 0.05-0.1%
 Type VI collagen or
 Type I gelatin



713-1088

713-1089

713-1088

Ordering Information:

TSK-GEL PW & PW_{XL} Polymer-Based Columns

Column	Packing Particle Size (µm)	Column Dimensions		Cat. No.
		Length (cm)	Diameter (mm)	
TSKgel G-Oligo-PW	6	30	7.8	8-08031
TSKgel Oligo guard column	12	4.0	6.0	8-08034
TSKgel G2500PW _{XL}	6	30	7.8	8-08020
TSKgel G3000PW _{XL}	6	30	7.8	8-08021
TSKgel G4000PW _{XL}	10	30	7.8	8-08022
TSKgel G5000PW _{XL}	10	30	7.8	8-08023
TSKgel G6000PW _{XL}	13	30	7.8	8-08024
TSKgel GMPW _{XL}	13	30	7.8	8-08025
TSKgel G-DNA-PW	10	30	7.8	8-08032
TSKgel PW _{XL} guard column	12	4.0	6.0	8-08033
TSKgel PW _{XL} packing (1g)	10	—	—	8-08035
TSKgel G1000PW*	10	30	7.5	8-05760
TSKgel G2000PW*	10	30	7.5	8-05761
TSKgel G2500PW	10	30	7.5	8-08028
TSKgel G3000PW	10	30	7.5	8-05762
TSKgel G4000PW	17	30	7.5	8-05763
TSKgel G5000PW	17	30	7.5	8-05764
TSKgel G6000PW	17	30	7.5	8-05765
TSKgel GMPW	17	30	7.5	8-08026
TSKgel PWH guard column	17	7.5	7.5	8-06732

*Use Oligo guard column for G2000PW; PWH guard column recommended for G2500PW through GMPW.

For more information, or current prices, contact your nearest Supelco subsidiary listed below. If your country is not listed, see the Supelco catalog for a complete list of all Supelco representatives, or contact Supelco, Bellefonte, PA 16823-0048 USA.

ARGENTINA · Sigma-Aldrich de Argentina, S.A. · Buenos Aires 1119 AUSTRALIA · Sigma-Aldrich Pty. Ltd. · Castle Hill NSW 2154 AUSTRIA · Sigma-Aldrich Handels GmbH · A-1110 Wien
 BELGIUM · Sigma-Aldrich N.V./S.A. · B-2880 Bornem BRAZIL · Sigma-Aldrich Quimica Brasil Ltda. · 01239-010 São Paulo, SP CANADA · Sigma-Aldrich Canada, Ltd. · 2149 Winston Park Drive, Ontario L6H 6J8
 CZECH REPUBLIC · Sigma-Aldrich s.r.o. · 186 00 Praha 8 FINLAND · Sigma-Aldrich Finland/YA-Kemia Oy · FIN-00700 Helsinki FRANCE · Sigma-Aldrich Chimie · 38297 Saint-Quentin-Fallavier Cedex
 GERMANY · Sigma-Aldrich Chemie GmbH · D-82041 Deisenhofen GREECE · Sigma-Aldrich (o.m.) Ltd. · Ilioupoli 16346, Athens HUNGARY · Sigma-Aldrich Kft. · H-1067 Budapest
 INDIA · Sigma-Aldrich Co. · Hyderabad 500 033 IRELAND · Sigma-Aldrich Ireland Ltd. · Dublin 24 ISRAEL · Sigma Israel Chemicals Ltd. · Rehovot 76100 ITALY · Sigma-Aldrich s.r.l. · 20151 Milano
 JAPAN · Sigma-Aldrich Japan K.K. · Chuo-ku, Tokyo 103 MEXICO · Sigma-Aldrich Quimica S.A. de C.V. · 14210 México D.F. NETHERLANDS · Sigma-Aldrich Chemie BV · 3331 LL Zwijndrecht
 NORWAY · Sigma-Aldrich Norway · Torshov · N-0401 Oslo POLAND · Sigma-Aldrich Sp. z o.o. · 61-663 Poznań SINGAPORE · Sigma-Aldrich Pte. Ltd.
 SOUTH AFRICA · Sigma-Aldrich (pty) Ltd. · Midrand 1685 SPAIN · Sigma-Aldrich Quimica, S.A. · 28100 Alcobendas, Madrid SWEDEN · Sigma-Aldrich Sweden AB · 135 70 Stockholm
 SWITZERLAND · Supelco · CH-9471 Buchs UNITED KINGDOM · Sigma-Aldrich Company Ltd. · Poole, Dorset BH12 4QH
 UNITED STATES · Supelco · Supelco Park · Bellefonte, PA 16823-0048 · Phone 800-247-6628 or 814-359-3441 · Fax 800-447-3044 or 814-359-3044 · email:supelco@sial.com

G

Supelco is a member of the Sigma-Aldrich family. Supelco products are sold through Sigma-Aldrich, Inc. Sigma-Aldrich warrants that its products conform to the information contained in this and other Sigma-Aldrich publications. Purchaser must determine the suitability of the product for a particular use. Additional terms and conditions may apply. Please see the reverse side of the invoice or packing slip.