

Viscotek Column Selection Guide



MOLECULAR WEIGHT

Introduction

The Viscotek range of GPC/SEC systems and detectors includes a wide selection of general and specialty columns for a wide range of applications. This technical note provides an introduction to the columns as well as providing some their technical details.



Figure 1: A selection of Viscotek GPC/SEC columns

Columns for synthetic polymer applications

T-columns

T-columns are a selection of general purpose columns made from a styrene divinylbenzene copolymer. They are available in a range of linear and mixed bed sizes and are applicable for synthetic polymer samples dissolved in THF. Typical samples measured using T-columns include PS, PMMA, low MW PEG, asphaltanes, xylene solubles, polysiloxanes, PLA, PLGA, polyurethanes, PVC, and rubber materials.

Figure 2 shows calibration curves for the T-columns. The columns from T1000 to T7000 are single-pore columns, each with a narrow separation range that may need to be combined to cover the range required for the application. The T6000M is a mixed bed column suitable for separations covering a wide molecular weight range and its relationship with the T single porosity columns is shown in the left hand side of Figure 2. The LT series are linear mixed-bed columns covering a range of pore sizes, and the ranges covered are shown on the right hand side of Figure 2. FIPA columns are intended for use in FIPA applications. They offer no separation of the sample but do separate the sample from the solvent for an ensemble-type measurement.

T-columns are 300 x 8 mm. FIPA H100-3078 columns are 300 x 7.8 mm. FIPA H100-1078 columns are 100 x 7.8 mm.

Details of the T-column specifications and ranges are shown in Table 1 and the solvent compatibilities are shown in Table 2.

For more detailed information about the T-columns, please download the user manual from the web-site.

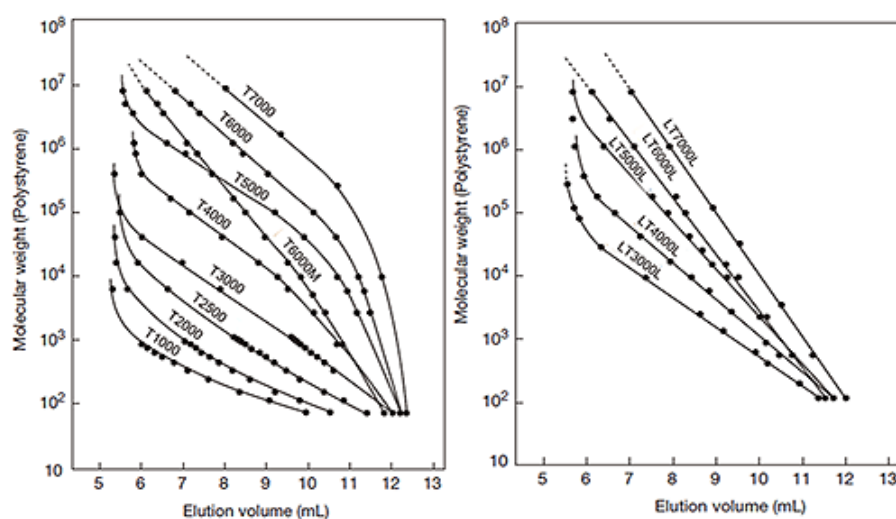


Figure 2: Calibration curves for T-columns. Calibration curves represent polystyrene in THF

Table 1: Viscotek T-column details.

Part Number	Grade	Particle Size (µm)	Theoretical Plate Number (per column)	Exclusion Limit MW polystyrene	Max. pore size (Å)
CLM3000	T1000, Org GPC/SEC Col	6	> 18,000	1,500	50
CLM3001	T2000, Org GPC/SEC Col	6	> 18,000	5,000	150
CLM3002	T2500, Org GPC/SEC Col	6	> 18,000	20,000	300
CLM3003	T3000, Org GPC/SEC Col	6	> 18,000	70,000	500
CLM3004	T4000, Org GPC/SEC Col	7	> 18,000	400,000	1,500
CLM3005	T5000, Org GPC/SEC Col	10	> 11,000	4,000,000	5,000
CLM3006	T6000, Org GPC/SEC Col	10	> 11,000	(20,000,000)	10,000
CLM3007	T7000, Org GPC/SEC Col	18	> 6,000	(200,000,000)	20,000
CLM3008	TGuard	8	guard column		
CLM3009	T6000M, General Mixed Org	10	> 13,000	(20,000,000)	10,000
CLM3010	LT3000L, Mixed, Ultra-Low Org	6	> 18,000	70,000	500
CLM3011	LT4000L, Mixed, Low Org	7	> 18,000	400,000	1,500
CLM3012	LT5000L, Mixed, Medium Org	10	> 11,000	4,000,000	5,000
CLM3013	LT6000L, Mixed, High Org	10	> 11,000	(20,000,000)	10,000
CLM3014	LT7000L, Mixed, Ultra-High Org	18	> 6,000	(200,000,000)	20,000
CLM2100	FIPA H100-3078 Non-Polar Organic Column	5	FIPA column		
CLM1100	FIPA H100-1078 Non-Polar Organic Column	5	FIPA column		

Part Number	Grade	Particle Size (μm)	Theoretical Plate Number (per column)	Exclusion Limit MW polystyrene	Max. pore size (A)
CLM1210	FIPA Guard Column H100-0478	5		FIPA column	

Table 2: T-column solvent compatibility.

Solvent	Column				
	T1000	T2000 T2500 LT3000L LT4000L	T3000	T4000 T5000 T6000 T7000 T6000M LT5000L LT6000L LT7000L	FIPA
THF	•	•	•	•	•
Chloroform	•	•	•	•	•
Carbon tetrachloride	x	•	•	•	•
Benzene	•	•	•	•	•
Toluene	•	•	•	•	•
p-Xylene	x	•	•	•	•
o-Dichlorobenzene (ODCB)	x	x	•	•	•
Trichlorobenzene (TCB)	x	x	•	•	•
Dioxane	x	•	•	•	•
Diethyl ether	x	x	•	•	•
Ethyl acetate	x	x	•	•	•
Acetone	x	x	•	•	•
Methyl ethyl ketone	x	x	•	•	•
Dimethylformamide (DMF)	x	x	•	•	•
Dimethylacetamide (DMAc)	x	x	•	•	•
Hexafluoroisopropan (HFIP)	x	x	x	•	•
m-Cresol	x	x	•	•	x
o-Chlorophenol	x	x	•	•	x
Quinolin	x	x	•	•	x
N-Methylpyrrolidone (NMP)	x	x	•	•	•
Dimethylsulfoxide (DMSO)	x	x	x	Δ	•
m-Cresol/ Chloroform 30/70 v/v	x	•	•	•	x

Solvent	Column				
	T1000	T2000 T2500 LT3000L LT4000L	T3000	T4000 T5000 T6000 T7000 T6000M LT5000L LT6000L LT7000L	FIPA
o-Chlorophenol/ Chloroform 30/70 v/v	x	•	•	•	x
HFIP/ Chloroform 30/70 v/v	x	•	•	•	•
Hexane	x	x	x	x	•
Acetonitrile	x	x	x	x	•
Methanol	x	x	x	x	•
Water	x	x	x	x	x

• Can be exchanged
 Δ Can be exchanged but may cause the column performance to deteriorate.
 x Cannot be used/exchanged

C-columns, D-columns & HFIP-columns

C-columns, D-columns, and HFIP-columns are an extension to the T-Column range of styrene divinyl-benzene columns. They are similar to the T-columns but shipped in chloroform, dimethylformamide (DMF), and hexafluoro-isopropanol (HFIP), respectively. Tables 3, 4, and 5 list the columns available in each of these ranges.

Typical samples for C-columns include PMMA, PLA, PLGA, polycarbonate, and polythiophenes. Typical samples for D-columns include PMMA, pullulan, PEG, PNIPAm, cotton, polyvinyl pyridine, and starch. Typical samples for HFIP-columns include nylon, PET and PMMA.

C-, D- and HFIP-columns are single-pore columns. The C6000M, D6000M, and HFIP6000M are mixed bed columns suitable for separations covering a wide molecular weight range. The LC series are linear mixed-bed columns covering a range of pore sizes. C-columns are single-pore columns. They are 300 x 8 mm.

Since C-columns, D-columns and HFIP-columns are based on the same gels as T-columns, the calibration curves for T-columns can be used for their respective C-, D-, and HFIP-column equivalents. Solvent compatibility is also comparable to T-columns so table 2 can be used as a reference.

For more detailed information about the C-columns, please download the user manual from the web-site.

For more detailed information about the D-columns, please download the user manual from the web-site.

For more detailed information about the HFIP-columns, please download the user manual from the web-site.

Table 3: C-column details

Part Number	Grade	Particle Size (µm)	Theoretical Plate Number (per column)	Exclusion Limit MW Polystyrene	Max. pore size (Å)
CLM3029	C1000, Org GPC/SEC Col	6	> 18,000	1,500	50
CLM3030	C2000, Org GPC/SEC Col	6	> 18,000	5,000	150
CLM3031	C2500, Org GPC/SEC Col	6	> 18,000	20,000	300
CLM3032	C3000, Org GPC/SEC Col	6	> 18,000	70,000	500
CLM3033	C4000, Org GPC/SEC Col	7	> 18,000	400,000	1,500
CLM3034	C5000, Org GPC/SEC Col	10	> 11,000	4,000,000	5,000
CLM3035	C6000, Org GPC/SEC Col	10	> 11,000	(20,000,000)	10,000
CLM3036	C7000, Org GPC/SEC Col	18	> 6,000	(200,000,000)	20,000
CLM3037	CGuard	8	guard column		
CLM3038	C6000M, General Mixed Org	10	> 13,000	(20,000,000)	10,000
CLM3039	LC3000L, Mixed, Ultra-Low Org	6	> 18,000	70,000	500
CLM3040	LC4000L, Mixed, Low Org	7	> 18,000	400,000	1,500
CLM3041	LC5000L, Mixed, Medium Org	10	> 11,000	4,000,000	5,000
CLM3042	LC6000L, Mixed, High Org	10	> 11,000	(20,000,000)	10,000
CLM3043	LC7000L, Mixed, Ultra-High Org	18	> 6,000	(200,000,000)	20,000

Table 4: D-column details

Part Number	Grade	Particle Size (µm)	Theoretical Plate Number (per column)	Exclusion Limit MW Polystyrene	Max. pore size (Å)
CLM3044	D1000, Org GPC/SEC Col	6	> 17,000	2,500	50
CLM3045	D2000, Org GPC/SEC Col	6	> 17,000	5,000	150
CLM3046	D2500, Org GPC/SEC Col	6	> 17,000	20,000	300
CLM3047	D3000, Org GPC/SEC Col	6	> 17,000	70,000	500
CLM3048	D4000, Org GPC/SEC Col	7	> 17,000	400,000	1,500
CLM3049	D5000, Org GPC/SEC Col	10	> 11,000	4,000,000	5,000
CLM3050	D6000, Org GPC/SEC Col	10	> 11,000	(20,000,000)	10,000
CLM3051	D7000, Org GPC/SEC Col	18	> 6,000	(200,000,000)	20,000
CLM3052	DGuard	8	guard column		
CLM3053	D6000M, General Mixed Org	10	> 13,000	(20,000,000)	10,000

Table 5: HFIP-column details

Part Number	Grade	Particle Size (µm)	Theoretical Plate Number (per column)	Exclusion Limit MW PMMA	Max. pore size (Å)
CLM3054	HFIP3000, HFIP-GPC Col	10	> 10,000	10,000	500
CLM3055	HFIP4000, HFIP-GPC Col	7	> 12,000	100,000	1,500
CLM3056	HFIP5000, HFIP-GPCCol	10	> 10,000	1,000,000	5,000
CLM3057	HFIP6000, HFIP-GPC Col	10	> 10,000	(10,000,000)	10,000
CLM3058	HFIP7000, HFIP-GPC Col	18	> 4,000	(100,000,000)	20,000
CLM3060	HFIP6000M, HFIP-GPC Col	10	> 10,000	(10,000,000)	10,000
CLM3059	HFIPGuard, HFIP-GPC Guard Col	15	Guard column		

Inert-columns (I-columns)

Viscotek I-columns are made from a styrene divinyl-benzene material coated to reduce interaction between the column and the sample. I-columns are ideal for particular applications where interaction between the column and the sample is common. They are designed for use in polar organic solvents such as DMF, dichloromethane (DCM), and dimethylsulphoxide (DMSO). They are also suited to running formic acid. They are shipped in DCM.

Key applications for I-columns include nylon dissolved in formic acid and PNIPAm.

If you think an I-column might be useful, contact a Malvern representative for more information.

I-columns are mixed bed columns covering a range of pore sizes. They are 300 x 7.8 mm. Figure 3 shows calibration curves for the I-columns. Details of the I-column specifications and ranges are shown in Table 6 and the solvent compatibilities are shown in Table 7.

For more detailed information about the I-columns, please download the user manual from the web-site

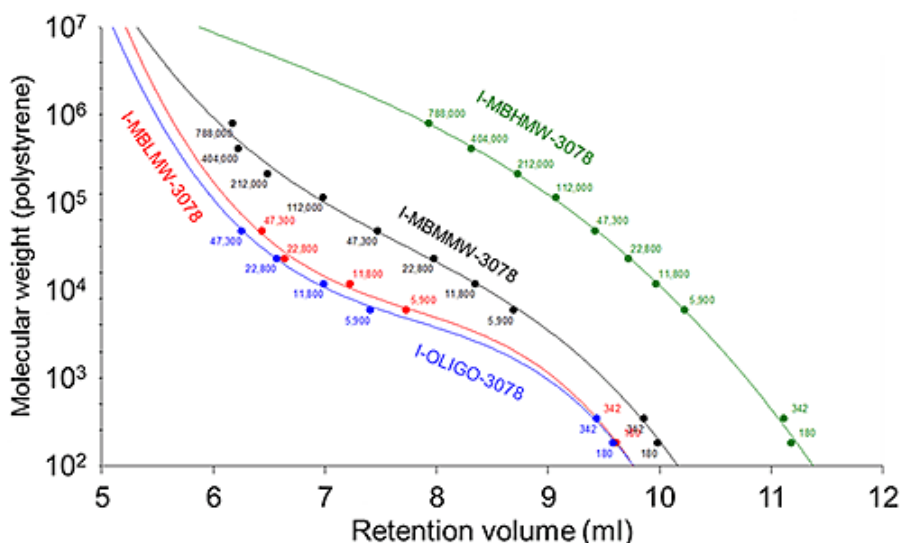


Figure 3: Calibration curves for I-columns. Samples are polystyrene in THF.

Table 6: I-column details.

Part Number	Grade	Particle Size (µm)	Theoretical Plate Number (per column)	Exclusion Limit MW polystyrene	Max. pore size (Å)
CLM1011	I-MBLMW-3078	10	> 7,500	20,000	1,000
CLM1012	I-MBMMW-3078	10	> 7,500	200,000	10,000
CLM1013	I-MBHMW-3078	10	> 7,500	10,000,000	100,000
CLM1014	I-OLIGO-3078	5	> 15,000	10,000	500
CLM1019	I-GUARD-0478	10	NA	20,000	1,000

Table 7: I-column solvent compatibility.

Solvent	All I-Columns	Solvent	All I-Columns
THF	•	Hexafluoroisopropanol (HFIP)	•
Chloroform	•	m-Cresol	×
Benzene	•	o-Chlorophenol	×
Toluene	•	Quinolin	•
p-Xylene	•	N-Methylpyrrolidone (NMP)	•
o-Dichlorobenzene (ODCB)	•	Dimethylsulfoxide (DMSO)	•
Trichlorobenzene (TCB)	•	30% m-Cresol/ Chloroform	×
Dioxane	•	30% o-Chlorophenol/ Chloroform	×
Diethyl ether	•	30% HFIP/Chloroform	•
Ethyl acetate	•	Hexane	•
Acetone	•	Acetonitrile	•
Methyl ethyl ketone	•	Methanol	•
Dimethylformamide(DMF)	•	Water	×
Dimethylacetamide(DMAc)	•		
• Can be exchanged × Cannot be used/exchanged			

Columns for aqueous applications

A-columns

Viscotek A-columns are a general purpose polymethylmethacrylate column for use with polymers and polysaccharides soluble in water and aqueous buffers.

Typical samples for A-columns include PEO, pullulan, dextran, polyvinyl alcohol, polyacrylamide, polyacrylic acid, polystyrene sulfonate, cellulose derivatives, hyaluronic acids and most other polysaccharides.

A-columns are single-pore columns, with dimensions of 300 x 8 mm. The A6000M is a mixed bed column suitable for separations covering a wide molecular weight range. Figure 4 shows the calibration curves for the A-columns.

Details of the A-column specifications and ranges are shown in Table 8 and the solvent compatibilities are shown in Table 9.

For more detailed information about the A-columns, please download the user manual from the web-site.

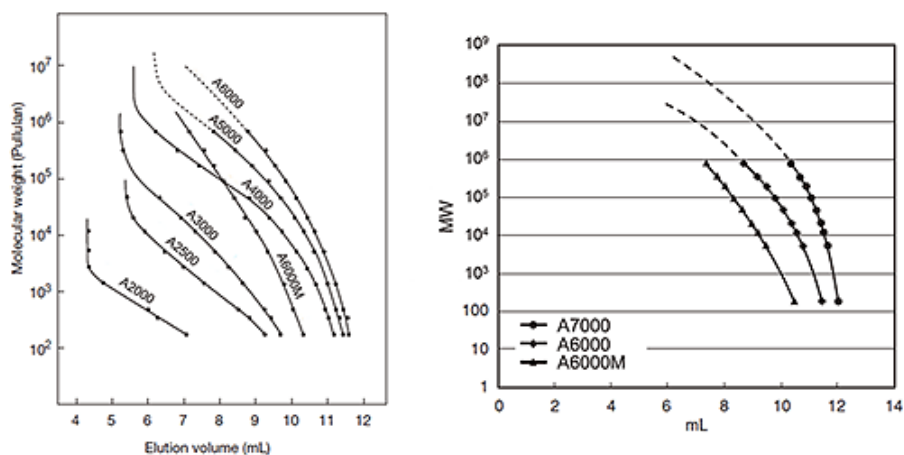


Figure 4: Calibration curves for A-columns. Samples are pullulan in water.

Table 8: A-column details.

Part Number	Grade	Particle Size (µm)	Theoretical Plate Number (per column)	Exclusion Limit MW Pullulan	Max. pore size (Å)	Max pressure (MPa)
CLM3015	A2000, Aq GPC/ SEC Col	8	> 12,000	4,000	100	5.0
CLM3016	A2500, Aq GPC/ SEC Col	6	> 16,000	10,000	200	5.0
CLM3017	A3000, Aq GPC/ SEC Col	6	> 16,000	100,000	800	5.0
CLM3018	A4000, Aq GPC/ SEC Col	10	> 16,000	1,000,000	2,000	3.0
CLM3019	A5000, Aq GPC/ SEC Col	13	> 12,000	(4,000,000)	7,000	3.0
CLM3020	A6000, Aq GPC/ SEC Col	13	> 12,000	(20,000,000)	15,000	3.0
CLM3021	A6000M, Aq GPC/ SEC Col	13	> 12,000	(20,000,000)	15,000	3.0
CLM3022	A7000, Aq GPC/ SEC Col	35	> 1,500	(500,000,000)	30,000	0.5
CLM3023	AGuard	10	guard column			
CLM3024	A7Guard	35	guard column			

Table 9: A-column solvent compatibility

Column type	Methanol	Acetonitrile	DMF	DMSO
A2000	0 %	0 %	0 %	0%
A2500 (refer to caution below)	0 - 100 %	0 - 75 %	0 - 100 %	100%
A3000	0 - 100 %	0 - 75 %	0 - 100 %	0%
A4000, A5000, A6000, A6000M	0 - 75 %	0 - 75 %	0 - 100 %	0%
A7000	0 - 30%	0 - 30%	0%	0%

Cation-columns

Viscotek cation-columns are designed for cationic polymers in aqueous buffers that are difficult to elute due to a positive charge. The packing material is an aminated divinylbenzene which eliminates sample adsorption for cationic polymers in buffers with low salt concentrations.

They are primarily intended for cationic polysaccharides such as chitosans run in 5% Acetic acid.

Cation-columns are mixed bed columns covering a range of pore sizes and are 300 x 7.8 mm.

Details of the cation-column specifications and ranges are shown in Table 9 and the solvent compatibilities are shown in Table 10.

For more detailed information about the Cation-columns, please download the user manual from the web-site.

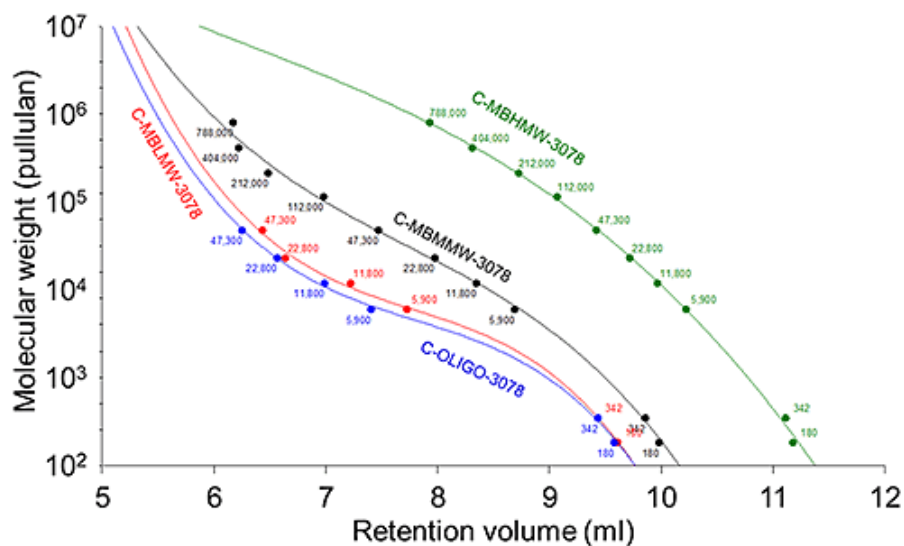


Figure 5: Calibration curves for the Cation-columns. Samples are pullulan in water.

Table 9: Cation-column details

Part number	Grade	Description	Exclusion Limit	Max Pressure	Dimensions
CLM1031	C-MBLMW-3078	Mixed Bed Low MW	>20K PS	2500 PSI	7.8 mm x 30 cm
CLM1032	C-MBMMW-3078	Mixed Bed Mid MW	>200K PS	1500 PSI	7.8 mm x 30 cm
CLM1033	C-MBHMW-3078	Mixed Bed High MW	>10M PS	1500 PSI	7.8 mm x 30 cm
CLM1034	C-OLIGO-3078	Oligomeric MW	>10K PS	2500 PSI	7.8 mm x 30 cm
CLM1039	C-Guard-0478	Guard Column	>20K PS	2500 PSI	7.8 mm x 4 cm

Table 10: Cation-column solvent compatibility

Solvent	CATION Columns	Solvent	CATION Columns
THF	•	Dimethylacetamide (DMAc)	•
Chloroform	•	Hexafluoroisopropanol (HFIP)	•
Carbon tetrachloride	•	m-Cresol	×
Benzene	•	o-Chlorophenol	×
Toluene	•	Quinolin	×
p-Xylene	•	N-Methylpyrrolidone (NMP)	•
o-Dichlorobenzene (ODCB)	•	Dimethylsulfoxide (DMSO)	•
Trichlorobenzene (TCB)	•	m-Cresol/ Chloroform 30/70 v/v	×
Dioxane	•	o-Chlorophenol/ Chloroform 30/70 v/v	×
Diethyl ether	•	HFIP/Chloroform 30/70 v/v	•
Ethyl acetate	•	Hexane	•
Acetone	•	Acetonitrile	•
Methyl ethyl ketone	•	Methanol	•
Dimethylformamide (DMF)	•	Water	•

Columns for protein applications

P-columns

Viscotek P-columns are silica-based columns for the separations of proteins in aqueous buffers. They can be used at a pH range of 3 - 7.5 and they can be used for light scattering experiments. They are 300 x 8 mm.

P-columns can be used with up to 100% acetonitrile or methanol.

Figure 6 shows calibration curves for the P-columns and the specifications are shown in Table 11.

For more detailed information about the P-columns, please download the user manual from the web-site.

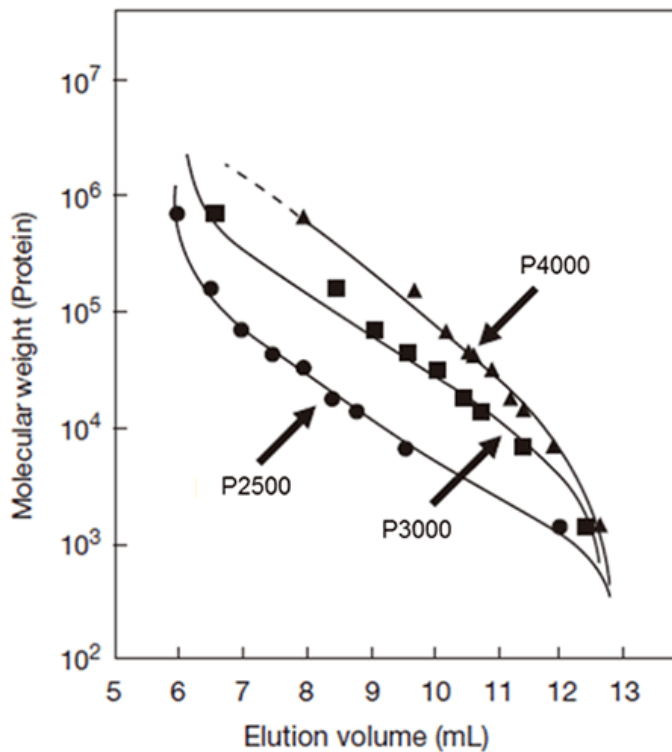


Figure 6: P-column calibration curves. Samples are different proteins in PBS

Table 11: P-column details.

Part Number	Grade	Particle Size (µm)	Theoretical Plate Number (per column)	Exclusion Limit MW		Max. pore size (Å)	Max pressure (MPa)
				Protein	Pullulan		
CLM3025	P2500, Protein SEC Col	5	>21,000	150,000	60,000	400	5.0
CLM3026	P3000, Protein SEC Col	5	> 21,000	700,000	170,000	1,000	5.0
CLM3027	P4000, Protein SEC Col	7	> 16,000	(1,000,000)	500,000	1,500	5.0
CLM3028	PGuard	7	guard column				

PLS-columns

Viscotek PLS-columns are silica-based columns for the separation of proteins for light scattering applications. Their excellent stability minimizes particle shedding to maintain light scattering baselines as clean as possible. They offer excellent separation and have slightly improved pH stability over other silica columns.

Three columns types are available and Figure 7 shows the calibration curves for them and the specifications are in Table 12. PLS5030 have larger particle size and are for general purposes. PLS3030 have smaller particle sizes for improved resolution but have slightly higher back pressure. PLS3030H are smaller particle sizes and have a modified surface for use with particularly hydrophobic proteins. Each is available with a guard column of similar type.

PLS-columns can be used with up to 100% acetonitrile or methanol. They can be used at pH 2 - 8.5 and are 300 x 7.8 mm.

For more detailed information about the PLS-columns, please download the user manual from the web-site.

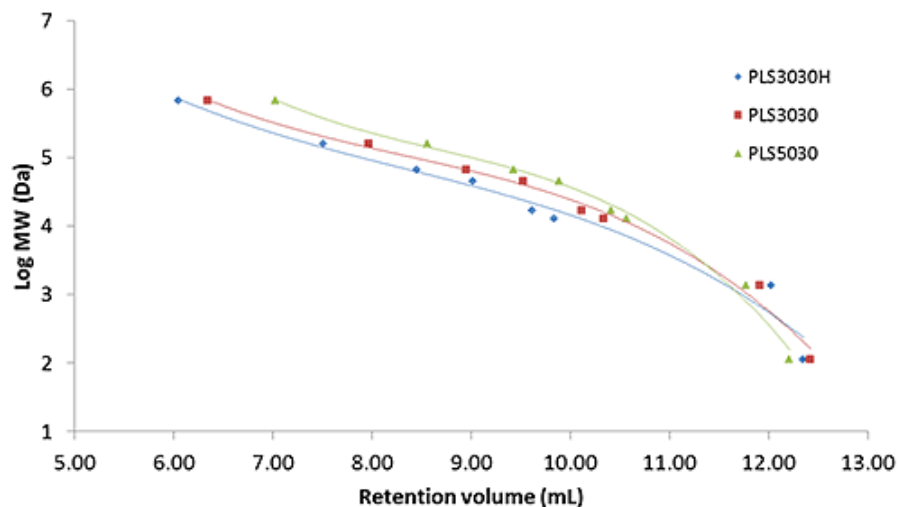


Figure 7: PLS-column calibration curves. Samples are various proteins in PBS

Table 12: PLS column details.

Part Number	Grade	Particle Size (µm)	Exclusion Limit MW Protein	Max. pore size (Å)	Max. Pressure (MPa)
CLM5004	PLS5030 Protein LS col	5	1,250,000	300	5.0
CLM5007	PLS5200G Protein LS guard col	5	Guard column		
CLM5008	PLS3030 Protein LS col high-res	3	1,250,000	300	5
CLM5012	PLS3030G Protein LS guard col high-res	3	Guard column		
CLM5013	PLS3030H Protein LS col high-res hydrophobic	3	1,250,000	300	5
CLM5017	PLS3030G Protein LS guard col high-res hydrophobic	3	Guard column		



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