



HICHROM

Chromatography Columns and Supplies

LC COLUMNS
Shodex

Catalogue 9

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- Silica- and polymer-based phases
- Columns for all chromatographic modes
- Wide application range
- Capillary, microbore, analytical and preparative dimensions



Showa Denko K.K., Japan manufactures the Shodex® line of HPLC columns for the pharmaceutical and biotechnology industries. A wide range of products with both silica-based and polymer-based materials is available. An overview of the products is shown on the following pages: reversed-phase (page 210), ligand exchange (page 211), ion-exchange and ion chromatography (page 212), size exclusion (page 213), HIC (page 214) and affinity (page 214). Please enquire for additional details.

Shodex Reversed-Phase Columns

The Shodex product range contains both polymer-based and silica-based phases. Please enquire for ordering details where not listed.

Reversed-Phase (Polymer-based) Phases

The table below lists the polymer-based phases available.

Column Series	Base Material	Functional Group	Comments/Applications
RSpak RP18, DS	Styrene-divinylbenzene	-	Analysis of proteins and peptides
RSpak DE, GOLF, CARB	Polymethacrylate	-	DE series columns have similar selectivity to C18 columns
RSpak DM-614	Polyhydroxymethacrylate	-	Suitable for analysis of amino acids and polypeptides
RSpak NN	Polyhydroxymethacrylate	Sulpho	Suitable for separation of mixtures of neutral and ionic compounds
RSpak JJ-50	Polyvinyl alcohol	Quaternary ammonium	
Asahipak ODP	Polyvinyl alcohol	Octadecyl	Large pore size phases, suitable for high molecular weight compounds eg. proteins, as well as low molecular weight compounds. LC-MS applications
Asahipak ODP2 HP	Polyhydroxymethacrylate	Octadecyl	
Asahipak C8P-50	Polyvinyl alcohol	Octyl	
Asahipak C4P-50	Polyvinyl alcohol	Butyl	
Asahipak NH2P	Polyvinyl alcohol	Amino	Analysis of saccharides (NP)

Shodex ODP2 HP is a macroporous polyhydroxymethacrylate reversed-phase material offering better efficiencies than many other resin-based phases and comparable to that of silica-based C18 columns. It has a recommended pH range of 3 to 12. The high polarity and small pore size (40Å) of this phase is designed to exclude proteins and can be used for the analysis of drugs in biological samples ie. as restricted access material (see Figure 1 for example).

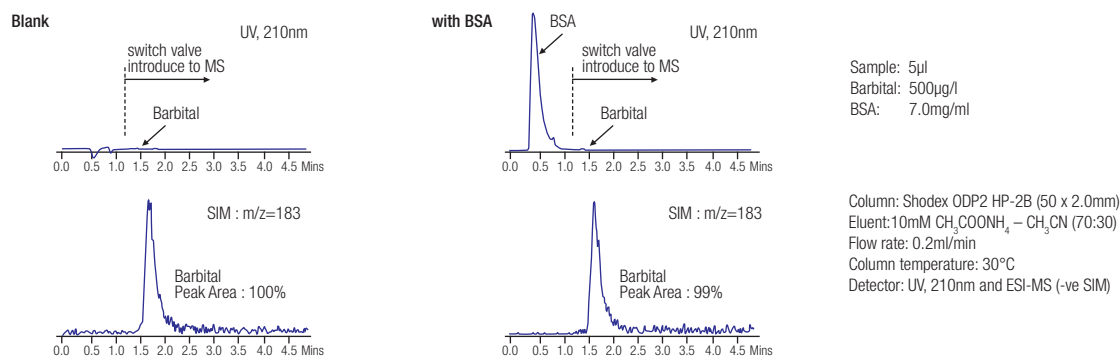


Figure 1. LC-MS of barbitol in BSA

Ordering Information - Shodex ODP2 HP

Product	Particle Size (µm)	Column Dimensions (mm)	Catalogue No.	Price
ODP2 HP-4B	5	50 x 4.6	F7622001	
ODP2 HP-4D	5	150 x 4.6	F7622002	
ODP2 HP-4E	5	250 x 4.6	F7622003	
ODP2 HPG-4A	5	10 x 4.6 (guard column, 1/pk)	F6714010	
ODP2 HP-4GC	5	10 x 4.0 (guard cartridge, 3/pk) ¹	F6714012	
ODP2 HP-2B	5	50 x 2.0	F7622004	
ODP2 HP-2D	5	150 x 2.0	F7622005	
ODP2 HPG-2A	5	10 x 2.0 (guard column, 1/pk)	F6714011	

¹ Use with guard cartridge holder HLD-4GC (Cat. No. F8700020)

Reversed-Phase (Silica-based) Phases

Please enquire for details of reversed-phase silica-based columns, including Silica NPE (nitrophenylethyl) and Silica PYE (pyrenylethyl).

Shodex® Columns for Saccharide Analysis

Ligand Exchange Phases (Shodex SUGAR Series)

Column Series	Base Material	Functional Group	Comments/Applications
SUGAR SH	Styrene-divinylbenzene	Sulpho (H ⁺)	Separation of saccharides by ligand exchange, size exclusion, ion exclusion and normal-phase. Suitable for separation of sugars and sugar alcohols
SUGAR SC	Styrene-divinylbenzene	Sulpho (Ca ²⁺)	
SUGAR SP	Styrene-divinylbenzene	Sulpho (Pb ²⁺)	
SUGAR SZ	Styrene-divinylbenzene	Sulpho (Zn ²⁺)	
SUGAR KS	Styrene-divinylbenzene	Sulpho (Na ⁺)	Separation of saccharides by size exclusion and ligand exchange
USPpak MN	Styrene-divinylbenzene	Sulpho (Ca ²⁺)	Analysis of mannitol by USP method

There are two series of Shodex® columns for saccharide analysis – the SUGAR series for operation in ligand exchange mode and Asahipak NH2P-50 polymeric amino columns for normal-phase and HILIC modes.

A. Shodex SUGAR Series

The SUGAR series columns are based on polystyrene-divinylbenzene copolymer with strong cation-exchange resin incorporating functional sulpho groups coupled with metal counter ions (H⁺, Ca²⁺, Pb²⁺, Zn²⁺, Na⁺).

B. Shodex Asahipak NH2P

Shodex Asahipak NH2P is an amino bonded column in which polyamine is bonded to a hydrophilic polyvinyl alcohol polymer. The high separation power of conventional silica-based columns is maintained, whilst showing an increased usable pH range (2 – 13) and increased robustness. Figure 2 illustrates the reproducibility over time obtained from the polymeric Asahipak NH2P column.

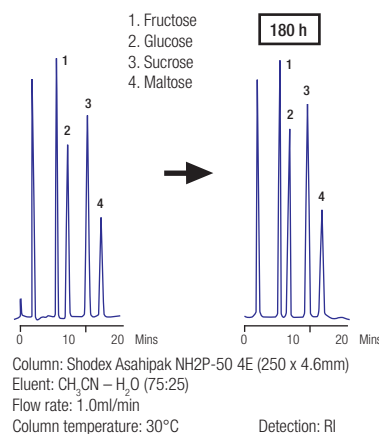


Figure 2. Reproducibility with Asahipak NH2P-50

Ordering Information - Columns for Saccharide Analysis

Product	Counter Ion	Separation Mode	Exclusion Limit (Da)	Particle Size (µm)	Column Dimensions ¹ (mm)	Catalogue No.	Price
SUGAR SH1011	H ⁺	SEC + IEX	1,000	6	300 x 8.0	F6378100	
SUGAR SH1821	H ⁺	SEC + IEX	10,000	6	300 x 8.0	F6378101	
SUGAR SH-G	H ⁺	-	Guard column	10	50 x 6.0	F6700080	
SUGAR SC1011	Ca ²⁺	SEC + LEX	1,000	6	300 x 8.0	F6378102	
SUGAR EP SC1011-7F	Ca ²⁺	SEC + LEX	1,000	6	300 x 7.8	F6379300	
SUGAR SC1821	Ca ²⁺	SEC + LEX	10,000	6	300 x 8.0	F6378103	
SUGAR SC-LG	Ca ²⁺	-	Guard column	10	50 x 6.0	F6700090	
SUGAR SP0810	Pb ²⁺	SEC + LEX	1,000	7	300 x 8.0	F6378105	
SUGAR SP-G	Pb ²⁺	-	Guard column	10	50 x 6.0	F6700081	
SUGAR SC1211	Ca ²⁺	NP + LEX	-	6	250 x 6.0	F7001400	
SUGAR SC-G	Ca ²⁺	-	Guard column	10	10 x 4.6	F6700120	
SUGAR SZ5532	Zn ²⁺	NP + LEX	-	6	150 x 6.0	F7001300	
SUGAR SZ-G	Zn ²⁺	-	Guard column	6	10 x 4.6	F6700110	
SUGAR KS-801	Na ⁺	SEC + LEX	1,000	6	300 x 8.0	F6378010	
SUGAR KS-802	Na ⁺	SEC + LEX	10,000	6	300 x 8.0	F6378020	
SUGAR KS-803	Na ⁺	SEC	50,000	6	300 x 8.0	F6378025	
SUGAR KS-804	Na ⁺	SEC	400,000	7	300 x 8.0	F6378035	
SUGAR KS-805	Na ⁺	SEC	5,000,000	17	300 x 8.0	F6378050	
SUGAR KS-806	Na ⁺	SEC	50,000,000	17	300 x 8.0	F6378060	
SUGAR KS-G	Na ⁺	-	Guard column	10	50 x 6.0	F6700020	
SUGAR KS-807	Na ⁺	SEC	200,000,000	30	300 x 8.0	F6378070	
SUGAR KS-807G	Na ⁺	-	Guard column	30	50 x 8.0	F6700021	
USPpak MN-431	Ca ²⁺	LEX	-	8	250 x 4.0	F6379230	
Asahipak Phases							
NH2P-40 3E	-	NP/HILIC	-	4	250 x 3.0	F7630007	
NH2P-50G 3A	-	-	Guard column	5	10 x 3.0	F6710030	
NH2P-50 4D	-	NP/HILIC	-	5	150 x 4.6	F7630002	
NH2P-50 4E	-	NP/HILIC	-	5	250 x 4.6	F7630001	
NH2P-50G 4A	-	-	Guard column	5	10 x 4.6	F6710016	
NH2P-50 2D	-	NP/HILIC	-	5	150 x 2.0	F7630006	
NH2P-50G 2A	-	-	Guard column	5	10 x 2.0	F6713000	
NH2P-LF	-	-	Line filter	-	75 x 8.0	F6710100	

¹ Preparative columns also available

Shodex® Ion-Exchange Phases

Ion-Exchange Phases

Column Series	Base Material	Functional Group	Comments/Applications
IEC QA	Polyhydroxymethacrylate	Quaternary ammonium	Strong anion-exchange
IEC DEAE	Polyhydroxymethacrylate	Diethylaminoethyl	Weak anion-exchange
IEC SP	Polyhydroxymethacrylate	Sulphopropyl	Strong cation-exchange
IEC CM	Polyhydroxymethacrylate	Carboxymethyl	Weak cation-exchange
Asahipak ES-502N	Polyvinyl alcohol	Diethylaminoethyl	Weak anion-exchange
Asahipak ES-502C	Polyvinyl alcohol	Carboxymethyl	Weak cation-exchange
AXpak WA	Polyhydroxymethacrylate	Diethylaminoethyl	Weak anion-exchange, suitable for analysis of nucleic acids
CXpak P	Styrene-divinylbenzene	Sulpho (Na ⁺)	Analysis of amino acids and amino sugars
PIKESS DEAE	Polyhydroxymethacrylate	Diethylaminoethyl	Weak anion-exchange
PIKESS SP	Polyhydroxymethacrylate	Sulphopropyl	Strong cation-exchange

Suitable for analysis of proteins, peptides, DNA, RNA, oligonucleotides

The IEC series (QA and DEAE anion-exchange phases and SP and CM cation-exchange phases) is based on polyhydroxymethacrylate. Columns are suitable for the analysis of relatively high molecular weight compounds, such as proteins. The newer PIKESS materials are non-porous 2.5µm particles, suitable for rapid protein analyses using UHPLC systems (see Figure 3).

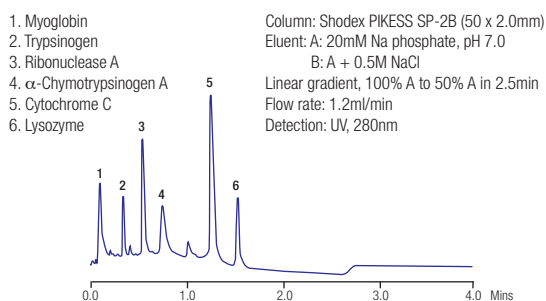


Figure 3. Rapid analysis of proteins using UHPLC and ion-exchange

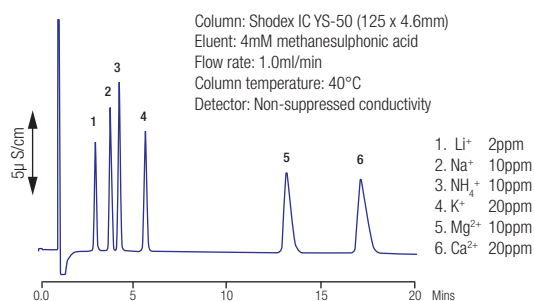


Figure 4. Separation of cations using ion chromatography

Please enquire for ordering details of ion-exchange columns.

Shodex Ion Chromatography Phases

Ion Chromatography Phases

Column Series	Base Material	Functional Group	Comments/Applications
IC NI, I	Polyhydroxymethacrylate	Quaternary ammonium	Anion analysis with non-suppressed detection
IC SI	Polyvinyl alcohol	Quaternary ammonium	Anion analysis with suppressed detection
IC Y, T, R	Styrene-divinylbenzene	Sulpho	Cations by non-suppressed detection. Y for alkylamines. T for transition metals and R for rare earth metals by post-column reaction
IC YK	Silica	Carboxyl	Monovalent and divalent cations by non-suppressed detection
IC YS	Silica	Carboxyl	Higher performance version of YK

A range of Shodex columns are available for both non-suppressed and suppressed ion chromatography. Columns are also supplied for analysing transition metal ions and rare earth metal ions using post-column reactions. Figure 4 shows the separation of six common cations on a Shodex IC YS-50 column with non-suppressed conductivity detection.

Ordering Information - Columns for Ion Chromatography

Column	Particle Size (µm)	Column Dimensions (mm)	Catalogue No.	Price	Guard Column	Catalogue No.	Price
IC NI-424	5	100 x 4.6	F6995243		IC NI-G	F6709616	
IC I-524A	12	100 x 4.6	F6995240		IC IA-G	F6700400	
IC Y-521	12	150 x 4.6	F6995210		IC Y-G	F6700230	
IC YK-421	5	125 x 4.6	F7120012		IC YK-G	F6709608	
IC YS-50	5	125 x 4.6	F7122000		IC YS-G	F6700530	
IC SI-90 4E ¹	9	250 x 4.0	F6995244		IC SI-90G ¹	F6709620	
IC SI-50 4E ¹	5	250 x 4.0	F6995245		IC SI-50G ¹	F6709625	
IC T-521 ¹	12	150 x 4.6	F6995250		IC T-G ¹	F6700412	
IC R-621	5	50 x 6.0	F6998000		IC R-G	F6709090	

¹ PEEK hardware

Shodex® GFC Phases

Aqueous SEC (GFC) Phases

Column Series	Base Material	Functional Group	Comments/Applications
PROTEIN KW	Silica	Hydrophilic polymer	Analysis of high MW biological fluids. Suitable for separating proteins of MW few thousand to few million Da
OHpak SB	Polyhydroxymethacrylate	-	Analysis of water-soluble samples and for molecular weight distribution

PROTEIN KW-800 and KW400 are silica based series with high protein recovery rates. Whereas the KW-800 columns have the highest sample loading, the reduced particle size of KW400 columns enable 3-4 times greater sensitivity. Figure 5 illustrates the enhanced sensitivity achieved for a range of proteins with a KW400 column.

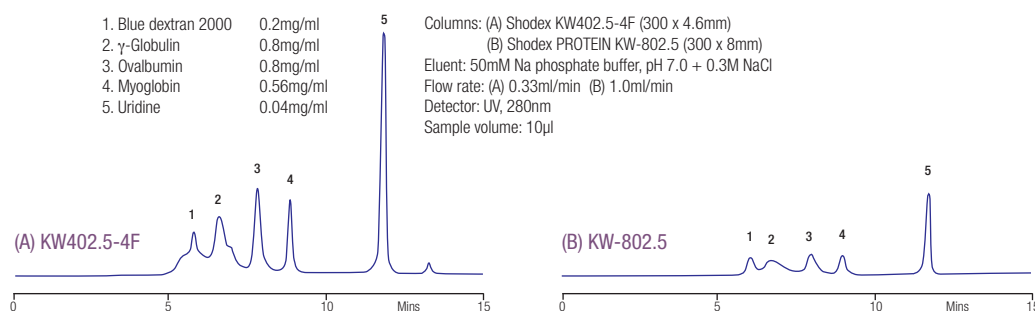


Figure 5. Comparison between KW400 and KW-800 columns

The OHpak SB-800 and SB400 series are based on polyhydroxymethacrylate and are used for the analysis of a wide range of molecular weight compounds.

Ordering Information – GFC Columns

PROTEIN Product	Particle Size (µm)	Pore Size (Å)		Exclusion Limit (Da)		Column Dimensions (mm)	Catalogue No.	Price
		Average	Maximum	Pullulan	Protein			
KW-802.5	5	150	400	60,000	150,000	300 x 8.0	F6989000	
KW-803	5	300	1,000	170,000	700,000	300 x 8.0	F6989103	
KW-804	7	500	1,500	500,000	1,000,000	300 x 8.0	F6989104	
KW-G	7	Guard column				50 x 6.0	F6700131	
KW402.5-4F	3	150	400	60,000	150,000	300 x 4.6	F6989201	
KW403-4F	3	250	800	150,000	600,000	300 x 4.6	F6989202	
KW404-4F	5	500	1,500	500,000	1,000,000	300 x 4.6	F6989203	
KW405-4F	5	700	2,000	1,300,000	20,000,000	300 x 4.6	F6989204	
KW400G-4A	5	Guard column				10 x 4.6	F6700132	

OHpak Product	Particle Size (µm)	Pore Size (Å) (Maximum)	Exclusion Limit (Da)		Column Dimensions (mm)	Catalogue No.	Price	
			Pullulan	Protein				
SB-802 HQ	8	100	4,000		300 x 8.0	F6429100		
SB-802.5 HQ	6	200	10,000		300 x 8.0	F6429101		
SB-803 HQ	6	800	100,000		300 x 8.0	F6429102		
SB-804 HQ	10	2,000	1,000,000		300 x 8.0	F6429103		
SB-805 HQ	13	7,000	4,000,000		300 x 8.0	F6429104		
SB-806 HQ	13	15,000	20,000,000		300 x 8.0	F6429105		
SB-806M HQ	13	15,000	20,000,000		300 x 8.0	F6429106		
SB-G	10	Guard column				50 x 6.0	F6709430	
SB-807 HQ	35	30,000	500,000,000		300 x 8.0	F6429108		
SB-807G	35	Guard column				50 x 8.0	F6709431	
SB401-4E	10	40	1,000		250 x 4.6	F6429111		
SB402.5-4E	6	200	10,000		250 x 4.6	F6429112		
SB403-4E	6	800	100,000		250 x 4.6	F6429113		
SB404-4E	7	2,000	1,000,000		250 x 4.6	F6429114		
SB400G-4A	7	Guard column				10 x 4.6	F6709432	

Other Shodex® Phases

Aqueous/Organic SEC Phases

Column Series	Base Material	Functional Group	Comments/Applications
Asahipak GF	Polyvinyl alcohol	None	Both water and organic solvents can be used. Suitable for samples with both hydrophilic and hydrophobic moieties.

The Asahipak GF Series columns are based on polyvinyl alcohol and can be used with both aqueous and organic solvents. Please enquire for further details and ordering information for aqueous/organic SEC phases.

Organic SEC (GPC) Phases

Column Series	Base Material	Functional Group	Comments/Applications
GPC KF, K, KD, HFIP, LF, HT, UT, AT	Styrene-divinylbenzene	None	KF-800 series shipped in THF. K-800 series shipped in CHCl ₃ . KD-800 series shipped in DMF – suitable for assay of polar polymers. HFIP suitable for engineering plastics eg. PET, polyamides. HT, UT and AT series for higher temperature GPC.

Please enquire for further details and ordering information for organic SEC (GPC) phases.

Hydrophobic Interaction Phase

Column Series	Base Material	Functional Group	Comments/Applications
HIC PH	Polyhydroxymethacrylate	Phenyl	Analysis of proteins

The HIC PH-814 column separates proteins without denaturation. It is applicable to samples after treatment of ammonium sulphate fractions.

Organic Acids Phase

Column Series	Base Material	Functional Group	Comments/Applications
RSpak KC	Styrene-divinylbenzene	Sulpho	Analysis of organic acids by ion exclusion and reversed-phase modes

Shodex® RSpak KC columns are suitable for the analysis of organic acids by ion exclusion and reversed-phase modes.

Affinity Phases

Column Series	Base Material	Functional Group	Comments/Applications
AFpak 6 kinds	Polyhydroxymethacrylate	6 kinds of ligand	Purification of biological molecules depending on biochemical affinity

The Shodex AFpak range of affinity columns consists of 6 different ligand materials, designed for specific applications.

Chiral Separation Phases

Column Series	Base Material	Functional Group	Comments/Applications
ORpak CDA, CDB, CDC	Polyhydroxymethacrylate	Cyclodextrin derivative	Suitable for separation of optical isomers and structural isomers. CDA is α -CD, CDB is β -CD, CDC is γ -CD
ORpak CDBS	Silica	Cyclodextrin derivative	CDBS is β -CD
ORpak CRX	Polyhydroxymethacrylate	L-amino acid derivative	Separation of amino acids by ligand exchange

Shodex ORpak CD phases consist of α -, β - or γ -cyclodextrin bonded to polyhydroxymethacrylate base material or silica (α -cyclodextrin). Shodex ORpak CRX columns have an L-amino acid derivative bonded to polyhydroxymethacrylate and are suitable for the separation of optical isomers of amino acids and hydroxy acids.

Please contact Hichrom for further information on any Shodex column and for ordering information for columns not listed.

