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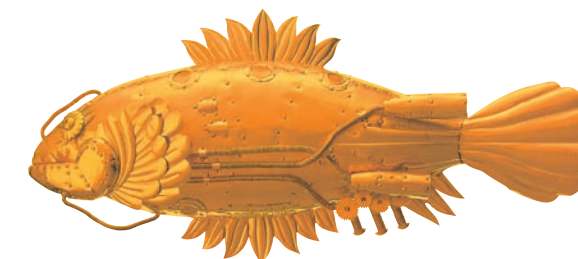
Manufactured by

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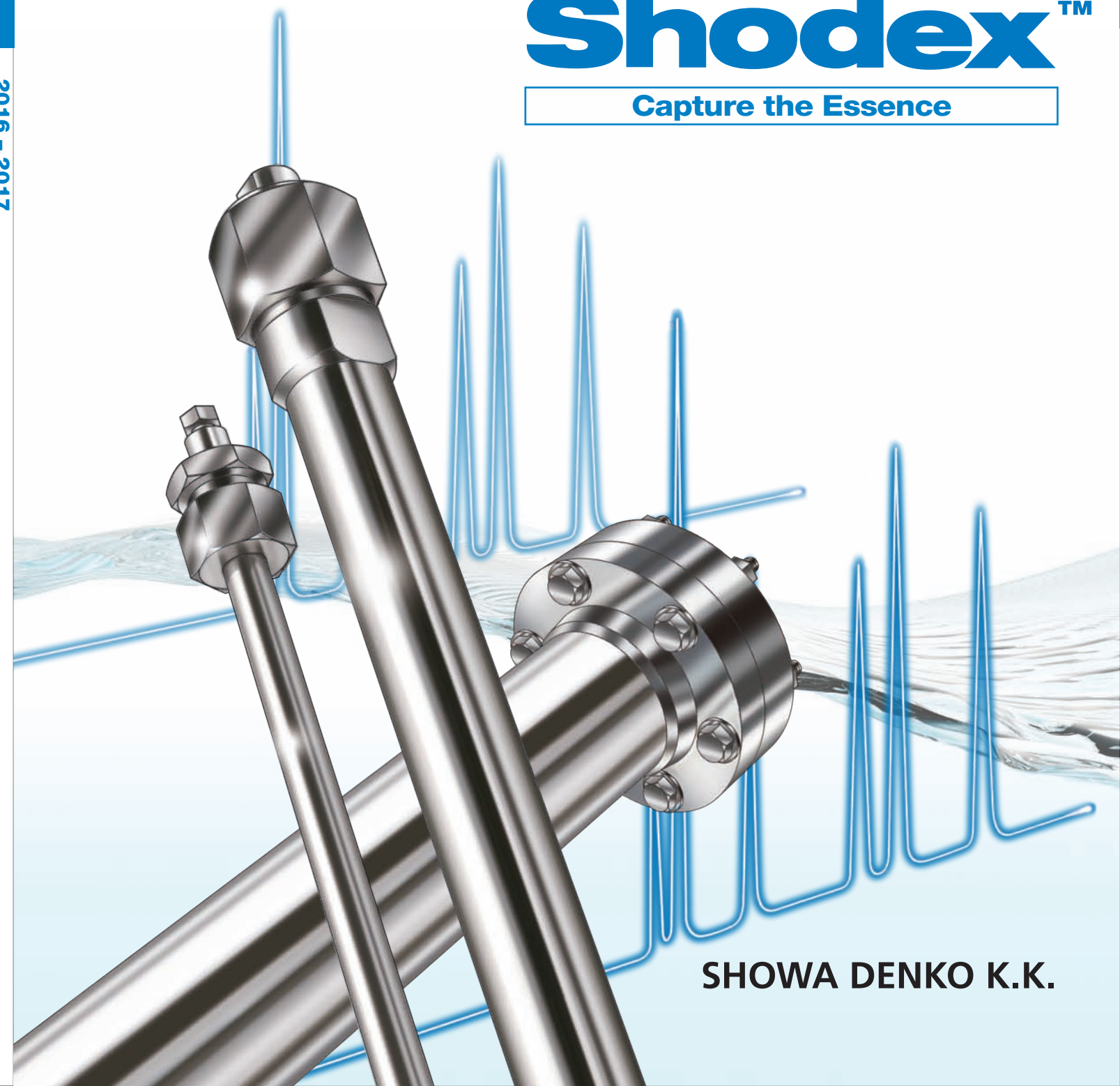
HPLC Columns 2016-2017



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Shodex™ HPLC Columns

2016 - 2017



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- [Caution]
1. Please read the operating manual included on the product carefully before use.
 2. For improvement purposes, some specifications are subject to change without notice.
 3. Provided to help you select the appropriate column, the figures and descriptions in this catalogue are not guaranteed and do not warrant suitability for your applications.
 4. It is essential to take normal precautions when handling reagents and other chemical products even if the safety information is not included on the operating manual.
 5. Products described in this brochure are not intended for medical use or medical applications including medical diagnosis.

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Types of Columns, Base Materials, Functional Groups and Ligands

Separation Type	Product Name		Base Material	Functional Group, Ligand	Page
Reversed Phase & HILIC (Polymer-based)		ODP2 HP	Polyhydroxymethacrylate	—	8
	Asahipak	ODP-50, ODP-40	Polyvinyl alcohol	Octadecyl	10
	Asahipak	C8P-50	Polyvinyl alcohol	Octyl	10
	Asahipak	C4P-50	Polyvinyl alcohol	Butyl	10
	RSpak	RP18-415, DS	Styrene divinylbenzene copolymer	—	12
	RSpak	DE	Polymethacrylate	—	12
	RSpak	DM-614	Polyhydroxymethacrylate	—	12
	RSpak	NN	Polyhydroxymethacrylate	Sulfo	12
	RSpak	JJ-50	Polyvinyl alcohol	Quaternary ammonium	12
	HILICpak	VG-50	Polyvinyl alcohol	Amino	20
Reversed Phase & HILIC & Normal Phase (Silica-based)	HILICpak	VT-50	Polyvinyl alcohol	Quaternary ammonium	20
	Asahipak	NH2P	Polyvinyl alcohol	Amino	22
		ET-RP1	Polyvinyl alcohol	Octadecyl	68
	Silica	C18M, C18P	Silica	Octadecyl	16
	Silica	5C8	Silica	Octyl	17
	Silica	5C4	Silica	Butyl	17
	Silica	5CN	Silica	Cyanopropyl	17
	Silica	5NPE	Silica	Nitrophenylethyl	17
	Silica	5PYE	Silica	Pyrenylethyl	17
	Silica	5SIL	Silica	—	17
Ligand Exchange	Silica	5NH	Silica	Aminopropyl	17
	SUGAR	SC	Styrene divinylbenzene copolymer	Sulfo(Ca ²⁺)	24
	SUGAR	SP0810	Styrene divinylbenzene copolymer	Sulfo(Pb ²⁺)	24
	SUGAR	KS-800	Styrene divinylbenzene copolymer	Sulfo(Na ⁺)	24
	RSpak	DC-613	Styrene divinylbenzene copolymer	Sulfo(Na ⁺)	24
	SUGAR	SZ5532	Styrene divinylbenzene copolymer	Sulfo(Zn ²⁺)	24
	EP	SC1011-7F	Styrene divinylbenzene copolymer	Sulfo(Ca ²⁺)	25
	USPpak	MN-431	Styrene divinylbenzene copolymer	Sulfo(Ca ²⁺)	25
	SUGAR	SH	Styrene divinylbenzene copolymer	Sulfo	28
	RSpak	KC-811	Styrene divinylbenzene copolymer	Sulfo	28
Ion Exclusion	IC	NI-424, I-524A	Polyhydroxymethacrylate	Quaternary ammonium	30
	IC	SI	Polyvinyl alcohol	Quaternary ammonium	30
Ion Chromatography	IC	YS-50	Polyvinyl alcohol	Carboxyl	32
	IC	YK-421	Silica	Carboxyl	32
	IC	Y-521, T-521	Styrene divinylbenzene copolymer	Sulfo	32
Aqueous SEC (GFC)	PROTEIN	KW-800	Silica	Hydrophilic polymer	36
		KW400	Silica	Hydrophilic polymer	36
	OHpak	SB-800 HQ	Polyhydroxymethacrylate	—	38
	OHpak	LB-800	Polyhydroxymethacrylate	—	38
Multimode	Asahipak	GS-HQ	Polyvinyl alcohol	—	42
Aqueous/Organic SEC	Asahipak	GF-HQ	Polyvinyl alcohol	—	44
	MSpak	GF-310	Polyvinyl alcohol	—	44
Organic SEC (GPC)		KF-800, K-800, KD-800, KF-600, KF-400HQ, LF, HT-800, UT-800, AT-806MS HFIP-800, HFIP-600	Styrene divinylbenzene copolymer	—	46, 48, 50, 52, 56, 58, 60
Ion Exchange	IEC	QA-825	Polyhydroxymethacrylate	Quaternary ammonium	64
	IEC	DEAE-825	Polyhydroxymethacrylate	Diethylaminoethyl	64
	IEC	DEAE3N	Polyhydroxymethacrylate	Diethylaminoethyl	64
	PIKESS	DEAE-2B	Polyhydroxymethacrylate	Diethylaminoethyl	64
	Asahipak	ES-502N	Polyvinyl alcohol	Diethylaminoethyl	64
	AXpak	WA-624	Polyhydroxymethacrylate	Diethylaminoethyl	64
	IEC	SP-825	Polyhydroxymethacrylate	Sulfopropyl	66
	IEC	SP-420N	Polyhydroxymethacrylate	Sulfopropyl	66
	PIKESS	SP-2B	Polyhydroxymethacrylate	Sulfopropyl	66
	IEC	CM-825	Polyhydroxymethacrylate	Carboxymethyl	66
	Asahipak	ES-502C	Polyvinyl alcohol	Carboxymethyl	66
	CXpak	P-421S	Styrene divinylbenzene copolymer	Sulfo(Na ⁺)	66
Hydrophobic Interaction	HIC	PH-814	Polyhydroxymethacrylate	Phenyl	68
Affinity	AFpak	Various	Polyhydroxymethacrylate	Various ligand	68
Chiral Separation	ORpak	CDBS-453	Silica	β-Cyclodextrin derivative	68
	ORpak	CRX-853	Polyhydroxymethacrylate	L-Amino acid derivative	68
GPC Clean-up	CLNpak	EV	Styrene divinylbenzene copolymer	—	70
	CLNpak	PAE	Polyvinyl alcohol	—	70
Column Switching Pretreatment	MSpak	PK	Hydrophilic copolymers containing N-vinyl acetamide	—	72
	MSpak	GF-4A	Polyvinyl alcohol	—	72

HPLC Separation Modes

Liquid chromatography (LC) uses liquid as mobile phase (eluent). It is an analytical method that separates a mixture of compounds based on their physical and chemical differences. High performance liquid chromatography (HPLC) is a method that introduces the mobile phase under high-pressure conditions resulting in rapid and high-performance separations. The various interactions between the analyte, stationary phase (packing material), and mobile phase are the key factors for the separation. A wide variety of separation modes can be achieved by using particular combinations of stationary and mobile phases.

Separation mode	Characteristics
Reversed Phase Chromatography (RPC)	• Separation is based on the partition equilibrium between stationary phase and mobile phase. • The polarity of the stationary phase is lower than that of the mobile phase. • Typically the mobile phase contains a mixture of organic solvents (methanol, acetonitrile, or THF) and aqueous solvents (water or buffer). • Using the lower polarity mobile phase causes a faster elution.
Hydrophilic Interaction Chromatography (HILIC)	• Separation is based on hydrophilic interaction. • A high polarity stationary phase is used. • Typically the mobile phase contains a mixture of organic solvents such as acetonitrile and aqueous solvents (water or buffer). • Using the higher polarity mobile phase causes a faster elution. • Applicable for the analysis of high polar substances.
Normal Phase Chromatography (NPC)	• Separation is based on the partition equilibrium between the stationary phase and the mobile phase. • The polarity of the stationary phase is higher than that of the mobile phase. • Typically the mobile phase contains a mixture of organic solvents with different polarities such as hexane and isopropanol. • Using the higher polarity mobile phase causes a faster elution.
Ligand Exchange Chromatography (LEX)	• Separation is based on differences in analytes' coordination complex. • Stationary phase modified with metal sulfonate complex ion. • Works in combination with size exclusion or HILIC modes.
Ion Exclusion Chromatography (IEX)	• Separation is based on electrostatic interaction (repulsion) between the ion exchanger and ionic solutes. • Dissociated ionic molecules elute faster than non-dissociated forms. • Used mainly for the analysis of organic acids.
Ion Chromatography (IC)	• Separation is based on electrostatic interaction (bonding) between the ion exchanger and ionic solutes. • Has a relatively small ion exchange capacity. • Electrical conductivity detector can be used with low-salt concentration mobile phase. • Used mainly for the analysis of inorganic compounds.
Size Exclusion Chromatography (SEC)	• Network or pores on the surface of the packing material works as molecular sieve to separate molecules based on their sizes. • To separate molecules solely based on their sizes, it requires an analytical condition without any analyte and packing gel interaction. • The bigger the molecule size, the faster the elution sequence. • Used for molecular weight or molecular distribution determination of macromolecules and qualification of oligomers.
Ion Exchange Chromatography (IEC)	• Separation is based on electrostatic interactions between the ion exchanger and ionic solutes. • The mobile phase of choice should have a sufficient buffering capacity at the pH that produces the largest charge differences between the analyte of interest. • The elution position is optimized by varying the pH, salt concentration, and/or ionic strength of the mobile phase.
Hydrophobic Interaction Chromatography (HIC)	• Separation is based on hydrophobic interaction. • Hydrophobic functional group is modified on the stationary phase. • Adsorption of analytes generally occurs at a high salt concentration and they are released by lowering the salt concentration. • Used mainly for the analysis of proteins.
Affinity Chromatography (AFC)	• Separation is based on adsorption of the analyte to the specific biologically derived ligand pair. • Highly selective. • A buffer solution with the appropriate pH and ionic strength is selected based on the type of ligand, analytes, and their interaction. • Used mainly for the purification and concentration of biological active substances.
Chiral Separation Chromatography (CS)	• Separation of optical isomers using chiral selectors. • Highly selective.
Multimode Chromatography	• Separation is based on the combination of different modes.

Column Selection by Sample Character and Separation Mode

Sample Solubility	Sample MW	Separation Mode	Sample Solubility	Sample MW	Separation Mode
Aqueous soluble	≥ 2,000	RPC	Organic soluble	≥ 2,000	SEC
		LEX			
		IEX			
		SEC			
		IEC			
		HIC			
		AFC			
		RPC		≤ 2,000	RPC
	≤ 2,000	HILIC			
		LEX			
		IEX			
		IC			NPC
		SEC			
		IEC			
		AFC			
		CS			SEC

RPC : Reversed Phase Chromatography
HILIC : Hydrophilic Interaction Chromatography
NPC : Normal Phase Chromatography
LEX : Ligand Exchange Chromatography
IEX : Ion Exclusion Chromatography
IC : Ion Chromatography
SEC : Size Exclusion Chromatography
IEC : Ion Exchange Chromatography
HIC : Hydrophobic Interaction Chromatography
AFC : Affinity Chromatography
CS : Chiral Separation Chromatography

Column Selection (Application)

Pharmaceuticals, Cosmetics

		Separation Mode	Page
Pharmaceuticals Metabolites Additives	Hydrophobic substances	RPC	8, 10, 12, 16, 17
	Hydrophilic substances	HILIC	20, 22
		IEC+RPC	12
		LEX+SEC	24, 25
	Substances in bio-fluid (serum-plasma-urine)	RPC	8
		SEC+RPC	42, 44, 72
	Polymer	SEC	38, 44, 50, 56
Moisturizers	Polyalcohols	RPC	12
		LEX+SEC	24
		LEX+HILIC	24
		SEC	38, 44
	Protein hydrolysates	RPC	10, 12
		SEC	36
	Mucopolysaccharides	SEC	38
Emulsifiers	Surfactants	SEC+RPC	44
		SEC	46, 52
Preservatives	Paraben Dehydroacetic acid	RPC	10, 12, 16, 17
Optical active materials		CS	68

Foods

		Separation Mode	Page
Nutritional ingredients	Monosaccharides	HILIC	20, 22
	Disaccharides	LEX+SEC	24
	Sugar alcohols	LEX+HILIC	24
	Oligosaccharides	HILIC	20, 22
		LEX+HILIC	24
		SEC	24, 38, 42
	Low molecular water-soluble dietary fiber	SEC	42
	Polysaccharides	SEC	24, 38
	Organic acids	RPC	8, 12
		IEX+RPC	28
		IC	30
	Water-soluble vitamins	RPC	8, 10, 12
		IEC+RPC	12
		HILIC	20, 22
	Fat-soluble vitamins	RPC	10
		NPC	17
		SEC	46, 52
	Fatty acids	RPC	12, 16, 17
		SEC	44, 46, 48, 52
	Nucleic acids (umami)	IEC+SEC	42
Food safety	Amino acids	IEC+IEX+RPC	12
		IC	32
		IEC	66
	Food additives	RPC	10, 12, 68
		HILIC	20, 22
	Pesticides	RPC	12
		IEC+RPC	12
		HILIC	20
		IC	30
	Mycotoxin	RPC	16
	Pretreatment of residual pesticides	SEC GPC (Clean-up)	70

New Materials

		Separation Mode	Page
Synthetic polymers	Organic solvent soluble	SEC	44, 46, 48, 52, 56
	Polar organic solvent soluble		38, 44, 50, 52, 56
	High temperature/ Ultra high temperature		58
	Water-soluble		36, 38, 42, 44
Additives Oligomers		RPC	10, 12, 16, 17
	Organic solvent soluble	SEC	44, 46, 48, 52
	Polar organic solvent soluble		38, 44, 50, 52
	Water-soluble		36, 38, 42, 44

Biotechnology

		Separation Mode	Page
Genomics	Nucleobases Nucleotides Nucleosides	RPC	12
		IEC+SEC	12, 42
		IEC	64
	Oligo nucleic acids	RPC	12
		IEC+SEC	42
		IEC	64
	DNA/RNA	SEC	38, 44
Proteomics	Amino acids	RPC	10
		IEC+IEX+RPC	12
		IEC	66
		IEC+SEC	42
	Peptides Proteins	RPC	10, 12
		SEC	36, 38, 42, 44
Glycomics	Glycoproteins	IEC	64, 66
		HIC	68
		RPC	10, 12
		SEC	36, 38, 42, 44
		IEC	64, 66
		HIC	68
	Sugar chains	AFC	68
		HILIC	20, 22
	Monosaccharides	AFC	68
		HILIC	20, 22
Hormones	Amines	IEC	66
		RPC	10
	Steroids	HILIC	20, 22
		SEC	38, 44
	Sialic acids Uronic acids Aldonic acids	IEX+RPC	28
		IEC+SEC	24
Lipids	Phospholipids	NPC	17
		SEC	44, 46, 52
	Lipoproteins	SEC	38
		AFC	68

Environment

		Separation Mode	Page
Water quality	Anions	IC	30
	Oxyhalides	IC	30
		IEC+HILIC	20
	Cyanide Cyanogen chloride	IEX	28
	Cations	IC	32
	Surfactants	RPC	10, 16
		SEC+RPC	44
	Perchloric acids	IC	30
		IEC+HILIC	20
	Pesticides	RPC	12, 16, 17
		IEC+RPC	12
		HILIC	20
IC		30	
Soil	Anions	IC	30
	Heavy metals	IC	32
	Humic substances	SEC	38
	Organic arsenic	IEX+RPC	12
	Pesticides	RPC	12, 16, 17
		IEC+RPC	12
		HILIC	20
		IC	30
Environmental hormones	Pretreatment of Phthalates PCBs Benzo [a] pyrene	SEC GPC (Clean-up)	70
Bioethanols	Monosaccharides Oligosaccharides	HILIC	20, 22
		LEX+SEC	24
	Oligosaccharides Alcohols Furfural	LEX+SEC	24
	Saccharides Organic acids Alcohols Furfural	IEX+RPC+SEC	28
	Hemicelluloses Celluloses	SEC	50, 56
Biodiesels	Cations	IC	32
	Fatty acid glycerides	SEC	44
	Fatty acid methyl esters	RPC	12
	Organic acids	IC	30

Separation Mode (Page 4 and Page 5)

- RPC : Reversed Phase Chromatography
HILIC : Hydrophilic Interaction Chromatography
NPC : Normal Phase Chromatography
LEX : Ligand Exchange Chromatography
IEX : Ion Exclusion Chromatography
IC : Ion Chromatography
SEC : Size Exclusion Chromatography
IEC : Ion Exchange Chromatography
HIC : Hydrophobic Interaction Chromatography
AFC : Affinity Chromatography
CS : Chiral Separation Chromatography

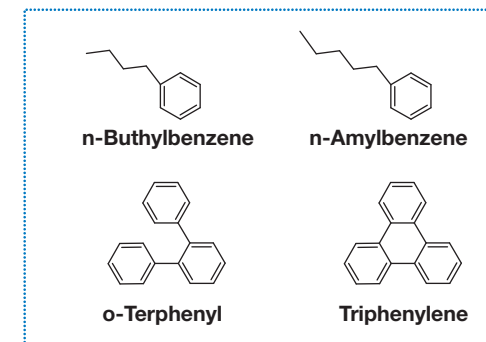
Comparison of the Features Among Shodex Reverse Phase Chromatography (RPC) Columns

ODS columns are the most popular reversed phase columns that are packed with silica-based octadecyl group. Shodex provides not only ODS columns but also polymer-based reversed phase columns with different functional groups. You can choose a suitable column for your application based on the features listed below.

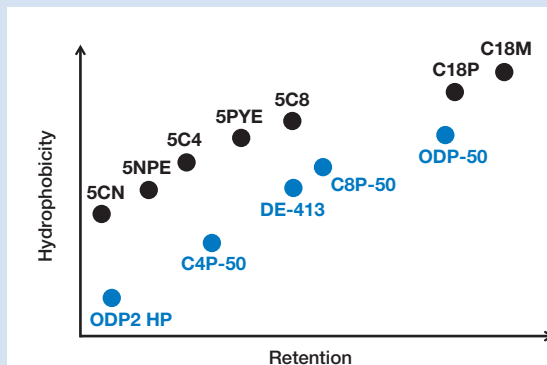
Features

ODP2 HP	- Provides a large theoretical plate number nearly twice as much as generally available polymer-based reversed phase columns - Offers enhanced retention of high polar substances compared to ODS columns - Suitable for the analysis of small molecules such as pharmaceuticals in the presence of protein matrix - Ideal for LC/MS analysis of high polar compounds - Corresponds to USP L39
ODP-50	Relatively large pore size is suitable for the analysis of amino acids, peptides, and proteins
C8P-50	Usable in a wide pH range from pH 2 to 13
C4P-50	- Usable in 100% water or buffer solution - Best used for the analysis of basic substances - ODP-50 corresponds to USP L67
ODP-40	- Higher performance type of ODP-50 series - Corresponds to USP L67
RP18-415	- Large pore size is suitable for the analysis of proteins and peptides - Corresponds to USP L21
DS-613 DS-413	- Suitable for reversed phase analysis of highly hydrophilic substances, that are not well retained by ODS columns - Corresponds to USP L21
DE	- Polymer-based columns, with similar polarity to that of ODS columns, can be used in general purposes - Wide working pH range (from pH 2 to 12), usable in 100% water and buffer solutions - Corresponds to USP L71
DM-614	- Suitable for the analysis of amino acids and water-soluble vitamins - Corresponds to USP L39
NN	- The packing material contains sulfo groups, and supports multimode (reversed phase and cation exchange) analysis - Ideal for the analysis of complex samples containing neutral and ionic substances
JJ-50	- The packing material contains trace amounts of quaternary ammonium groups, and supports multimode (reversed phase and anion exchange) analysis - Ideal for analysis of complex samples containing neutral and ionic substances
C18M	- Monomeric type ODS column, fully end capped high purity silica (99.99% or higher) - Corresponds to USP L1
C18P	- Polymeric type ODS column, fully end capped high purity silica (99.99% or higher) - Excellent acid tolerance - Advantageous for separating planar and nonplanar compounds from each other - Corresponds to USP L1
5C8	- Use when the retention capacity of C18 is too strong or that of C4 is too weak - Applicable to ion pair chromatography, because of its rapid mass transfer and equilibrium - Corresponds to USP L7
5C4	- Use when the retention capacity of C18 or C8 is too strong - Corresponds to USP L26
5CN	- Utilizes reversed phase interaction and π-electron interaction to separate regioisomers, which typically cannot be separated with ODS, C8, or C4 columns - Corresponds to USP L10
5NPE 5PYE	- Utilizes several types of interactions based on π-electrons to separate structural isomers 5NPE corresponds to USP L67

The interrelation between hydrophobicity and retention, and the interrelation between steric selectivity and retention were compared among Shodex columns for reversed phase chromatography. The retention factor (k') of amylbenzene was used as the retention, the separation factor (α) between n-butylbenzene and n-amino benzene was used as the hydrophobicity. The separation factor between o-terphenyl and triphenylene was used as the steric recognition. Larger separation factor means higher hydrophobicity and higher steric selectivity.

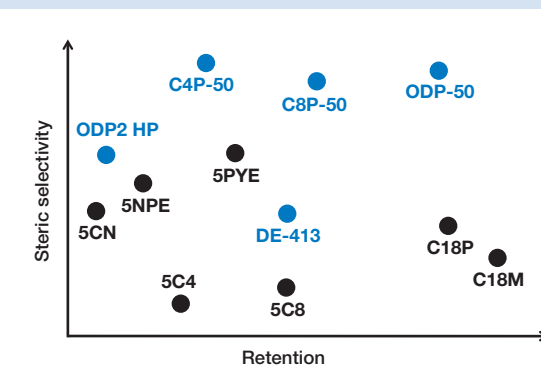


Interrelation between hydrophobicity and retention



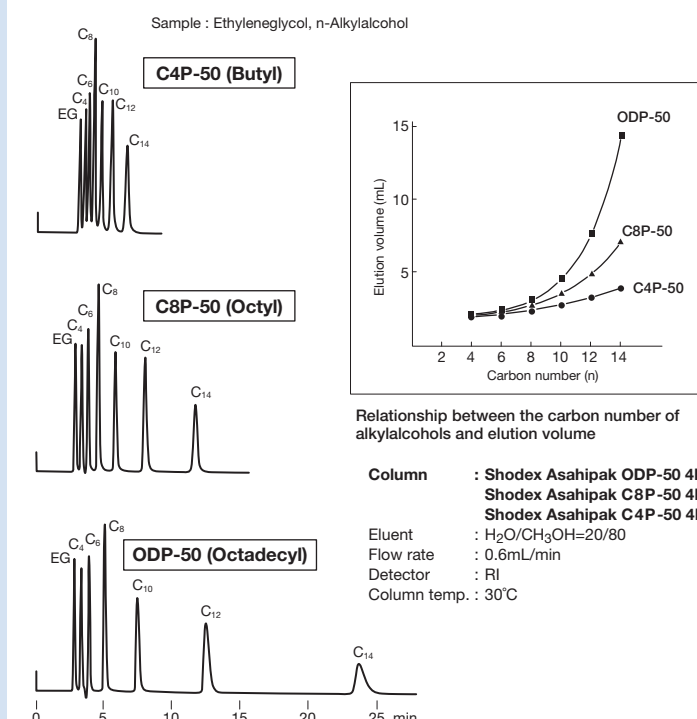
Column size : 4.6mm I.D. x 150mm each
Eluent : H₂O/CH₃OH=20/80
Flow rate : 1.0mL/min
Detector : UV (254nm)
Column temp. : 40°C

Interrelation between steric selectivity and retention

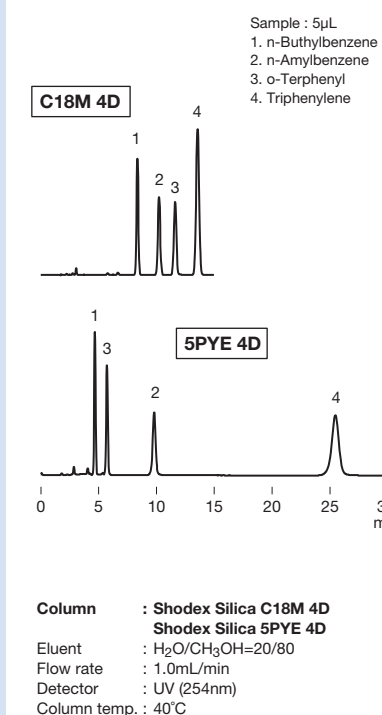


Column size : 4.6mm I.D. x 150mm each
Eluent : H₂O/CH₃OH=20/80
Flow rate : 1.0mL/min
Detector : UV (254nm)
Column temp. : 40°C

Comparison of separation of alkylalcohol due to different functional groups



Comparison of separation due to the difference in steric selectivity



Columns for Polymer-based Reversed Phase Chromatography (ODP2 HP)

Please refer to “Comparison of the Features Among Shodex Reverse Phase Chromatography (RPC) Columns” on page 6 and 7 for features.

Standard columns

Product Code	Product Name	Plate Number (TP/column)	Functional Group	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length	Shipping Solvent
F7622001	ODP2 HP-4B	≥ 3,500	–	5	40	4.6 × 50	H ₂ O/CH ₃ CN=55/45
F7622002	ODP2 HP-4D	≥ 13,000	–	5	40	4.6 × 150	H ₂ O/CH ₃ CN=55/45
F7622003	ODP2 HP-4E	≥ 17,000	–	5	40	4.6 × 250	H ₂ O/CH ₃ CN=55/45
F6714010	ODP2 HPG-4A	(guard column)	–	5	–	4.6 × 10	H ₂ O/CH ₃ CN=55/45
F7622004	ODP2 HP-2B	≥ 3,000	–	5	40	2.0 × 50	H ₂ O/CH ₃ CN=55/45
F7622005	ODP2 HP-2D	≥ 7,000	–	5	40	2.0 × 150	H ₂ O/CH ₃ CN=55/45
F6714011	ODP2 HPG-2A	(guard column)	–	5	–	2.0 × 10	H ₂ O/CH ₃ CN=55/45

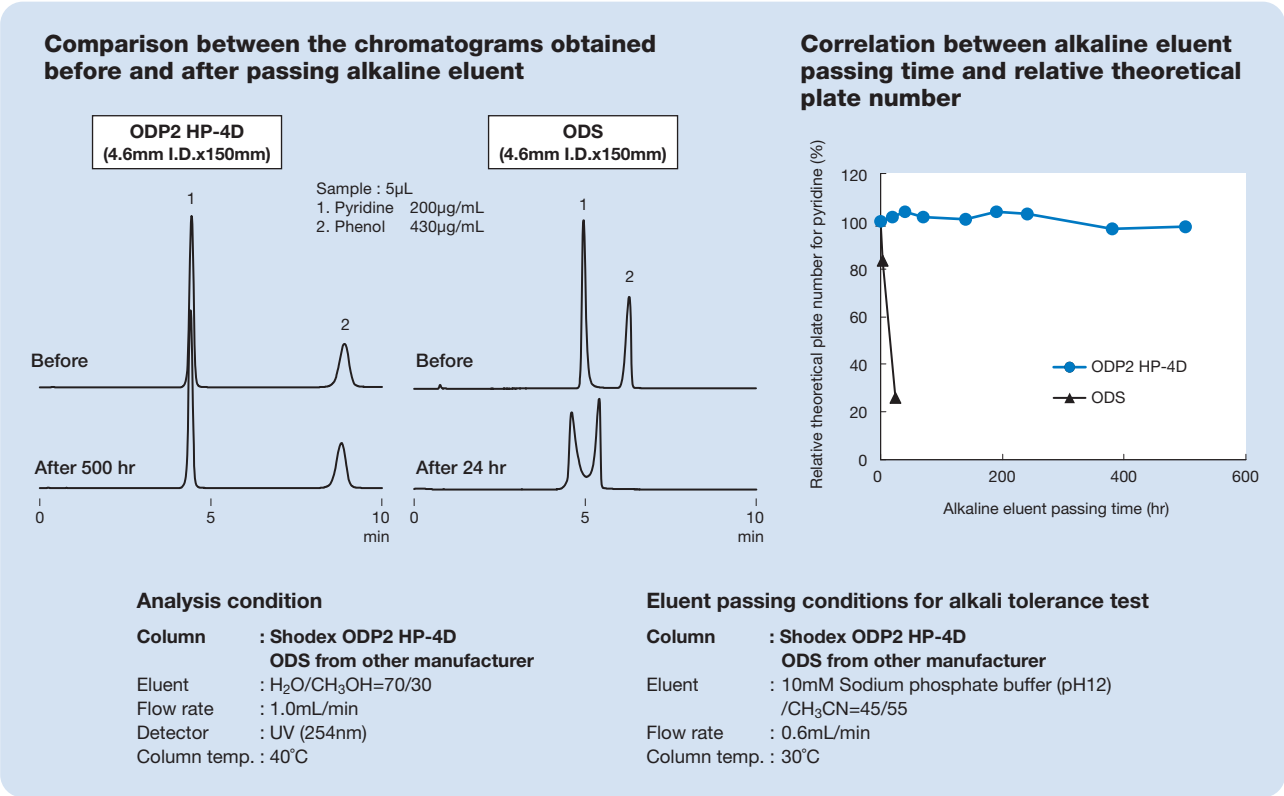
Base Material : Polyhydroxymethacrylate

3mm I.D columns [Customized columns]

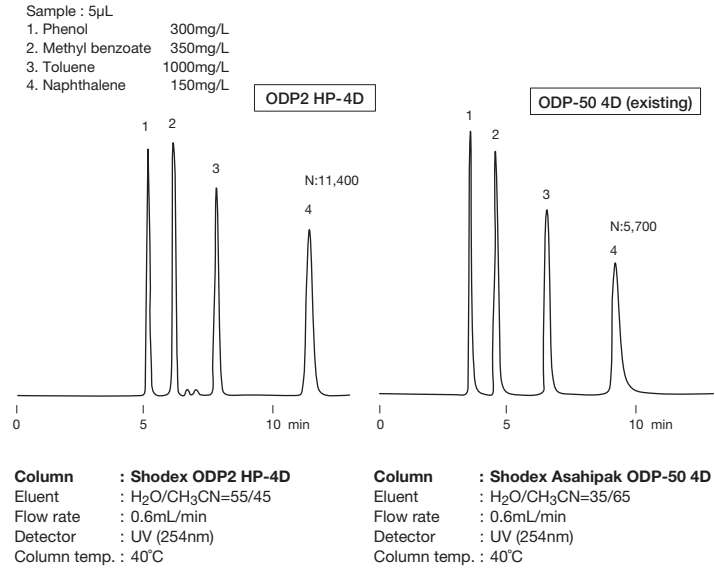
Product Code	Product Name	Functional Group	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length
F7622006	ODP2 HP-3B	–	5	40	3.0 × 50
F7622007	ODP2 HP-3D	–	5	40	3.0 × 150
F6714014	ODP2 HPG-3A (guard column)	–	5	–	3.0 × 10

Base Material : Polyhydroxymethacrylate

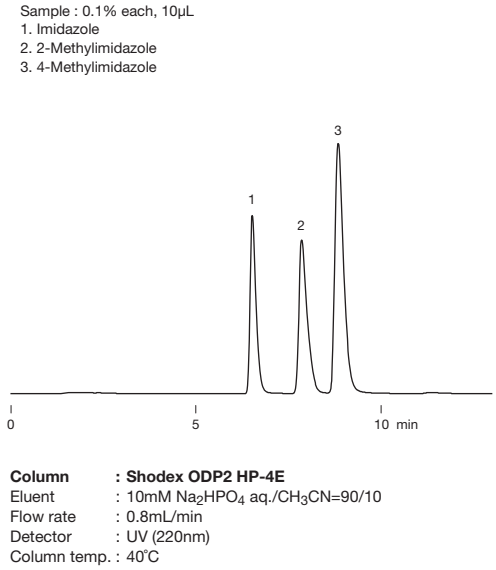
Tolerance of ODP2 HP for alkaline condition



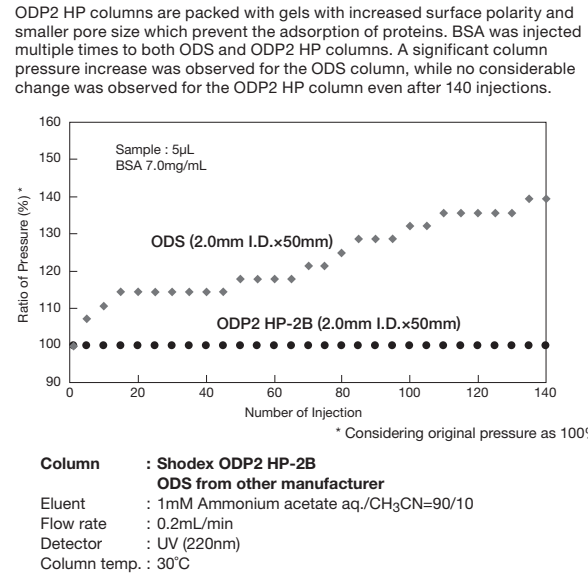
Comparison between ODP2 HP and ODP-50 (existing)



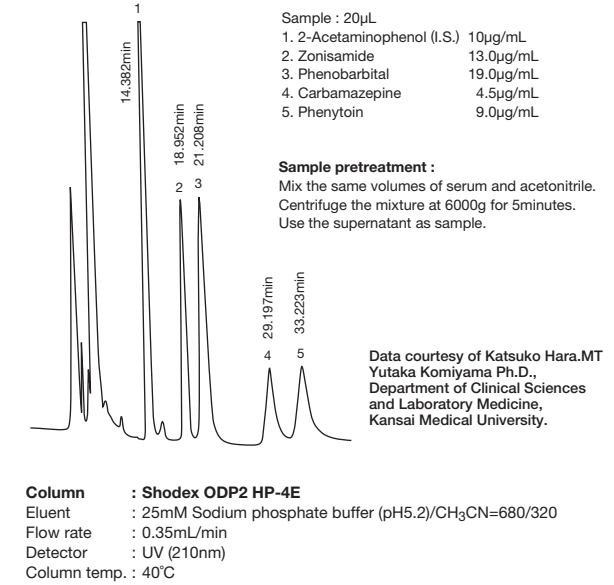
Imidazoles



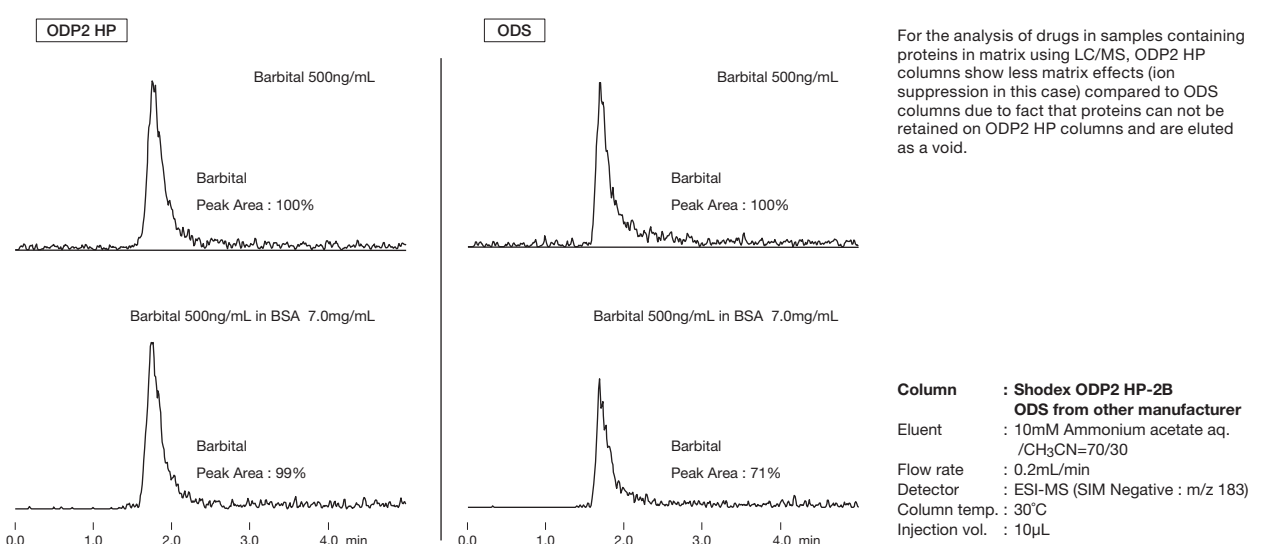
Influence of repeated protein injection on column pressure



Anticonvulsant in serum



Barbital recovery rate comparison of ODP2 HP-2B and ODS in the presence of BSA



Columns for Polymer-based Reversed Phase Chromatography (Asahipak)

Please refer to “Comparison of the Features Among Shodex Reverse Phase Chromatography (RPC) Columns” on page 6 and 7 for features.

Standard columns

Product Code	Product Name	Plate Number (TP/column)	Functional Group	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length	Shipping Solvent
F7621001	Asahipak ODP-40 4D	≥ 11,000	Octadecyl	4	250	4.6 × 150	H ₂ O/CH ₃ CN=35/65
F7621002	Asahipak ODP-40 4E	≥ 17,000	Octadecyl	4	250	4.6 × 250	H ₂ O/CH ₃ CN=35/65
F7620002	Asahipak ODP-50 6D	≥ 9,000	Octadecyl	5	250	6.0 × 150	H ₂ O/CH ₃ CN=35/65
F7620001	Asahipak ODP-50 6E	≥ 14,000	Octadecyl	5	250	6.0 × 250	H ₂ O/CH ₃ CN=35/65
F6710001	Asahipak ODP-50G 6A	(guard column)	Octadecyl	5	—	6.0 × 10	H ₂ O/CH ₃ CN=35/65
F6710023	Asahipak ODP-50 4B	≥ 2,500	Octadecyl	5	250	4.6 × 50	H ₂ O/CH ₃ CN=35/65
F7620004	Asahipak ODP-50 4D	≥ 9,000	Octadecyl	5	250	4.6 × 150	H ₂ O/CH ₃ CN=35/65
F7620003	Asahipak ODP-50 4E	≥ 14,000	Octadecyl	5	250	4.6 × 250	H ₂ O/CH ₃ CN=35/65
F6710022	Asahipak ODP-50G 4A	(guard column)	Octadecyl	5	—	4.6 × 10	H ₂ O/CH ₃ CN=35/65
F7620009	Asahipak ODP-50 2D	≥ 5,000	Octadecyl	5	250	2.0 × 150	H ₂ O/CH ₃ CN=35/65
F6713001	Asahipak ODP-50G 2A	(guard column)	Octadecyl	5	—	2.0 × 10	H ₂ O/CH ₃ CN=35/65
F7620006	Asahipak C8P-50 4D	≥ 7,000	Octyl	5	250	4.6 × 150	H ₂ O/CH ₃ CN=35/65
F7620005	Asahipak C8P-50 4E	≥ 11,000	Octyl	5	250	4.6 × 250	H ₂ O/CH ₃ CN=35/65
F6710002	Asahipak C8P-50G 4A	(guard column)	Octyl	5	—	4.6 × 10	H ₂ O/CH ₃ CN=35/65
F7620008	Asahipak C4P-50 4D	≥ 6,000	Butyl	5	250	4.6 × 150	H ₂ O/CH ₃ CN=35/65
F7620007	Asahipak C4P-50 4E	≥ 9,000	Butyl	5	250	4.6 × 250	H ₂ O/CH ₃ CN=35/65
F6710003	Asahipak C4P-50G 4A	(guard column)	Butyl	5	—	4.6 × 10	H ₂ O/CH ₃ CN=35/65

Base Material : Polyvinyl alcohol

3mm I.D columns [Customized columns]

Product Code	Product Name	Functional Group	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length
F7621101	Asahipak ODP-40 3B	Octadecyl	4	250	3.0 × 50
F7621102	Asahipak ODP-40 3D	Octadecyl	4	250	3.0 × 150
F6714013	Asahipak ODP-40G 3A (guard column)	Octadecyl	4	250	3.0 × 10

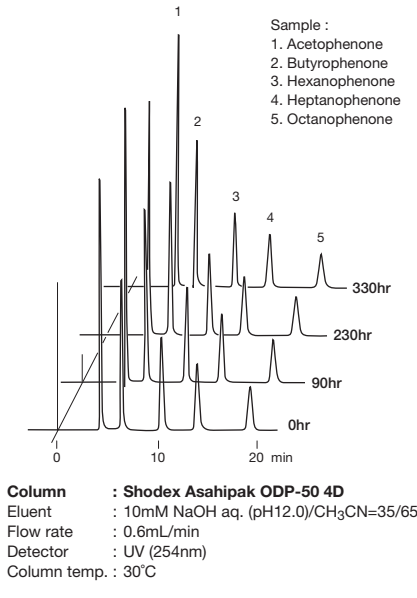
Semi-micro columns * The following semi-micro columns are made to order.

Product Code	Product Name	Functional Group	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length
F7838023	ODP40-2B	Octadecyl	4	250	2.0 × 50
F7838022	ODP40-2D	Octadecyl	4	250	2.0 × 150

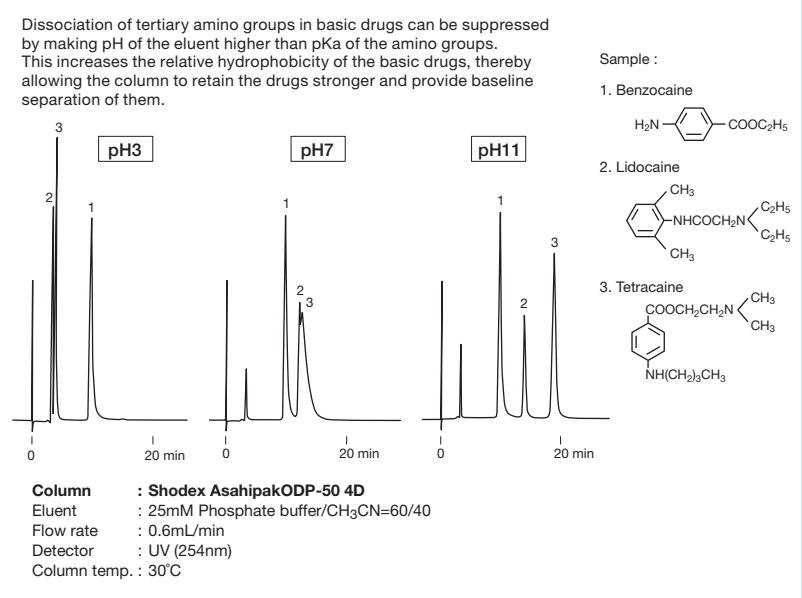
Preparative columns * Preparative columns are made to order.

Product Code	Product Name	Plate Number (TP/column)	Particle Size (μm)	Column Size (mm) I.D. x Length	Standard Column
F6820001	Asahipak ODP-50 10E	≥ 10,000	5	10.0 × 250	ODP-40, ODP-50
F6820035	Asahipak ODP-90 20F	≥ 9,000	9	20.0 × 300	ODP-40, ODP-50
F6710004	Asahipak ODP-130G 7B	(guard column)	13	7.5 × 50	(guard column)
F6820003	Asahipak C8P-50 10E	≥ 8,000	5	10.0 × 250	C8P-50
F6714004	Asahipak C8P-50G 7B	(guard column)	5	7.5 × 50	(guard column)
F6820005	Asahipak C4P-50 10E	≥ 7,000	5	10.0 × 250	C4P-50
F6714005	Asahipak C4P-50G 7B	(guard column)	5	7.5 × 50	(guard column)

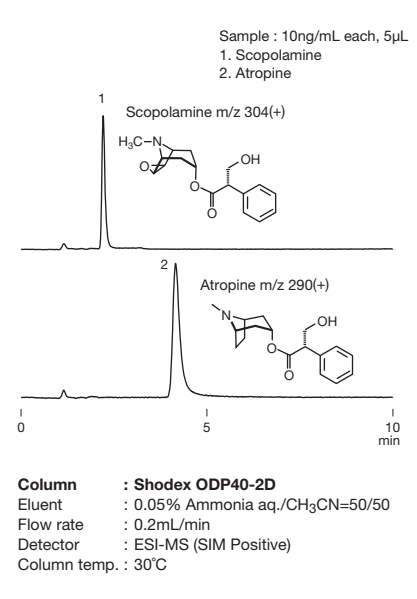
Tolerance of ODP-50 for alkaline condition



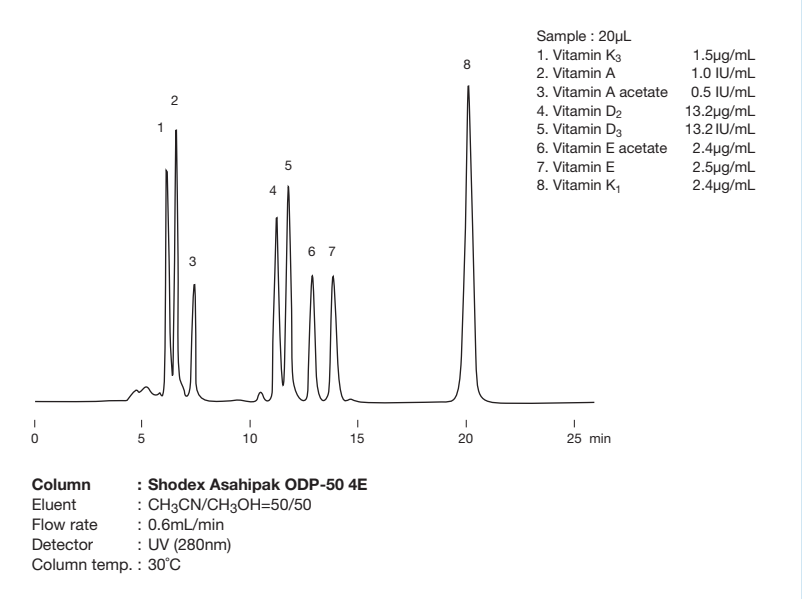
Local anesthetics



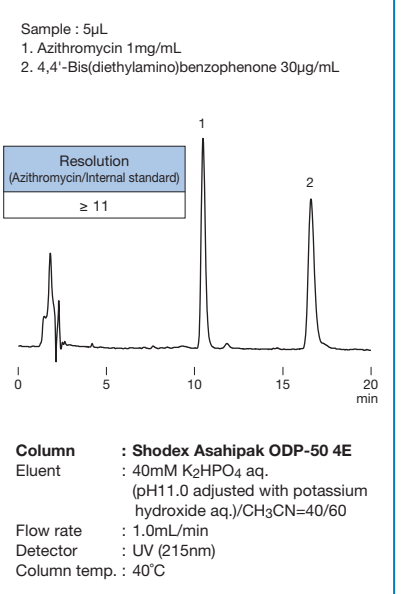
LC/MS analysis of basic drugs



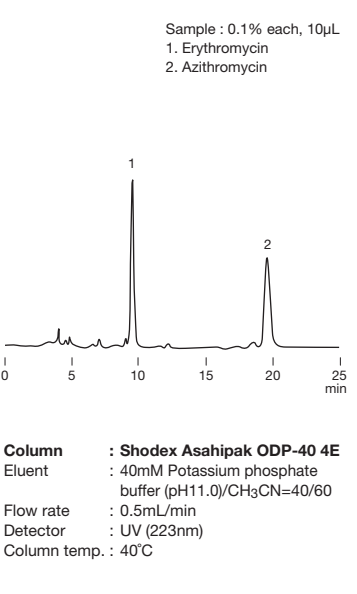
Fat-soluble vitamins



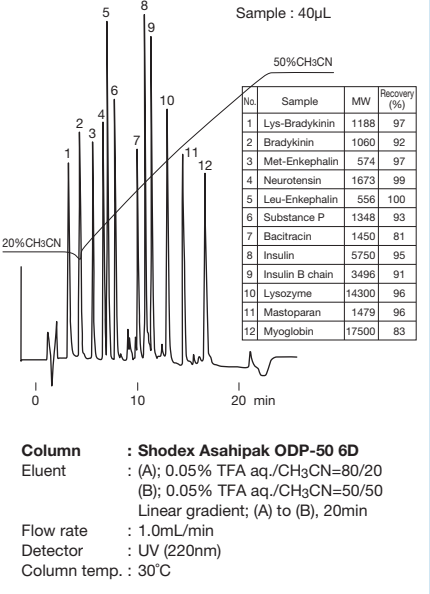
Analysis of azithromycin according to JP method



Macrolide antibiotics



Gradient analysis of proteins and peptides



Columns for Polymer-based Reversed Phase Chromatography (RSpak)

Please refer to “Comparison of the Features Among Shodex Reverse Phase Chromatography (RPC) Columns” on page 6 and 7 for features.

Standard columns

Product Code	Product Name	Plate Number (TP/column)	Functional Group	Base Material	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length	Shipping Solvent
F7009000	RSpak RP18-415	≥ 5,000	–	Styrene divinylbenzene copolymer	6	450	4.6 × 150	H ₂ O/CH ₃ CN=5/95
F6709558	RSpak RP18-G	(guard column)	–	Styrene divinylbenzene copolymer	6	–	4.6 × 10	H ₂ O/CH ₃ CN/THF=40/30/30
F7001001	RSpak DS-613	≥ 6,500	–	Styrene divinylbenzene copolymer	6	200	6.0 × 150	H ₂ O/CH ₃ CN/THF=30/40/30
F7001012	RSpak DS-413	≥ 11,000	–	Styrene divinylbenzene copolymer	3.5	200	4.6 × 150	H ₂ O/CH ₃ CN/THF=40/30/30
F6700140	RSpak DS-G	(guard column)	–	Styrene divinylbenzene copolymer	10	–	4.6 × 10	H ₂ O/CH ₃ CN/THF=30/40/30
F7001004	RSpak DE-613	≥ 7,000	–	Polymethacrylate	6	25	6.0 × 150	H ₂ O
F7001005	RSpak DE-413	≥ 11,000	–	Polymethacrylate	4	25	4.6 × 150	H ₂ O/CH ₃ CN=50/50
F7009030	RSpak DE-413L	≥ 17,000	–	Polymethacrylate	4	25	4.6 × 250	H ₂ O/CH ₃ CN=50/50
F6700150	RSpak DE-G 4A (RSpak DE-G)	(guard column)	–	Polymethacrylate	10	–	4.6 × 10	H ₂ O
F7001007	RSpak DE-213	≥ 8,000	–	Polymethacrylate	4	25	2.0 × 150	H ₂ O/CH ₃ CN=50/50
F6700151	RSpak DE-G 2A (RSpak DE-SG)	(guard column)	–	Polymethacrylate	6	–	2.0 × 10	H ₂ O/CH ₃ CN=50/50
F7001002	RSpak DM-614	≥ 4,500	–	Polyhydroxymethacrylate	10	200	6.0 × 150	5mM H ₃ PO ₄ aq.
F6700160	RSpak DM-G 4A (RSpak DM-G)	(guard column)	–	Polyhydroxymethacrylate	12	–	4.6 × 10	5mM H ₃ PO ₄ aq.
F7008140	RSpak NN-814	≥ 9,000	Sulfo	Polyhydroxymethacrylate	10	200	8.0 × 250	0.1M Sodium phosphate buffer (pH3.0)
F7008150	RSpak NN-614	≥ 4,000	Sulfo	Polyhydroxymethacrylate	10	200	6.0 × 150	0.1M Sodium phosphate buffer (pH3.0)
F6700510	RSpak NN-G	(guard column)	Sulfo	Polyhydroxymethacrylate	10	–	6.0 × 50	0.1M Sodium phosphate buffer (pH3.0)
F7008160	RSpak NN-414	≥ 6,000	Sulfo	Polyhydroxymethacrylate	10	200	4.6 × 150	0.1M Sodium phosphate buffer (pH3.0)
F7008240	RSpak JJ-50 4D	≥ 4,500	Quaternary ammonium	Polyvinyl alcohol	5	100	4.6 × 150	H ₂ O/CH ₃ CN=40/60
F7008220	RSpak JJ-50 2D	≥ 3,500	Quaternary ammonium	Polyvinyl alcohol	5	100	2.0 × 150	H ₂ O/CH ₃ CN=40/60

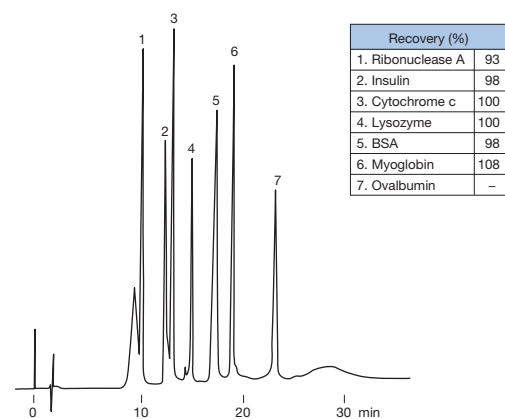
Semi-micro columns * The following semi-micro columns are made to order.

Product Code	Product Name	Functional Group	Base Material	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length
F7840123	DE413-2B	–	Polymethacrylate	4	25	2.0 × 50
F7840121	DE413-2E	–	Polymethacrylate	4	25	2.0 × 250
F7860122	NN414-2D	Sulfo	Polyhydroxymethacrylate	10	200	2.0 × 150

Preparative columns * Preparative columns are made to order.

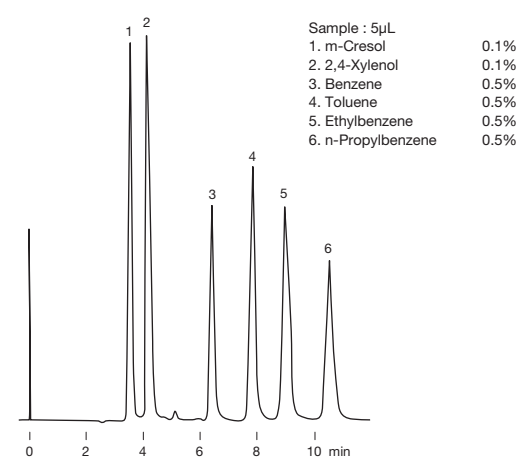
Product Code	Product Name	Plate Number (TP/column)	Particle Size (μm)	Column Size (mm) I.D. x Length	Standard Column
F6513013	RSpak DE-2013	≥ 10,000	12	20.0 × 300	DE-413, DE-613
F6700190	RSpak DE-G 8B (RSpak DE-LG)	(guard column)	12	8.0 × 50	DE-413, DE-613
F6513015	RSpak DE-5013	–	12	50.0 × 300	DE-413, DE-613
F6700191	RSpak DE-G 20C (RSpak DE-LLG)	(guard column)	12	20.0 × 100	(guard column)
F6514014	RSpak DM-2014	≥ 5,000	12	20.0 × 300	DM-614
F6700404	RSpak DM-G 8B (RSpak DM-LG)	(guard column)	12	8.0 × 50	(guard column)
F6514022	RSpak DM-5014	–	12	50.0 × 300	DM-614
F6700162	RSpak DM-G 20C (RSpak DM-LLG)	(guard column)	12	20.0 × 100	(guard column)

Separation and recovery rate of standard proteins



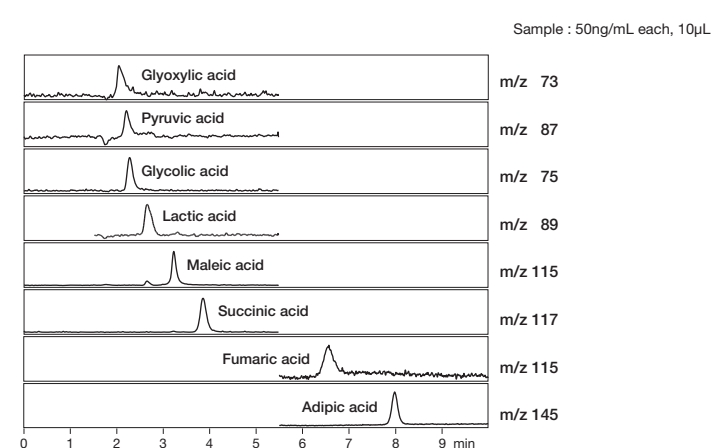
Column : Shodex RSpak RP18-415
Eluent : (A); 0.1% TFA aq./CH₃CN=99/1
 (B); 0.1% TFA aq./CH₃CN=5/95
 Linear gradient; (B%) 20% to 60%, 20min
Flow rate : 1.0mL/min
Detector : UV (220nm)
Column temp. : Room temp.

Alkylbenzenes



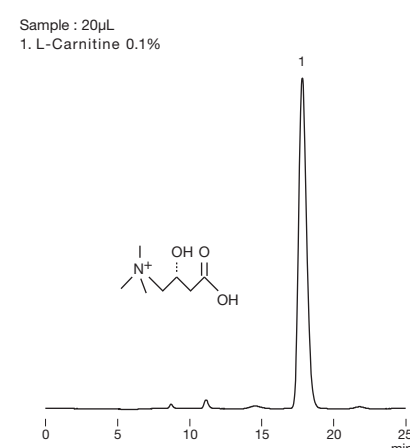
Column : Shodex RSpak DS-613
Eluent : H₂O/CH₃CN/THF=30/40/30
Flow rate : 1.0mL/min
Detector : UV (254nm)
Column temp. : 40°C

LC/MS analysis of organic acids



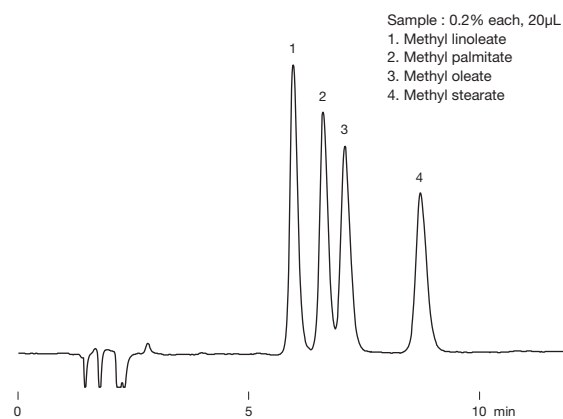
Column : Shodex RSpak DE-213
Eluent : (A); 0.1% (v/v) Formic acid aq. (B); CH₃CN
 Linear gradient; B%; 5% (0min)→5% (2min)→15% (2.5min)→15% (10min)
Flow rate : 0.2mL/min
Detector : ESI-MS (SIM Negative)
Column temp. : 30°C

Carnitine



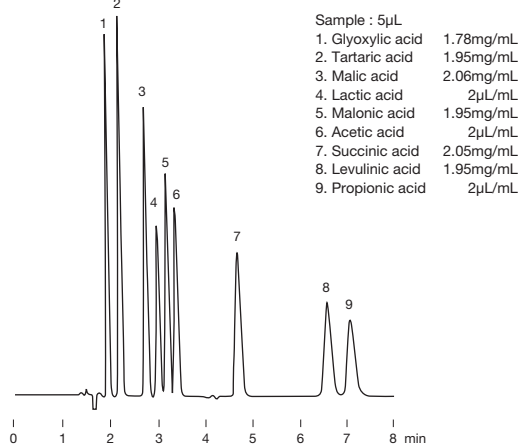
Column : Shodex RSpak NN-814
Eluent : 0.1M H₃PO₄ aq.
Flow rate : 1.0mL/min
Detector : UV (210nm)
Column temp. : 25°C

Fatty acid methyl esters



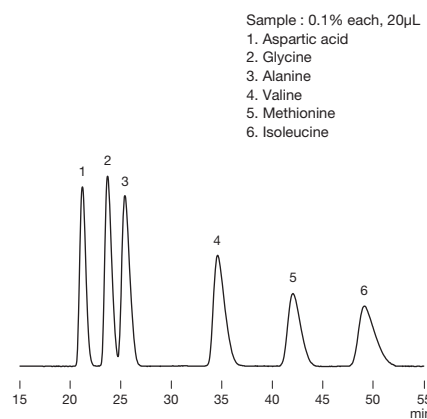
Column : Shodex RSpak DS-413
Eluent : H₂O/CH₃CN/THF=25/45/30
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 40°C

Organic acids



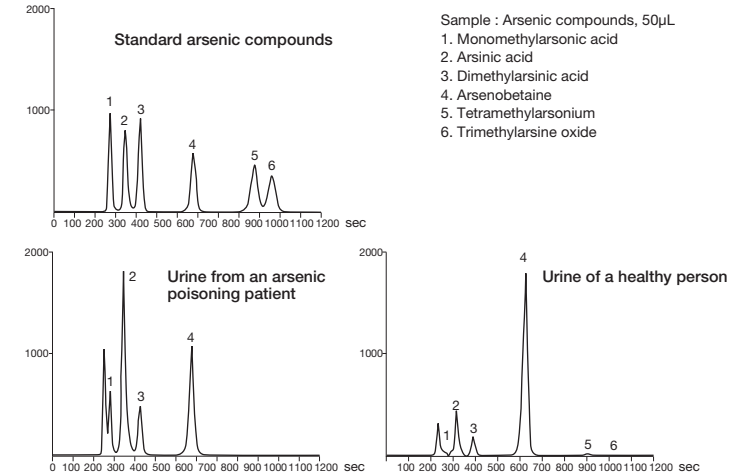
Column : Shodex RSpak DE-413
Eluent : 10mM H₃PO₄ aq.
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 50°C

Amino acids



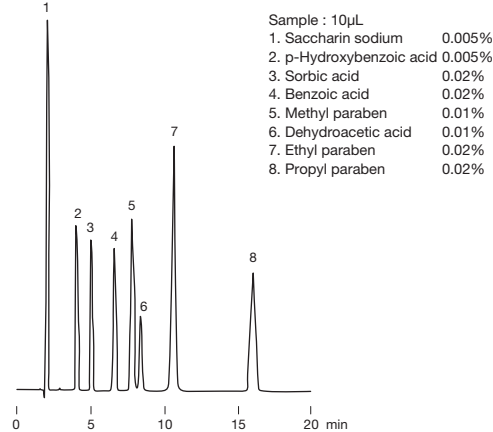
Column : Shodex RSpak NN-814
Eluent : 40mM H₃PO₄ aq.
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 40°C

Speciation of arsenic



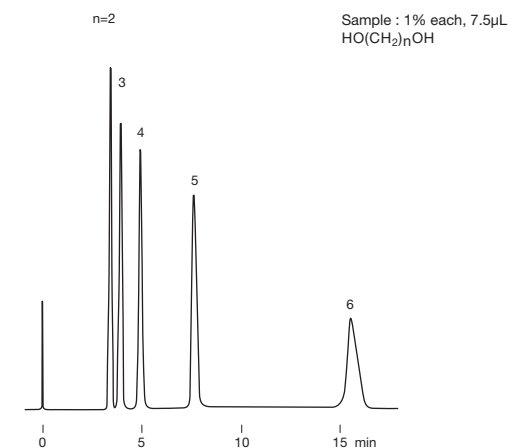
Column : Shodex RSpak NN-614
Eluent : 5mM HNO₃/8mM NH₄NO₃ aq.
Flow rate : 0.8mL/min
Detector : ICP-MS (SIM m/z 75)
Source : Noriko Tsunoda, Pharmacia. 1998, vol.34, No.12, p.1237-1241

Food additives (Preservatives)



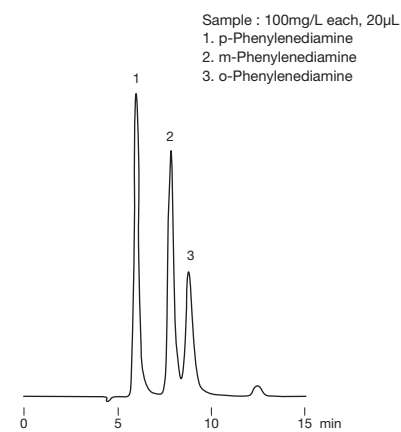
Column : Shodex RSpak DE-413
Eluent : 50mM KH₂PO₄ + 0.1% H₃PO₄ aq.
 /CH₃CN=65/35
Flow rate : 1.0mL/min
Detector : UV (210nm)
Column temp. : 40°C

Diols



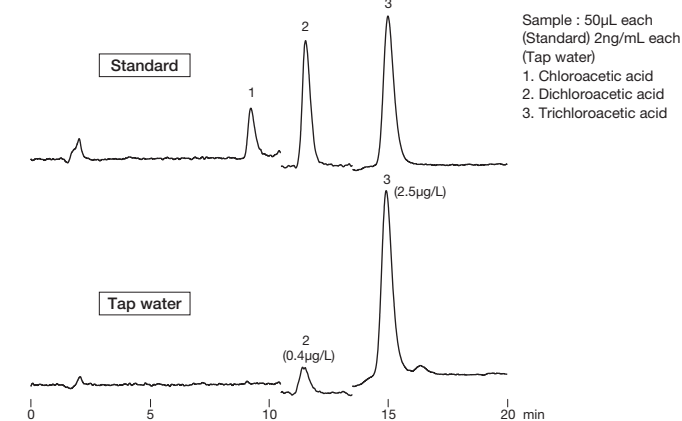
Column : Shodex RSpak DE-613
Eluent : H₂O
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 60°C

Phenylenediamine isomers



Column : Shodex RSpak JJ-50 4D
Eluent : 25mM Ammonium acetate buffer
 (pH9.2)/CH₃CN=70/30
Flow rate : 0.4mL/min
Detector : UV (254nm)
Column temp. : 30°C

LC/MS analysis of haloacetic acids



Column : Shodex RSpak JJ-50 2D
Eluent : 25mM Ammonium acetate aq. (pH9.2)/CH₃CN=50/50
Flow rate : 0.2mL/min
Detector : Chloroacetic acid : ESI-MS (SIM Negative : m/z 93)
 Dichloroacetic acid : ESI-MS/MS (MRM Negative : m/z 127→83)
 Trichloroacetic acid : ESI-MS (SIM Negative : m/z 161)
Column temp. : 40°C

Columns for Silica-based Reversed Phase Chromatography (ODS Columns)

Please refer to “Comparison of the Features Among Shodex Reverse Phase Chromatography (RPC) Columns” on page 6 and 7 for features.

Standard columns

Product Code	Product Name	Plate Number (TP/column)	Functional Group	Particle Size (μm)	Carbon Load (%)	Pore Size (Å)	Column Size (mm) I.D. x Length	Shipping Solvent
F6650040	Silica C18M 4D	≥ 10,000	Octadecyl	5	16	100	4.6 × 150	H ₂ O/CH ₃ OH=30/70
F6650041	Silica C18M 4E	≥ 16,000	Octadecyl	5	16	100	4.6 × 250	H ₂ O/CH ₃ OH=30/70
F6650042	Silica C18M 2D	≥ 9,000	Octadecyl	5	16	100	2.0 × 150	H ₂ O/CH ₃ OH=40/60
F6650045	Silica C18P 4D	≥ 10,000	Octadecyl	5	17	100	4.6 × 150	H ₂ O/CH ₃ OH=30/70
F6650046	Silica C18P 4E	≥ 16,000	Octadecyl	5	17	100	4.6 × 250	H ₂ O/CH ₃ OH=30/70
F6650047	Silica C18P 2D	≥ 9,000	Octadecyl	5	17	100	2.0 × 150	H ₂ O/CH ₃ OH=40/60

Base Material : Silica

Preparative columns * Preparative columns are made to order.

Product Code	Product Name	Plate Number (TP/column)	Particle Size (μm)	Column Size (mm) I.D. x Length	Standard Column
F7560040	Silica C18M 10E	≥ 16,000	5	10.0 × 250	C18M
F7560041	Silica C18M 20E	≥ 16,000	5	20.0 × 250	C18M

Columns for Silica-based Reversed Phase Chromatography (Other Columns)

Please refer to “Comparison of the Features Among Shodex Reverse Phase Chromatography (RPC) Columns” on page 6 and 7 for features.

Standard columns

Product Code	Product Name	Plate Number (TP/column)	Functional Group	Particle Size (μm)	Carbon Load (%)	Pore Size (Å)	Column Size (mm) I.D. x Length	Shipping Solvent
F6650052	Silica 5C8 4D	≥ 9,000	Octyl	5	10	100	4.6 × 150	H ₂ O/CH ₃ OH=34/66
F6650053	Silica 5C8 4E	≥ 15,000	Octyl	5	10	100	4.6 × 250	H ₂ O/CH ₃ OH=34/66
F6650054	Silica 5C4 4D	≥ 9,000	Butyl	5	7	100	4.6 × 150	H ₂ O/CH ₃ OH=45/55
F6650055	Silica 5C4 4E	≥ 15,000	Butyl	5	7	100	4.6 × 250	H ₂ O/CH ₃ OH=45/55
F6650058	Silica 5CN 4D	≥ 7,000	Cyanopropyl	5	–	100	4.6 × 150	H ₂ O/CH ₃ OH=60/40
F6650059	Silica 5CN 4E	≥ 12,000	Cyanopropyl	5	–	100	4.6 × 250	H ₂ O/CH ₃ OH=60/40
F6650062	Silica 5NPE 4D	≥ 8,000	Nitrophenylethyl	5	–	100	4.6 × 150	H ₂ O/CH ₃ OH=45/55
F6650063	Silica 5PYE 4D	≥ 7,000	Pyrenylethyl	5	–	100	4.6 × 150	H ₂ O/CH ₃ OH=30/70

Base Material : Silica

Preparative columns * Preparative columns are made to order.

Product Code	Product Name	Plate Number (TP/column)	Particle Size (μm)	Column Size (mm) I.D. x Length	Standard Column
F7560062	Silica 5C8 10E	≥ 15,000	5	10.0 × 250	5C8
F7560063	Silica 5C8 20E	≥ 15,000	5	20.0 × 250	5C8
F7560054	Silica 5C4 10E	≥ 15,000	5	10.0 × 250	5C4
F7560055	Silica 5C4 20E	≥ 15,000	5	20.0 × 250	5C4

Columns for Silica-based HILIC and Normal Phase Chromatography

Features

- 5SIL**
 - Uses high purity silica (99.99% or higher)
 - Suitable for normal phase analysis using a nonpolar organic solvent
 - Corresponds to USP L3
- 5NH**
 - Suitable for saccharides analysis by hydrophilic interaction chromatography (HILIC)
 - Corresponds to USP L8

Standard columns

Product Code	Product Name	Plate Number (TP/column)	Functional Group	Particle Size (μm)	Carbon Load (%)	Pore Size (Å)	Column Size (mm) I.D. x Length	Shipping Solvent
F6650050	Silica 5SIL 4D	≥ 9,000	–	5	–	100	4.6 × 150	C ₆ H ₁₄ /C ₂ H ₅ OH=95/5
F6650051	Silica 5SIL 4E	≥ 15,000	–	5	–	100	4.6 × 250	C ₆ H ₁₄ /C ₂ H ₅ OH=95/5
F6650060	Silica 5NH 4D	≥ 5,000	Aminopropyl	5	–	100	4.6 × 150	H ₂ O/CH ₃ CN=5/95
F6650061	Silica 5NH 4E	≥ 8,000	Aminopropyl	5	–	100	4.6 × 250	H ₂ O/CH ₃ CN=5/95

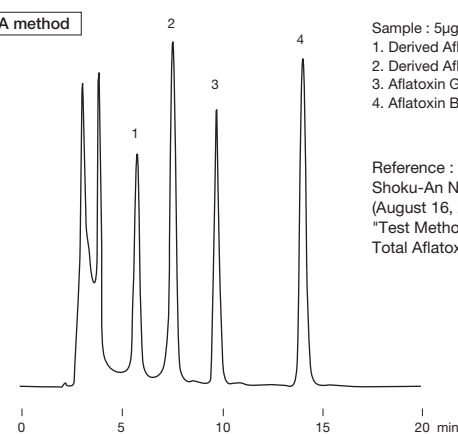
Base Material : Silica

Preparative columns * Preparative columns are made to order.

Product Code	Product Name	Plate Number (TP/column)	Particle Size (μm)	Column Size (mm) I.D. x Length	Standard Column
F7560050	Silica 5SIL 10E	≥ 15,000	5	10.0 × 250	5SIL
F7560051	Silica 5SIL 20E	≥ 15,000	5	20.0 × 250	5SIL
F7560060	Silica 5NH 10E	≥ 8,000	5	10.0 × 250	5NH
F7560061	Silica 5NH 20E	≥ 8,000	5	20.0 × 250	5NH

Aflatoxins

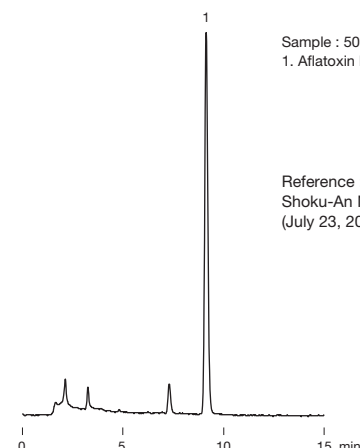
TFA method



Sample : 5µg/L each, 20µL
1. Derived Aflatoxin G₁
2. Derived Aflatoxin B₁
3. Aflatoxin G₂
4. Aflatoxin B₂

Reference :
Shoku-An No. 0816-1
(August 16, 2011, Japan)
*Test Methods Related to
Total Aflatoxin" in Notice

Column : Shodex Silica C18M 4E
Eluent : H₂O/CH₃CN/CH₃OH=60/10/30
Flow rate : 1.0mL/min
Detector : Fluorescence (Ex. : 365nm, Em. : 450nm)
Column temp. : 40°C

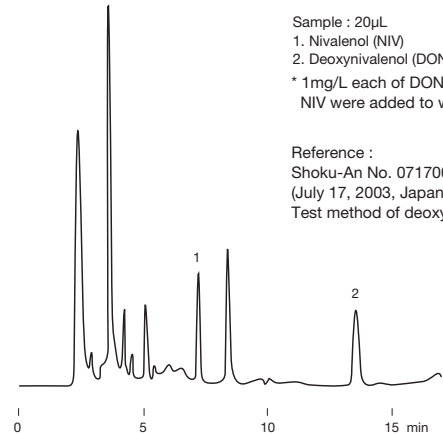


Sample : 50µL
1. Aflatoxin M₁ 1µg/L

Reference :
Shoku-An No. 0723-5
(July 23, 2015, Japan)

Column : Shodex Silica C18M 4E
Eluent : H₂O/CH₃CN=75/25
Flow rate : 1.0mL/min
Detector : Fluorescence (Ex. : 365nm, Em. : 435nm)
Column temp. : 40°C

Trichothecene mycotoxins

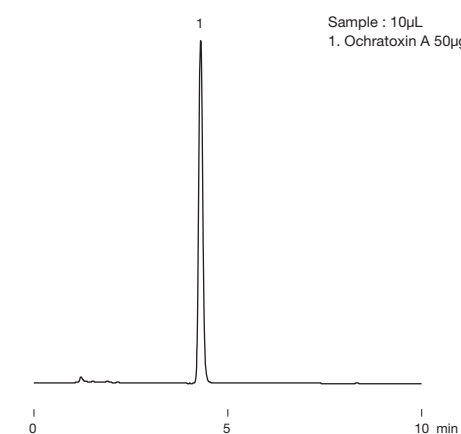


Sample : 20µL
1. Nivalenol (NIV)
2. Deoxynivalenol (DON)
* 1mg/L each of DON and
NIV were added to wheat sample

Reference :
Shoku-An No. 0717001
(July 17, 2003, Japan)
Test method of deoxynivalenol

Column : Shodex Silica C18M 4E
Eluent : H₂O/CH₃CN/CH₃OH=90/5/5
Flow rate : 1.0mL/min
Detector : UV (220nm)
Column temp. : 40°C

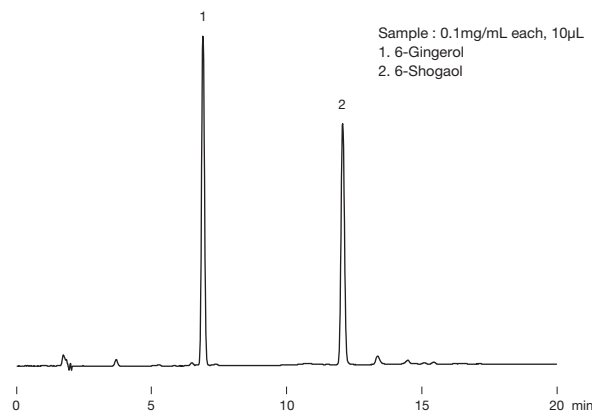
Ochratoxin



Sample : 10µL
1. Ochratoxin A 50µg/L

Column : Shodex Silica C18M 4D
Eluent : H₂O/CH₃COOH/CH₃CN=43/2/55
Flow rate : 1.0mL/min
Detector : Fluorescence (Ex. : 333nm, Em. : 460nm)
Column temp. : 40°C

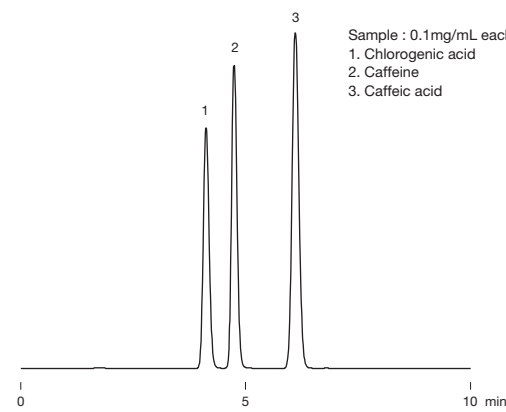
Gingerol and shogaol



Sample : 0.1mg/mL each, 10µL
1. 6-Gingerol
2. 6-Shogaol

Column : Shodex Silica C18M 4D
Eluent : (A) : H₂O (B) : CH₃CN
Linear gradient : (B%) 40% to 70% (15min)
Flow rate : 1.0mL/min
Detector : UV (280nm)
Column temp. : 40°C

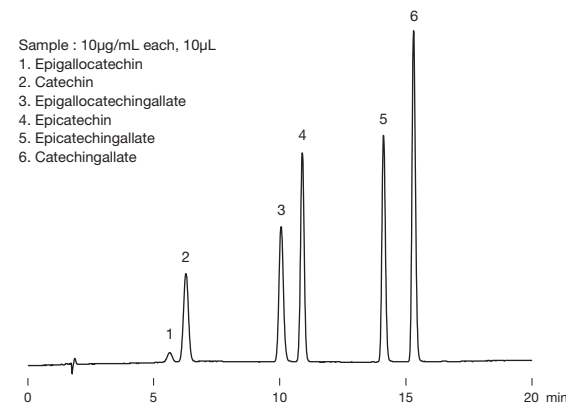
Chlorogenic acid



Sample : 0.1mg/mL each, 10µL
1. Chlorogenic acid
2. Caffeine
3. Caffeic acid

Column : Shodex Silica C18M 4D
Eluent : 20mM H₃PO₄ aq. /CH₃OH=70/30
Flow rate : 1.0mL/min
Detector : UV (280nm)
Column temp. : 30°C

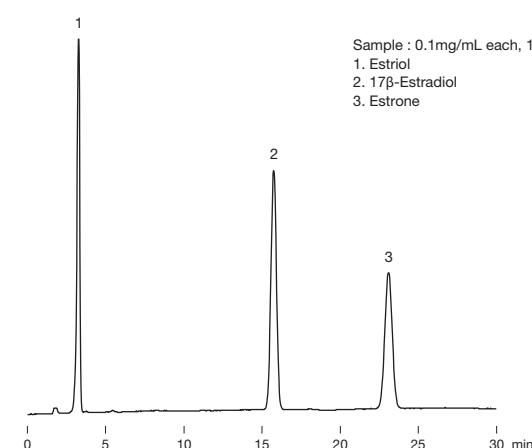
Catechins



Sample : 10µg/mL each, 10µL
1. Epigallocatechin
2. Catechin
3. Epigallocatechingallate
4. Epicatechin
5. Epicatechingallate
6. Catechingallate

Column : Shodex Silica C18P 4D
Eluent : (A) : 20mM H₃PO₄ aq. (B) : CH₃CN
Linear gradient:
(B%) 20% (0 to 5min), 20 to 40% (5 to 15min),
40% (15 to 20min)
Flow rate : 1.0mL/min
Detector : UV (280nm)
Column temp. : 30°C

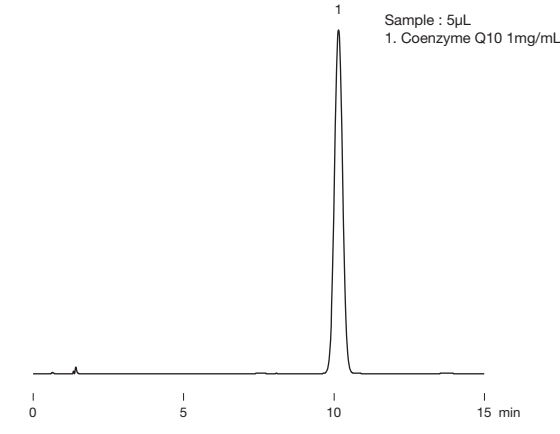
Estradiols



Sample : 0.1mg/mL each, 10µL
1. Estriol
2. 17β-Estradiol
3. Estrone

Column : Shodex Silica C18P 4D
Eluent : H₂O/CH₃CN=65/35
Flow rate : 1.0mL/min
Detector : UV (280nm)
Column temp. : 30°C

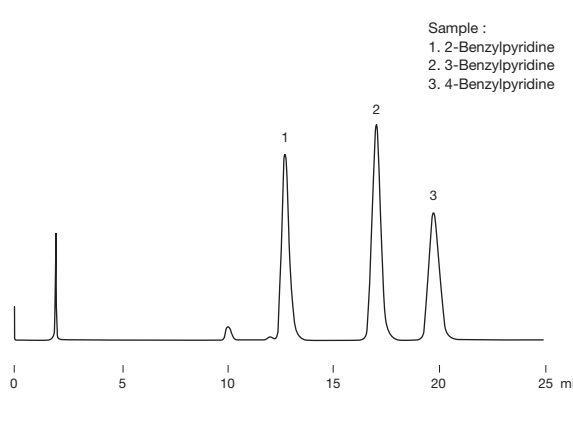
Coenzyme Q10



Sample : 5µL
1. Coenzyme Q10 1mg/mL

Column : Shodex Silica C18P 4D
Eluent : CH₃OH/C₂H₅OH=13/7
Flow rate : 1.2mL/min
Detector : UV (275nm)
Column temp. : 35°C

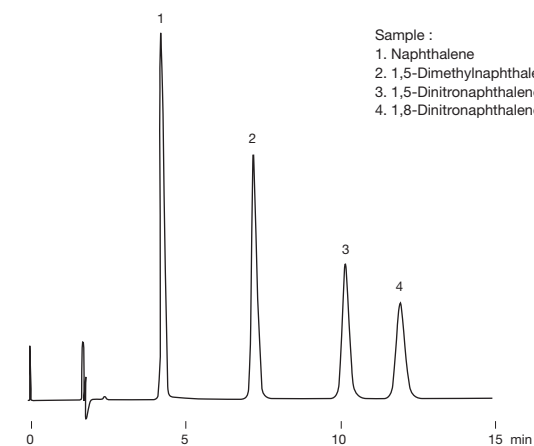
Benzylpyridine isomers



Sample :
1. 2-Benzylpyridine
2. 3-Benzylpyridine
3. 4-Benzylpyridine

Column : Shodex Silica 5PYE 4D
Eluent : 20mM KH₂PO₄ aq./CH₃OH=40/60
Flow rate : 1.0mL/min
Detector : UV (254nm)
Column temp. : 30°C

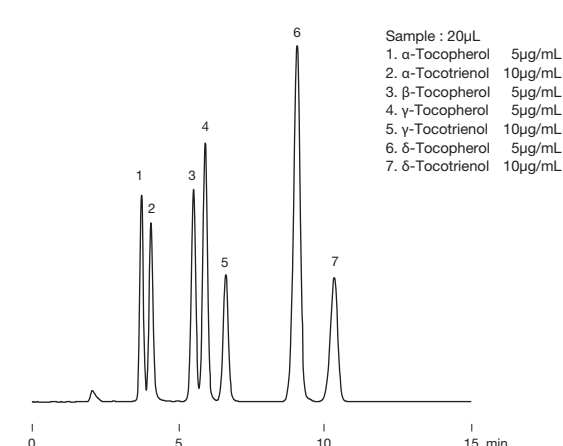
Dinitronaphthalene isomers



Sample :
1. Naphthalene
2. 1,5-Dimethylnaphthalene
3. 1,5-Dinitronaphthalene
4. 1,8-Dinitronaphthalene

Column : Shodex Silica 5NPE 4D
Eluent : H₂O/CH₃OH=30/70
Flow rate : 1.0mL/min
Detector : UV (254nm)
Column temp. : 30°C

Simultaneous analysis of vitamin E homologs



Sample : 20µL
1. α-Tocopherol 5µg/mL
2. α-Tocotrienol 10µg/mL
3. β-Tocopherol 5µg/mL
4. γ-Tocopherol 5µg/mL
5. γ-Tocotrienol 10µg/mL
6. δ-Tocopherol 5µg/mL
7. δ-Tocotrienol 10µg/mL

Column : Shodex Silica 5SIL 4D
Eluent : n-Hexane/Isopropanol/Acetic acid=1000/6/5
Flow rate : 1.0mL/min
Detector : Fluorescence (Ex. : 298nm, Em. : 325nm)
Column temp. : 30°C

Columns for Polymer-based Hydrophilic Interaction Chromatography (HILIC) (HILICpak)

Features

- New

VG-50
- Suitable for saccharides analysis by hydrophilic interaction chromatography (HILIC)
 - High recovery ratio of reducing saccharides
 - Polymer-based packing material provides excellent chemical stability and minimum deterioration over extended time period
 - Easily regenerated by washing in a alkaline solution
 - Also suitable for evaporative light scattering detector, corona charged aerosol detector, and LC/MS
- New

VT-50
- Suitable for anionic substances analysis by hydrophilic interaction chromatography (HILIC)
 - Depends on the eluent selected, the column adds ion exchange mode
 - Polymer-based packing material provides excellent chemical stability and minimum deterioration over extended time period
 - Suitable for LC/MS

Standard columns

● VG-50 (Housing Material : SUS)

Product Code	Product Name	Plate Number (TP/column)	Functional Group	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length	Shipping Solvent
F7630200	New HILICpak VG-50 4D	≥ 5,500	Amino	5	100	4.6 × 150	H ₂ O/CH ₃ CN=20/80
F7630100	New HILICpak VG-50 4E	≥ 7,500	Amino	5	100	4.6 × 250	H ₂ O/CH ₃ CN=20/80
F6711100	New HILICpak VG-50G 4A	(guard column)	Amino	5	100	4.6 × 10	H ₂ O/CH ₃ CN=20/80

Base Material : Polyvinyl alcohol

(Housing Material : PEEK)

Product Code	Product Name	Plate Number (TP/column)	Functional Group	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length	Shipping Solvent
F7630300	New HILICpak VG-50 2D	≥ 3,500	Amino	5	100	2.0 × 150	H ₂ O/CH ₃ CN=15/85
F6711200	New HILICpak VG-50G 2A	(guard column)	Amino	5	100	2.0 × 10	H ₂ O/CH ₃ CN=15/85

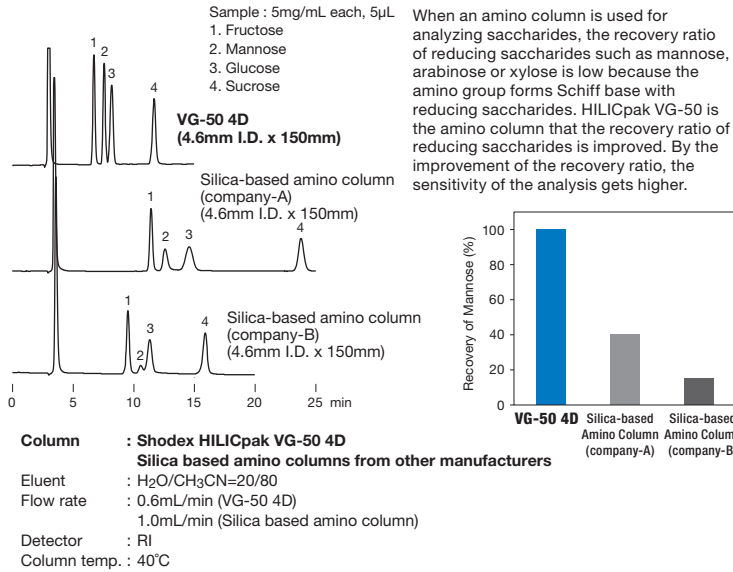
Base Material : Polyvinyl alcohol

● VT-50 (Housing Material : PEEK)

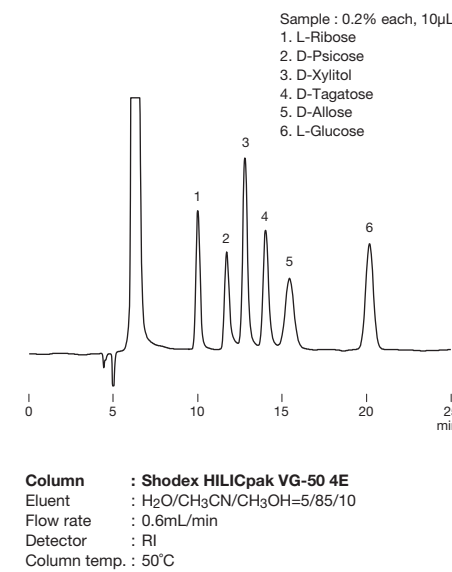
Product Code	Product Name	Plate Number (TP/column)	Functional Group	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length	Shipping Solvent
F7630400	New HILICpak VT-50 2D	≥ 4,500	Quaternary ammonium	5	100	2.0 × 150	25mM HCOONH ₄ aq. /CH ₃ CN=15/85
F6711300	New HILICpak VT-50G 2A	(guard column)	Quaternary ammonium	5	100	2.0 × 10	25mM HCOONH ₄ aq. /CH ₃ CN=15/85

Base Material : Polyvinyl alcohol

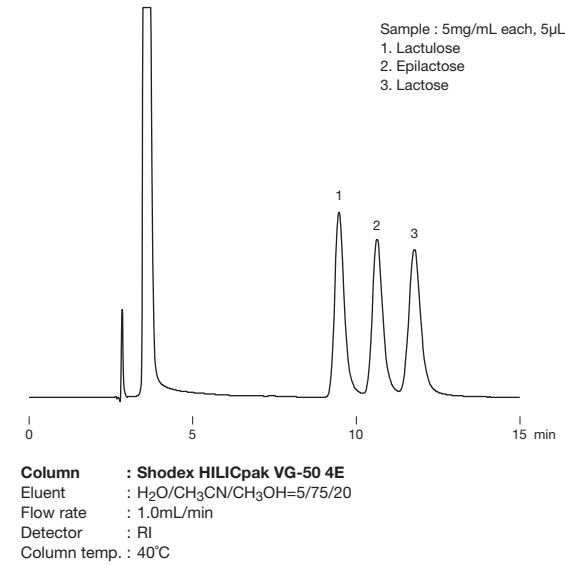
Recovery of reducing sugar



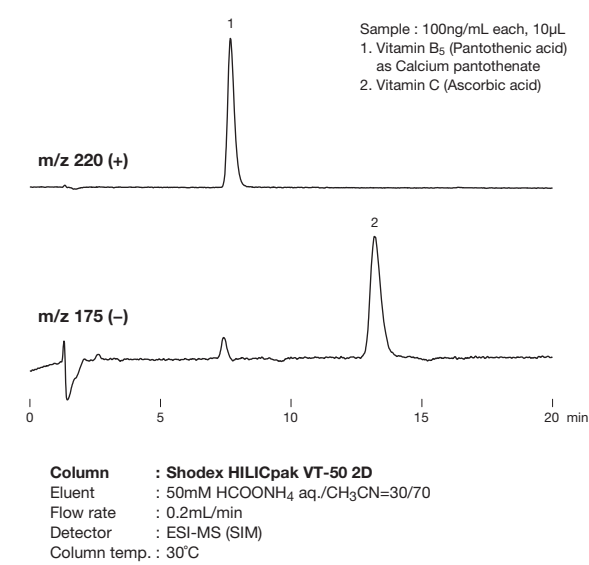
Rare sugar



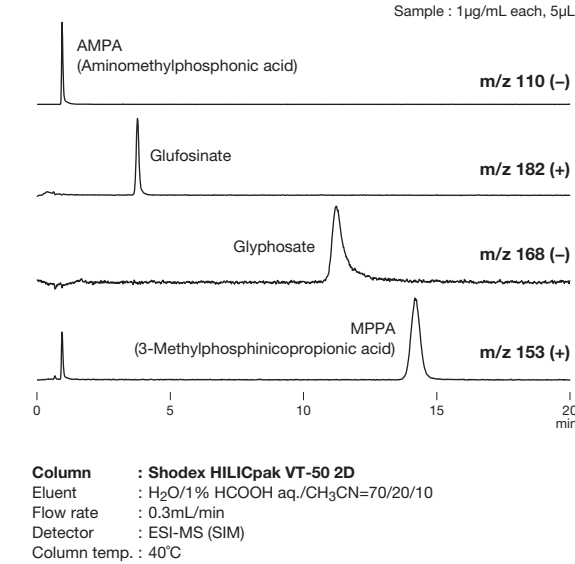
Lactose, epilactose, and aactulose



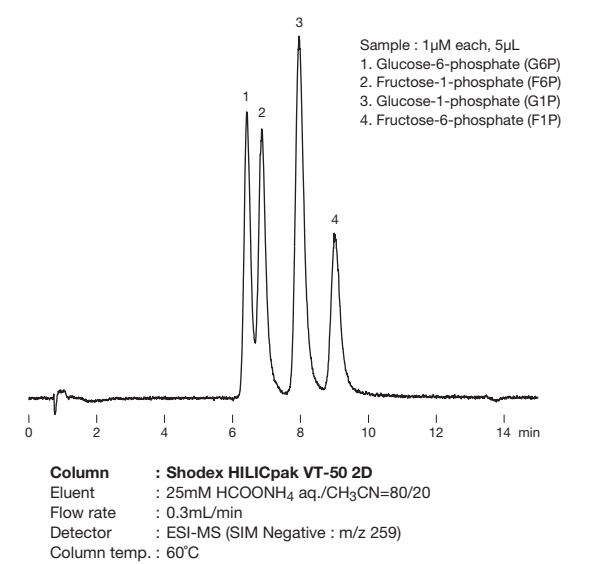
LC/MS analysis of pantothenic acid and vitamin C



LC/MS analysis of glyphosate and glufosinate



LC/MS analysis of phosphorylated saccharides



Columns for Polymer-based Hydrophilic Interaction Chromatography (HILIC) (Asahipak)

Features

- NH2P**
 - Suitable for saccharides analysis by hydrophilic interaction chromatography (HILIC)
 - Polymer-based packing material provides excellent chemical stability and minimum deterioration over extended time period
 - Easily regenerated by washing in a alkaline solution
 - Also suitable for evaporative light scattering detector, corona charged aerosol detector, and LC/MS
 - Corresponds to USP L82
- NH2P-40**
 - Provides higher theoretical plate number compared to NH2P-50 series
 - Corresponds to USP L82

Standard columns

Product Code	Product Name	Plate Number (TP/column)	Functional Group	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length	Shipping Solvent
F7630005	Asahipak NH2P-50 4B	≥ 1,500	Amino	5	100	4.6 × 50	CH ₃ CN
F7630002	Asahipak NH2P-50 4D	≥ 5,500	Amino	5	100	4.6 × 150	CH ₃ CN
F7630001	Asahipak NH2P-50 4E	≥ 7,500	Amino	5	100	4.6 × 250	CH ₃ CN
F6710016	Asahipak NH2P-50G 4A	(guard column)	Amino	5	–	4.6 × 10	CH ₃ CN
F7630006	Asahipak NH2P-50 2D	≥ 3,500	Amino	5	100	2.0 × 150	CH ₃ CN
F6713000	Asahipak NH2P-50G 2A	(guard column)	Amino	5	–	2.0 × 10	CH ₃ CN
F7630007	Asahipak NH2P-40 3E	≥ 8,500	Amino	4	100	3.0 × 250	CH ₃ CN
F6710030	Asahipak NH2P-50G 3A	(guard column)	Amino	5	–	3.0 × 10	CH ₃ CN
F7630008	Asahipak NH2P-40 2B	≥ 2,000	Amino	4	100	2.0 × 50	CH ₃ CN
F7630009	Asahipak NH2P-40 2D	≥ 5,500	Amino	4	100	2.0 × 150	CH ₃ CN
F7630010	Asahipak NH2P-40 2E	≥ 7,000	Amino	4	100	2.0 × 250	CH ₃ CN
F6710100	Asahipak NH2P-LF	(line filter)	Amino	–	–	8.0 × 75	CH ₃ CN

Base Material : Polyvinyl alcohol

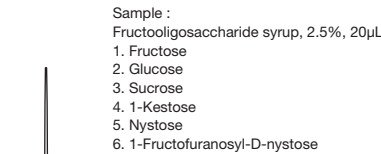
3mm I.D columns [Customized columns]

Product Code	Product Name	Functional Group	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length
F7630011	Asahipak NH2P-40 3B	Amino	4	100	3.0 × 50
F7630012	Asahipak NH2P-40 3D	Amino	4	100	3.0 × 150

Preparative columns * Preparative columns are made to order.

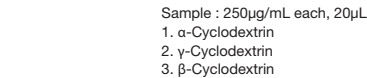
Product Code	Product Name	Plate Number (TP/column)	Particle Size (μm)	Column Size (mm) I.D. x Length	Standard Column
F6830001	Asahipak NH2P-50 10E	≥ 10,000	5	10.0 × 250	NH2P-50
F6830031	Asahipak NH2P-90 20F	≥ 10,000	9	20.0 × 300	NH2P-50
F6710017	Asahipak NH2P-130G 7B	(guard column)	13	7.5 × 50	(guard column)

Fructooligosaccharide syrup



Column : Shodex Asahipak NH2P-50 4E
Eluent : H₂O/CH₃CN=30/70
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 25°C

Cyclodextrins



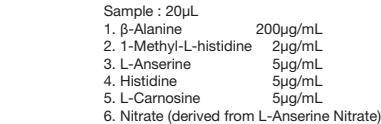
Column : Shodex Asahipak NH2P-50 4E
Eluent : H₂O/CH₃CN=40/60
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 40°C

Stevioside and rebaudioside A



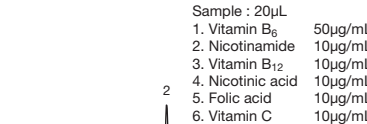
Column : Shodex Asahipak NH2P-50 4E
Eluent : H₂O/CH₃CN=25/75
Flow rate : 1.0mL/min
Detector : UV (210nm)
Column temp. : 30°C

Imidazole dipeptides



Column : Shodex Asahipak NH2P-50 4E
Eluent : 50mM NaH₂PO₄ aq./CH₃CN=40/60
Flow rate : 1.0mL/min
Detector : UV (210nm)
Column temp. : 40°C

Simultaneous analysis of water-soluble vitamins



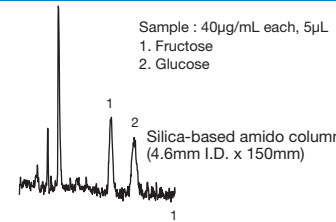
Column : Shodex Asahipak NH2P-50 4E
Eluent : 40mM H₃PO₄ aq./CH₃CN=45/55
Flow rate : 1.0mL/min
Detector : UV (254nm)
Column temp. : 40°C

Ascorbic acid and erythorbic acid



Column : Shodex Asahipak NH2P-50 4E
Eluent : 20mM NaH₂PO₄ + 30mM H₃PO₄ aq./CH₃CN=20/80
Flow rate : 1.0mL/min
Detector : UV (254nm)
Column temp. : 30°C

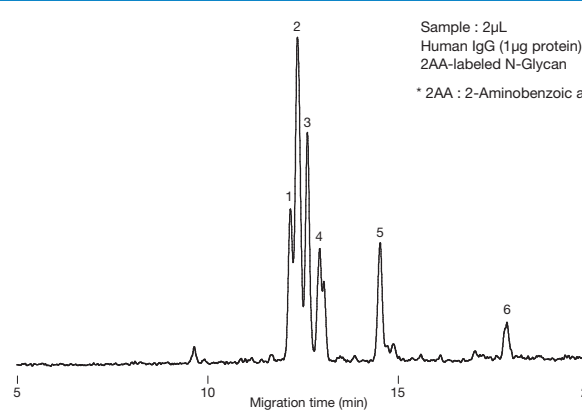
Comparison of saccharides analysis using corona charged aerosol detector



A corona charged aerosol detector measures effluents as particles. Accordingly, the baseline will be significantly influenced by the components eluted from the column. NH2P series, the polymer based amino columns eliminate the components originated from the column, resulting a stable baseline with lower noise level.

Column : Shodex Asahipak NH2P-50 4E
Silica based amino column from other manufacturer
Silica based amide column from other manufacturer
Eluent : H₂O/CH₃CN=20/80
Flow rate : 1.0mL/min
Detector : Corona charged aerosol
Column temp : 30°C (NH2P-50 4E, Silica based amino column)
80°C (Silica based amide column)

LC/TOF-MS analysis of 2-amino benzoic acid derivatized sugar chains



Column : Shodex Asahipak NH2P-40 2D
Eluent : (A); 95% CH₃CN/0.1% Formic acid aq.
(B); 5% CH₃CN/0.1% Formic acid aq.
Linear gradient; (B%) 30% (0-2.5min), 30-95% (2.5-20min)
Flow rate : 0.2mL/min
Detector : ESI-TOF MS (Polarity : Negative, Full MS range : 2000)
Column temp. : 45°C

Data provided by Michihiro Kinoshita Ph.D.,
Faculty of Pharmacy, Kinki University

Columns for Ligand Exchange Chromatography

* A list of elution volume of saccharides for Shodex columns is available.
Please refer to our website (http://www.shodex.com/en/) or technical notebook (No.2 and 3).

Features

SC1011 SC1821 SP0810 KS-801 to 802	• Separates saccharides by the combination of ligand exchange and size exclusion modes • Three types of counter ions are available: Ca²⁺, Pb²⁺, and Na⁺ • Only water is required for the analysis of neutral sugars • SC1011 and SC1821 correspond to USP L19 and L22 • SP0810 corresponds to USP L22 and L34 • KS-801 and KS-802 correspond to USP L22 and L58
KS-803 to 807	• Suitable for separation of polysaccharides by size exclusion mode • Can be used in combination with other columns e.g., KS-802 and KS-801 • Only water is required for the analysis of neutral sugars • Corresponds to USP L22 and L58
DC-613 SZ5532 SC1211	• Separates by the combination of ligand exchange and HILIC modes • DC-613 can analyze sugars without removing sodium salts in the sample • SZ5532 is recommended for the separation of disaccharides or trisaccharides • SC1211 is suitable for separation of sugar alcohols • DC-613 corresponds to USP L22 and L58 • SZ5532 corresponds to USP L22 • SC1211 corresponds to USP L19 and L22
SC1011-7F	• For the analysis of mannitol under the method of JP, USP and EP • Ca-type ligand exchange chromatography column • Only water is required for the analysis of neutral sugars • Corresponds to USP L19 and L22

Standard columns

● Ligand exchange and size exclusion

Product Code	Product Name	Plate Number (TP/column)	Functional Group (Counter Ion)	Exclusion Limit (Pullulan)	Particle Size (μm)	Column Size (mm) I.D. x Length	Shipping Solvent
F6378102	SUGAR SC1011	≥ 13,000	Sulfo (Ca ²⁺)	1,000	6	8.0 × 300	H ₂ O
F6378103	SUGAR SC1821	≥ 13,000	Sulfo (Ca ²⁺)	10,000	6	8.0 × 300	H ₂ O
F6700090	SUGAR SC-G 6B (SUGAR SC-LG)	(guard column)	Sulfo (Ca ²⁺)	—	10	6.0 × 50	H ₂ O
F6378105	SUGAR SP0810	≥ 11,000	Sulfo (Pb ²⁺)	1,000	7	8.0 × 300	H ₂ O
F6700081	SUGAR SP-G 6B (SUGAR SP-G)	(guard column)	Sulfo (Pb ²⁺)	—	10	6.0 × 50	H ₂ O
F6378010	SUGAR KS-801	≥ 17,000	Sulfo (Na ⁺)	1,000	6	8.0 × 300	H ₂ O
F6378020	SUGAR KS-802	≥ 17,000	Sulfo (Na ⁺)	10,000	6	8.0 × 300	H ₂ O
F6378025	SUGAR KS-803	≥ 17,000	Sulfo (Na ⁺)	50,000	6	8.0 × 300	H ₂ O
F6378035	SUGAR KS-804	≥ 17,000	Sulfo (Na ⁺)	400,000	7	8.0 × 300	H ₂ O
F6378050	SUGAR KS-805	≥ 9,000	Sulfo (Na ⁺)	5,000,000	17	8.0 × 300	H ₂ O
F6378060	SUGAR KS-806	≥ 9,000	Sulfo (Na ⁺)	*(50,000,000)	17	8.0 × 300	H ₂ O
F6700020	SUGAR KS-G 6B (SUGAR KS-G)	(guard column)	Sulfo (Na ⁺)	—	10	6.0 × 50	H ₂ O
F6378070	SUGAR KS-807	≥ 4,000	Sulfo (Na ⁺)	*(200,000,000)	30	8.0 × 300	H ₂ O
F6700021	SUGAR KS-807G	(guard column)	Sulfo (Na ⁺)	—	30	8.0 × 50	H ₂ O

*() Estimated value Base Material : Styrene divinylbenzene copolymer

● Ligand exchange and HILIC

Product Code	Product Name	Plate Number (TP/column)	Functional Group (Counter Ion)	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length	Shipping Solvent
F7001003	RSpak DC-613	≥ 5,500	Sulfo(Na ⁺)	6	100	6.0 × 150	H ₂ O/CH ₃ CN=30/70
F6700170	RSpak DC-G 4A (RSpak DC-G)	(guard column)	Sulfo(Na ⁺)	10	—	4.6 × 10	H ₂ O/CH ₃ CN=30/70
F7001300	SUGAR SZ5532	≥ 5,500	Sulfo(Zn ²⁺)	6	—	6.0 × 150	H ₂ O/CH ₃ CN=30/70
F6700110	SUGAR SZ-G	(guard column)	Sulfo(Zn ²⁺)	6	—	4.6 × 10	H ₂ O/CH ₃ CN=30/70
F7001400	SUGAR SC1211	≥ 5,500	Sulfo(Ca ²⁺)	6	50	6.0 × 250	H ₂ O/CH ₃ CN=75/25
F6700120	SUGAR SC1211G 4A (SUGAR SC-G)	(guard column)	Sulfo(Ca ²⁺)	10	—	4.6 × 10	H ₂ O/CH ₃ CN=75/25

Base Material : Styrene divinylbenzene copolymer

For the analysis of mannitol in conformity with JP and USP

Product Code	Product Name	Functional Group (Counter Ion)	Particle Size (μm)	Column Size (mm) I.D. x Length	Shipping Solvent
F6379300	EP SC1011-7F	Sulfo (Ca ²⁺)	8	7.8 × 300	H ₂ O
F6379230	USPpak MN-431	Sulfo (Ca ²⁺)	8	4.0 × 250	H ₂ O

See p.75 for USP (Ver.38) Column List.
Base Material : Styrene divinylbenzene copolymer

Preparative columns * Preparative columns are made to order.

● Ligand exchange and size exclusion

Product Code	Product Name	Plate Number (TP/column)	Particle Size (μm)	Column Size (mm) I.D. x Length	Standard Column
F6502007	SUGAR KS-2001	≥ 7,000	13	20.0 × 300	KS-801
F6502008	SUGAR KS-2002	≥ 7,000	13	20.0 × 300	KS-802
F6502009	SUGAR KS-2003	≥ 8,000	13	20.0 × 300	KS-803
F6502010	SUGAR KS-2004	≥ 6,000	18	20.0 × 300	KS-804
F6502011	SUGAR KS-2005	≥ 6,000	18	20.0 × 300	KS-805
F6502012	SUGAR KS-2006	≥ 6,000	18	20.0 × 300	KS-806
F6700002	SUGAR KS-G 8B (SUGAR KS-LG)	(guard column)	13	8.0 × 50	(guard column)

● Ligand exchange and HILIC

Product Code	Product Name	Plate Number (TP/column)	Particle Size (μm)	Column Size (mm) I.D. x Length	Standard Column
F6514013	RSpak DC-2013	≥ 6,000	10	20.0 × 300	DC-613
F6700402	RSpak DC-G 8B (RSpak DC-LG)	(guard column)	10	8.0 × 50	(guard column)
F6514021	RSpak DC-5013	—	10	50.0 × 300	DC-613
F6700172	RSpak DC-G 20C (RSpak DC-LLG)	(guard column)	10	20.0 × 100	(guard column)

Elution volume of saccharides analysis with various columns

[Partial list only; refer to our website for complete list]

Substances	Elution Volume (mL)					
	SP0810	SC1011	KS-801	SZ5532	NH2P-50 4E	SC1211
Arabinose	10.42	8.91	8.21	5.11	6.18	5.56
D-Arabitol	15.86	11.33	7.63	7.27	6.29	8.16
Dulcitol	20.18	12.76	7.40	9.46	7.45	11.28
meso-Erythritol	12.70	10.09	7.86	5.73	5.43	6.27
D(-)-Fructose	11.05	8.85	7.71	5.37	6.75	5.90
D(+)-Fucose	10.48	8.84	8.09	4.50	5.43	4.96
D(+)-Galactose	9.74	7.98	7.58	6.46	8.10	4.98
Gentiobiose	7.22	6.08	5.75	10.50	16.36	*
Glucose	8.63	7.30	7.17	5.87	8.61	4.76
myo-Inositol	12.77	8.86	7.99	12.63	9.96	7.87
Isomaltose	7.68	6.26	5.95	10.57	15.18	*
Isomaltotriose	7.09	5.75	5.34	21.17	27.55	*
1-Kestose	6.79	5.75	5.26	13.09	20.11	*
Kojibiose	7.56	6.21	5.88	9.65	14.82	*
Lactitol	13.27	8.09	6.13	16.35	11.82	6.67
Lactose	8.05	6.51	5.99	10.12	13.27	4.07
Lactulose	9.13	6.99	6.19	9.16	10.72	4.65
Maltitol	12.23	8.26	6.03	13.04	11.82	6.77
Maltose	7.85	6.34	5.94	8.67	14.24	*
Maltotriose	7.48	5.89	5.38	13.79	24.96	*
Mannitol	15.80	11.10	7.23	8.75	7.39	9.03

(-)→Not detected (-)→Overlap with solvent peak

Column : SUGAR SP0810, SC1011, KS-801
Eluent : H₂O
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 80°C

Column : SUGAR SC1211
Eluent : H₂O/CH₃CN=65/35
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 70°C

Column : SUGAR SZ5532
Eluent : H₂O/CH₃CN=25/75
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 60°C

Column : Asahipak NH2P-50 4E
Eluent : H₂O/CH₃CN=25/75
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 30°C

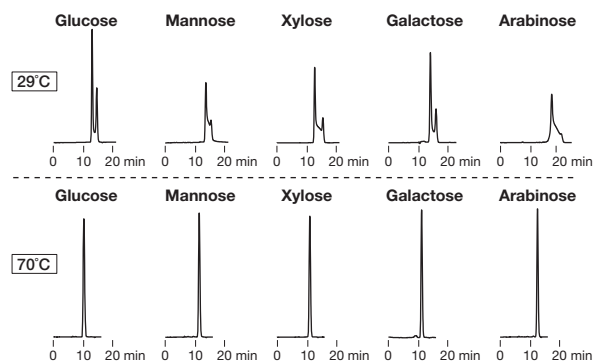
Substances	Elution Volume (mL)					
	SP0810	SC1011	KS-801	SZ5532	NH2P-50 4E	SC1211
D-Mannose	10.72	8.17	7.64	5.83	7.84	5.01
Melibiose	8.16	6.45	5.98	11.69	14.70	4.23
Nystose	6.38	5.45	4.93	20.05	31.90	*
Palatinit	2peaks	2peaks	5.90	2peaks	12.73	2peaks
Palatinose	7.84	6.45	5.89	8.08	12.12	3.99
Panose	7.14	5.78	5.32	16.87	25.60	*
D(+)-Raffinose	7.14	5.78	5.29	16.36	20.25	*
Rhamnose	9.77	8.23	7.37	3.93	5.52	4.43
D(-)-Ribose	19.35	13.66	9.04	4.82	5.45	8.64
D(-)-Sorbitol	21.61	13.31	7.42	9.79	7.09	11.88
Sorbose	9.67	8.03	7.38	5.12	7.35	4.92
Stachyose	6.82	5.57	4.97	—	36.22	*
Sucrose	7.54	6.29	5.87	7.91	11.87	*
α-D-Talose	21.33	12.59	8.76	5.69	6.47	8.51
Trehalose	7.62	6.27	5.78	10.85	13.25	*
Trehalulose	8.92	6.95	6.10	9.54	11.68	4.78
Xylitol	19.87	13.14	7.94	7.77	6.10	10.16
Xylobiose	8.16	6.68	6.40	5.65	9.05	*
D(+)-Xylose	9.21	7.90	7.71	4.55	6.58	4.48
D-Xylulose	10.64	9.02	8.04	4.06	5.41	5.07

(-)→Not detected (-)→Overlap with solvent peak

Anomer separation of saccharides

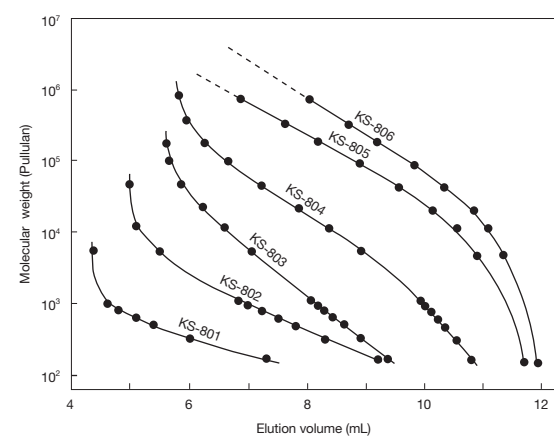
Temperature can affect chromatograms when separating saccharide anomers. When using a SUGAR column to analyze saccharides, the analysis at high temperatures would suppress the influence of anomer separation, resulting in better chromatograms.

Sample :
0.5% each, 10 μ L



Column : Shodex SUGAR SC1011
Eluent : H₂O
Flow rate : 0.7mL/min
Detector : RI
Column temp. : 29°C, 70°C

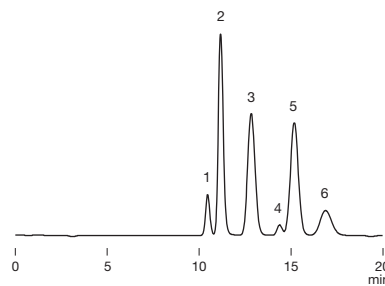
Calibration curves for KS-800 series using pullulan



Column : Shodex SUGAR KS-800 series
Eluent : H₂O
Detector : RI
Column temp. : 80°C

Acesulfame K and sucralose

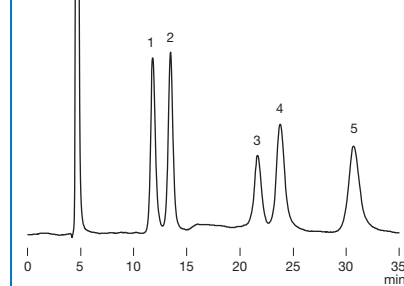
Sample : 20 μ L
1. Acesulfame K 0.1%
2. Sucrose 0.5%
3. Glucose 0.5%
4. Unknown from Acesulfame K
5. Fructose 0.5%
6. Sucralose 0.1%



Column : Shodex SUGAR SC1011
Eluent : 10mM CaSO₄ aq.
Flow rate : 0.6mL/min
Detector : RI
Column temp. : 80°C

Sucrose and turanose

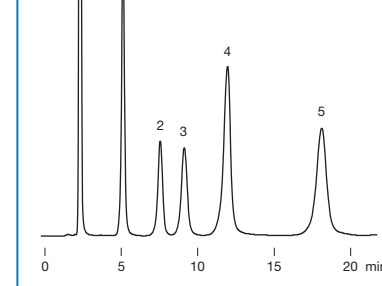
Sample : 0.5% each, 10 μ L
1. Fructose
2. Glucose
3. Sucrose
4. Turanose
5. Lactose



Column : Shodex SUGAR SZ5532
Eluent : H₂O/CH₃CN=20/80
Flow rate : 0.6mL/min
Detector : RI
Column temp. : 60°C

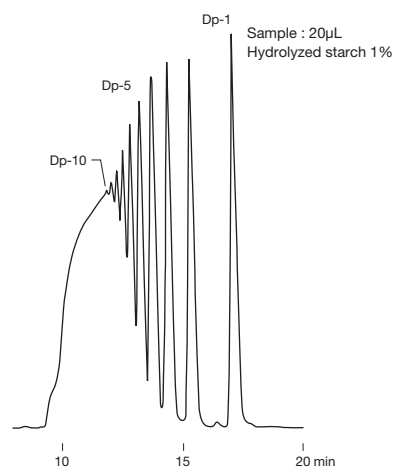
Maltose and isomaltose

Sample : 0.5% each, 20 μ L
1. Glucose
2. Maltose
3. Isomaltose
4. Maltotriose
5. Isomaltotriose



Column : Shodex SUGAR SZ5532
Eluent : H₂O/CH₃CN=25/75
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 60°C

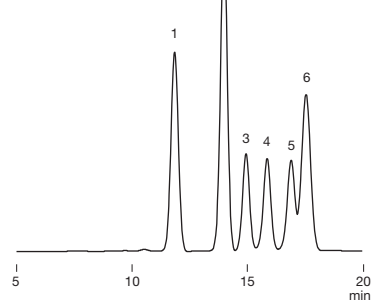
Hydrolyzed starch



Column : Shodex SUGAR KS-802 x 2
Eluent : H₂O
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 80°C

Saccharides in wood (model)

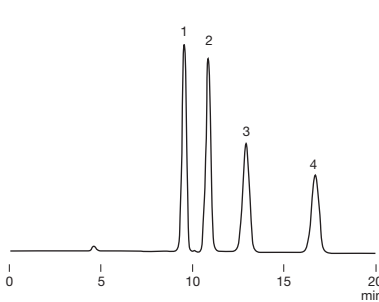
Sample : 5 μ L
1. Cellobiose 1.0%
2. Glucose 1.5%
3. Xylose 0.5%
4. Galactose 0.5%
5. Arabinose 0.5%
6. Mannose 1.0%



Column : Shodex SUGAR SP0810
Eluent : H₂O
Flow rate : 0.6mL/min
Detector : RI
Column temp. : 85°C

Ketohexoses

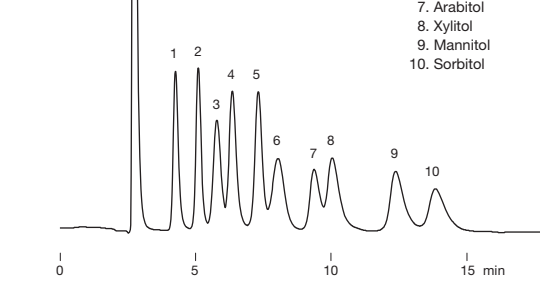
Sample : 0.025% each, 10 μ L
1. Sorbose
2. Fructose
3. Tagatose
4. Psicose



Column : Shodex SUGAR SP0810
Eluent : H₂O
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 80°C

Saccharides and sugar alcohols

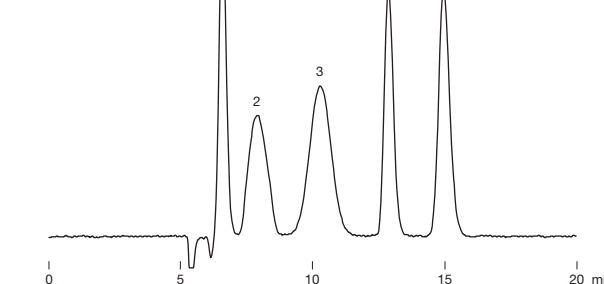
Sample : 0.5% each, 20 μ L
1. Rhamnose
2. Xylose
3. Arabinose
4. Fructose
5. Glucose
6. Galactose
7. Arabinol
8. Xylitol
9. Mannitol
10. Sorbitol



Column : Shodex SUGAR SZ5532
Eluent : H₂O/CH₃CN=20/80
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 65°C

Saccharides and Amino Acids

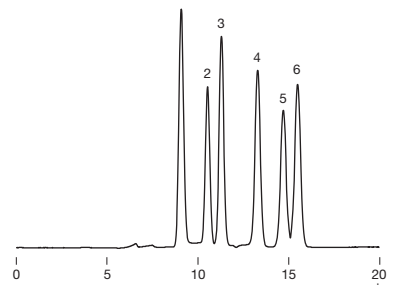
Sample : 0.1% each, 20 μ L
1. Sucrose
2. Glucose
3. Fructose
4. Taurine
5. *myo*-Inositol



Column : Shodex SUGAR SC1211
Eluent : H₂O/CH₃CN=60/40
Flow rate : 0.6mL/min
Detector : RI
Column temp. : 70°C

Pinitol

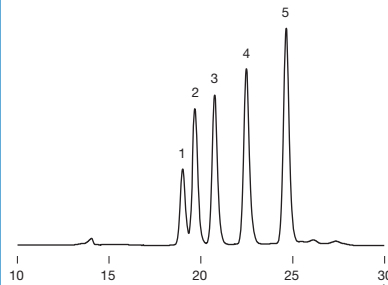
Sample : 0.1% each, 20 μ L
1. Sucrose
2. Glucose
3. Pinitol
4. Fructose
5. *chiro*-Inositol
6. *myo*-Inositol



Column : Shodex SUGAR SP0810
Eluent : H₂O
Flow rate : 0.8mL/min
Detector : RI
Column temp. : 85°C

Oligosaccharides in soybean

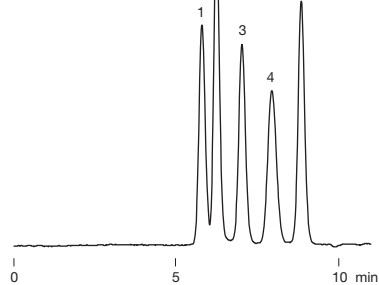
Sample : 0.1% each, 20 μ L
1. Verbascose
2. Stachyose
3. Raffinose
4. Sucrose
5. Pinitol



Column : Shodex SUGAR KS-802 + KS-801
Eluent : H₂O
Flow rate : 0.6mL/min
Detector : RI
Column temp. : 85°C

Saccharides related to raffinose biosynthesis

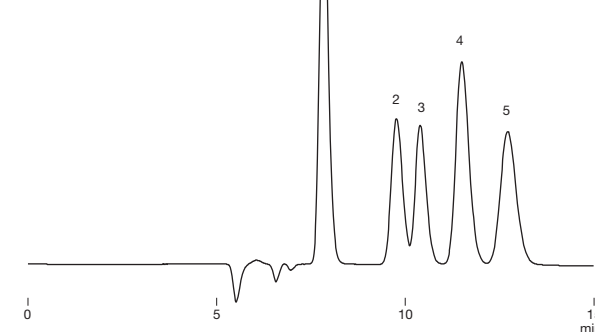
Sample : 0.1% each, 20 μ L
1. Raffinose
2. Sucrose
3. Galactinol
4. Galactose
5. *myo*-Inositol



Column : Shodex SUGAR SC1011
Eluent : H₂O
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 80°C

Moisturizing components

Sample : 0.1% each, 20 μ L
1. 1,3-Propanediol
2. Propylene glycol
3. Ethylene glycol
4. Glycerin
5. *meso*-Erythritol

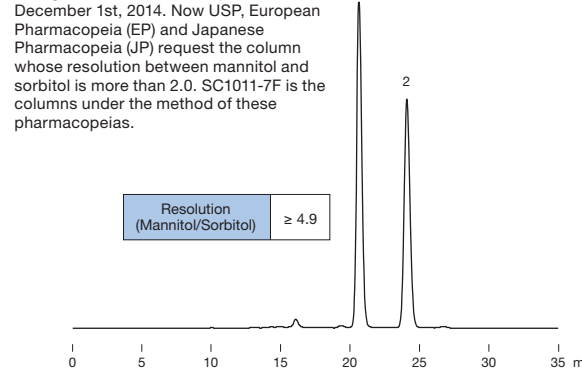


Column : Shodex SUGAR SC1211
Eluent : H₂O/CH₃CN=60/40
Flow rate : 0.6mL/min
Detector : RI
Column temp. : 40°C

Mannitol and sorbitol

Analytical conditions of mannitol for United States Pharmacopeia (USP) were partially changed in USP 37-NF 32 operated on December 1st, 2014. Now USP, European Pharmacopeia (EP) and Japanese Pharmacopeia (JP) request the column whose resolution between mannitol and sorbitol is more than 2.0. SC1011-7F is the columns under the method of these pharmacopeias.

Sample : 25mg/mL each, 20 μ L
1. Mannitol
2. Sorbitol



Column : Shodex EP SC1011-7F
Eluent : H₂O
Flow rate : 0.5mL/min
Detector : RI
Column temp. : 85°C

Columns for Ion Exclusion Chromatography

Features

- SH1011

SH1821
- Columns for simultaneous analysis of saccharides and organic acids
 - Separates neutral sugars in size exclusion mode and organic acids in ion exclusion mode
 - Suitable for the analysis of uronic and aldonic acids
 - Corresponds to USP L17 and L22
- KC-811
- Columns for the analysis of organic acids
 - Ion exclusion mode (+ reversed phase mode)
 - Highly selective detection with post column method
 - KC-811 6E is suitable for the analysis of cyanide ions and cyanogen chloride in accordance with the Japanese Water Supply Act
 - Corresponds to USP L17 and L22

Standard columns

For simultaneous analysis of saccharides and organic acids

Product Code	Product Name	Plate Number (TP/column)	Functional Group	Exclusion Limit (Pullulan)	Particle Size (μm)	Column Size (mm) I.D. x Length	Shipping Solvent
F6378100	SUGAR SH1011	≥ 17,000	Sulfo	1,000	6	8.0 × 300	H ₂ O
F6378101	SUGAR SH1821	≥ 17,000	Sulfo	10,000	6	8.0 × 300	H ₂ O
F6700080	SUGAR SH-G	(guard column)	Sulfo	—	10	6.0 × 50	H ₂ O

Base Material : Styrene divinylbenzene copolymer

For organic acids, cyanide ions and cyanogen chloride

Product Code	Product Name	Plate Number (TP/column)	Functional Group	Particle Size (μm)	Column Size (mm) I.D. x Length	Shipping Solvent
F6378030	RSpak KC-811	≥ 17,000	Sulfo	6	8.0 × 300	0.1% H ₃ PO ₄ aq.
F6378033	RSpak KC-811 6E	≥ 13,000	Sulfo	6	6.0 × 250	0.1% H ₃ PO ₄ aq.
F6700030	RSpak KC-G 6B (RSpak KC-G)	(guard column)	Sulfo	10	6.0 × 50	0.1% H ₃ PO ₄ aq.
F6700010	RSpak KC-G 8B (RSpak KC-LG)	(guard column)	Sulfo	13	8.0 × 50	0.1% H ₃ PO ₄ aq.

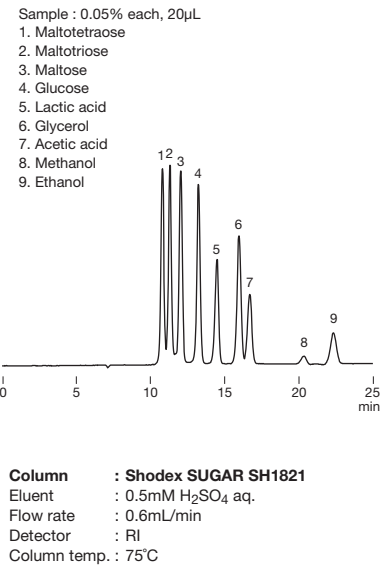
* As a guard column, use KC-G 8B for samples with relatively high impurity and KC-G 6B for samples with relatively low impurity.

Base Material : Styrene divinylbenzene copolymer

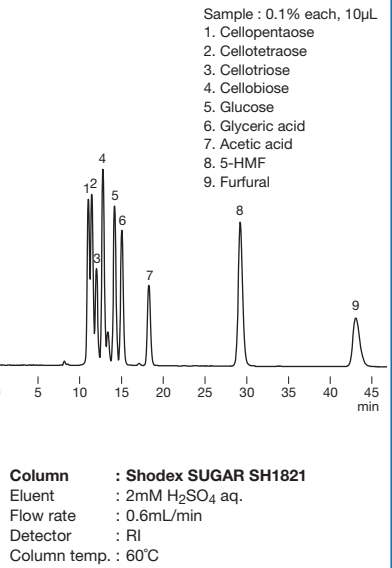
Preparative columns * Preparative columns are made to order.

Product Code	Product Name	Plate Number (TP/column)	Particle Size (μm)	Column Size (mm) I.D. x Length	Standard Column
F6505012	RSpak KC-2011	≥ 8,000	13	20.0 × 300	KC-811
F6700010	RSpak KC-G 8B (RSpak KC-LG)	(guard column)	13	8.0 × 50	(guard column)

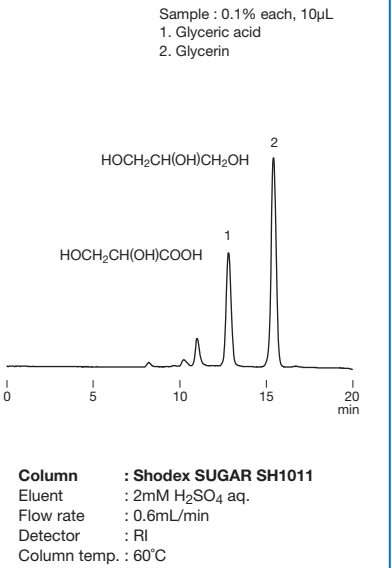
Maltooligosaccharides, organic acids and ethanol



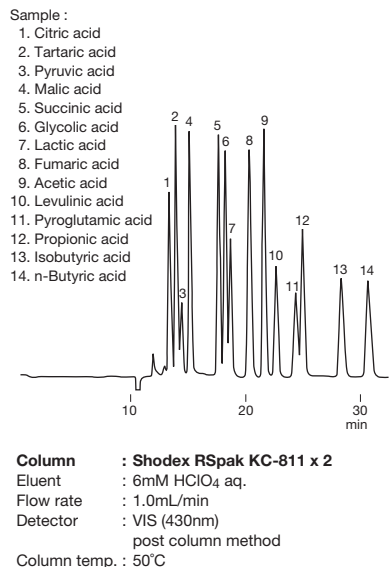
Cello-oligosaccharides and furfurals



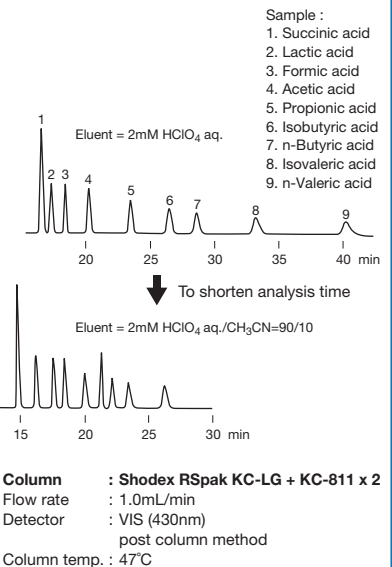
Glycerin and glyceric acid



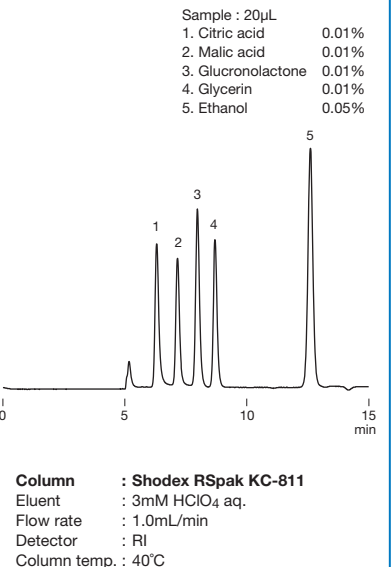
General organic acids



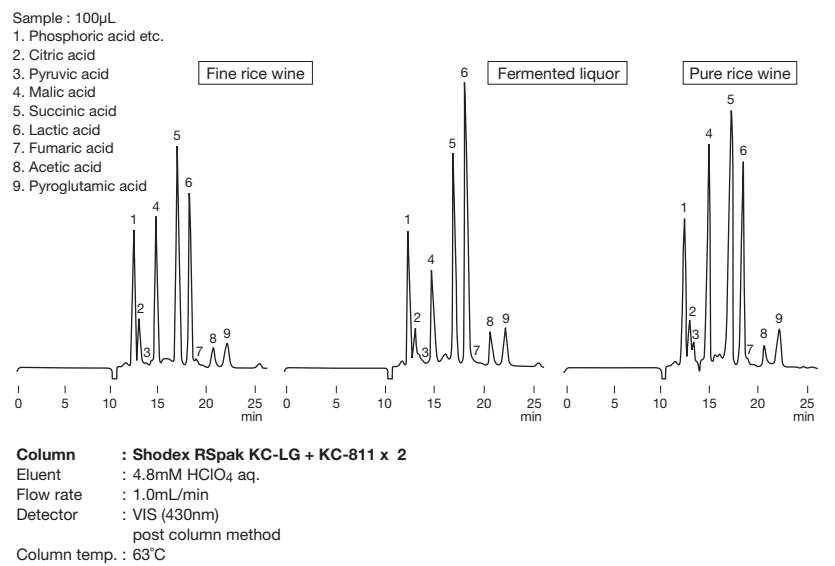
Hydrophobic organic acids



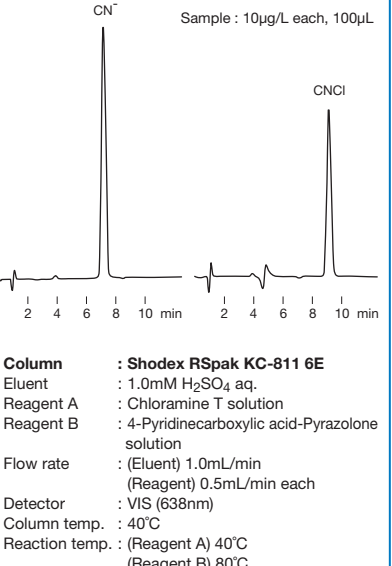
Glucronolactone and organic acids



Organic acids in sake



Analysis of Cyanide ion and cyanogen chloride with post column method



Columns for Ion Chromatography (Anion Analysis)

Features

NI-424	Columns for anion analysis with non-suppressor method
I-524A	NI-424 supports simultaneous analysis of fluoride and phosphate ions
SI-90 4E	Columns for anion analysis with suppressor method
SI-50 4E	Suitable for the quantitative analysis of fluoride ion
	SI-50 separates target inorganic anions from organic acids
	Not interfered by the system peak derived from carbonate
SI-35 4D	Columns for the analysis of oxyhalides with suppressor method
SI-52 4E	SI-35 supports rapid analysis of oxyhalides and general inorganic ions
	SI-52 supports simultaneous analysis of oxyhalides and general inorganic ions

Standard columns

For anions (non-suppressor method)

Product Code	Product Name	Plate Number (TP/column)	Functional Group	Particle Size (μm)	Column Size (mm) I.D. x Length	Shipping Solvent
F6995243	IC NI-424	≥ 5,000	Quaternary ammonium	5	4.6 × 100	8mM 4-Hydroxybenzoic acid + 2.8mM Bis-Tris + 2mM Phenylboronic acid + 0.005mM CyDTA aq.
F6709616	IC NI-G	(guard column)	Quaternary ammonium	5	4.6 × 10	8mM 4-Hydroxybenzoic acid + 2.8mM Bis-Tris + 2mM Phenylboronic acid + 0.005mM CyDTA aq.
F6995240	IC I-524A	≥ 2,000	Quaternary ammonium	12	4.6 × 100	2.5mM Phthalic acid aq.
F6700400	IC IA-G	(guard column)	Quaternary ammonium	12	4.6 × 10	2.5mM Phthalic acid aq.

Base Material : Polyhydroxymethacrylate
Housing Material : SUS

For anions (suppressor method)

Product Code	Product Name	Plate Number (TP/column)	Functional Group	Particle Size (μm)	Column Size (mm) I.D. x Length	Shipping Solvent
F6995244	IC SI-90 4E	≥ 5,000	Quaternary ammonium	9	4.0 × 250	1.8mM Na ₂ CO ₃ + 1.7mM NaHCO ₃ aq.
F6709620	IC SI-90G	(guard column)	Quaternary ammonium	9	4.6 × 10	1.8mM Na ₂ CO ₃ + 1.7mM NaHCO ₃ aq.
F6995245	IC SI-50 4E	≥ 10,000	Quaternary ammonium	5	4.0 × 250	3.2mM Na ₂ CO ₃ + 1.0mM NaHCO ₃ aq.
F6709625	IC SI-50G	(guard column)	Quaternary ammonium	5	4.6 × 10	3.2mM Na ₂ CO ₃ + 1.0mM NaHCO ₃ aq.

Base Material : Polyvinyl alcohol
Housing Material : PEEK

For oxyhalides (suppressor method)

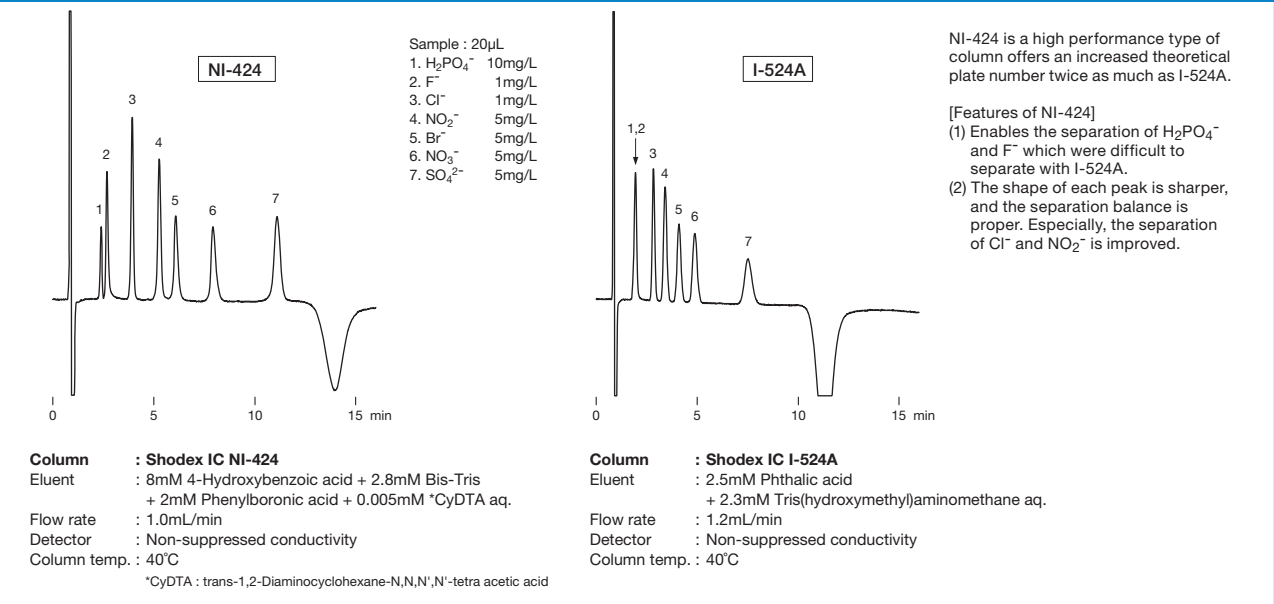
Product Code	Product Name	Plate Number (TP/column)	Functional Group	Particle Size (μm)	Column Size (mm) I.D. x Length	Shipping Solvent
F6995290	IC SI-35 4D	≥ 13,000	Quaternary ammonium	3.5	4.0 × 150	3.6mM Na ₂ CO ₃ aq.
F6709627	IC SI-95G	(guard column)	Quaternary ammonium	9	4.6 × 10	3.6mM Na ₂ CO ₃ aq.
F6995260	IC SI-52 4E	≥ 14,000	Quaternary ammonium	5	4.0 × 250	3.6mM Na ₂ CO ₃ aq.
F6709626	IC SI-92G	(guard column)	Quaternary ammonium	9	4.6 × 10	3.6mM Na ₂ CO ₃ aq.

Base Material : Polyvinyl alcohol
Housing Material : PEEK

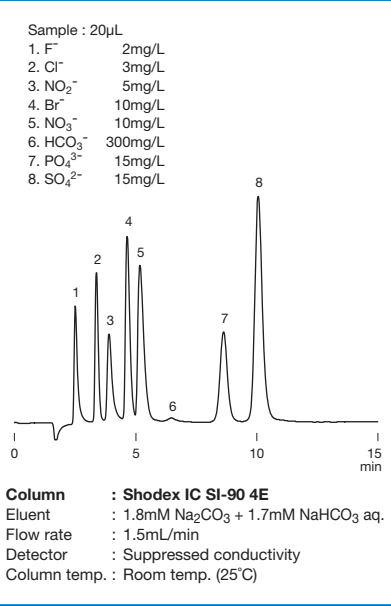
Line filters for IC

Product Code	Product Name	Contents
F8500630	IC FL-1	One holder and one filter
F8500640	IC FL-1 filter	5 filters

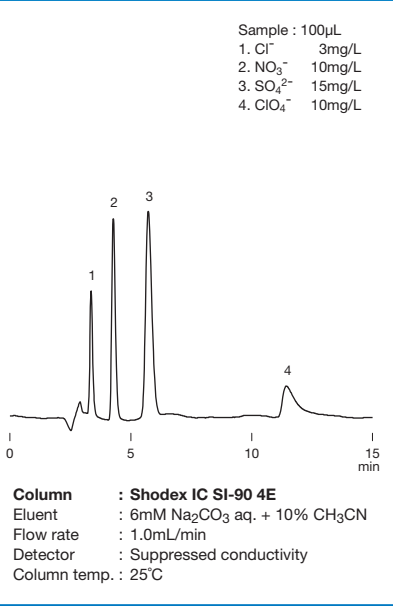
Anions analysis with non-suppressor method (NI-424 and I-524A)



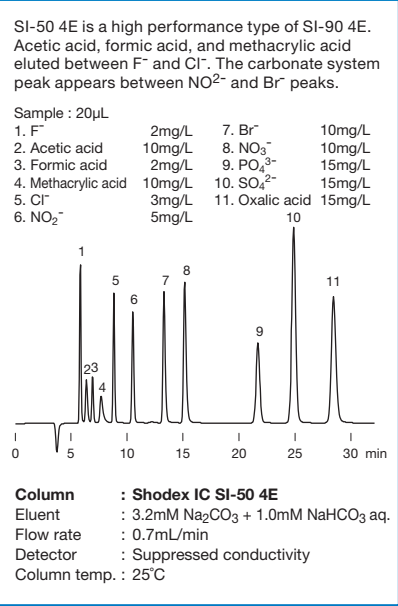
Anions analysis using SI-90 4E (suppressor method)



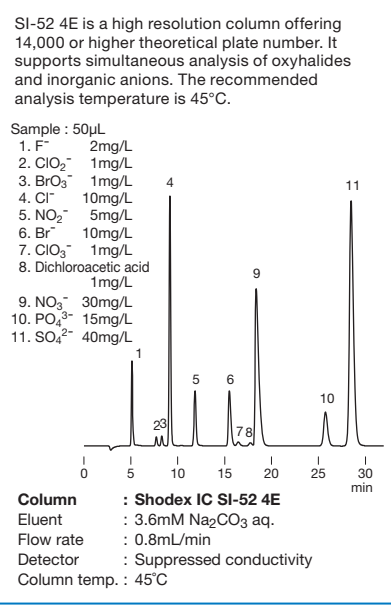
Perchloric acid analysis using SI-90 4E (suppressor method)



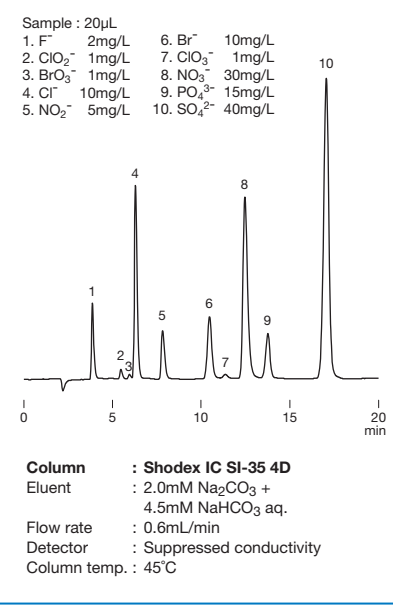
Anions analysis using SI-50 4E (suppressor method)



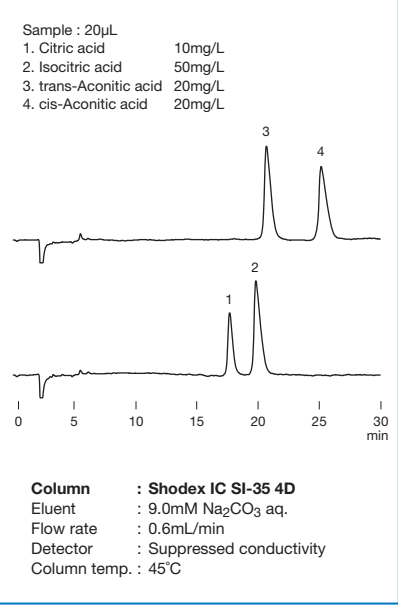
Oxyhalides and anions analysis using SI-52 4E (suppressor method)



Oxyhalides and anions analysis using SI-35 4D (suppressor method)



Tricarboxylic acid (suppressor method)



Columns for Ion Chromatography (Cation Analysis)

Features

- YS-50**
 - High performance type of YK-421
 - Applicable to both suppressor and non-suppressor methods
 - Peak shape is sharper, especially for divalent cation analysis
 - Supports the analysis of alkylamines and transition metals
- YK-421**
 - Column for cation analysis with non-suppressor method
 - Simultaneous analysis of monovalent and divalent cations
 - Suitable for separation of alkylamines
- Y-521**
 - Column for cation analysis with non-suppressor method
 - For the separation of monovalent or divalent cations
 - Corresponds to USP L17 and L22
- T-521**
 - Column for transition metal ion analysis
 - Highly sensitive analysis is achieved by post column color reaction method

Standard columns

For cations

Product Code	Product Name	Plate Number (TP/column)	Functional Group	Base Material	Particle Size (μm)	Column Size (mm) I.D. x Length	Shipping Solvent
F7122000	IC YS-50	≥ 5,500	Carboxyl	Polyvinyl alcohol	5	4.6 × 125	H ₂ O
F6700530	IC YS-G	(guard column)	Carboxyl	Polyvinyl alcohol	5	4.6 × 10	H ₂ O
F7120012	IC YK-421	≥ 2,800	Carboxyl	Silica	5	4.6 × 125	5mM Tartaric acid + 1mM Dipicolinic acid + 1.5g/L Boric acid aq.
F6709608	IC YK-G	(guard column)	Carboxyl	Silica	5	4.6 × 10	5mM Tartaric acid + 1mM Dipicolinic acid + 1.5g/L Boric acid aq.
F6995210	IC Y-521	≥ 3,000	Sulfo	Styrene divinylbenzene copolymer	12	4.6 × 150	4mM HNO ₃ aq.
F6700230	IC Y-G	(guard column)	Sulfo	Styrene divinylbenzene copolymer	12	4.6 × 10	4mM HNO ₃ aq.

Housing Material : SUS

For transition metal ions

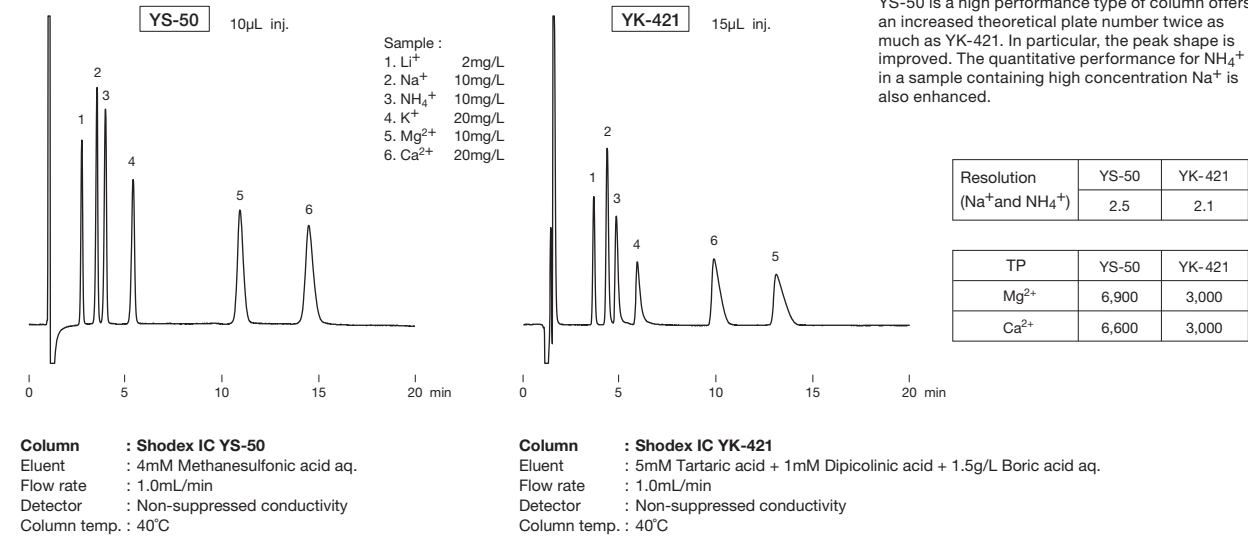
Product Code	Product Name	Plate Number (TP/column)	Functional Group	Particle Size (μm)	Column Size (mm) I.D. x Length	Shipping Solvent
F6995250	IC T-521	≥ 3,000	Sulfo	12	4.6 × 150	3mM HNO ₃ aq.
F6700412	IC T-G	(guard column)	Sulfo	12	4.6 × 10	3mM HNO ₃ aq.

Base Material : Styrene divinylbenzene copolymer
Housing Material : PEEK

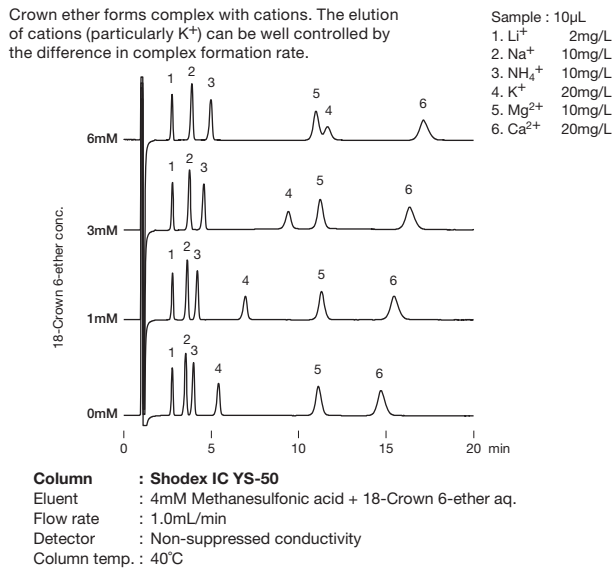
Line filters for IC

Product Code	Product Name	Contents
F8500630	IC FL-1	One holder and one filter
F8500640	IC FL-1 filter	5 filters

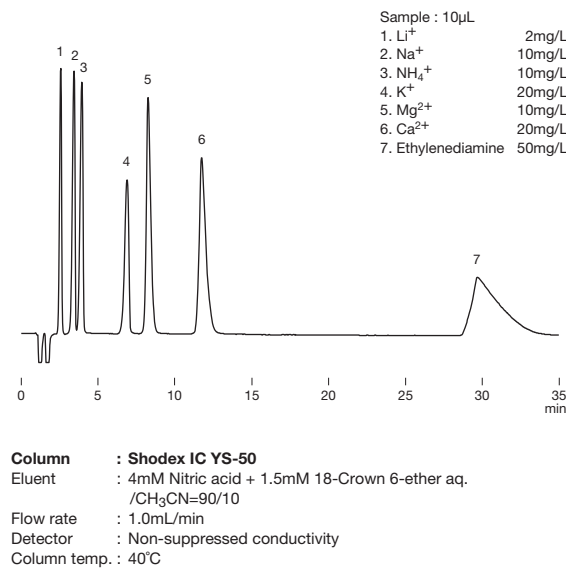
Standard cations (YS-50 and YK-421)



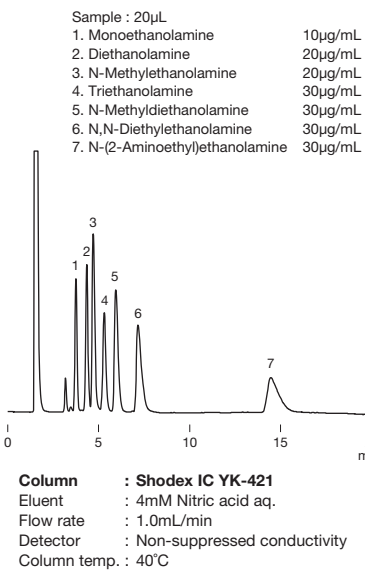
Effects of crown ether in eluent



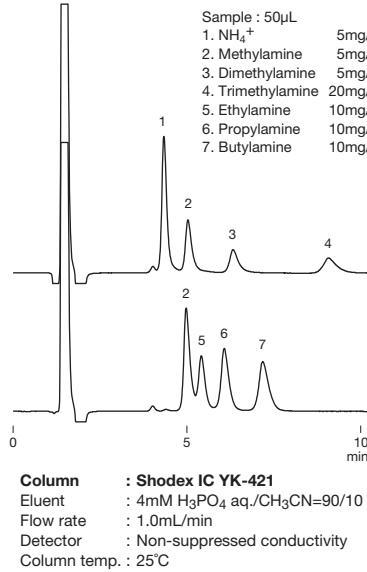
Simultaneous analysis for cations and ethylenediamine



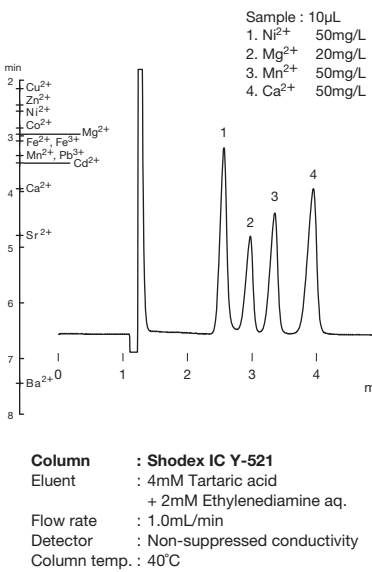
Amino alcohols



Alkylamines

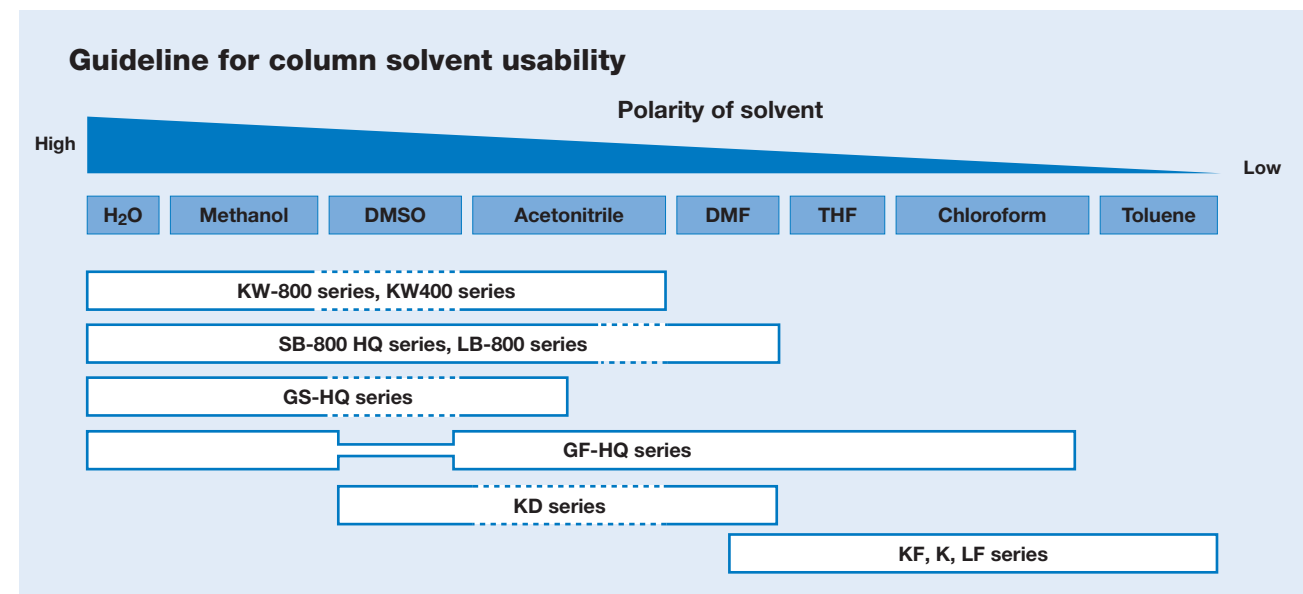


Alkaline earth metal ions



Column Selection for Size Exclusion Chromatography (SEC)

	Application	Solvent	Column	Page
Aqueous SEC (GFC)	Biological macromolecules (proteins, peptides, nucleic acids, etc.)	Buffer etc.	KW-800 series	36
			KW400 series High performance (solvent-saving)	36
	Biological macromolecules (high MW range)	Buffer etc.	SB-800 HQ series	38
			LB-800 series	38
	Water-soluble polymers (polyacrylamide, polyethylenimine, etc.) Polysaccharides	H ₂ O, Buffer Aqueous solution etc.	SB-800 HQ series	38
			LB-800 series	38
Organic SEC (GPC)	General polymers	THF	KS-800 series	24
			GS-HQ series	42
			KF-800 series	46
			KF-600 series Rapid analysis (solvent-saving)	52
	Polar polymers (polyimides, polyvinylpyrrolidones etc.)	DMF	KF-400HQ series High performance (solvent-saving)	52
			LF series High linearity of calibration curve	56
			Chloroform	48
			K-800 series	48
	Analysis at high temperature (polyethylene, polypropylene etc.)	ODCB etc.	KD-800 series	50
			SB-800 HQ series	38
			LB-800 series	38
			HT-800 series	58
Aqueous/Organic SEC	Engineering resin analysis at room temperature [polyamide (Nylon), polyethylene terephthalate (PET) etc.]	HFIP	UT-800 series	58
			AT-806MS	58
			HFIP-800 series	60
			HFIP-600 series Rapid analysis (solvent-saving)	60
			LF series High linearity of calibration curve	56
			GF-HQ series	44



* See page 62 for the solvent replaceability of organic solvent SEC (GPC) packed columns.

Precautions for Polar Polymer Analysis

Size exclusion chromatography analysis of polar polymers can be influenced by unexpected interactions in the column. These interactions may change elution patterns and results in an invalid molecular weight calculation. It is important to reduce them in order to obtain the accurate molecular weight distribution.

Interfering interactions likely to be observed

Interactions between the analyte and the packing materials

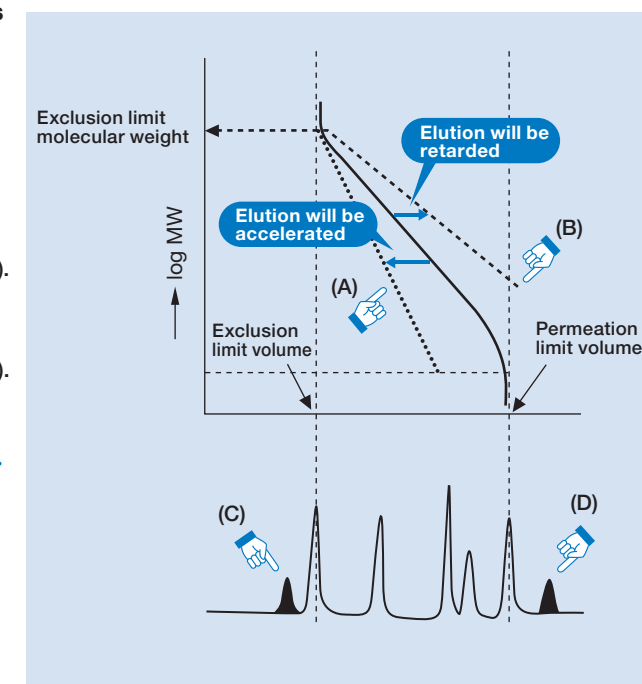
- **Hydrophobic interaction**
 - The analyte is adsorbed into the packing material. This delays the analyte elution, and thus results in under estimation of its molecular weight (Figure B, D).
- **Ionic interaction**
 - (1) Ion Exclusion
 - The analyte is repelled from the packing material. This accelerates the analyte elution, and thus results in over estimation of its molecular weight (Figure A, C).
 - (2) Ion Exchange
 - The analyte is adsorbed onto the packing material. This delays the analyte elution, and thus results in under estimation of its molecular weight (Figure B, D).

Interaction within and between the analyte

- **Ionic repulsion effects observed within the multivalent macromolecules causes structure expansion**
 - This accelerates the analyte elution, and thus results in over estimation of its molecular weight (Figure A).
- **Association between the molecules**
 - Associated molecule detected as a larger molecule (Figure A).

Interactions between the analyte and the solvent

- **The multivalent ion of the solvent works as a bridge to bind ionic molecules (analyte).**



Methods to reduce interactions

Aqueous SEC (GFC)

Ionic Interaction

- Add salt

Hydrophobic interaction

- Increase dissociation of the analyte
 - Cationic polymer → Lower the pH
 - Anionic polymer → Higher the pH
- Lower the eluent polarity
 - (Example) Add acetonitrile or methanol

Organic solvent SEC (GPC)

Ionic Interaction

- Add salt
 - (Example) Add LiBr to DMF
 - Add CF₃COONa to HFIP

Hydrophobic interaction

- Lower the polarity of the eluent
 - (Example) Change the eluent from DMF to THF

Hydrophillic interaction

- Increase the polarity of the eluent
 - (Example) Change the eluent from THF to DMF

Aqueous SEC (GFC) Columns : Silica-based

Features

- KW-800

 - Silica-based packed columns for aqueous SEC (GFC) analysis
 - Suitable for the analysis of proteins and enzymes
 - Corresponds to USP L20, L33, and L59
- KW400

 - Reducing particle size of the packing material enhances column performance
 - Three- or four-fold higher sensitivity than KW-800 series
 - KW405-4F is applicable to samples with a molecular weight above 1,000,000
 - Corresponds to USP L20, L33, and L59

Standard columns

Product Code	Product Name	Plate Number (TP/column)	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length	Shipping Solvent
F6989000	PROTEIN KW-802.5	≥ 21,000	5	400	8.0 × 300	H ₂ O
F6989103	PROTEIN KW-803	≥ 21,000	5	1,000	8.0 × 300	H ₂ O
F6989104	PROTEIN KW-804	≥ 16,000	7	1,500	8.0 × 300	H ₂ O
F6700131	PROTEIN KW-G 6B (PROTEIN KW-G)	(guard column)	7	–	6.0 × 50	H ₂ O

Base Material : Silica Usable pH range : pH3.0-7.5

High performance semi-micro columns

◎ Use of the KW400 series with semi-micro type devices is recommended.

Product Code	Product Name	Plate Number (TP/column)	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length	Shipping Solvent
F6989201	KW402.5-4F	≥ 35,000	3	400	4.6 × 300	H ₂ O
F6989202	KW403-4F	≥ 35,000	3	800	4.6 × 300	H ₂ O
F6989203	KW404-4F	≥ 25,000	5	1,500	4.6 × 300	H ₂ O
F6989204	KW405-4F	≥ 25,000	5	2,000	4.6 × 300	H ₂ O
F6700132	KW400G-4A	(guard column)	5	–	4.6 × 10	H ₂ O

Base Material : Silica Usable pH range : pH3.0-7.5

Semi-micro columns

* The following semi-micro columns are made to order. ◎ Use of the KW400 series with semi-micro type devices is recommended.

Product Code	Product Name	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length
F7781213	KW402.5-4B	3	400	4.6 × 50
F7781212	KW402.5-4D	3	400	4.6 × 150
F7781313	KW403-4B	3	800	4.6 × 50
F7781312	KW403-4D	3	800	4.6 × 150

Preparative columns * Preparative columns are made to order.

Product Code	Product Name	Plate Number (TP/column)	Particle Size (μm)	Column Size (mm) I.D. x Length	Standard Columns
F6505020	PROTEIN KW-2002.5	≥ 17,000	5	20.0 × 300	KW-802.5
F6505021	PROTEIN KW-2003	≥ 17,000	5	20.0 × 300	KW-803
F6505022	PROTEIN KW-2004	≥ 14,000	7	20.0 × 300	KW-804
F6709556	PROTEIN KW-G 8B (PROTEIN KW-LG)	(guard column)	7	8.0 × 50	(guard column)

Target molecular weight range and Exclusion limit

● With Protein (eluent : phosphate buffer)

Product Name	Target Molecular Weight Range	Exclusion Limit
KW-802.5	5,000 – 100,000	150,000
KW-803	10,000 – 700,000	*(1,000,000)
KW-804	30,000 – *(4,000,000)	*(4,000,000)
KW402.5	5,000 – 70,000	150,000
KW403	10,000 – 500,000	600,000
KW404	30,000 – *(4,000,000)	*(4,000,000)
KW405	200,000 – *(20,000,000)	*(20,000,000)

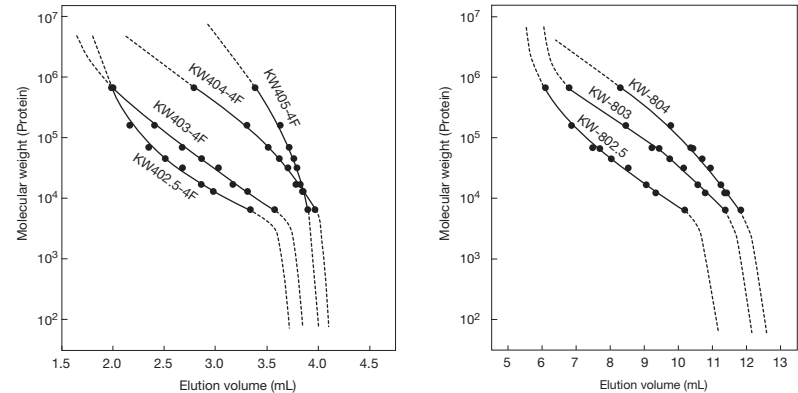
* Please use the above table as a rough indication for the column selection. *() Estimated value

● With Pullulan (eluent : ultrapure water)

Product Name	Target Molecular Weight Range	Exclusion Limit
KW-802.5	2,000 – 50,000	60,000
KW-803	5,000 – 100,000	170,000
KW-804	20,000 – 300,000	500,000
KW402.5	2,000 – 40,000	60,000
KW403	3,000 – 50,000	80,000
KW404	20,000 – 300,000	400,000
KW405	100,000 – 700,000	1,300,000

* Please use the above table as a rough indication for the column selection.

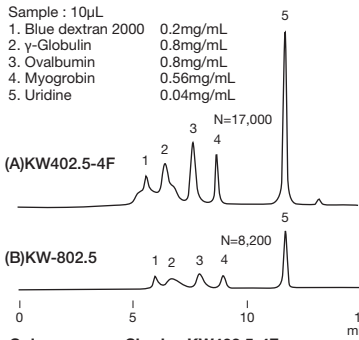
Calibration curves for KW400 series and KW-800 series using protein



Column : Shodex KW400-4F series, Shodex PROTEIN KW-800 series
Eluent : 50mM Sodium phosphate buffer + 0.3M NaCl (pH7.0)
Flow rate : 0.33mL/min (KW400) 1.0mL/min (KW-800)
Detector : UV (280nm) (small cell volume) (KW400) UV (280nm) (conventional type) (KW-800)
Column temp. : 30°C

Comparison of KW402.5-4F and KW-802.5

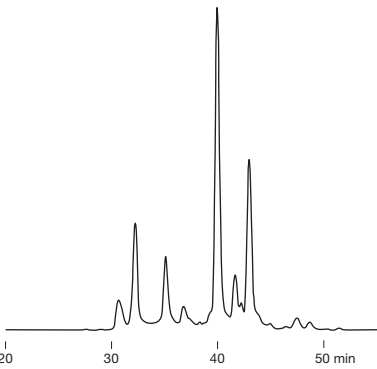
KW400 series is a high performance type of semi-micro columns, offering approximately 1.5 times larger theoretical plate number and 3 to 4 times higher detection sensitivity (peak height) than KW-800 series columns does.



Column : Shodex KW402.5-4F Shodex PROTEIN KW-802.5
Eluent : 50mM Sodium phosphate buffer + 0.3M NaCl (pH7.0)
Flow rate : (A) 0.33mL/min, (B) 1.0mL/min
Detector : UV (280nm) (small cell volume)
Column temp. : 25°C

Whey in yogurt

Sample : Whey, 5μL



Column : Shodex KW402.5-4F + KW403-4F
Eluent : 50mM Sodium phosphate buffer + 0.3M NaCl (pH7.0)
Flow rate : 0.20mL/min
Detector : UV (280nm) (small cell volume)
Column temp. : 30°C

Recovery rate of proteins

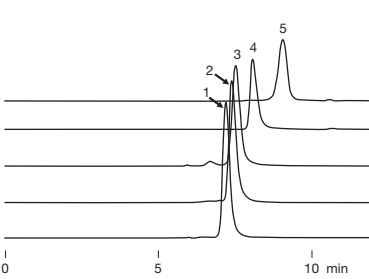
Protein	Recovery (%)	
	KW402.5-4F	KW403-4F
γ - Globulin	98	96
Bovine serum albumin	89	96
Ovalbumin	89	97
Myoglobin	90	89
Cytochrome c	92	92
Lysozyme	87	98
α-Chymotrypsinogen A	95	94

Column : Shodex KW402.5-4F Shodex KW403-4F
Eluent : 50mM Sodium phosphate buffer + 0.3M NaCl (pH7.0)
Flow rate : 0.33mL/min
Detector : UV (280nm) (small cell volume)
Column temp. : 25°C

Lectins

Sample : 5μL

- Lectin from Soybean 0.6mg/mL
- Lectin from Arachis hypogaea 1.1mg/mL
- Lectin from Canavalia ensiformis (Con A) 0.9mg/mL
- Lectin from Lens culinaris (LCA) 0.7mg/mL
- Lectin from Triticum vulgaris (WGA) 0.8mg/mL

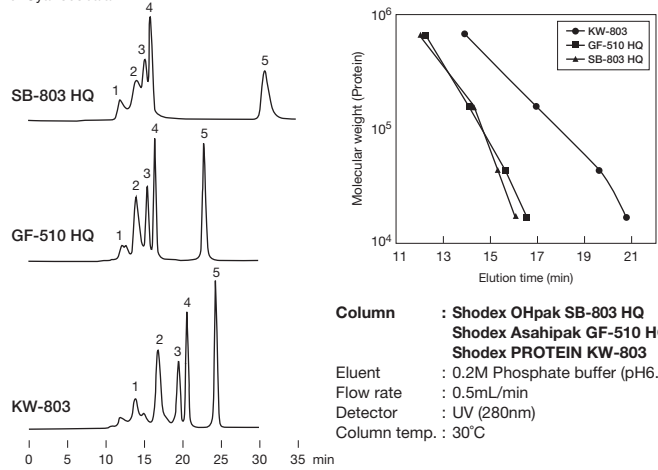


Column : Shodex KW402.5-4F
Eluent : 50mM Sodium phosphate buffer + 0.3M NaCl (pH7.0)
Flow rate : 0.33mL/min
Detector : UV (220nm) (small cell volume)
Column temp. : 30°C

Comparison of various GFC columns for separation of standard proteins

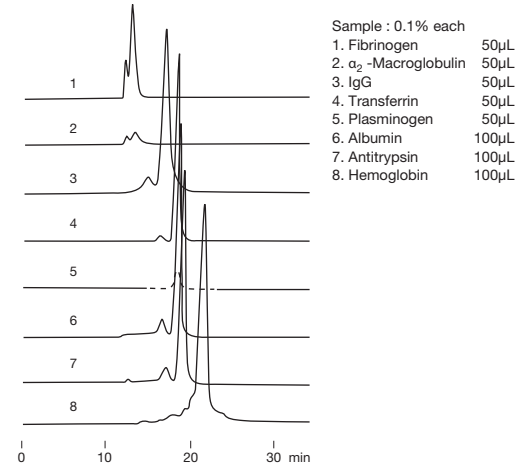
Sample : 1. Thyroglobulin (bovine) 2. γ-Globulin (bovine) 3. Ovalbumin (chicken) 4. Myoglobin (horse) 5. Cyanocobalamin

Three aqueous SEC columns (SB-803 HQ, GF-510 HQ, and KW-803) were compared for their separation performances. KW-803, silica-based column, showed the best separation performance for the analysis of protein standards.



Column : Shodex OHpak SB-803 HQ Shodex Asahipak GF-510 HQ Shodex PROTEIN KW-803
Eluent : 0.2M Phosphate buffer (pH6.9)
Flow rate : 0.5mL/min
Detector : UV (280nm)
Column temp. : 30°C

Proteins in human blood serum



Column : Shodex PROTEIN KW-803
Eluent : 50mM Phosphate buffer + 0.3M NaCl (pH7.0)
Flow rate : 1.0mL/min
Detector : UV (280nm)
Column temp. : Room temp.

Aqueous SEC (GFC) Columns : Polymer-based

Features

SB-800 HQ	- Polymer-based packed columns for aqueous SEC (GFC) analysis - Supports a wide range of molecular weight sample analysis - The eluent can be replaced with DMF (except SB-802 HQ and SB-807 HQ), enabling the analysis of polar polymers - Method using SB-804 HQ or SB-805 HQ for gelatin's mean molecular weight determination is comparable with PAGI method (Ver. 10, Japan) - Corresponding to USP L38 and L39 - SB-802 HQ corresponds to USP L25 - SB-802.5 HQ corresponds to USP L25 - SB-803 HQ corresponds to USP L37
SB-807 HQ	- Column for the analysis of water-soluble ultra high molecular weight polymers - Large particle size gel is packed to prevent shear degradation of polymers - Corresponds to USP L38 and L39
New LB-800	- Suitable for light scattering detector because of the controlled column bleed - Polymer-based packed columns for aqueous SEC (GFC) analysis - The eluent can be replaced with DMF enabling the analysis of polar polymers - Corresponds to USP L38 and L39

Standard columns

Product Code	Product Name	Plate Number (TP/column)	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length	Shipping Solvent
F6429100	OHpak SB-802 HQ	≥ 12,000	8	100	8.0 × 300	0.02% NaN ₃ aq.
F6429101	OHpak SB-802.5 HQ	≥ 16,000	6	200	8.0 × 300	0.02% NaN ₃ aq.
F6429102	OHpak SB-803 HQ	≥ 16,000	6	800	8.0 × 300	0.02% NaN ₃ aq.
F6429103	OHpak SB-804 HQ	≥ 16,000	10	2,000	8.0 × 300	0.02% NaN ₃ aq.
F6429104	OHpak SB-805 HQ	≥ 12,000	13	7,000	8.0 × 300	0.02% NaN ₃ aq.
F6429105	OHpak SB-806 HQ	≥ 12,000	13	15,000	8.0 × 300	0.02% NaN ₃ aq.
F6429106	OHpak SB-806M HQ	≥ 12,000	13	15,000	8.0 × 300	0.02% NaN ₃ aq.
F6709430	OHpak SB-G 6B (OHpak SB-G)	(guard column)	10	–	6.0 × 50	0.02% NaN ₃ aq.

SB-806M HQ is a mixed-gel column capable of analyzing samples over a wide range of molecular weight distribution.

Base Material : Polyhydroxymethacrylate
Usable pH range : pH3-10

For water-soluble ultra high molecular weight polymers

Product Code	Product Name	Plate Number (TP/column)	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length	Shipping Solvent
F6429108	OHpak SB-807 HQ	≥ 1,500	35	30,000	8.0 × 300	H ₂ O
F6709431	OHpak SB-807G	(guard column)	35	–	8.0 × 50	H ₂ O

Base Material : Polyhydroxymethacrylate
Usable pH range : pH3-10

For light scattering

Product Code	Product Name	Plate Number (TP/column)	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length	Shipping Solvent
F6429201	New OHpak LB-803	≥ 16,000	6	800	8.0 × 300	H ₂ O
F6429202	New OHpak LB-806M	≥ 12,000	13	15,000	8.0 × 300	H ₂ O
F6709434	New OHpak LB-G 6B	(guard column)	13	–	6.0 × 50	H ₂ O

Base Material : Polyhydroxymethacrylate
Usable pH range : pH3-10

Preparative columns * Preparative columns are made to order.

Product Code	Product Name	Plate Number (TP/column)	Particle Size (μm)	Column Size (mm) I.D. x Length	Standard Column
F6516011	OHpak SB-2002	≥ 9,000	15	20.0 × 300	SB-802 HQ
F6516012	OHpak SB-2002.5	≥ 12,000	10	20.0 × 300	SB-802.5 HQ
F6516013	OHpak SB-2003	≥ 12,000	10	20.0 × 300	SB-803 HQ
F6516014	OHpak SB-2004	≥ 12,000	18	20.0 × 300	SB-804 HQ
F6516015	OHpak SB-2005	≥ 12,000	20	20.0 × 300	SB-805 HQ
F6516016	OHpak SB-2006	≥ 12,000	20	20.0 × 300	SB-806 HQ
F6516017	OHpak SB-2006M	≥ 12,000	20	20.0 × 300	SB-806M HQ
F6709555	OHpak SB-G 8B (OHpak SB-LG)	(guard column)	18	8.0 × 50	(guard column)

Usable concentration of organic solvents

Product Code	The maximum usable concentration (%)		
	Methanol	Acetonitrile	DMF
SB-802 HQ	0	0	0
SB-802.5 HQ, SB-803 HQ	100	75	100
SB-804 HQ~SB-806M HQ	75	75	100
SB-G 6B	75	75	100
SB-807 HQ, SB-807G	30	30	0
LB-803, LB-806M, LB-G 6B	100	100	100

(Note)
The maximum solvent tolerance of preparative type SB-800 HQ, SB-2000 series, is 50% of methanol, acetonitrile, and DMF (SB-2002 is not tolerant of organic solvents, similar to SB-802 HQ).

Target molecular weight range and Exclusion limit

● With Pullulan (eluent : ultrapure water)

Product Name	Target Molecular Weight Range	Exclusion Limit
SB-802 HQ	200 – 1,000	1,000
SB-802.5 HQ	500 – 10,000	10,000
SB-803 HQ	1,000 – 100,000	100,000
SB-804 HQ	5,000 – 400,000	1,000,000
SB-805 HQ	100,000 – 1,000,000	*(4,000,000)
SB-806 HQ	100,000 – *(20,000,000)	*(20,000,000)
SB-806M HQ	500 – *(20,000,000)	*(20,000,000)
SB-807 HQ	500,000 – *(500,000,000)	*(500,000,000)
LB-803	1,000 – 100,000	100,000
LB-806M	500 – *(20,000,000)	*(20,000,000)

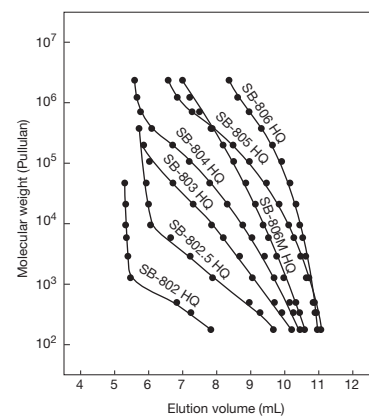
* Please use the above table as a rough indication for the column selection. *() Estimated value

● With *PEG/PEO (eluent : DMF)

Product Name	Target Molecular Weight Range
SB-802.5 HQ	100 – 2,000
SB-803 HQ	200 – 40,000
SB-804 HQ	500 – 300,000
SB-805 HQ	50,000 – 700,000
SB-806 HQ	70,000 – *(20,000,000)
SB-806M HQ	200 – *(20,000,000)
LB-803	500 – 50,000
LB-806M	200 – *(20,000,000)

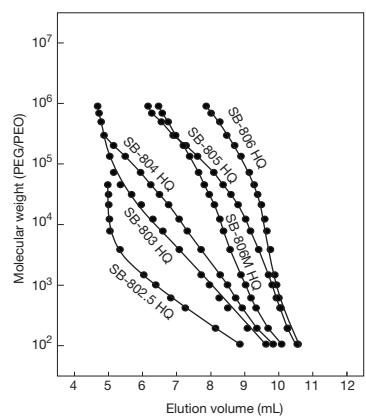
* Please use the above table as a rough indication for the column selection. *PEG : polyethylene glycol
*PEO : polyethylene oxide
** () Estimated value

Calibration curves for SB-800 HQ series using pullulan (eluent : H₂O)



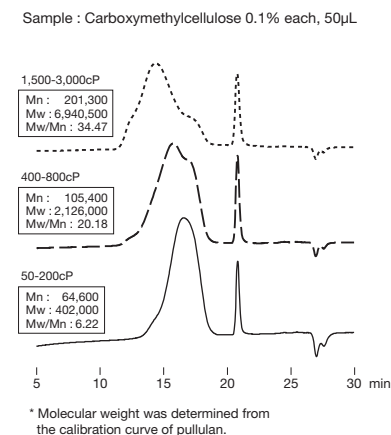
Column : Shodex OHpak SB-800 HQ series
Eluent : H₂O
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 30°C

Calibration curves for SB-800 HQ series using PEG/PEO (eluent : DMF)



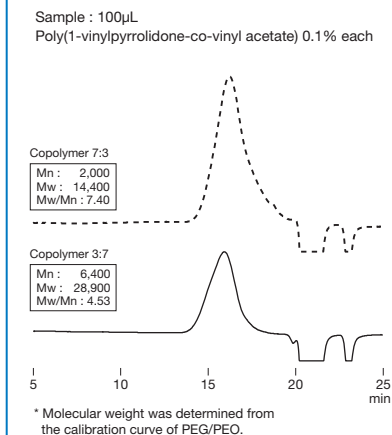
Column : Shodex OHpak SB-800 HQ series
Eluent : DMF
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 40°C

Carboxymethylcellulose



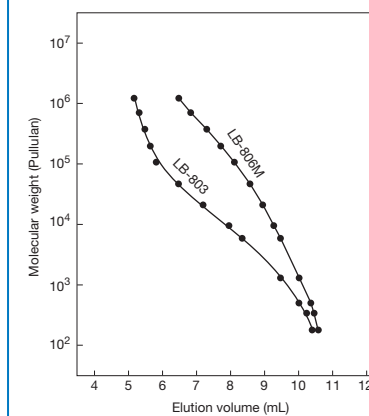
Column : Shodex OHpak SB-806M HQ x 2
Eluent : 0.1M NaCl aq.
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 40°C

Copovidones



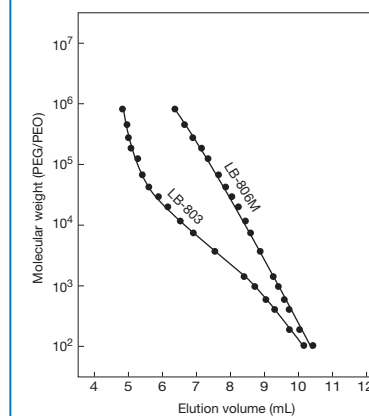
Column : Shodex OHpak SB-806M HQ x 2
Eluent : 20mM LiBr in DMF
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 40°C

Calibration curves for LB-800 series using pullulan (eluent : H₂O)



Column : Shodex OHpak LB-800 series
Eluent : H₂O
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 30°C

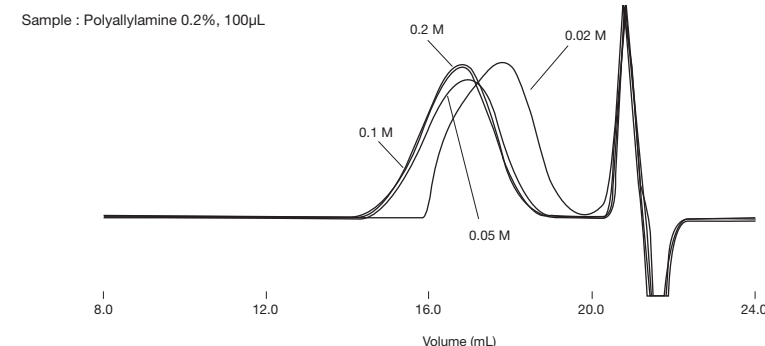
Calibration curves for LB-800 series using PEG/PEO (eluent : DMF)



Column : Shodex OHpak LB-800 series
Eluent : DMF
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 40°C

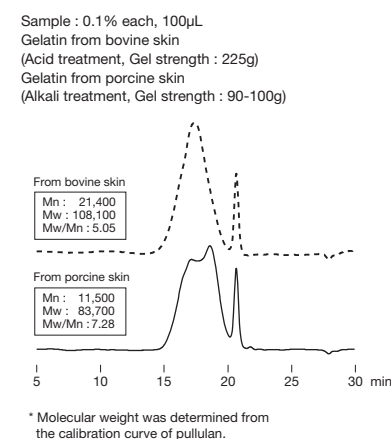
Effects of sodium nitrate in eluent on the analysis of polyallylamine

For the analysis of cationic polymers, such as polyallylamine, undesired adsorption of the polymer is observed when low (0.02M) sodium nitrate eluent was used. By using higher concentration (> 0.1M) salt, it suppresses the sample adsorption and enables to obtain accurate chromatograms.



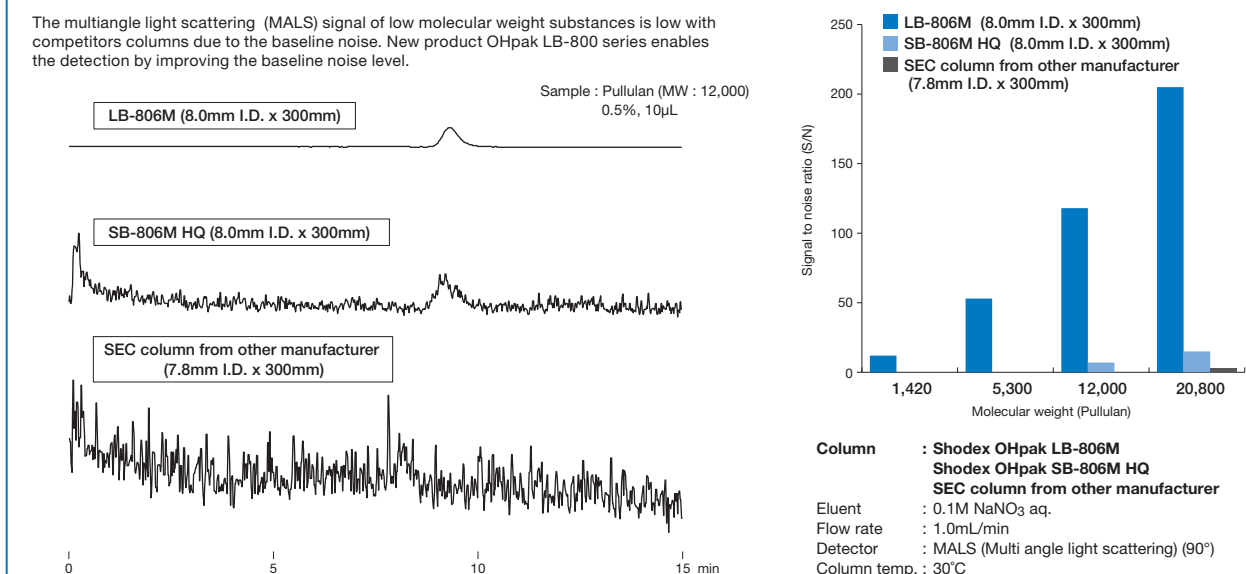
Column : Shodex OHpak SB-806M HQ x 2
Eluent : 0.5M Acetic acid + NaNO₃ aq.
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 40°C

Gelatin

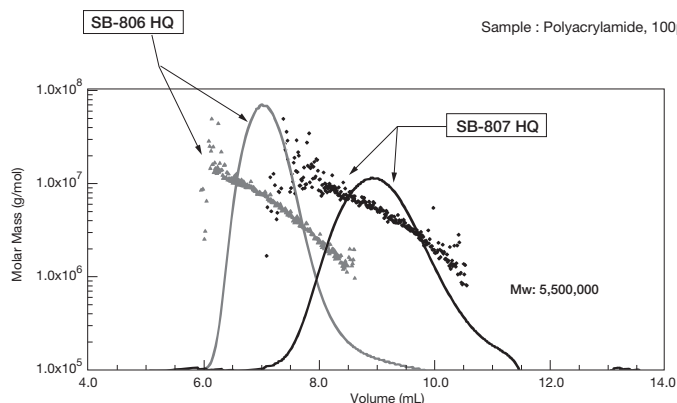


Column : Shodex OHpak SB-806M HQ x 2
Eluent : 0.1M KH₂PO₄ aq./
0.1M Na₂HPO₄ aq.=50/50
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 40°C

Comparison of the detection of pullulan using multiangle light scattering detector

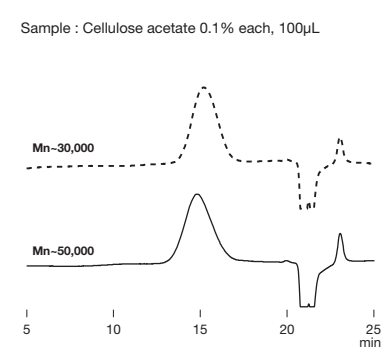


Polyacrylamide



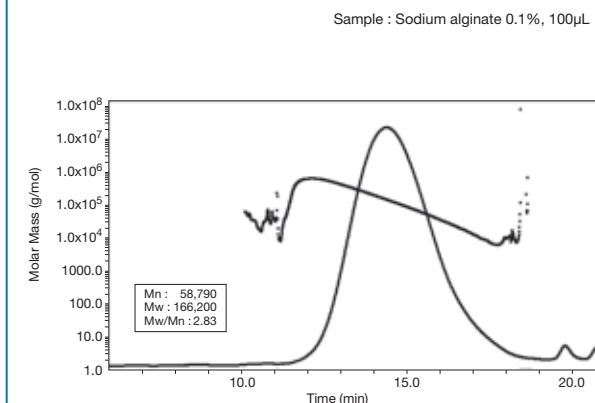
Column : Shodex OHpak SB-807 HQ, SB-806 HQ
Eluent : 0.2M NaCl aq.
Flow rate : 0.5mL/min
Detector : RI
MALS (Multi angle light scattering)
Column temp. : 30°C

Cellulose acetate



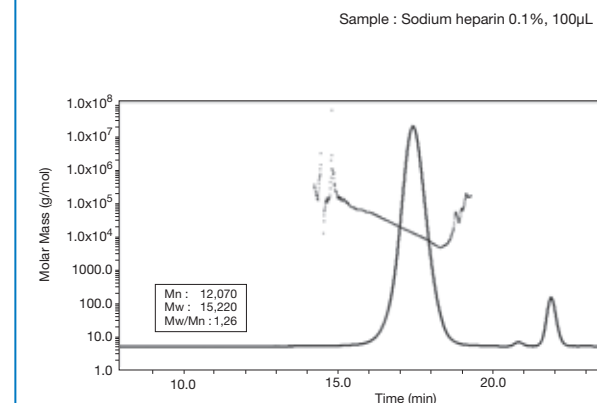
Column : Shodex OHpak SB-806M HQ x 2
Eluent : 20mM LiBr in DMF
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 40°C

Sodium alginate



Column : Shodex OHpak LB-806M x 2
Eluent : 0.1M NaNO₃ aq.
Flow rate : 1.0mL/min
Detector : RI
MALS (Multi angle light scattering)
Column temp. : 30°C

Sodium heparin



Column : Shodex OHpak LB-806M x 2
Eluent : 0.1M NaNO₃ aq.
Flow rate : 1.0mL/min
Detector : RI
MALS (Multi angle light scattering)
Column temp. : 30°C

Multimode Columns

Features

- GS-HQ**
 - SEC is the main separation mode
 - Depends on the eluent selected, the column adds multimode features of reversed phase, HILIC, and ion exchange modes to SEC
 - Suitable for the separation of peptides or nucleic acids with similar molecular weights
 - Suitable for desalting samples or substituting buffer in protein analysis

Standard columns

Product Code	Product Name	Plate Number (TP/column)	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length	Shipping Solvent
F7600005	Asahipak GS-220 HQ	≥ 19,000	6	150	7.5 × 300	H ₂ O/CH ₃ OH=70/30
F7600006	Asahipak GS-320 HQ	≥ 19,000	6	400	7.5 × 300	H ₂ O/CH ₃ OH=70/30
F7600007	Asahipak GS-520 HQ	≥ 18,000	7	2,000	7.5 × 300	H ₂ O/CH ₃ OH=70/30
F7600008	Asahipak GS-620 HQ	≥ 18,000	7	7,000	7.5 × 300	H ₂ O/CH ₃ OH=70/30
F6710019	Asahipak GS-2G 7B	(guard column)	9	–	7.5 × 50	H ₂ O/CH ₃ OH=70/30

Semi-micro columns

* The following semi-micro columns are made to order.

Product Code	Product Name	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length
F7750312	GS320A-4D	6	150	4.6 × 150
F7750311	GS320A-4E	6	400	4.6 × 250
F7750613	GS620A-4B	7	2,000	4.6 × 50

Preparative columns * Preparative columns are made to order.

Product Code	Product Name	Plate Number (TP/column)	Particle Size (μm)	Column Size (mm) I.D. x Length	Standard Column
F6810017	Asahipak GS-220 20F	≥ 8,000	13	20.0 × 300	GS-220 HQ
F6810018	Asahipak GS-320 20F	≥ 8,000	13	20.0 × 300	GS-320 HQ
F6810019	Asahipak GS-520 20F	≥ 8,000	13	20.0 × 300	GS-520 HQ
F6810020	Asahipak GS-620 20F	≥ 8,000	13	20.0 × 300	GS-620 HQ
F6810034	Asahipak GS-220 20G	≥ 14,000	13	20.0 × 500	GS-220 HQ
F6810035	Asahipak GS-320 20G	≥ 14,000	13	20.0 × 500	GS-320 HQ
F6810036	Asahipak GS-520 20G	≥ 14,000	13	20.0 × 500	GS-520 HQ
F6810037	Asahipak GS-620 20G	≥ 14,000	13	20.0 × 500	GS-620 HQ
F6710021	Asahipak GS-20G 7B	(guard column)	20	7.5 × 50	(guard column)

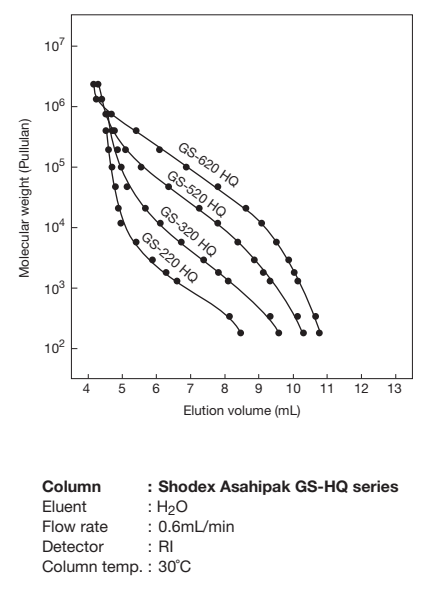
Target molecular weight range and Exclusion limit

With Pullulan (eluent : ultrapure water)

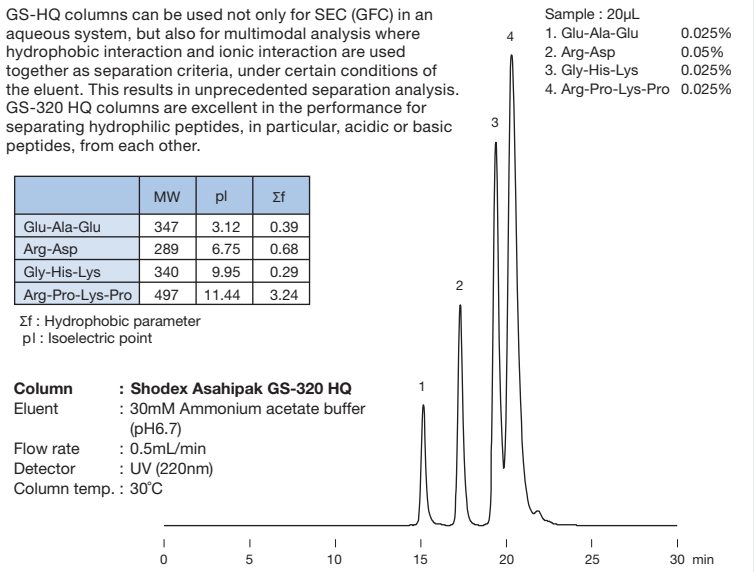
Product Name	Target Molecular Weight Range	Exclusion Limit
GS-220	300 – 3,000	7,000
GS-320	300 – 20,000	40,000
GS-520	5,000 – 200,000	300,000
GS-620	10,000 – 800,000	1,000,000

* Please use the above table as a rough indication for the column selection.

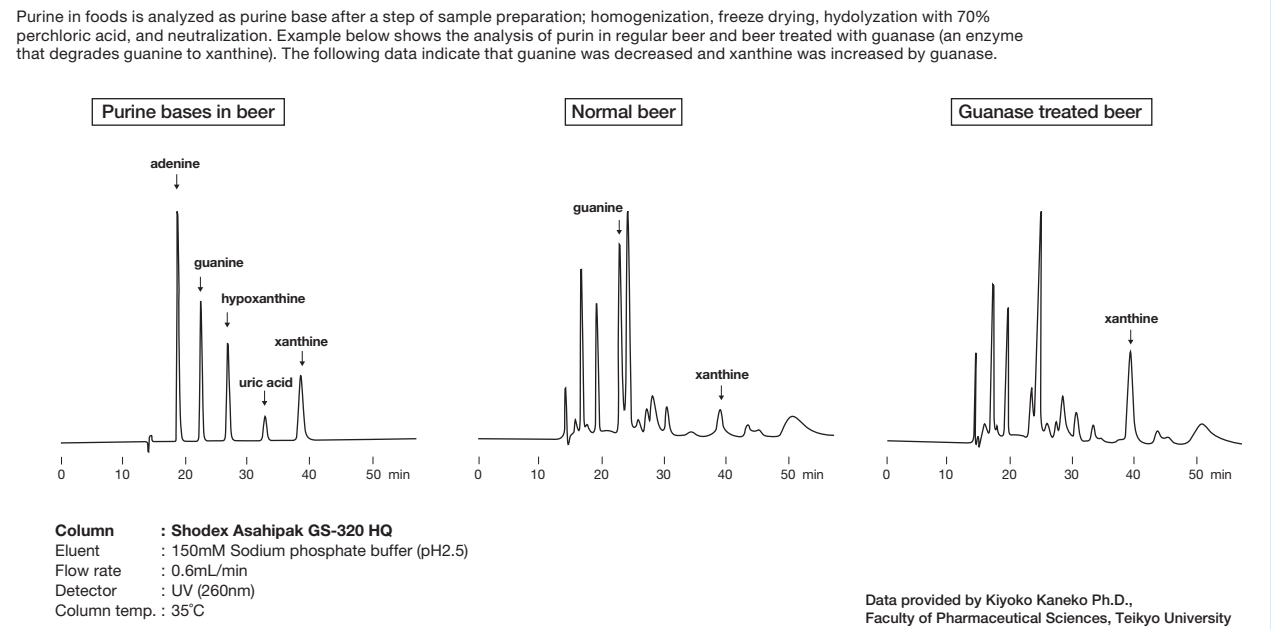
Calibration curves for GS-HQ series using pullulan (eluent : H₂O)



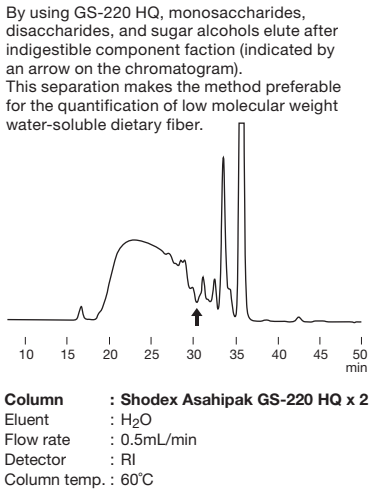
Peptides



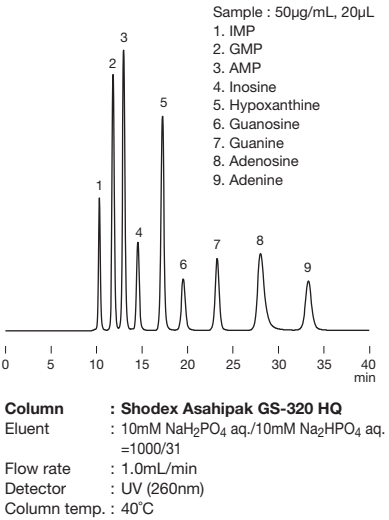
Analysis of purine bases in beer



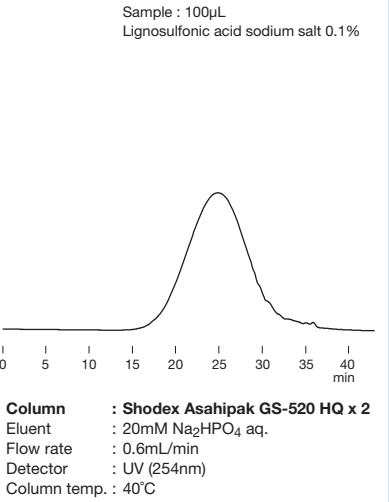
Low molecular weight water-soluble dietary fiber



“Umami”



Lignosulfonic acid



Aqueous/Organic SEC Columns

Features

- GF-HQ** • Polymer-based SEC columns exhibit high solvent durability
- Supports both aqueous and organic solvents

Standard columns

Product Code	Product Name	Plate Number (TP/column)	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length	Shipping Solvent
F7600000	Asahipak GF-210 HQ	≥ 19,000	5	180	7.5 × 300	H ₂ O
F7600001	Asahipak GF-310 HQ	≥ 19,000	5	400	7.5 × 300	H ₂ O/CH ₃ OH=70/30
F7600002	Asahipak GF-510 HQ	≥ 19,000	5	2,000	7.5 × 300	H ₂ O/CH ₃ OH=70/30
F7600003	Asahipak GF-710 HQ	≥ 11,000	9	10,000	7.5 × 300	H ₂ O/CH ₃ OH=70/30
F7600004	Asahipak GF-7M HQ	≥ 13,000	9	10,000	7.5 × 300	H ₂ O/CH ₃ OH=70/30
F6710018	Asahipak GF-1G 7B	(guard column)	9	—	7.5 × 50	H ₂ O/CH ₃ OH=70/30
F7600100	MSpak GF-310 4B	≥ 3,000	5	400	4.6 × 50	H ₂ O
F7600110	MSpak GF-310 4D	≥ 10,000	5	400	4.6 × 150	H ₂ O
F7600024	MSpak GF-310 4E	≥ 16,000	5	400	4.6 × 250	H ₂ O
F7600120	MSpak GF-310 2D	≥ 5,500	5	400	2.0 × 150	H ₂ O

GF-7M HQ is a mixed-gel column capable of analyzing samples over a wide range of molecular weight. Base Material : Polyvinyl alcohol Usable pH range : pH2-9

Semi-micro columns * The following semi-micro columns are made to order.

Product Code	Product Name	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length
F7600200	Asahipak GF-210 4D	5	180	4.6 × 150
F7600201	Asahipak GF-210 4E	5	180	4.6 × 250
F7760512	GF510A-4D	5	2,000	4.6 × 150
F7760511	GF510A-4E	5	2,000	4.6 × 250
F7760712	GF710A-4D	9	10,000	4.6 × 150

Preparative columns * Preparative columns are made to order.

Product Code	Product Name	Plate Number (TP/column)	Particle Size (μm)	Column Size (mm) I.D. x Length	Standard Columns
F6810030	Asahipak GS-310 20F	≥ 8,000	13	20.0 × 300	GF-310 HQ
F6810031	Asahipak GS-510 20F	≥ 8,000	13	20.0 × 300	GF-510 HQ
F6810032	Asahipak GS-710 20F	≥ 8,000	13	20.0 × 300	GF-710 HQ
F6810033	Asahipak GSM-700 20F	≥ 8,000	13	20.0 × 300	GF-7M HQ
F6810038	Asahipak GS-310 20G	≥ 14,000	13	20.0 × 500	GF-310 HQ
F6810039	Asahipak GS-510 20G	≥ 14,000	13	20.0 × 500	GF-510 HQ
F6810040	Asahipak GS-710 20G	≥ 14,000	13	20.0 × 500	GF-710 HQ
F6810041	Asahipak GSM-700 20G	≥ 14,000	13	20.0 × 500	GF-7M HQ
F6710020	Asahipak GS-10G 7B	(guard column)	20	7.5 × 50	(guard column)

Target molecular weight range and Exclusion limit

● With Pullulan (eluent : ultrapure water)

Product Name	Target Molecular Weight Range	Exclusion Limit
GF-210	300 – 4,000	9,000
GF-310	300 – 30,000	40,000
GF-510	5,000 – 200,000	300,000
GF-710	100,000 – *(10,000,000)	*(10,000,000)
GF-7M	300 – *(10,000,000)	*(10,000,000)

* Please use the above table as a rough indication for the column selection. *() Estimated value

● With *PEG/PEO (eluent : DMF)

Product Name	Target Molecular Weight Range
GF-210	100 – 2,000
GF-310	200 – 4,000
GF-510	2,000 – 200,000
GF-710	20,000 – *(10,000,000)
GF-7M	200 – *(10,000,000)

* Please use the above table as a rough indication for the column selection. *PEG : polyethylene glycol *PEO : polyethylene oxide *() Estimated value

Usable solvents

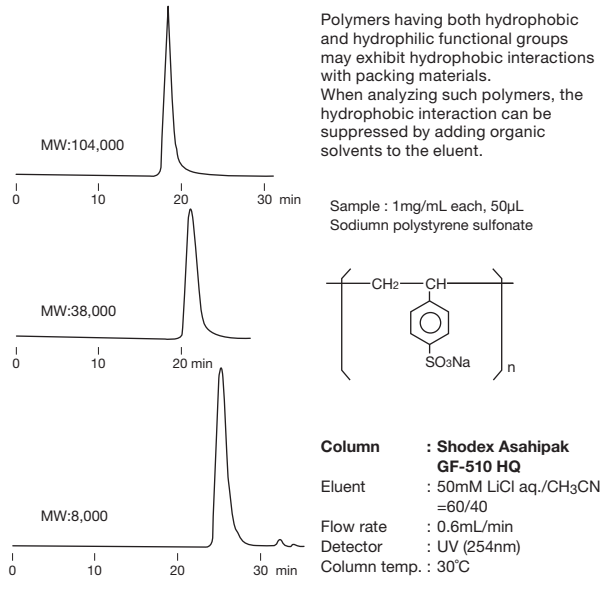
Solvent	GF-210	GF-310 GF-510 GF-710 GF-7M
Water (0 - 0.5M sodium concentration)	○	○
Methanol	○	○
Ethanol	○	○
Acetonitrile	○*	○
THF	○	○
DMF	○	○
Acetone	○	○
Chloroform	○*	○
Ethylacetate	○*	○
DMSO	○	0-50% ○

* When replacing acetonitrile, ethyl acetate or chloroform with water, replace with methanol first and then replace with water.

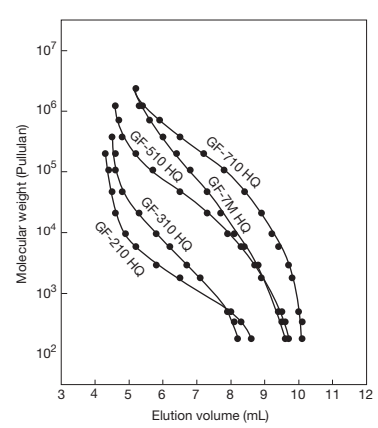
* When replacing water with ethyl acetate or chloroform, replace with methanol first and then replace with the required eluent condition.

(Note)
The usable solvents for preparative columns of GF-710 HQ, GS-710 20F and 20G, are water and methanol. GSM-700 20F or 20G is recommended when other solvents are required.

Sodium polystyrene sulfonates

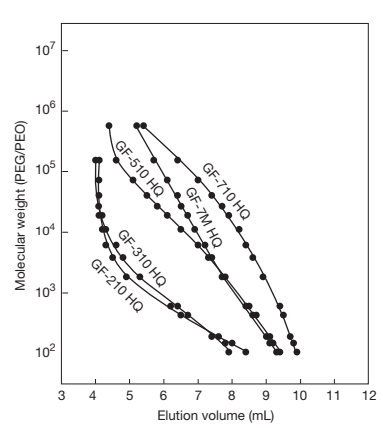


Calibration curves for GF-HQ series using pullulan (eluent : H₂O)



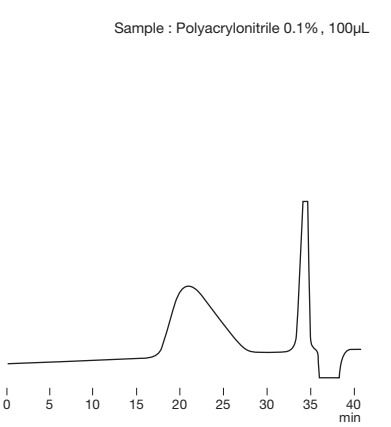
Column : Shodex Asahipak GF-HQ series
Eluent : H₂O
Flow rate : 0.6mL/min
Detector : RI
Column temp. : 30°C

Calibration curves for GF-HQ series using PEG/PEO (eluent : DMF)



Column : Shodex Asahipak GF-HQ series
Eluent : DMF
Flow rate : 0.6mL/min
Detector : RI
Column temp. : 40°C

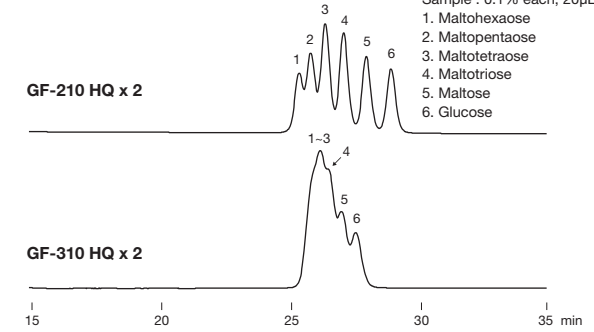
Polyacrylonitrile



Column : Shodex Asahipak GF-710 HQ x 2
Eluent : 20mM LiBr in DMF
Flow rate : 0.6mL/min
Detector : RI
Column temp. : 40°C

Comparison of two GF columns for the separation performance of maltooligosaccharides

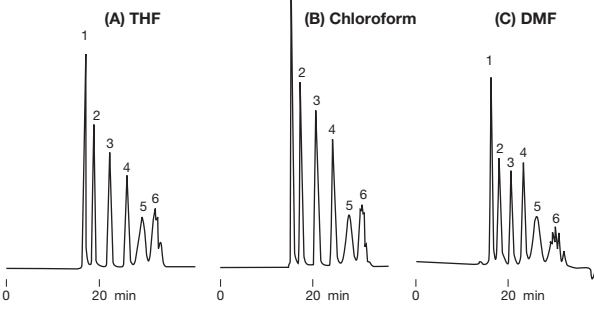
GF-210 HQ demonstrates an improved separation of low molecular substances. The sample below shows that the peaks obtained by GF-210 HQ are separated with deeper notches compared to peaks obtained by GF-310 HQ. GF-210 HQ is capable of separating oligosaccharides (trisaccharides to hexasaccharides) while those oligosaccharides were eluted all together when analyzed by GF-310 HQ.



Column : Shodex Asahipak GF-210 HQ x 2
Shodex Asahipak GF-310 HQ x 2
Eluent : H₂O
Flow rate : 0.6mL/min
Detector : RI
Column temp. : 50°C

Comparison of polystyrenes separation using various solvents

Sample : Polystyrene 1mg/mL each, 50μL
1. Mw : 1,090,000
2. Mw : 190,000
3. Mw : 37,900
4. Mw : 9,100
5. Mw : 2,980
6. Mw : 500



Column : Shodex Asahipak GF-510 HQ + GF-310 HQ
Eluent : (A); THF, (B); Chloroform, (C); DMF
Flow rate : 0.5mL/min
Detector : (A),(B) UV (254nm), (C) UV (270nm)
Column temp. : 30°C

Organic SEC (GPC) Columns (General Analysis) : Chloroform

Features

- K-800** • Standard organic solvent SEC (GPC) column
- Supports a wide range of applications from low to high molecular weight compounds
- Corresponds to USP L21

Standard columns

● K-800 series : Shipping solvent Chloroform

Product Code	Product Name	Plate Number (TP/column)	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length
F6028110	GPC K-801	≥ 18,000	8	50	8.0 × 300
F6028120	GPC K-802	≥ 18,000	6	150	8.0 × 300
F6028125	GPC K-802.5	≥ 18,000	6	300	8.0 × 300
F6028130	GPC K-803	≥ 18,000	6	500	8.0 × 300
F6028194	GPC K-803L	≥ 18,000	6	500	8.0 × 300
F6028140	GPC K-804	≥ 18,000	7	1,500	8.0 × 300
F6028195	GPC K-804L	≥ 18,000	7	1,500	8.0 × 300
F6028150	GPC K-805	≥ 11,000	10	5,000	8.0 × 300
F6028196	GPC K-805L	≥ 11,000	10	5,000	8.0 × 300
F6028160	GPC K-806	≥ 11,000	10	10,000	8.0 × 300
F6028190	GPC K-806M	≥ 13,000	10	10,000	8.0 × 300
F6028197	GPC K-806L	≥ 11,000	10	10,000	8.0 × 300
F6028170	GPC K-807	≥ 6,000	18	20,000	8.0 × 300
F6028198	GPC K-807L	≥ 6,000	18	20,000	8.0 × 300
F6700401	GPC K-G 4A (GPC K-G)	(guard column)	8	—	4.6 × 10
F6709450	GPC K-800D	(solvent-peak separation column)	10	—	8.0 × 100

* The columns with 'L' or 'M' at the end of column names are mixed-gel column capable of analyzing samples over a wide range of molecular weight distribution.
* See page 50 for details of the solvent-peak separation columns.
* See pages 54 and 55 for details preparative columns.
* See page 62 for applicability of SEC (GPC) columns to solvent replacement.

Base Material : Styrene divinylbenzene copolymer

Target molecular weight range and Exclusion limit

● With Polystyrene (eluent : Chloroform)

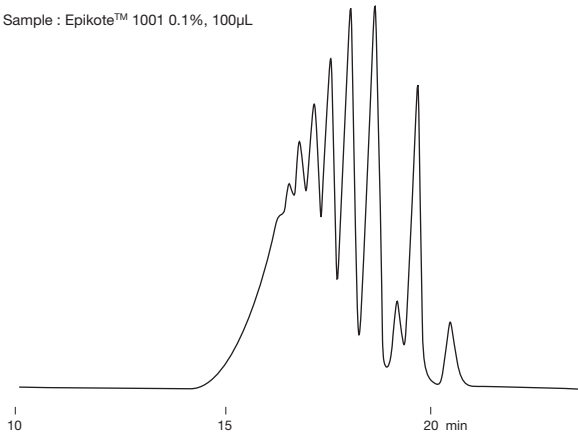
Product Name	Target Molecular Weight Range	Exclusion Limit	Product Name	Target Molecular Weight Range	Exclusion Limit
K-801	100 – 700	1,500	K-805	50,000 – 2,000,000	4,000,000
K-802	300 – 3,000	5,000	K-805L	300 – 2,000,000	4,000,000
K-802.5	300 – 8,000	20,000	K-806	150,000 – *(20,000,000)	*(20,000,000)
K-803	1,000 – 50,000	70,000	K-806M	1,000 – *(20,000,000)	*(20,000,000)
K-803L	100 – 50,000	70,000	K-806L	300 – *(20,000,000)	*(20,000,000)
K-804	7,000 – 300,000	400,000	K-807	300,000 – *(200,000,000)	*(200,000,000)
K-804L	100 – 300,000	400,000	K-807L	300 – *(200,000,000)	*(200,000,000)

* Please use the above table as a rough indication for the column selection.

*() Estimated value

Epoxy resin

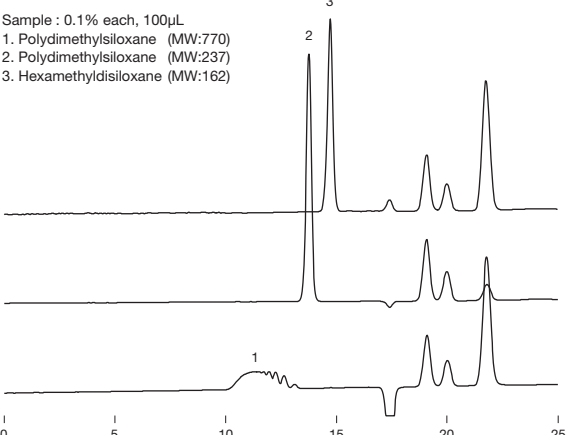
Sample : Epikote™ 1001 0.1%, 100μL



Column : Shodex GPC K-803L x 2
Eluent : Chloroform
Flow rate : 1.0mL/min
Detector : UV (254nm)
Column temp. : Room temp.

Low molecular polydimethylsiloxanes

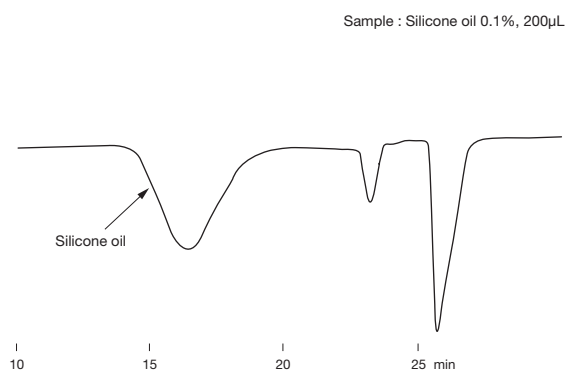
Sample : 0.1% each, 100μL
1. Polydimethylsiloxane (MW:770)
2. Polydimethylsiloxane (MW:237)
3. Hexamethyldisiloxane (MW:162)



Column : Shodex GPC K-801 x 2
Eluent : Chloroform
Flow rate : 1.0mL/min
Detector : RI (polarity : -)
Column temp. : 40°C

Silicon oil

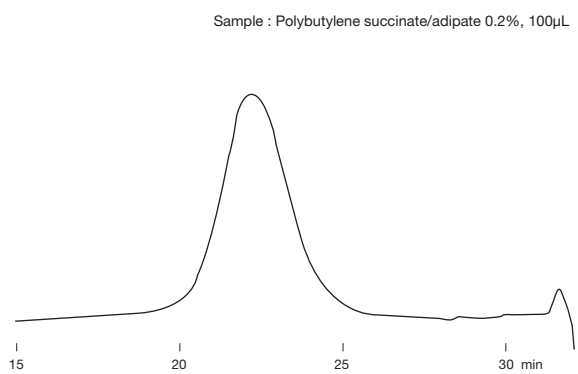
Sample : Silicone oil 0.1%, 200μL



Column : Shodex GPC K-806M x 2
Eluent : Toluene
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 45°C

Bionolle™ (Polybutylene succinate/adipate)

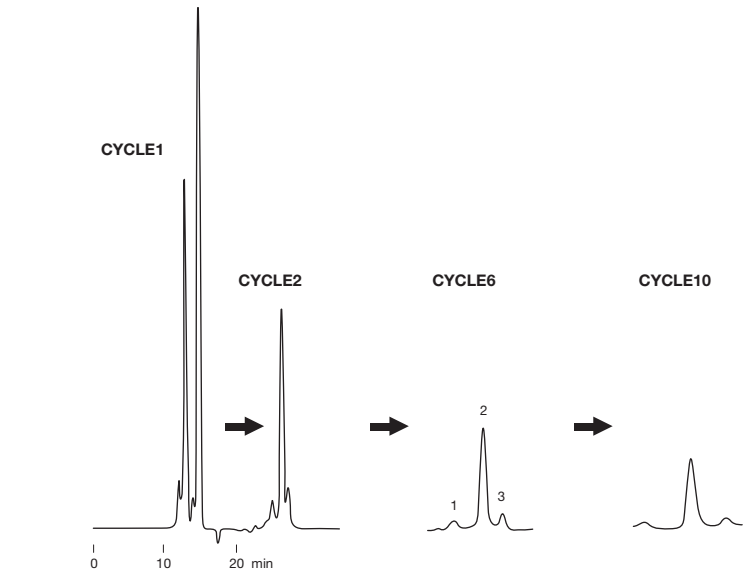
Sample : Polybutylene succinate/adipate 0.2%, 100μL



Column : Shodex GPC K-806M x 2 + K-801
Eluent : Chloroform
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 40°C

Recycling fractionation of lauryl stearyl thiodipropionate

Sample : 5%, 500μL
1. Distearyl stearyl thiodipropionate
2. Lauryl stearyl thiodipropionate
3. Dilauryl thiodipropionate



Column : Shodex GPC K-LG + K-2001
Eluent : Chloroform
Flow rate : 3.0mL/min
Detector : RI (preparative type)
Column temp. : 50°C

* See page 54 for K-2001

Organic SEC (GPC) Columns (General Analysis) : DMF

Features

- KD-800**
- Standard organic solvent SEC (GPC) column
 - Supports a wide range of applications from low to high molecular weight compounds
 - Corresponds to USP L21

Standard columns

● KD-800 series : Shipping solvent Dimethylformamide (DMF)

Product Code	Product Name	Plate Number (TP/column)	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length
F6028210	GPC KD-801	≥ 17,000	6	50	8.0 × 300
F6028220	GPC KD-802	≥ 17,000	6	150	8.0 × 300
F6028225	GPC KD-802.5	≥ 17,000	6	300	8.0 × 300
F6028230	GPC KD-803	≥ 17,000	6	500	8.0 × 300
F6028240	GPC KD-804	≥ 17,000	7	1,500	8.0 × 300
F6028250	GPC KD-805	≥ 11,000	10	5,000	8.0 × 300
F6028260	GPC KD-806	≥ 11,000	10	10,000	8.0 × 300
F6028290	GPC KD-806M	≥ 13,000	10	10,000	8.0 × 300
F6028270	GPC KD-807	≥ 6,000	18	20,000	8.0 × 300
F6700411	GPC KD-G 4A (GPC KD-G)	(guard column)	8	—	4.6 × 10

* The columns with 'L' or 'M' at the end of column names are mixed-gel column capable of analyzing samples over a wide range of molecular weight distribution.

* See page 62 for applicability of SEC (GPC) columns to solvent replacement.

Base Material : Styrene divinylbenzene copolymer

Target molecular weight range and Exclusion limit

● With *PEG/PEO (eluent : DMF)

Product Name	Target Molecular Weight Range	Exclusion Limit	Product Name	Target Molecular Weight Range	Exclusion Limit
KD-801	100 – 1,500	2,500	KD-805	30,000 – *(4,000,000)	*(4,000,000)
KD-802	200 – 4,000	7,000	KD-806	30,000 – *(40,000,000)	*(40,000,000)
KD-802.5	400 – 10,000	20,000	KD-806M	1,000 – *(40,000,000)	*(40,000,000)
KD-803	1,000 – 50,000	70,000	KD-807	50,000 – *(200,000,000)	*(200,000,000)
KD-804	4,000 – 200,000	200,000			

* Please use the above table as a rough indication for the column selection.

*PEG : polyethylene glycol

*PEO : polyethylene oxide

*() Estimated value

Solvent-peak Separation Columns for Organic SEC (GPC)

Features

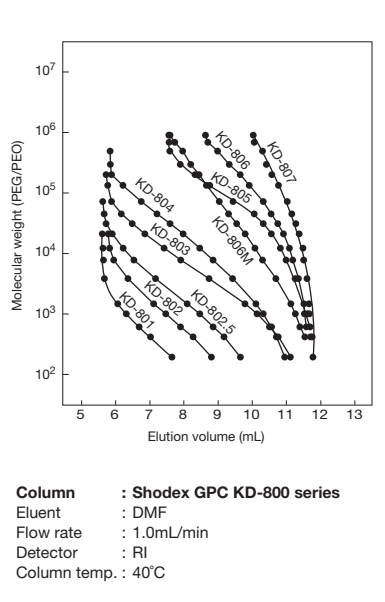
- KF-800D**
- K-800D**
- Use this column in combination with a linear column
 - By shifting the elution of monomers, polymer additives, and the solvent-peak in low molecular region, it reduces interferences in the calculation of the molecular weight distribution of polymers and oligomers

Solvent-peak separation columns

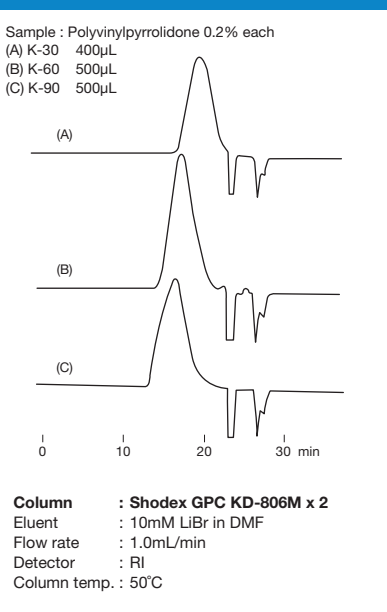
Product Code	Product Name	Column Combination	Particle Size (μm)	Column Size (mm) I.D. x Length	Shipping Solvent
F6709350	GPC KF-800D	KF-805L, 806L, 806M, 807L	10	8.0 × 100	THF
F6709450	GPC K-800D	K-805L, 806L, 806M, 807L	10	8.0 × 100	Chloroform

Base Material : Styrene divinylbenzene copolymer

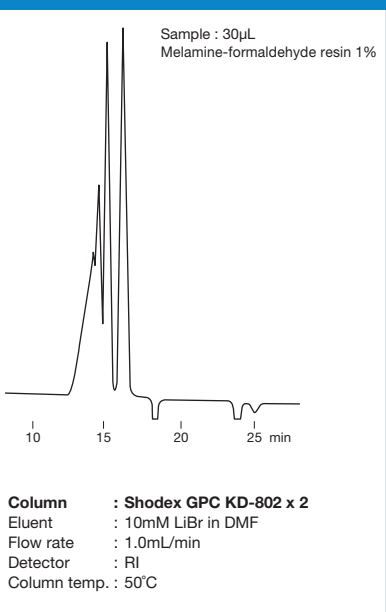
Calibration curves for KD-800 series using PEG/PEO



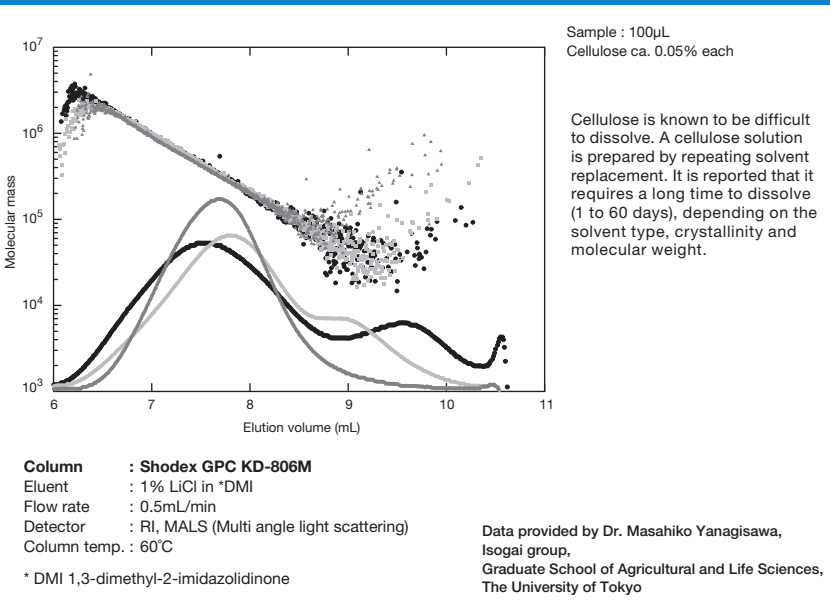
Polyvinylpyrrolidones



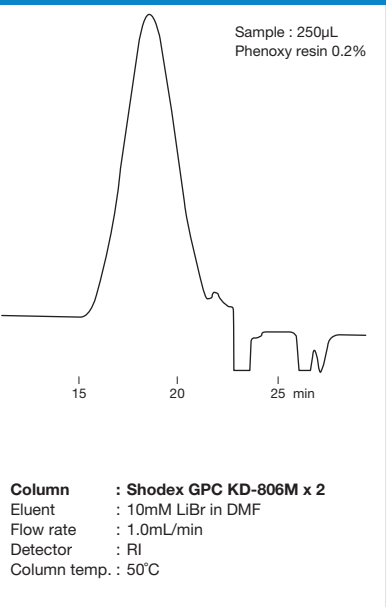
Melamine formaldehyde resin



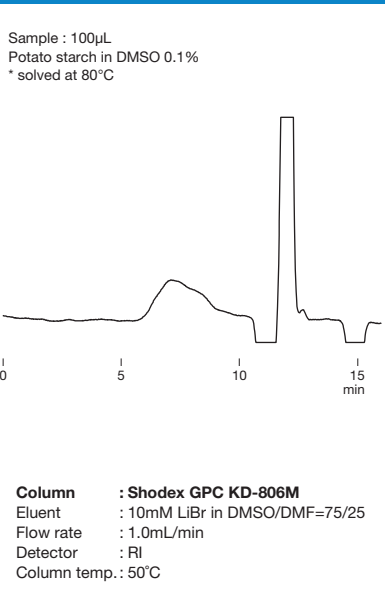
Celluloses



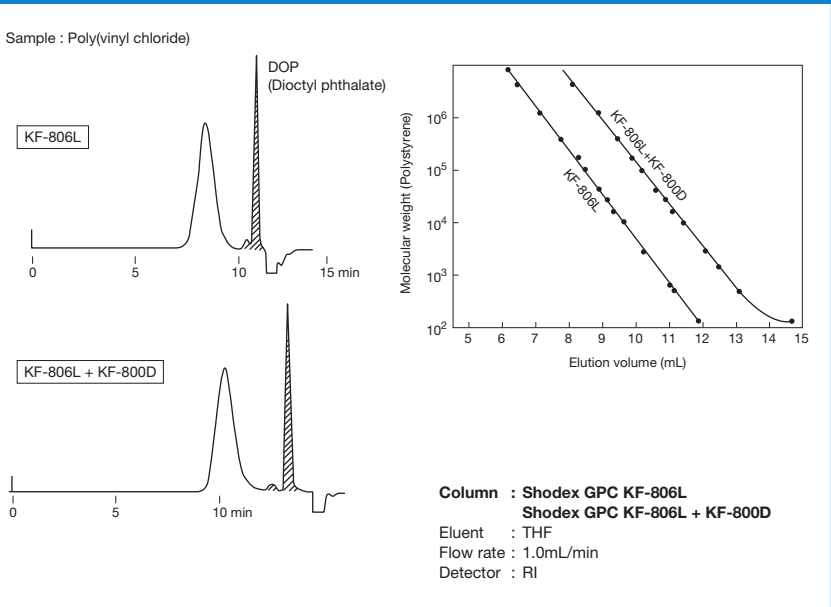
Phenoxy resin



Potato starch



Effects of solvent-peak separation column



Organic SEC (GPC) Columns : Rapid Analysis, High Performance Analysis

Features

KF-600	- Approximately half of the analysis time compared with standard columns - The amount of solvent used is reduced to about a third - Improved applicability of solvent replacement - Corresponds to USP L21
KF-400HQ	- About 1.5 times better separation performance than standard columns, obtains higher resolution - About 4 times better sensitivity than that of standard columns, supports high sensitivity analysis - The amount of solvent used is reduced to about a third - Improved applicability of solvent replacement - Corresponds to USP L21

Rapid analysis downsized columns

● **KF-600 series** © Use of the KF-600 series with semi-micro type devices is recommended.

Product Code	Product Name	Plate Number (TP/column)	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length
F6028091	GPC KF-601	≥ 17,000	3	50	6.0 × 150
F6028092	GPC KF-602	≥ 17,000	3	150	6.0 × 150
F6028093	GPC KF-602.5	≥ 17,000	3	300	6.0 × 150
F6028094	GPC KF-603	≥ 17,000	3	500	6.0 × 150
F6028095	GPC KF-604	≥ 16,000	3	1,500	6.0 × 150
F6028096	GPC KF-605	≥ 7,000	10	5,000	6.0 × 150
F6028097	GPC KF-606	≥ 7,000	10	10,000	6.0 × 150
F6028098	GPC KF-606M	≥ 8,000	10	10,000	6.0 × 150
F6028099	GPC KF-607	≥ 5,000	18	20,000	6.0 × 150
F6700300	GPC KF-G 4A (GPC KF-G)	(guard column)	8	—	4.6 × 10

High performance semi-micro columns

● **KF-400HQ series** © Use of the KF-400HQ series with semi-micro type devices is recommended.

Product Code	Product Name	Plate Number (TP/column)	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length
F6028111	GPC KF-401HQ	≥ 25,000	3	50	4.6 × 250
F6028112	GPC KF-402HQ	≥ 25,000	3	150	4.6 × 250
F6028114	GPC KF-402.5HQ	≥ 25,000	3	300	4.6 × 250
F6028116	GPC KF-403HQ	≥ 25,000	3	500	4.6 × 250
F6028118	GPC KF-404HQ	≥ 25,000	3	1,500	4.6 × 250
F6028119	GPC KF-405LHQ	≥ 10,000	10	5,000	4.6 × 250
F6028122	GPC KF-406LHQ	≥ 10,000	10	10,000	4.6 × 250
F6700300	GPC KF-G 4A (GPC KF-G)	(guard column)	8	—	4.6 × 10

[KF-600 series and KF-400HQ series]

* The columns with 'L' or 'M' at the end of column names are mixed-gel column capable of analyzing samples over a wide range of molecular weight distribution.

* See page 62 for applicability of SEC (GPC) columns to solvent replacement.

[KF-600 series and KF-400HQ series]

Base Material : Styrene divinylbenzene copolymer
Shipping Solvent : Tetrahydrofuran (THF)

Target molecular weight range and Exclusion limit

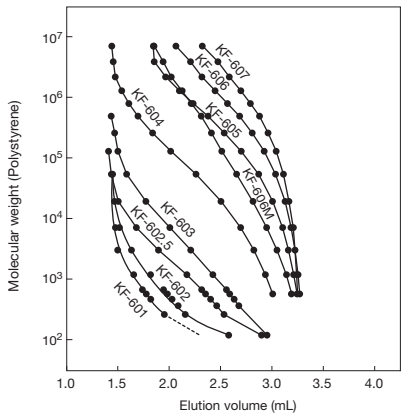
● With Polystyrene (eluent : THF)

Product Name	Target Molecular Weight Range	Exclusion Limit
KF-601	100 – 700	1,500
KF-602	200 – 1,500	4,000
KF-602.5	300 – 10,000	20,000
KF-603	600 – 50,000	70,000
KF-604	7,000 – 500,000	1,000,000
KF-605	50,000 – 2,000,000	4,000,000
KF-606	150,000 – *(20,000,000)	*(20,000,000)
KF-606M	1,000 – *(20,000,000)	*(20,000,000)
KF-607	300,000 – *(200,000,000)	*(200,000,000)

Product Name	Target Molecular Weight Range	Exclusion Limit
KF-401HQ	100 – 700	1,500
KF-402HQ	200 – 1,500	4,000
KF-402.5HQ	300 – 10,000	20,000
KF-403HQ	600 – 50,000	70,000
KF-404HQ	7,000 – 500,000	1,000,000
KF-405LHQ	300 – 2,000,000	4,000,000
KF-406LHQ	300 – *(20,000,000)	*(20,000,000)

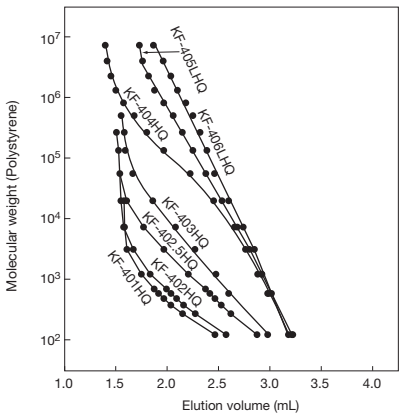
* Please use the above table as a rough indication for the column selection. *() Estimated value

Calibration curves for KF-600 series using polystyrene



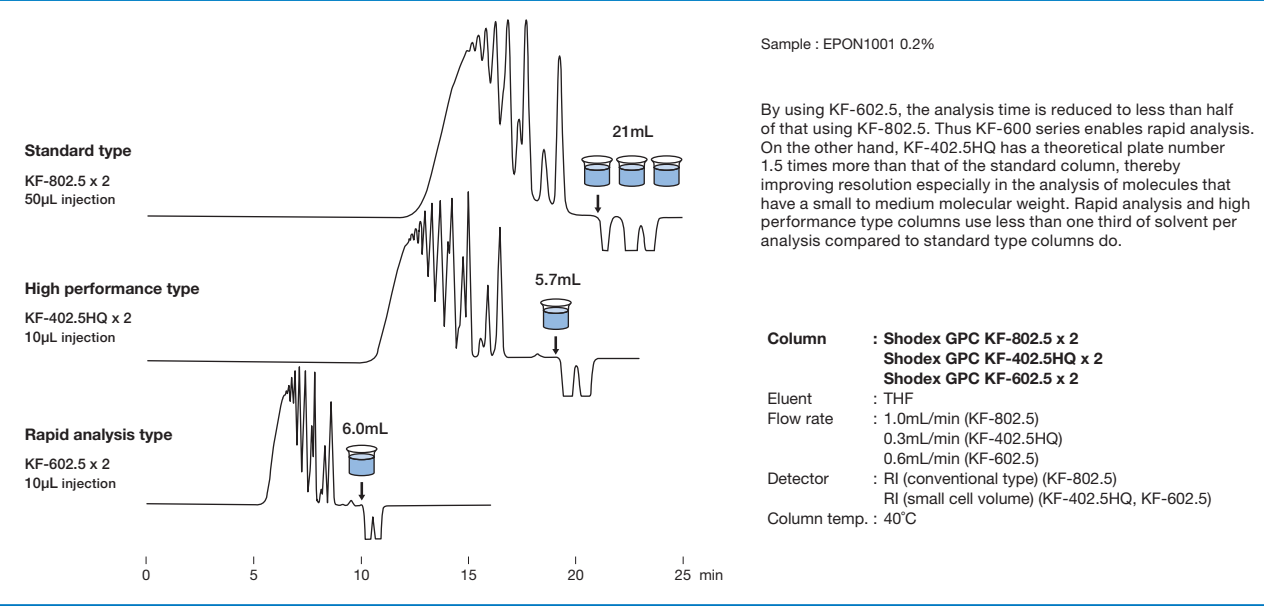
Column : Shodex GPC KF-600 series
Eluent : THF
Flow rate : 0.5mL/min
Detector : RI (small cell volume)
Column temp. : 40°C

Calibration curves for KF-400HQ series using polystyrene



Column : Shodex GPC KF-400HQ series
Eluent : THF
Flow rate : 0.3mL/min
Detector : RI (small cell volume)
Column temp. : 40°C

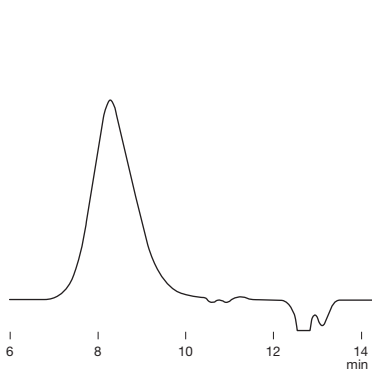
Comparison of standard, rapid analysis, and high performance type columns



Column : Shodex GPC KF-802.5 x 2
Shodex GPC KF-402.5HQ x 2
Shodex GPC KF-602.5 x 2
Eluent : THF
Flow rate : 1.0mL/min (KF-802.5)
0.3mL/min (KF-402.5HQ)
0.6mL/min (KF-602.5)
Detector : RI (conventional type) (KF-802.5)
RI (small cell volume) (KF-402.5HQ, KF-602.5)
Column temp. : 40°C

Styrene acrylonitrile copolymer

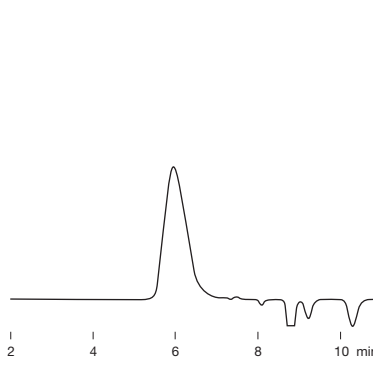
Sample : Styrene-Acrylonitrile (30:70) copolymer



Column : Shodex GPC KF-606M x 2
Eluent : 10mM LiBr in DMF
Flow rate : 0.5mL/min
Detector : RI (small cell volume)
Column temp. : 40°C

Liquid paraffin

Sample : Liquid paraffin 1%, 5μL

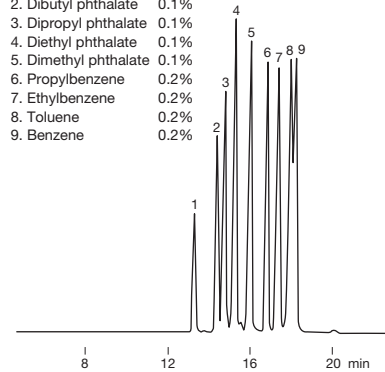


Column : Shodex GPC KF-401HQ
Eluent : Chloroform
Flow rate : 0.3mL/min
Detector : RI (small cell volume)
Column temp. : 40°C

Phthalates

Sample : 10μL

- Diethyl phthalate 0.1%
- Dibutyl phthalate 0.1%
- Dipropyl phthalate 0.1%
- Diethyl phthalate 0.1%
- Dimethyl phthalate 0.1%
- Propylbenzene 0.2%
- Ethylbenzene 0.2%
- Toluene 0.2%
- Benzene 0.2%



Column : Shodex GPC KF-401HQ x 2
Eluent : THF
Flow rate : 0.3mL/min
Detector : UV (254nm) (small cell volume)
Column temp. : 40°C

Preparative columns * Preparative columns are made to order.

● KF-2000 series : Shipping solvent Tetrahydrofuran (THF)

Product Code	Product Name	Plate Number (TP/column)	Particle Size (μm)	Column Size (mm) I.D. x Length	Standard Columns
F6102401	GPC KF-2001	≥ 18,000	6	20.0 × 300	KF-801
F6102402	GPC KF-2002	≥ 18,000	6	20.0 × 300	KF-802
F6102425	GPC KF-2002.5	≥ 18,000	6	20.0 × 300	KF-802.5
F6102403	GPC KF-2003	≥ 18,000	6	20.0 × 300	KF-803
F6102404	GPC KF-2004	≥ 14,000	7	20.0 × 300	KF-804
F6102405	GPC KF-2005	≥ 10,000	10	20.0 × 300	KF-805
F6102406	GPC KF-2006	≥ 10,000	10	20.0 × 300	KF-806
F6102409	GPC KF-2006M	≥ 10,000	10	20.0 × 300	KF-806M
F6700406	GPC KF-G 8B (GPC KF-LG)	(guard column)	15	8.0 × 50	(guard column)

* See page 46 for GPC KF-800 series.

Base Material : Styrene divinylbenzene copolymer

● K-2000 series : Shipping solvent Chloroform

Product Code	Product Name	Plate Number (TP/column)	Particle Size (μm)	Column Size (mm) I.D. x Length	Standard Columns
F6102301	GPC K-2001	≥ 18,000	6	20.0 × 300	K-801
F6102312	GPC K-2002	≥ 18,000	6	20.0 × 300	K-802
F6102315	GPC K-2002.5	≥ 18,000	6	20.0 × 300	K-802.5
F6102303	GPC K-2003	≥ 18,000	6	20.0 × 300	K-803
F6102304	GPC K-2004	≥ 14,000	7	20.0 × 300	K-804
F6102305	GPC K-2005	≥ 10,000	10	20.0 × 300	K-805
F6102306	GPC K-2006	≥ 10,000	10	20.0 × 300	K-806
F6102309	GPC K-2006M	≥ 10,000	10	20.0 × 300	K-806M
F6700407	GPC K-G 8B (GPC K-LG)	(guard column)	15	8.0 × 50	(guard column)

* See page 48 for GPC K-800 series.

Base Material : Styrene divinylbenzene copolymer

Preparative columns * Preparative columns are made to order.

● H-2000 series : Shipping solvent Chloroform

Product Code	Product Name	Plate Number (TP/column)	Particle Size (μm)	Column Size (mm) I.D. x Length	Standard Columns
F6102001	GPC H-2001	≥ 13,000	15	20.0 × 500	K-801
F6102002	GPC H-2002	≥ 13,000	15	20.0 × 500	K-802
F6102025	GPC H-2002.5	≥ 13,000	15	20.0 × 500	K-802.5
F6102003	GPC H-2003	≥ 13,000	15	20.0 × 500	K-803
F6102004	GPC H-2004	≥ 13,000	15	20.0 × 500	K-804
F6102005	GPC H-2005	≥ 13,000	15	20.0 × 500	K-805
F6102006	GPC H-2006	≥ 13,000	15	20.0 × 500	K-806
F6102009	GPC H-2006M	≥ 12,000	15	20.0 × 500	K-806M
F6700310	GPC H-G 8B (GPC H-G)	(guard column)	15	8.0 × 50	(guard column)

* See page 48 for GPC K-800 series.

Base Material : Styrene divinylbenzene copolymer

● KF-5000 series : Shipping solvent Tetrahydrofuran (THF) [Customized columns]

Product Code	Product Name	Particle Size (μm)	Column Size (mm) I.D. x Length	Standard Columns
F6108010	GPC KF-5001	15	50.0 × 300	KF-801
F6108020	GPC KF-5002	15	50.0 × 300	KF-802
F6108025	GPC KF-5002.5	15	50.0 × 300	KF-802.5
F6108030	GPC KF-5003	15	50.0 × 300	KF-803
F6108040	GPC KF-5004	15	50.0 × 300	KF-804
F6700408	GPC KF-G 20B (GPC KF-LLG)	15	20.0 × 100	(guard column)

* See page 46 for GPC KF-800 series.

Base Material : Styrene divinylbenzene copolymer

● K-5000 series : Shipping solvent Chloroform [Customized columns]

Product Code	Product Name	Particle Size (μm)	Column Size (mm) I.D. x Length	Standard Columns
F6109010	GPC K-5001	15	50.0 × 300	K-801
F6109020	GPC K-5002	15	50.0 × 300	K-802
F6109025	GPC K-5002.5	15	50.0 × 300	K-802.5
F6109030	GPC K-5003	15	50.0 × 300	K-803
F6109040	GPC K-5004	15	50.0 × 300	K-804
F6700409	GPC K-G 20B (GPC K-LLG)	15	20.0 × 100	(guard column)

* See page 48 for GPC K-800 series.

Base Material : Styrene divinylbenzene copolymer

Organic SEC (GPC) Columns : Linear Calibration Type

Features

- LF** • Employs a special packing material with a wide pore size distribution (multi pore type)
- Highly linear calibration curve without inflection points
- Molecular weight distribution can be determined with high precision
- Enables analysis over a broad range of molecular weights
- Column for rapid analysis (LF-604) and column for high performance analysis (LF-404) enabling reduction in solvent use are also available
- Corresponds to USP L21

Standard columns

Product Code	Product Name	Plate Number (TP/column)	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length
F6021041	GPC LF-804	≥ 17,000	6	3,000	8.0 × 300
F6709621	GPC LF-G	(guard column)	6	—	4.6 × 10

* See page 62 for applicability of SEC (GPC) columns to solvent replacement.

Base Material : Styrene divinylbenzene copolymer
Shipping Solvent : Tetrahydrofuran (THF)

Rapid analysis downsized column

◎ Use of the LF-604 with semi-micro type devices is recommended.

Product Code	Product Name	Plate Number (TP/column)	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length
F6021042	GPC LF-604	≥ 9,000	6	3,000	6.0 × 150
F6709621	GPC LF-G	(guard column)	6	—	4.6 × 10

* See page 62 for applicability of SEC (GPC) columns to solvent replacement.

Base Material : Styrene divinylbenzene copolymer
Shipping Solvent : Tetrahydrofuran (THF)

High performance semi-micro column

◎ Use of the LF-404 with semi-micro type devices is recommended.

Product Code	Product Name	Plate Number (TP/column)	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length
F6021043	GPC LF-404	≥ 14,000	6	3,000	4.6 × 250
F6709621	GPC LF-G	(guard column)	6	—	4.6 × 10

* See page 62 for applicability of SEC (GPC) columns to solvent replacement.

Base Material : Styrene divinylbenzene copolymer
Shipping Solvent : Tetrahydrofuran (THF)

Target molecular weight range and Exclusion limit

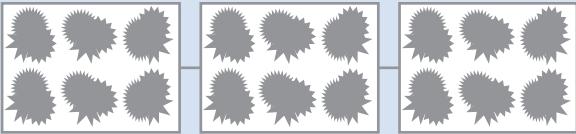
- With Polystyrene (eluent : THF)

Product Name	Target Molecular Weight Range	Exclusion Limit
LF-804	300 – 2,000,000	2,000,000
LF-604	300 – 2,000,000	2,000,000
LF-404	300 – 2,000,000	2,000,000

* Please use the above table as a rough indication for the column selection.

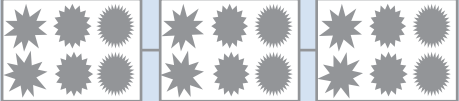
Schematic diagram of linear calibration type packing

Connecting linear calibration type columns (LF series)



The linear calibration type column covers a broad range of molecular weights with only one kind of packing (column).

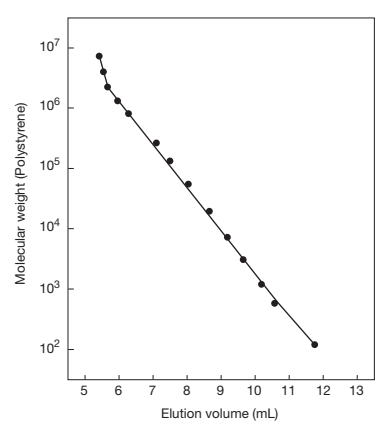
Connecting mixed-gel columns (KF-804L, etc.)



Connecting different grades columns (KF-804 + KF-803 + KF-802, etc.)

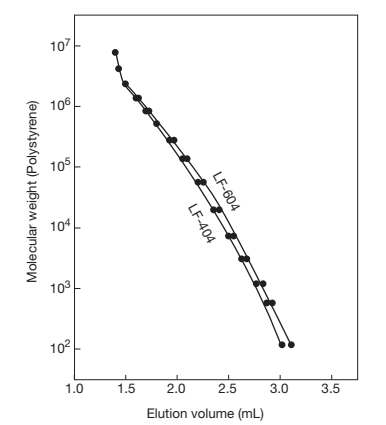


Calibration curve for LF-804 using polystyrene



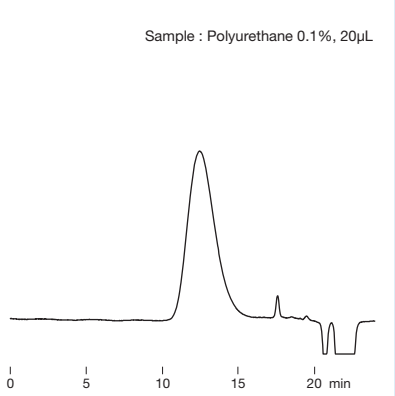
Column : Shodex GPC LF-804
Eluent : THF
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 40°C

Calibration curves for LF-604 and LF-404 using polystyrene



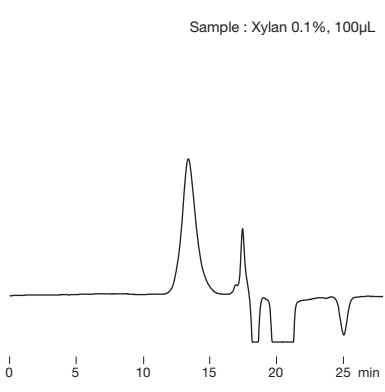
Column : Shodex GPC LF-604, LF-404
Eluent : THF
Flow rate : 0.5mL/min (LF-604)
0.3mL/min (LF-404)
Detector : RI (small cell volume)
Column temp. : 40°C

Polyurethane



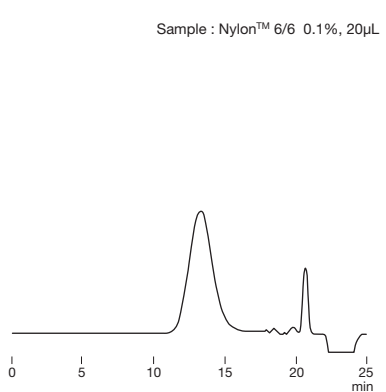
Column : Shodex GPC LF-404 x 2
Eluent : THF
Flow rate : 0.3mL/min
Detector : RI (small cell volume)
Column temp. : 40°C

Xylan



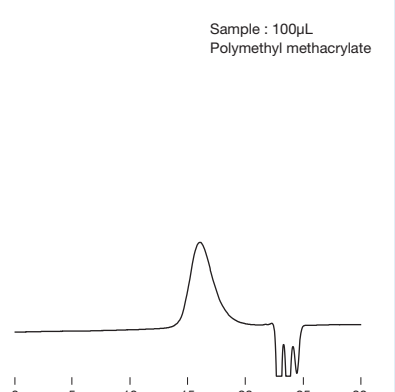
Column : Shodex GPC LF-804
Eluent : 20mM H₃PO₄ + 20mM LiBr in (DMSO/DMF=80/20)
Flow rate : 0.6mL/min
Detector : RI
Column temp. : 50°C

Polyamide (Nylon6/6)



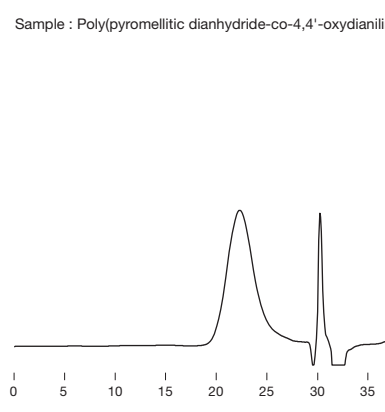
Column : Shodex GPC LF-404
Eluent : 5mM CF₃COONa in HFIP
Flow rate : 0.15mL/min
Detector : RI (small cell volume)
Column temp. : 40°C

Polymethyl methacrylate



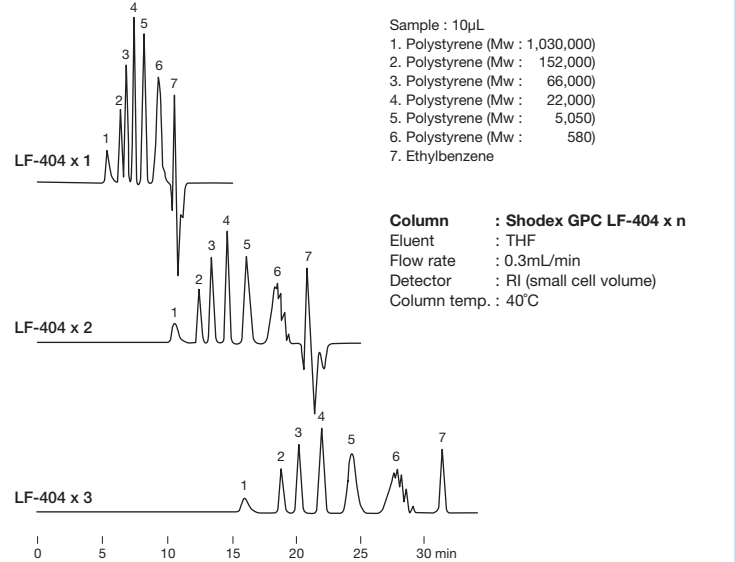
Column : Shodex GPC LF-804 x 2
Eluent : Methyl ethyl ketone
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 40°C

Polyamic acid



Column : Shodex GPC LF-804 x 2
Eluent : 30mM LiBr + 30mM H₃PO₄ in NMP
Flow rate : 0.7mL/min
Detector : RI
Column temp. : 50°C

Comparison of polystyrenes separation with different numbers of LF-404



Sample : 10μL
1. Polystyrene (Mw : 1,030,000)
2. Polystyrene (Mw : 152,000)
3. Polystyrene (Mw : 66,000)
4. Polystyrene (Mw : 22,000)
5. Polystyrene (Mw : 5,050)
6. Polystyrene (Mw : 580)
7. Ethylbenzene

Column : Shodex GPC LF-404 x n
Eluent : THF
Flow rate : 0.3mL/min
Detector : RI (small cell volume)
Column temp. : 40°C

Organic SEC (GPC) Columns : High Temperature/Ultra High Temperature Analysis

Features

- HT-800**
 - Varied product lineup to support a wide range of molecular weights
 - Corresponds to USP L21
- UT-800**
 - Dedicated to SEC analysis at high/ultra high temperatures with a maximum usable temperature of 210°C
 - Suitable for the analysis of ultra high molecular weight polymer containing samples
 - Corresponds to USP L21

Standard columns

Product Code	Product Name	Plate Number (TP/column)	Usable Temperature (°C)	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length
F6208700	GPC HT-803	≥ 7,000	100 ~ 150	13	500	8.0 × 300
F6208710	GPC HT-804	≥ 7,000	100 ~ 150	13	1,500	8.0 × 300
F6208720	GPC HT-805	≥ 7,000	100 ~ 150	13	5,000	8.0 × 300
F6208730	GPC HT-806	≥ 7,000	100 ~ 150	13	10,000	8.0 × 300
F6208740	GPC HT-806M	≥ 7,000	100 ~ 150	13	10,000	8.0 × 300
F6208770	GPC HT-807	≥ 4,000	100 ~ 150	18	20,000	8.0 × 300
F6709410	GPC HT-G	(guard column)	100 ~ 150	13	—	8.0 × 50
F6208600	GPC UT-802.5	≥ 4,400	100 ~ 210	30	300	8.0 × 300
F6208610	GPC UT-806M	≥ 4,400	100 ~ 210	30	10,000	8.0 × 300
F6208620	GPC UT-807	≥ 3,300	100 ~ 210	30	20,000	8.0 × 300
F6709400	GPC UT-G	(guard column)	100 ~ 210	30	—	8.0 × 50
F6208390	GPC AT-806MS	≥ 6,000	*Ta ~ 150	12	10,000	8.0 × 250
F6700280	GPC AT-G	(guard column)	*Ta ~ 150	15	—	8.0 × 50

* The columns with 'M' at the end of column names are mixed-gel column capable of analyzing samples over a wide range of molecular weight distribution.

Base Material : Styrene divinylbenzene copolymer
Shipping Solvent : Toluene
*Ta : Ambient temperature

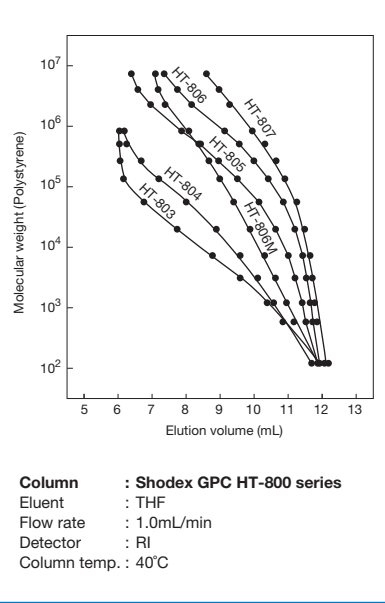
Target molecular weight range and Exclusion limit

● With Polystyrene (eluent : THF)

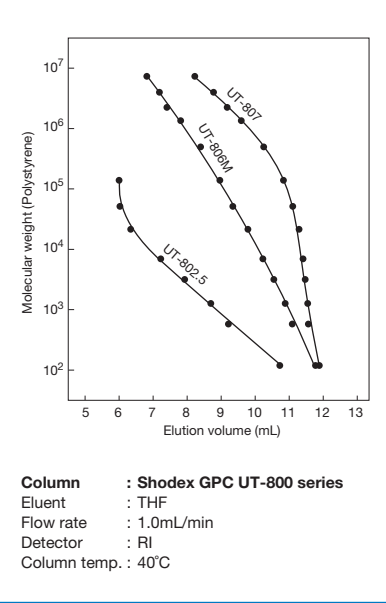
Product Name	Target Molecular Weight Range	Exclusion Limit
HT-803	1,000 – 50,000	70,000
HT-804	7,000 – 300,000	400,000
HT-805	50,000 – 2,000,000	4,000,000
HT-806	150,000 – *(20,000,000)	*(20,000,000)
HT-806M	1,000 – *(20,000,000)	*(20,000,000)
HT-807	300,000 – *(200,000,000)	*(200,000,000)
UT-802.5	300 – 10,000	20,000
UT-806M	1,000 – *(20,000,000)	*(20,000,000)
UT-807	500,000 – *(200,000,000)	*(200,000,000)
AT-806MS	1,000 – *(20,000,000)	*(20,000,000)

* Please use the above table as a rough indication for the column selection. *() Estimated value

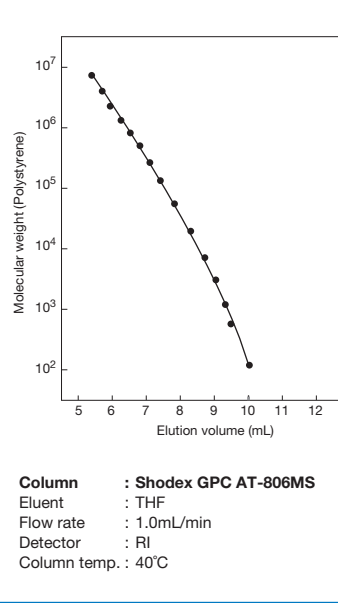
Calibration curves for HT-800 series using polystyrene



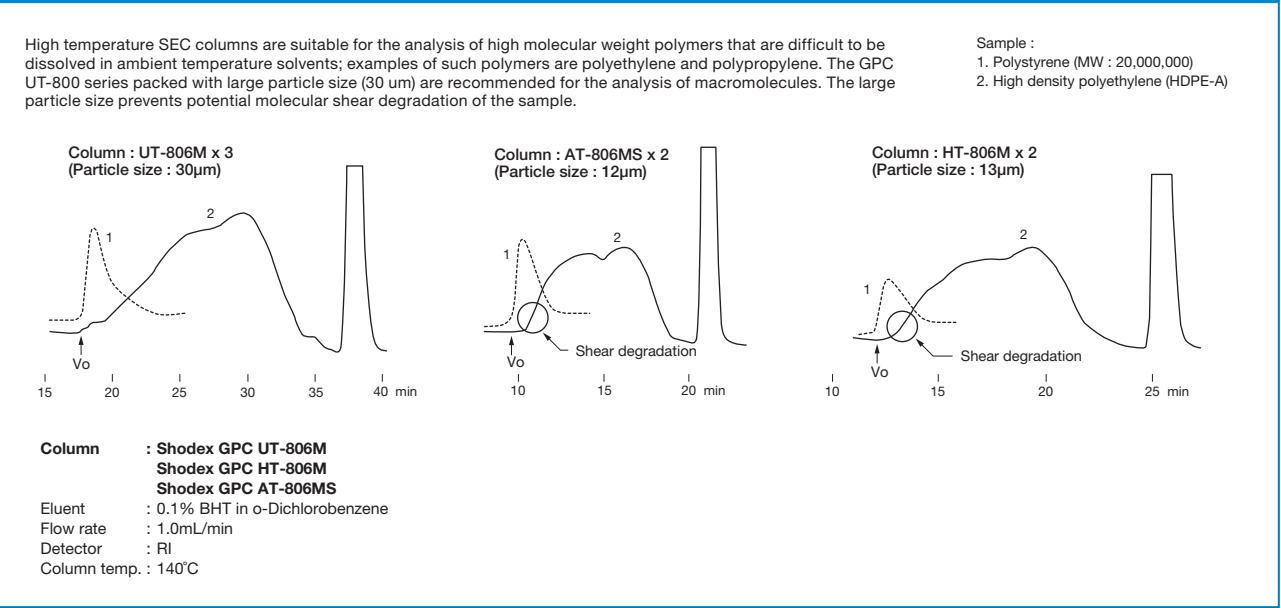
Calibration curves for UT-800 series using polystyrene



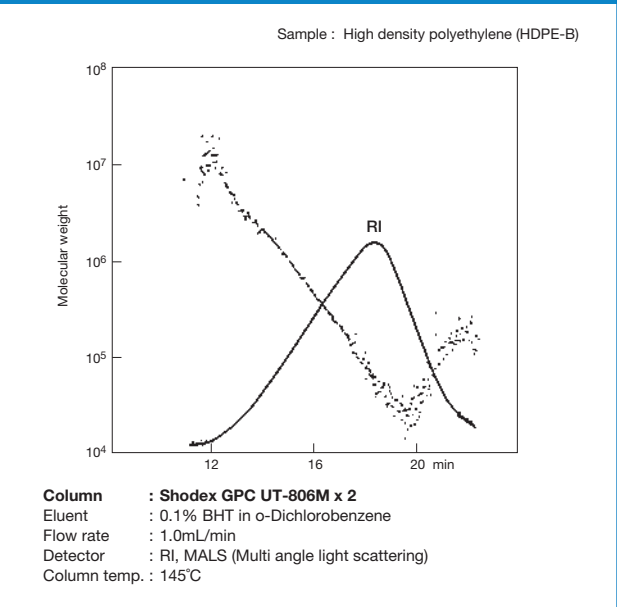
Calibration curve for AT-806MS using polystyrene



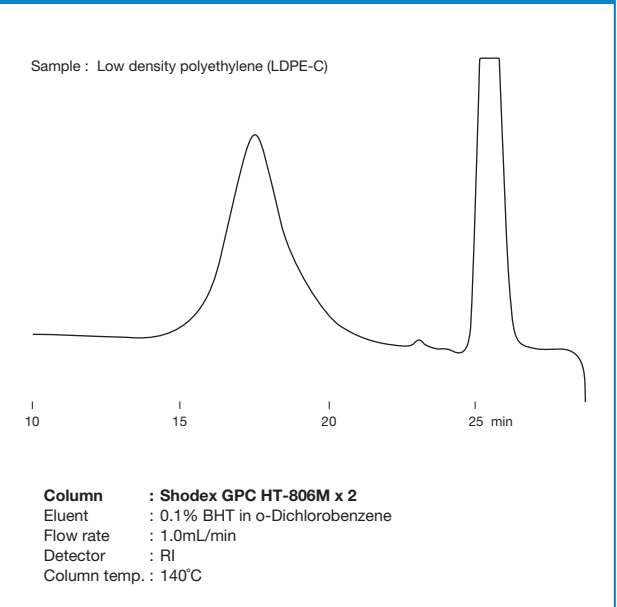
Effects of gel particle size in high temperature GPC columns



High density polyethylene



Low density polyethylene



Organic SEC (GPC) Columns : HFIP

Features

HFIP-800	Columns exclusively for use with hexafluoroisopropanol (HFIP)
	Corresponds to USP L21
HFIP-600	Rapid analysis, solvent saving type
	Corresponds to USP L21

Standard columns

HFIP-800 series

Product Code	Product Name	Plate Number (TP/column)	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length
F6028530	GPC HFIP-803	≥ 12,000	10	500	8.0 × 300
F6028540	GPC HFIP-804	≥ 12,000	7	1,500	8.0 × 300
F6028550	GPC HFIP-805	≥ 10,000	10	5,000	8.0 × 300
F6028560	GPC HFIP-806	≥ 10,000	10	10,000	8.0 × 300
F6028590	GPC HFIP-806M	≥ 10,000	10	10,000	8.0 × 300
F6028570	GPC HFIP-807	≥ 4,000	18	20,000	8.0 × 300
F6700500	GPC HFIP-G 8B (GPC HFIP-LG)	(guard column)	15	—	8.0 × 50

* The columns with 'M' at the end of column names are mixed-gel column capable of analyzing samples over a wide range of molecular weight distribution.

Base Material : Styrene divinylbenzene copolymer
Shipping Solvent : Hexafluoroisopropanol (HFIP)

Rapid analysis downsized columns

HFIP-600 series

© Use of the HFIP-600 series with semi-micro type devices is recommended.

Product Code	Product Name	Plate Number (TP/column)	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length
F6021030	GPC HFIP-603	≥ 12,000	3	500	6.0 × 150
F6021040	GPC HFIP-604	≥ 12,000	3	1,500	6.0 × 150
F6021050	GPC HFIP-605	≥ 5,000	10	5,000	6.0 × 150
F6021060	GPC HFIP-606	≥ 5,000	10	10,000	6.0 × 150
F6021080	GPC HFIP-606M	≥ 6,000	10	10,000	6.0 × 150
F6021070	GPC HFIP-607	≥ 3,000	18	20,000	6.0 × 150
F6700511	GPC HFIP-G 4A (GPC HFIP-G)	(guard column)	8	—	4.6 × 10

* The columns with 'M' at the end of column names are mixed-gel column capable of analyzing samples over a wide range of molecular weight distribution.

Base Material : Styrene divinylbenzene copolymer
Shipping Solvent : Hexafluoroisopropanol (HFIP)

Target molecular weight range and Exclusion limit

With *PMMA (eluent : HFIP)

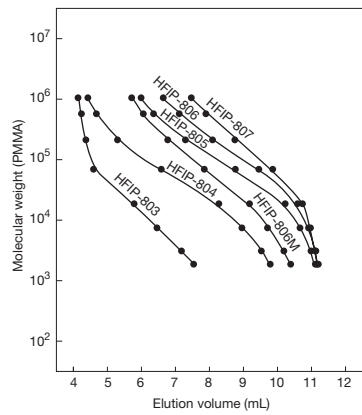
Product Name	Target Molecular Weight Range	Exclusion Limit
HFIP-803	1,000 – 30,000	60,000
HFIP-804	20,000 – 200,000	300,000
HFIP-805	20,000 – 600,000	1,000,000
HFIP-806	70,000 – *(8,000,000)	*(8,000,000)
HFIP-806M	1,000 – *(8,000,000)	*(8,000,000)
HFIP-807	70,000 – *(50,000,000)	*(50,000,000)

Product Name	Target Molecular Weight Range	Exclusion Limit
HFIP-603	1,000 – 30,000	60,000
HFIP-604	20,000 – 200,000	300,000
HFIP-605	20,000 – 600,000	1,000,000
HFIP-606	70,000 – *(8,000,000)	*(8,000,000)
HFIP-606M	1,000 – *(8,000,000)	*(8,000,000)
HFIP-607	70,000 – *(50,000,000)	*(50,000,000)

* Please use the above table as a rough indication for the column selection.

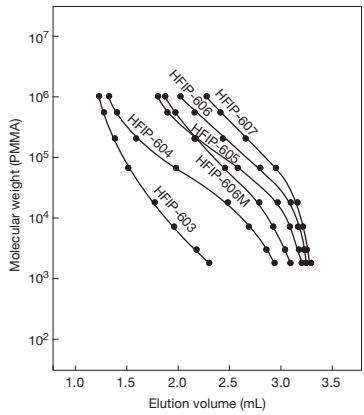
*PMMA : Polymethylmethacrylate
*() Estimated value

Calibration curves for HFIP-800 series using PMMA



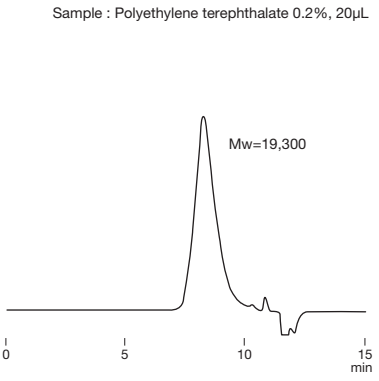
Column : Shodex GPC HFIP-800 series
Eluent : HFIP
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 40°C

Calibration curves for HFIP-600 series using PMMA



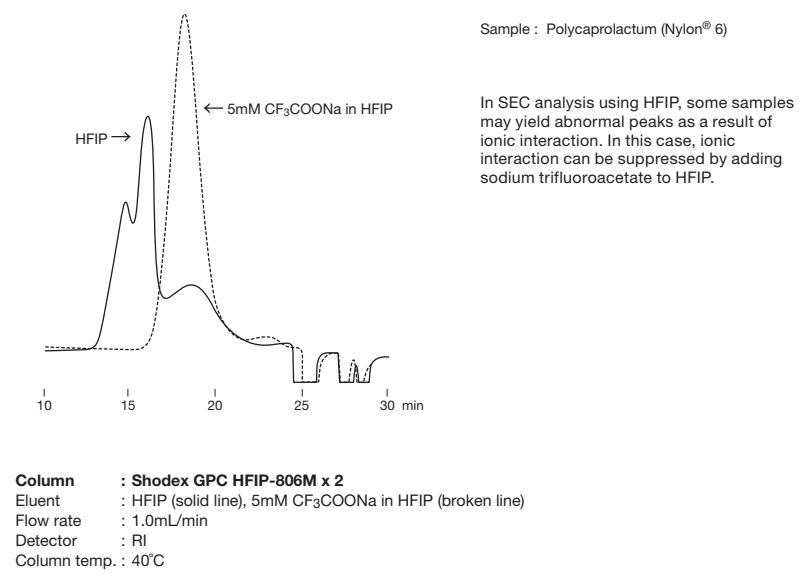
Column : Shodex GPC HFIP-600 series
Eluent : HFIP
Flow rate : 0.3mL/min (HFIP-603, 604)
0.5mL/min (HFIP-605, 606, 606M, 607)
Detector : RI (small cell volume)
Column temp. : 40°C

Polyethylene terephthalate (PET)



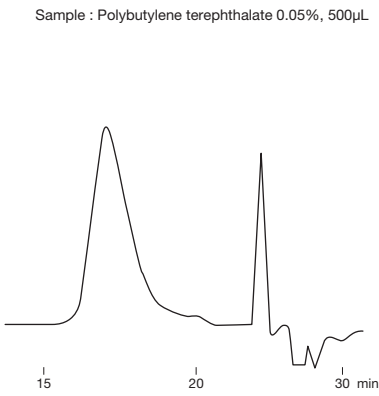
Column : Shodex GPC HFIP-606M x 2
Eluent : 5mM CF₃COONa in HFIP
Flow rate : 0.6mL/min
Detector : RI (small cell volume)
Column temp. : 40°C

Polyamide (effects of salt addition)



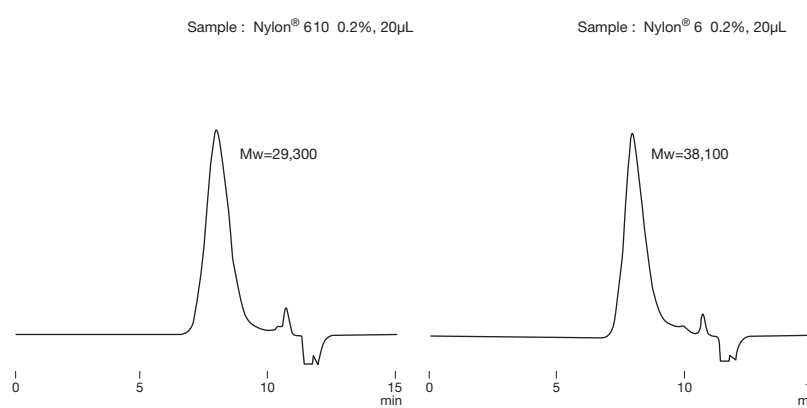
Column : Shodex GPC HFIP-806M x 2
Eluent : HFIP (solid line), 5mM CF₃COONa in HFIP (broken line)
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 40°C

Polybutylene terephthalate (PBT)



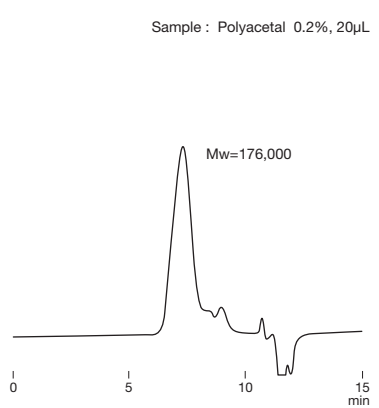
Column : Shodex GPC HFIP-805 + HFIP-803
Eluent : 5mM CF₃COONa in HFIP
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 40°C

Polyamides (Nylon 610 and Nylon 6)



Column : Shodex GPC HFIP-606M x 2
Eluent : 5mM CF₃COONa in HFIP
Flow rate : 0.6mL/min
Detector : RI (small cell volume)
Column temp. : 40°C

Polyacetal



Column : Shodex GPC HFIP-606M x 2
Eluent : 5mM CF₃COONa in HFIP
Flow rate : 0.6mL/min
Detector : RI (small cell volume)
Column temp. : 40°C

Applicability of SEC (GPC) Columns to Solvent Replacement

Solvent	Product Name									
	Shipping Solvent : THF						Shipping Solvent : DMF			
	KF-801	KF-802 KF-802.5 KF-803L KF-804L	KF-803	KF-804 KF-805 KF-806 KF-807 KF-806M KF-805L KF-806L KF-807L	KF-601 KF-602 KF-602.5	KF-603 KF-604 KF-605 KF-606 KF-607 KF-606M	LF-804 LF-604 LF-404	KD-801 KD-802 KD-802.5	KD-803	KD-804 KD-805 KD-806 KD-807 KD-806M
	Shipping Solvent : Chloroform				Shipping Solvent : THF					
	K-801	K-802 K-802.5 K-803L K-804L	K-803	K-804 K-805 K-806 K-807 K-806M K-805L K-806L K-807L	KF-401HQ KF-402HQ KF-402.5HQ	KF-403HQ KF-404HQ KF-405LHQ KF-406LHQ				
Tetrahydrofuran (THF)	○	○	○	○	○	○	○	×	×	○
Chloroform	○	○	○	○	○	○	○	×	×	○
Carbon tetrachloride	×	○	○	○			○	×	×	○
Benzene	○	○	○	○	○	○		×	○	○
Toluene	○	○	○	○	○	○	○	×	○	○
p-Xylene	×	○	○	○	○	○		×	○	○
o-Dichlorobenzene (ODCB)	×	×	○	○	○	○		×	○	○
Trichlorobenzene (TCB)	×	×	○	○	○	○		×	○	○
Dioxane	×	○	○	○				×	○	○
Diethyl ether	×	×	○	○				×	○	○
Ethyl acetate	×	×	○	○				×	×	○
Acetone	×	×	○	○	○	○		×	○	○
Methyl ethyl ketone	×	×	○	○	○	○	○	×	○	○
Dimethylformamide (DMF)	×	×	○	○	○*	○*	○*	○	○	○
Dimethylacetamide (DMAc)	×	×	○	○	○*	○*	○*	×	○	○
Hexafluoroisopropanol (HFIP)	×	×	×	○	×	△*	○*	×	○	○
m-Cresol	×	×	○	○				×	○	○
o-Chlorophenol	×	×	○	○				×	○	○
Quinolin	×	×	○	○				×	○	○
N-Methylpyrrolidone (NMP)	×	×	○	○	○*	○*	○*	×	○	○
Dimethylsulfoxide (DMSO)	×	×	×	△	△*	○*	○*	×	○	○
30% m-Cresol/Chloroform	×	○	○	○			○	×	○	○
30% o-Chlorophenol/Chloroform	×	○	○	○			○	×	○	○
30% HFIP/Chloroform	×	○	○	○				×	○	○
Hexane	×	×	×	×	×	×	×	×	×	×
Acetonitrile	×	×	×	×	×	×	×	×	×	×
Methanol	×	×	×	×	×	×	×	×	×	×
Water	×	×	×	×	×	×	×	×	×	×

○ : Solvent replacement possible
△ : Solvent replacement possible, but this may cause column performance to deteriorate slightly
* : Usable at 40°C or higher
× : Solvent replacement not possible

Calibration Standards for SEC

[Polystyrene (PS)]

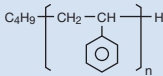
Features

- For organic solvent SEC (GPC)
- Less branched polystyrene with anionic polymerization
- Easily soluble in tetrahydrofuran (THF), chloroform, toluene, and o-dichlorobenzene (ODCB)

Kit type

Product Code	Product Name	Contents	MW Range
F8601105	STANDARD SL-105	0.5g x 10 kinds	580 – 19,500
F8602105	STANDARD SM-105	0.5g x 10 kinds	1,220 – 2,700,000
F8603075	STANDARD SH-75	0.5g x 7 kinds	591,000 – 6,870,000

Structural formula of S series



SL-105

Std. No.	Mp	Mw/Mn
S-19	19,500	1.03
S-13	13,300	1.02
S-9.9	9,970	1.03
S-6.9	6,940	1.03
S-4.8	4,830	1.04
S-2.7	2,780	1.04
S-1.8	1,860	1.04
S-1.3	1,390	1.05
S-0.8	860	1.07
S-0.5	580	0.11

SM-105

Std. No.	Mp	Mw/Mn
S-2700	2,700,000	1.07
S-1390	1,390,000	1.06
S-661	661,000	1.04
S-326	326,000	1.02
S-124	124,000	1.03
S-47	47,200	1.03
S-18	18,300	1.03
S-6.9	6,940	1.03
S-3.0	2,980	1.04
S-1.2	1,220	1.06

SH-75

Std. No.	Mp	Mw/Mn
S-6870	6,870,000	1.09
S-5190	5,190,000	1.03
S-3990	3,990,000	1.05
S-2350	2,350,000	1.04
S-1820	1,820,000	1.04
S-991	991,000	1.05
S-591	591,000	1.02

(Note)
Molecular weights (Mp, Mw/Mn) of each kit may vary depending on production lots.

[Polymethylmethacrylate (PMMA)]

Features

- For organic solvent SEC (GPC)
- Narrow molecular weight distribution range
- Easily soluble in hexafluoroisopropanol (HFIP) and dimethylformamide (DMF)

Kit type

Product Code	Product Name	Contents	MW Range
F8604075	STANDARD M-75	0.5g x 7 kinds	2,880 – 1,050,000

(Note)
Molecular weights (Mp, Mw/Mn) of each kit may vary depending on production lots.

Std. No.	Mp	Mw/Mn
M-1050	1,050,000	1.07
M-569	569,000	1.04
M-211	211,000	1.02
M-69	68,800	1.02
M-18	17,800	1.04
M-6.8	6,850	1.10
M-2.9	2,880	1.08

[Pullulan]

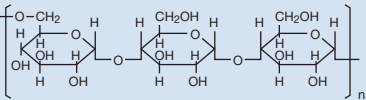
Features

- For aqueous SEC (GFC)
- Unbranched pullulan standard
- High solubility in water eliminates the possibility of recrystallization

Kit type

Product Code	Product Name	Contents	MW Range
F8400000	STANDARD P-82	0.2g x 8 kinds	6,100 – 642,000

Structural formula of P series



Std. No.	Mp	Mw/Mn
STD P-800	642,000	1.23
STD P-400	337,000	1.12
STD P-200	194,000	1.09
STD P-100	107,000	1.13
STD P-50	47,100	1.07
STD P-20	21,100	1.09
STD P-10	9,600	1.09
STD P-5	6,100	1.05

(Note)
Molecular weights (Mp, Mw/Mn) of each kit may vary depending on production lots.

Columns for Anion Exchange Chromatography

Features

QA-825 DEAE-825	- Suitable for analysis of relatively high molecular weight compounds: proteins, peptides, DNA, and RNA - Usable in a wide pH range from pH 2 to 12 - QA-825 corresponds to USP L23
DEAE3N-4T	- Non-porous base material - For rapid analysis
DEAE-2B	- Non-porous base material - Supports UHPLC (available under hyperbaric conditions up to 30 MPa)
ES-502N 7C	- Compared to IEC series columns, polyvinyl alcohol is used as base material and this offers different separation pattern - Low hydrophobic interaction of proteins allows analysis under mild conditions
WA-624	Suitable for anion exchange analysis of low molecular weight compounds such as nucleotides

Standard columns

Strong anion exchange resin [Functional Group : Quaternary ammonium]

Product Code	Product Name	Ion Exchange Capacity (meq/g)	Base Material	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length	Shipping Solvent
F6110011	IEC QA-825	0.45	Polyhydroxymethacrylate	12	5,000	8.0 × 75	50mM Na ₂ SO ₄ aq.

Weak anion exchange resin [Functional Group : Diethylaminoethyl]

Product Code	Product Name	Ion Exchange Capacity (meq/g)	Base Material	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length	Shipping Solvent
F6118255	IEC DEAE-825	0.6	Polyhydroxymethacrylate	8	5,000	8.0 × 75	50mM Na ₂ SO ₄ aq.
F6112100	IEC DEAE3N-4T	0.4	Polyhydroxymethacrylate	2.5	–	4.6 × 35	H ₂ O
F7640002	Asahipak ES-502N 7C	0.55	Polyvinyl alcohol	9	2,000	7.5 × 100	50mM 1,3-Diaminopropane + 50mM NaCl (pH10.0)
F6356240	AXpak WA-624	1.2	Polyhydroxymethacrylate	10	2,000	6.0 × 150	0.1M Sodium phosphate buffer (pH3.0)/CH ₃ CN =80/20
F6700245	AXpak WA-G	(guard column)	Polyhydroxymethacrylate	10	–	4.6 × 10	0.1M Sodium phosphate buffer (pH3.0)/CH ₃ CN =80/20

Weak anion exchange resin [Functional Group : Diethylaminoethyl] : For UHPLC column

Product Code	Product Name	Ion Exchange Capacity (meq/g)	Base Material	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length	Shipping Solvent
F6112110	PIKESS DEAE-2B	0.4	Polyhydroxymethacrylate	2.5	–	2.0 × 50	H ₂ O

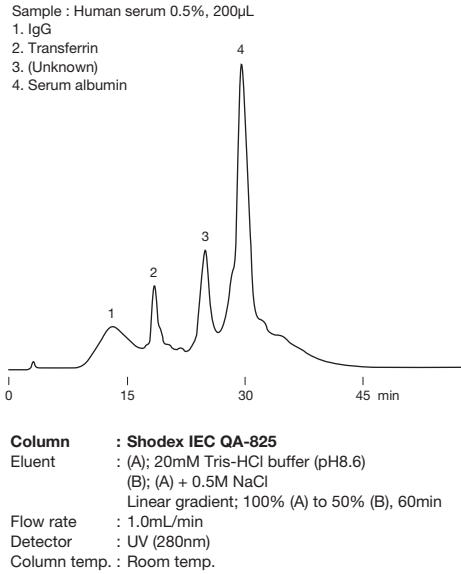
Semi-micro columns * The following semi-micro columns are made to order.

Product Code	Product Name	Ion Exchange Capacity (meq/g)	Base Material	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length
F7960122	DEAE9A-2D	0.55	Polyvinyl alcohol	9	2,000	2.0 × 150

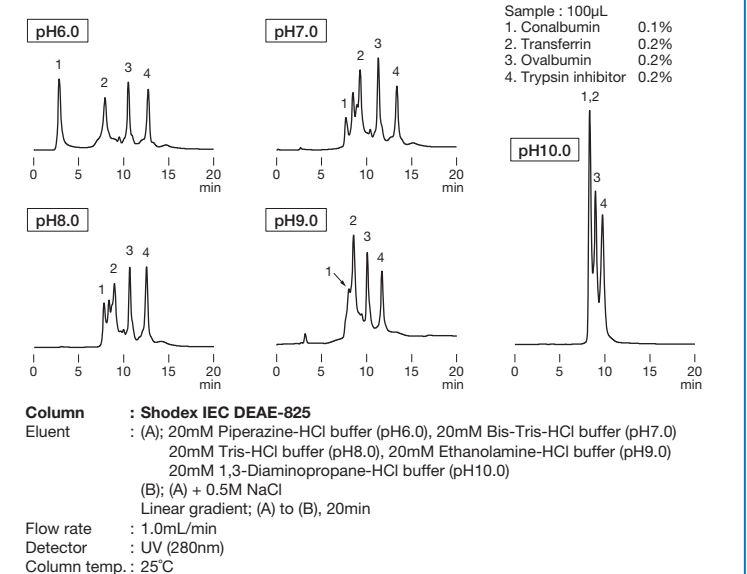
Preparative columns * Preparative columns are made to order.

Product Code	Product Name	Particle Size (μm)	Column Size (mm) I.D. x Length	Standard columns
F6548000	IEC QA-2025	20	20.0 × 150	QA-825
F6548050	IEC QA-5025	37	50.0 × 300	QA-825
F6709602	IEC QA-LG	20	8.0 × 50	(guard column)
F6548001	IEC DEAE-2025	20	20.0 × 150	DEAE-825
F6548051	IEC DEAE-5025	37	50.0 × 300	DEAE-825
F6709603	IEC DEAE-LG	20	8.0 × 50	(guard column)
F6840004	Asahipak ES-502N 20C	13	20.0 × 100	ES-502N 7C
F6710021	Asahipak GS-20G 7B	20	7.5 × 50	(guard column)

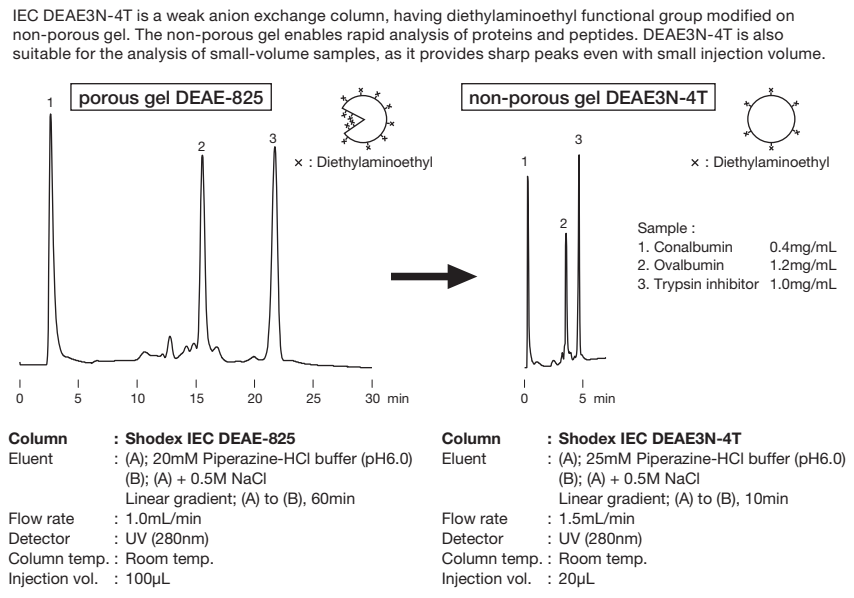
Proteins in human serum



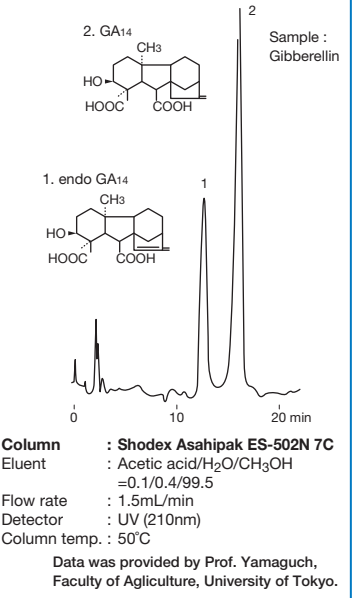
Effects of eluent pH for DEAE-825



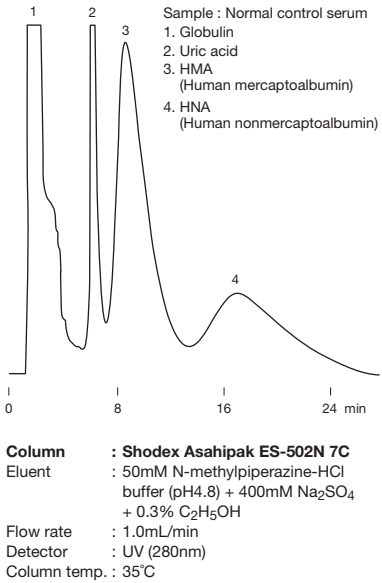
Comparison of porous DEAE-825 and non-porous DEAE3N-4T for protein separation



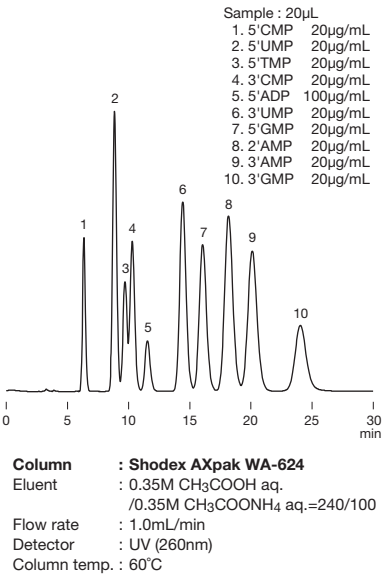
Gibberellin Isomers



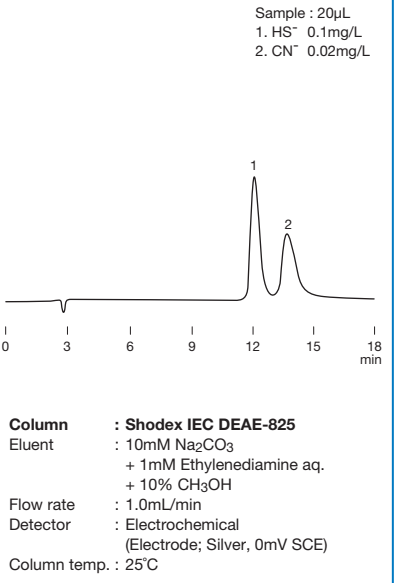
Mercaptoalbumin and non-mercaptoalbumin



Nucleotides



Sulfide ion and cyanide ion



Columns for Cation Exchange Chromatography

Features

SP-825 CM-825	- Suitable for analysis of relatively high molecular weight compounds: proteins, peptides, DNA, and RNA - Usable in a wide pH range from pH 2 to 12
SP-420N	- Non-porous base material - For rapid analysis
SP-2B	- Non-porous base material - Supports UHPLC (available under hyperbaric conditions for up to 30 MPa)
ES-502C 7C	- Compared to IEC series columns, polyvinyl alcohol is used as base material offering different separation pattern - Low hydrophobic interaction with proteins allows analysis under mild conditions
P-421S	- Column for amino acids analysis by cation exchange mode - Supports simultaneous analysis of different amino acids - Corresponds to USP L22 and L58

Standard columns

● Strong cation exchange resin [Functional Group : Sulfopropyl]

Product Code	Product Name	Ion Exchange Capacity (meq/g)	Base Material	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length	Shipping Solvent
F6118250	IEC SP-825	0.4	Polyhydroxymethacrylate	8	5,000	8.0 × 75	50mM Na ₂ SO ₄ aq.
F6113000	IEC SP-420N	0.3	Polyhydroxymethacrylate	2.5	–	4.6 × 35	20mM Sodium acetate buffer + 0.5M Na ₂ SO ₄ (pH5.0)

● Strong cation exchange resin [Functional Group : Sulfopropyl] : For UHPLC column

Product Code	Product Name	Ion Exchange Capacity (meq/g)	Base Material	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length	Shipping Solvent
F6113110	PIKESS SP-2B	0.3	Polyhydroxymethacrylate	2.5	–	2.0 × 50	20mM Sodium acetate buffer + 0.5M Na ₂ SO ₄ (pH5.0)

● Weak cation exchange resin [Functional Group : Carboxymethyl]

Product Code	Product Name	Ion Exchange Capacity (meq/g)	Base Material	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length	Shipping Solvent
F6110002	IEC CM-825	0.4	Polyhydroxymethacrylate	8	5,000	8.0 × 75	50mM Na ₂ SO ₄ aq.
F7640001	Asahipak ES-502C 7C	0.55	Polyvinyl alcohol	9	2,000	7.5 × 100	0.1M Sodium phosphate buffer (pH4.4)

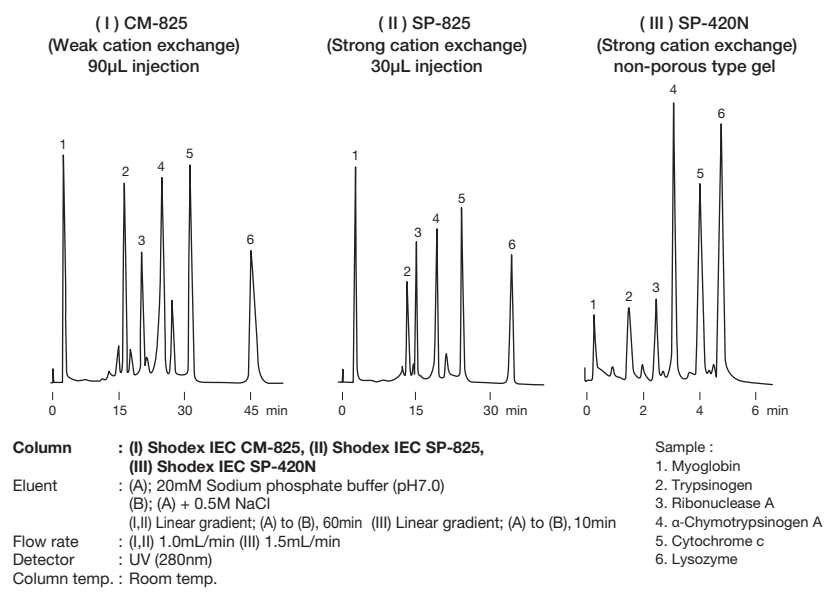
● For amino acids [Functional Group : Sulfo (Na⁺)]

Product Code	Product Name	Plate Number (TP/column)	Base Material	Particle Size (μm)	Column Size (mm) I.D. x Length	Shipping Solvent
F6354211	CXpak P-421S	≥ 3,500	Styrene divinylbenzene copolymer	6	4.6 × 150	H ₂ O
F6700210	CXpak P-G	(guard column)	Styrene divinylbenzene copolymer	6	4.6 × 10	H ₂ O

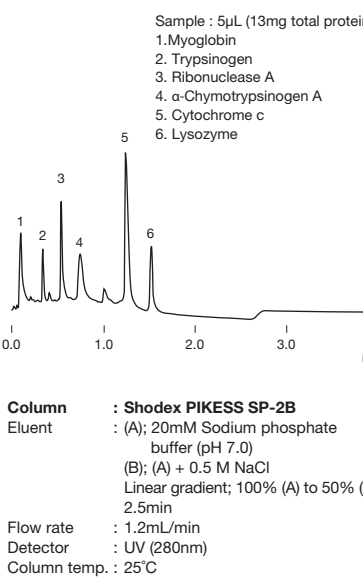
Preparative columns * Preparative columns are made to order.

Product Code	Product Name	Particle Size (μm)	Column Size (mm) I.D. x Length	Standard columns
F6548002	IEC SP-2025	20	20.0 × 150	SP-825
F6548052	IEC SP-5025	37	50.0 × 300	SP-825
F6709604	IEC SP-G 8B (IEC SP-LG)	20	8.0 × 50	(guard column)
F6548003	IEC CM-2025	20	20.0 × 150	CM-825
F6548053	IEC CM-5025	37	50.0 × 300	CM-825
F6709605	IEC CM-LG	20	8.0 × 50	(guard column)
F6840003	Asahipak ES-502C 20C	13	20.0 × 100	ES-502C 7C
F6710021	Asahipak GS-20G 7B	20	7.5 × 50	(guard column)

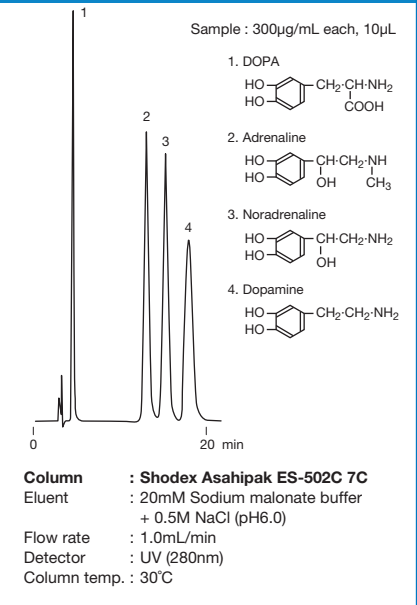
Protein separation using cation exchange columns



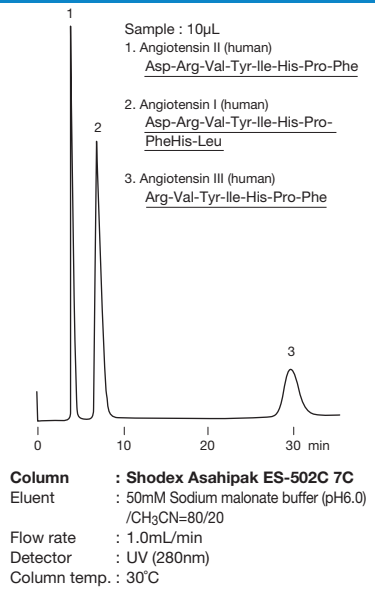
Rapid analysis of proteins using UHPLC



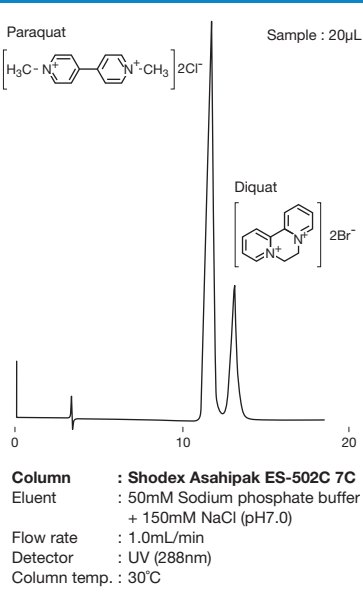
Catecholamines



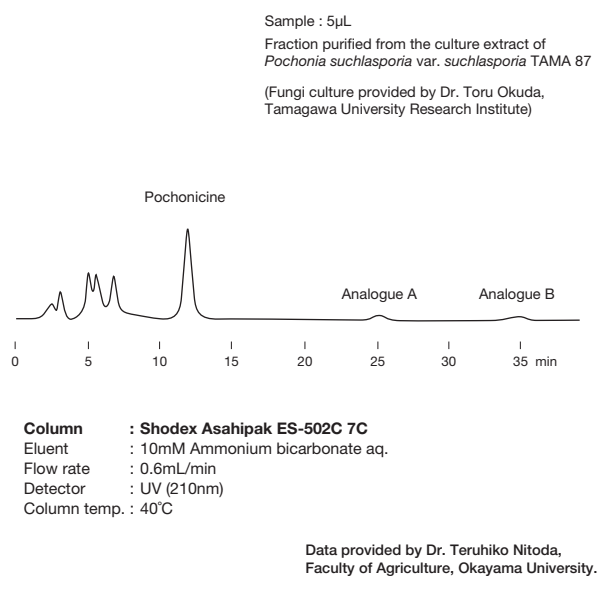
Angiotensins



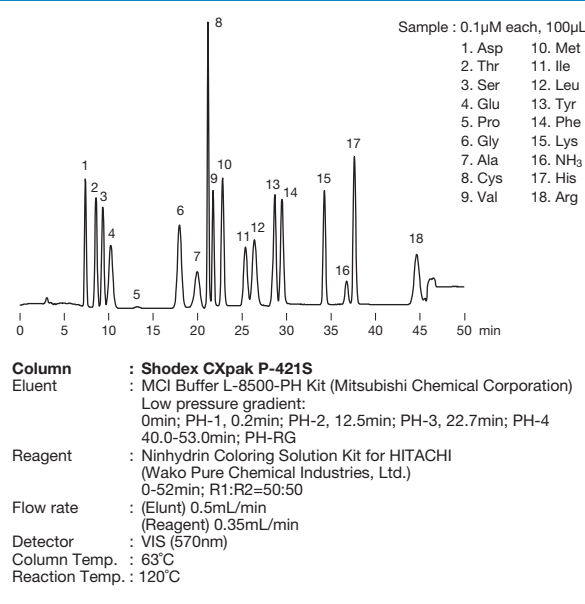
Paraquat and diquat



Analysis of pochonicine and its analogues in filamentous fungi culture extract



Standard amino acids



Columns for Special Separation Modes

Column for Hydrophobic Interaction Chromatography

Features

- PH-814
- Separates proteins without denaturation
 - Applicable to samples obtained after ammonium sulfate fraction treatment

Standard columns

Product Code	Product Name	Functional Group	Particle Size (µm)	Pore Size (Å)	Column Size (mm) I.D. x Length	Shipping Solvent
F6110003	HIC PH-814	Phenyl	10	2,000	8.0 × 75	H ₂ O

Base Material : Polyhydroxymethacrylate

Columns for Affinity Chromatography

Features

- AFpak
- Rigid polymer-based packing materials enable high speed analysis
 - Functional group is modified with chemically stable ligand (spacer)
 - Minimum detachment of functional groups ensures highly reproducible analysis

Standard columns

Product Code	Product Name	Ligand	Ligand Load/Gel (g)	Particle Size (µm)	Column Size (mm) I.D. x Length	Shipping Solvent
F7118954	AFpak ADS-894	Dextran sulfate	30mg	18	8.0 × 50	50mM Sodium phosphate buffer + 0.02% NaN ₃ (pH7.4)
F7118945	AFpak AHR-894	Heparin	5mg	18	8.0 × 50	10mM Tris-HCl buffer + 10mM NaCl + 0.02% NaN ₃ (pH7.4)
F7118946	AFpak APA-894	Protein A	4mg	18	8.0 × 50	0.1M Sodium phosphate buffer + 0.5M NaCl + 0.02% NaN ₃ (pH7.0)
F7113050	AFpak APG-894	Protein G	4–5mg	18	8.0 × 50	10mM Sodium phosphate buffer + 0.15M NaCl + 0.02% NaN ₃ (pH7.4)
F7118959	AFpak AWG-894	Wheat germ agglutinin (WGA)	14mg	18	8.0 × 50	0.1M Tris-HCl buffer + 0.15M NaCl + 0.2M N-Acetylglucosamine + 0.02% NaN ₃ (pH7.4)
F7118964	AFpak ACH-494	Choline oxydase, Acetylcholine esterase	–	18	4.6 × 10	10mM Phosphate buffer + 1.0M NaCl (pH7.4)

Base Material : Polyhydroxymethacrylate

Columns for Chiral Separation

Features

- CDBS-453
- Separates optical isomers by using their conformational compatibility differences
 - Versatile column for chiral separation
 - Corresponds to USP L45
- CRX-853
- Separates optical isomers by using the differences in metal complex formation capacities of functional group and metal ion in eluent and optical isomers
 - Suitable for amino acids, hydroxyl acids, and their derivatives

Standard columns

Product Code	Product Name	Functional Group	Base Material	Particle Size (µm)	Column Size (mm) I.D. x Length	Shipping Solvent
F7146003	ORpak CDBS-453	β -Cyclodextrin derivative	Silica	3	4.6 × 150	1.0% Acetic acid + 0.2M NaCl aq. /CH ₃ CN=70/30
F7140040	ORpak CRX-853	L-amino acid derivative	Polyhydroxymethacrylate	6	8.0 × 50	0.25mM CuSO ₄ aq.
F6709300	ORpak CRX-G	L-amino acid derivative	Polyhydroxymethacrylate	6	4.6 × 10	0.25mM CuSO ₄ aq.

Column for High Temperature Reversed Phase Chromatography

Features

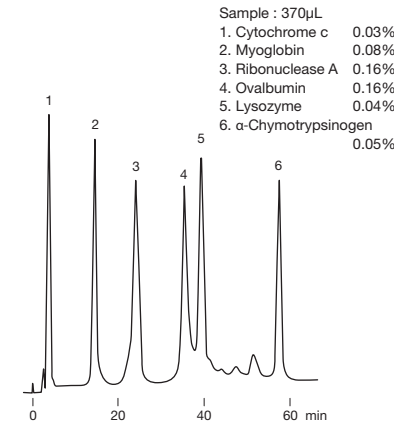
- ET-RP1
- Capable of high temperature analysis up to 150°C
 - High temperature analysis improves column efficiency and enables rapid analysis
 - Corresponds to USP L67

Standard columns

Product Code	Product Name	Plate Number (TP/column)	Functional Group	Particle Size (µm)	Pore Size (Å)	Column Size (mm) I.D. x Length	Shipping Solvent
F7623001	ET-RP1 4D	≥ 11,000	Octadecyl	4	250	4.6 × 150	H ₂ O/CH ₃ CN=35/65

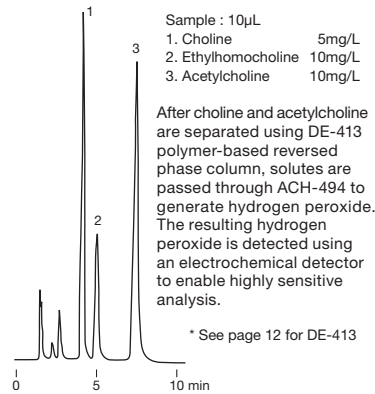
Base Material : Polyvinyl alcohol

Protein separation by hydrophobic interaction chromatography



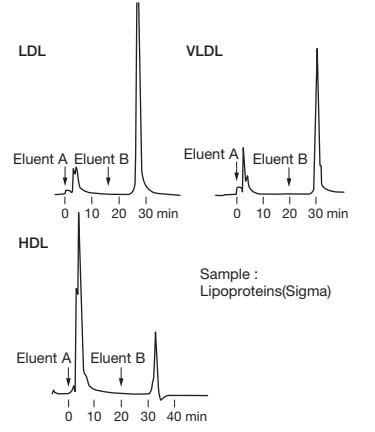
Column : Shodex HIC PH-814
Eluent : (A); 1.8M Ammonium sulfate + (B)
(B); 0.1M Phosphate buffer (pH7.0)
Linear gradient; (A) to (B), 60min
Flow rate : 1.0mL/min
Detector : UV (280nm)
Column temp. : Room temp.

Choline and acetylcholine



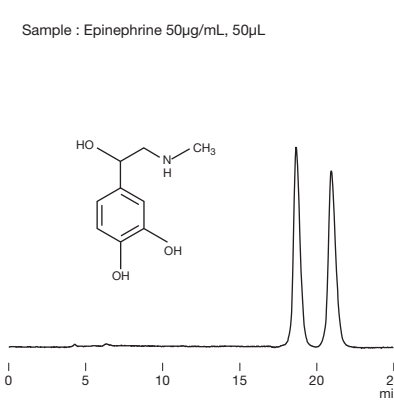
Column : Shodex RSpak DE-413
Post column : Shodex AFpak ACH-494
Eluent : 0.1M H₃PO₄ + 300mg/L Sodium 1-decansulfonate + 65mg/L Tetramethylammonium chloride (pH8.0 adjusted by 1.0M NaOH)
Flow rate : 1.0mL/min
Detector : Electrochemical (Electrode : Pt, 350mV SCE)
Column temp. : 37°C

Lipoproteins in plasma



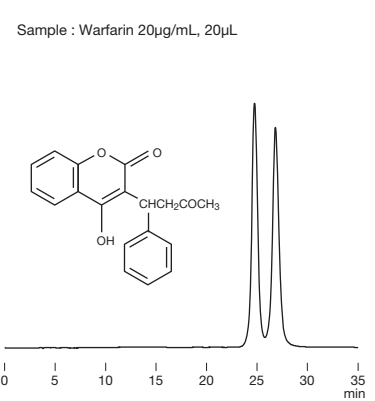
Column : Shodex AFpak ADS-894
Eluent : (A); 50mM Sodium phosphate buffer (pH7.4)
(B); (A) + 1.0M NaCl
Step gradient; (A) to (B)
Flow rate : 1.0mL/min
Detector : UV (280nm)
Column temp. : Room temp.

Chiral separation of epinephrines



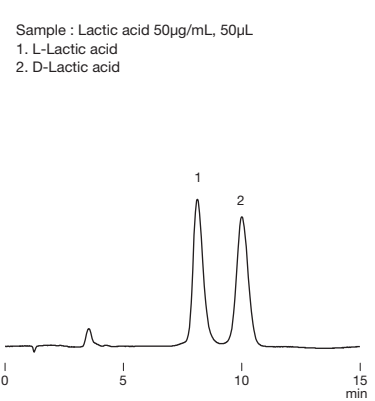
Column : Shodex ORpak CDBS-453
Eluent : 0.05% Acetic acid + 0.2M NaCl aq. /CH₃CN=95/5
Flow rate : 0.5mL/min
Detector : UV (254nm)
Column temp. : 10°C

Chiral separation of warfarin



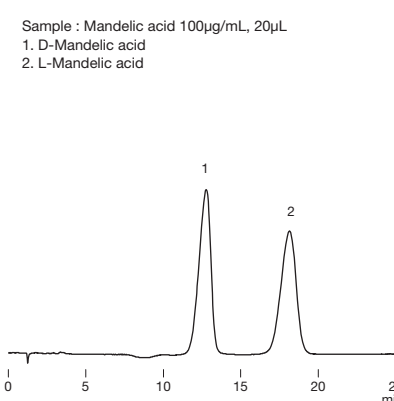
Column : Shodex ORpak CDBS-453
Eluent : 1.0% Acetic acid + 0.2M NaCl aq. /CH₃CN=80/20
Flow rate : 0.6mL/min
Detector : UV (310nm)
Column temp. : 16°C

Chiral separation of lactic acids



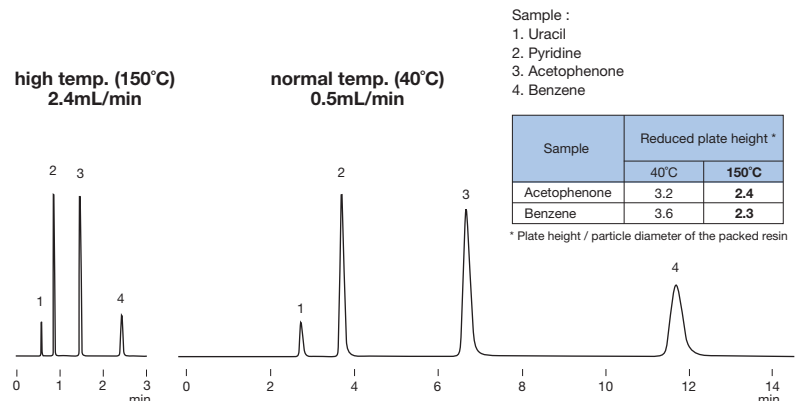
Column : Shodex ORpak CRX-853
Eluent : 0.5mM CuSO₄ aq.
Flow rate : 1.0mL/min
Detector : UV (230nm)
Column temp. : 50°C

Chiral separation of mandelic acids



Column : Shodex ORpak CRX-853
Eluent : 0.25mM CuSO₄ aq.
Flow rate : 1.0mL/min
Detector : UV (230nm)
Column temp. : 50°C

Comparison of ET-RP1's column efficiencies (theoretical plate height) observed at high and normal temperature conditions



Column : Shodex ET-RP1 4D
Eluent : (Left) H₂O/CH₃CN=50/50 (Right) H₂O/CH₃CN=75/25
Detector : Photodiode array (210nm)
Column Oven : Polaratherm 9000 Series (SandraSelerity Technologies, Inc)

Note : The eluent was introduced into the column after being preheated and was cooled after column elution, then introduced into the detector.

Data provided by Research Institute for Chromatography bvba

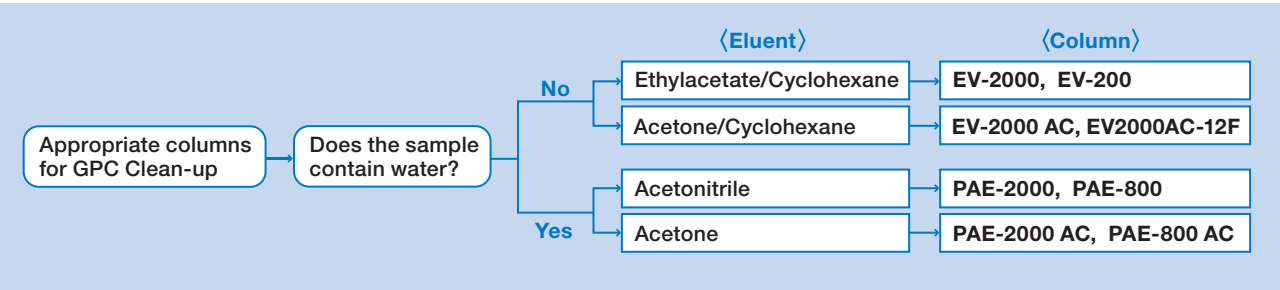
Columns for GPC Clean-up

Features

- EV

- Suitable for fractionation of residual pesticides in foods
 - EV-2000 AC is used in Shoku-An No. 1003001 (October 3rd, 2006, Japan) of the Pharmaceutical and Food Safety Bureau, MHLW, Section 2 “Simultaneous GC/MS (LC/MS) Analyses of Agricultural Chemicals in Livestock and Marine Products”.
 - EV2000AC-12F is used in Shoku-An No. 0226 (February 26th, 2015, Japan) of the Pharmaceutical and Food Safety Bureau, MHLW, Section 2 “LC/MS Analyses of Agricultural Chemicals in Livestock and Marine Products”.
- PAE

- Suitable for cleaning up high-moisture samples such as blood and bottom sediment
 - Highly effective for fractionation of endocrine disruptors in environmental samples



GPC Clean-up for residual pesticides in foods, etc.

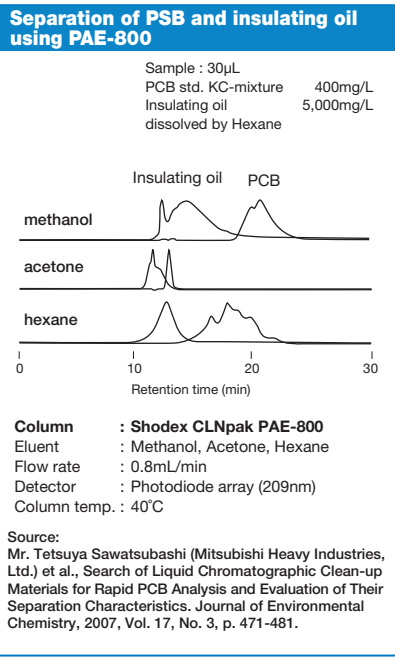
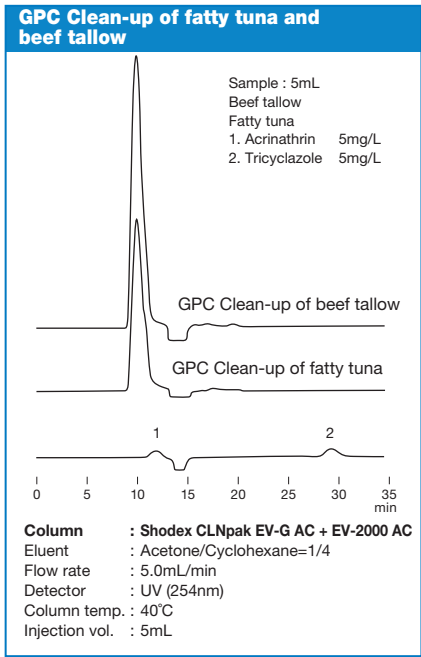
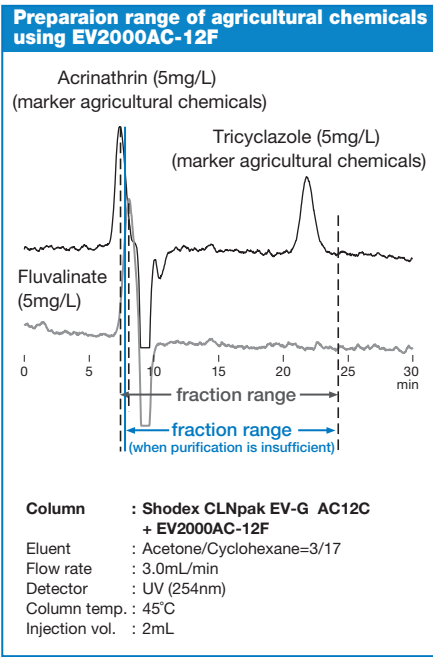
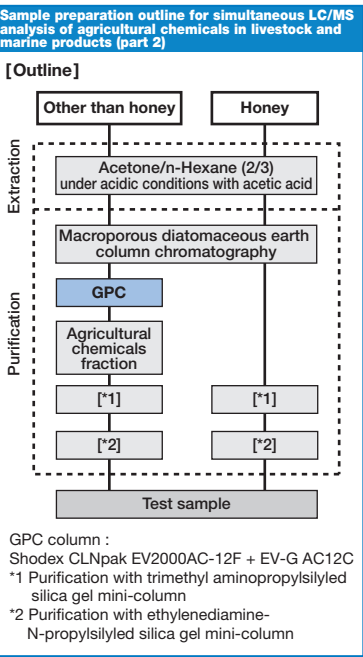
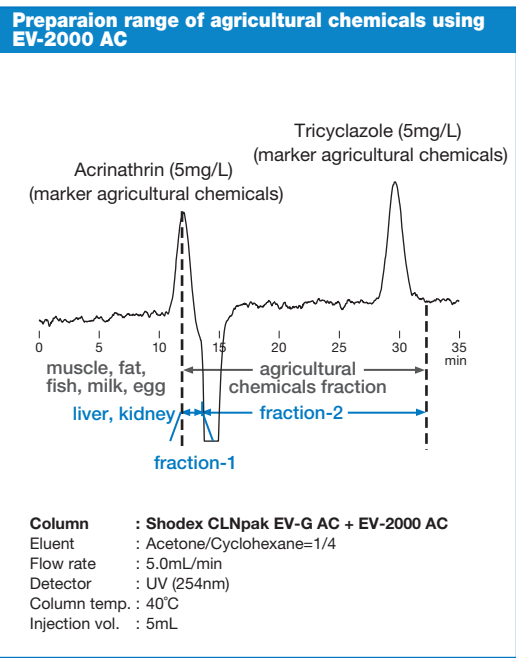
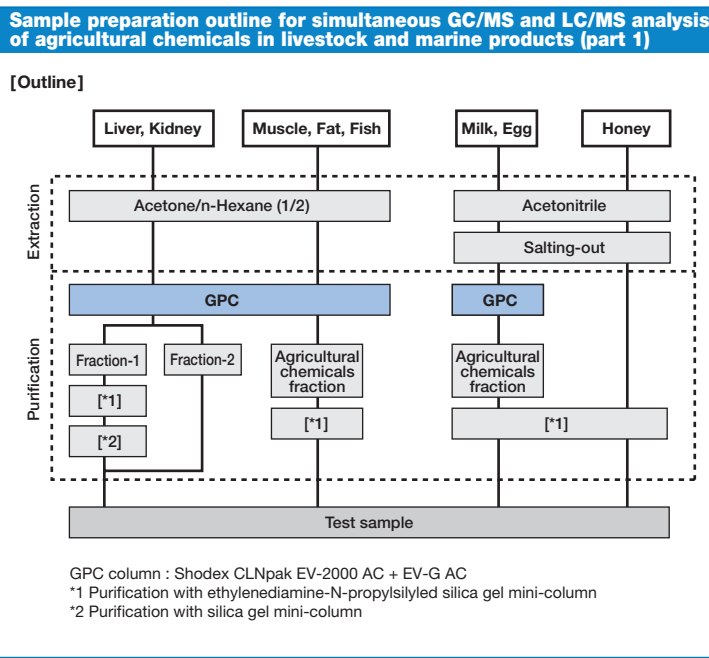
Product Code	Product Name	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length	Shipping Solvent
F6090006	CLNpak EV2000AC-12F	16	30	12.0 × 300	Acetone/Cyclohexane=3/7
F6090007	CLNpak EV-G AC12C	16	(guard column)	12.0 × 100	Acetone/Cyclohexane=3/7
F6090003	CLNpak EV-2000 AC	16	30	20.0 × 300	Acetone/Cyclohexane=3/7
F6090004	CLNpak EV-G AC	16	(guard column)	20.0 × 100	Acetone/Cyclohexane=3/7
F6090001	CLNpak EV-2000	16	30	20.0 × 300	Ethylacetate/Cyclohexane=3/7
F6090002	CLNpak EV-G	16	(guard column)	20.0 × 100	Ethylacetate/Cyclohexane=3/7
F6090005	CLNpak EV-200	16	30	2.0 × 150	Ethylacetate/Cyclohexane=3/7

Base Material : Styrene divinylbenzene copolymer

GPC Clean-up for phthalic acid esters in sediments, biological samples, blood, etc.

Product Code	Product Name	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length	Shipping Solvent
F6810022	CLNpak PAE-2000	5	400	20.0 × 300	Acetonitrile
F6714007	CLNpak PAE-G	9	(guard column)	8.0 × 50	Acetonitrile
F7600025	CLNpak PAE-800	5	400	8.0 × 300	Acetonitrile
F6810023	CLNpak PAE-2000 AC	5	400	20.0 × 300	Acetone
F6714008	CLNpak PAE-G AC	9	(guard column)	8.0 × 50	Acetone
F7600026	CLNpak PAE-800 AC	5	400	8.0 × 300	Acetone

Base Material : Polyvinyl alcohol



Pretreatment Columns for Column Switching Method

Features

- PK**
 - Effective for both hydrophilic and hydrophobic substances
 - The high protein removal rate enables efficient pretreatment
- GF-4A**
 - Higher protein removal rate than PK columns
 - * GF-4A column removes proteins well but is not suitable for trapping hydrophilic substances. Use PK columns for this purpose.

Cartridge columns and holder for column switching method

Product Code	Product Name	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length	Shipping Solvent	Pcs/box
F8700000	MSpak PK-2A 2p	30	30	2.0 × 10	H ₂ O	2
F8700012	MSpak PK-4A 2p	30	30	4.0 × 10	H ₂ O	2
F8700001	MSpak HLD	–	–	(Holder for PK)	–	1

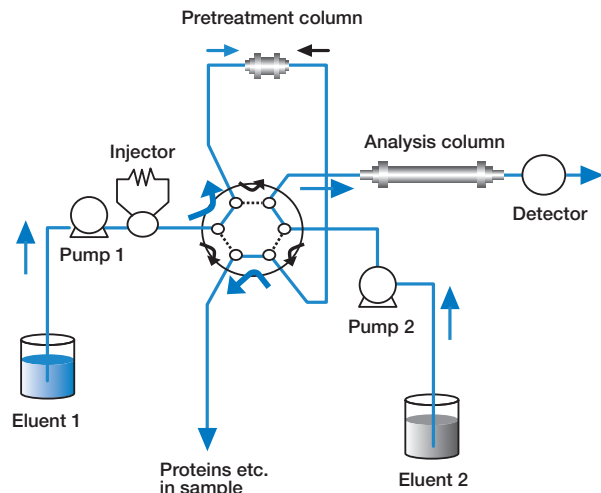
Base Material : Hydrophilic copolymers containing N-vinyl acetoamide
* PK series are cartridge columns and thus should be installed in a column holder "MSpak HLD" before use.

Column for column switching method

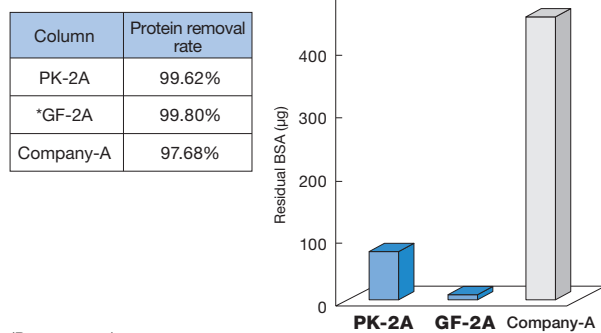
Product Code	Product Name	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length	Shipping Solvent
F8700015	MSpak GF-4A	9	400	4.6 × 10	H ₂ O

Base Material : Polyvinyl alcohol

System diagram for column switching



Protein removal rate using pretreatment columns



(Pretreatment)
Eluent : 10mM Ammonium acetate buffer (pH7.0)
Flow rate : 0.5mL/min
Column temp. : Room temp.

(Analysis)
Column : Shodex PROTEIN **KW-604S
Eluent : 0.1% TFA in (H₂O/CH₃CN=50/50)
Flow rate : 0.5mL/min
Detector : UV (280nm)
Column temp. : Room temp.
Switching time: 5min

*GF-2A : Custom-made column of GF-4A (2.0mmI.D. x 10mm)
**KW-604S is phase-out product.

Recovery rate of medical compounds using PK-2A

Sample	Recovery (%)	Sample	Recovery (%)	Sample	Recovery (%)
Acetaminophen	115	Cloxacolam	91	Mianserin	92
Acetylpheneturide	92	Desipramine	109	Nimetazepam	90
Aconitine	110	Diazepam	97	Nitrazepam	97
Alprazolam	99	Diphenhydramine	93	Nortriptyline	86
Amitriptyline	93	Estazolam	101	Oxazepam	97
Amobarbital	93	Ethenzamide	98	Oxazolam	99
Barbital	94	Etizolam	105	Pentobarbital	93
Benzoylaconitine	96	Fludiazepam	97	Perfenazine	86
Benzoylhypaconine	83	Flumazenil	93	Phenacetin	108
Biperiden	99	Flunitrazepam	97	Phenobarbital	96
Bromazepam	102	Flurazepam	106	Phenytoin	99
Bromocriptine	80	Glutethimide	93	Primidone	91
Bromperidol	89	Haloperidol	99	Promethazine	92
Bromvalerylurea	94	Haloxazolam	93	Propericiazine	90
Brotizolam	97	1-Hydroxymethyltriazolam	90	Propranolol	97
Caffeine	106	4-Hydroxytriazolam	91	Secobarbital	97
Carbamazepine	97	Hydroxyzine	99	Sildenafil citrate	95
Carpipramine	99	Hypaconitine	97	Thioridazine	97
Chlordiazepoxide	133	Imipramine	97	Timiperone	88
Chlormezanone	92	Indomethacin	93	Triazolam	96
Chlorpheniramine	111	Levomepromazine	96	Trihexyphenidyl	91
Chlorpromazine	77	Lofepamine	65	Trimethadione	137
Clocapramine	95	Maprotyline	90	Trimipramine	107
Clofedanol	91	Medazepam	91	Warfarin	81
Clomipramine	95	Mephobarbital	99	Zotepine	92
Clonazepam	96	Mesaconine	118		
Clotiazepam	96	Metharbital	94		

(Adsorption)
Eluent : 10mM Ammonium acetate buffer (pH7.0)
Flow rate : 0.5mL/min

(Elution)
Eluent : 10mM Ammonium acetate buffer (pH7.0)/CH₃CN
Flow rate : 0.5mL/min
Detector : UV (220nm)
Switching time : 5min

Notice of Product Name Changes

Some of Shodex guard columns have been renamed.
There is no change of product code.

Renamed products list

Page	New Product Name	Former Product Name	Product Code
12	RSpak DE-G 4A	RSpak DE-G	F6700150
12	RSpak DE-G 2A	RSpak DE-SG	F6700151
12	RSpak DM-G 4A	RSpak DM-G	F6700160
13	RSpak DE-G 8B	RSpak DE-LG	F6700190
13	RSpak DE-G 20C	RSpak DE-LLG	F6700191
13	RSpak DM-G 8B	RSpak DM-LG	F6700404
13	RSpak DM-G 20C	RSpak DM-LLG	F6700162
24	SUGAR SC-G 6B	SUGAR SC-LG	F6700090
24	SUGAR SP-G 6B	SUGAR SP-G	F6700081
24	SUGAR KS-G 6B	SUGAR KS-G	F6700020
24	RSpak DC-G 4A	RSpak DC-G	F6700170
24	SUGAR SC1211G 4A	SUGAR SC-G	F6700120
25	SUGAR KS-G 8B	SUGAR KS-LG	F6700002
25	RSpak DC-G 8B	RSpak DC-LG	F6700402
25	RSpak DC-G 20C	RSpak DC-LLG	F6700172
28	RSpak KC-G 6B	RSpak KC-G	F6700030
28	RSpak KC-G 8B	RSpak KC-LG	F6700010
36	PROTEIN KW-G 6B	PROTEIN KW-G	F6700131
36	PROTEIN KW-G 8B	PROTEIN KW-LG	F6709556
38	OHpak SB-G 6B	OHpak SB-G	F6709430
39	OHpak SB-G 8B	OHpak SB-LG	F6709555
46, 52	GPC KF-G 4A	GPC KF-G	F6700300
48	GPC K-G 4A	GPC K-G	F6700401
50	GPC KD-G 4A	GPC KD-G	F6700411
54	GPC KF-G 8B	GPC KF-LG	F6700406
54	GPC K-G 8B	GPC K-LG	F6700407
55	GPC H-G 8B	GPC H-G	F6700310
55	GPC KF-G 20B	GPC KF-LLG	F6700408
55	GPC K-G 20B	GPC K-LLG	F6700409
60	GPC HFIP-G 8B	GPC HFIP-LG	F6700500
60	GPC HFIP-G 4A	GPC HFIP-G	F6700511
66	IEC SP-G 8B	IEC SP-LG	F6709604

USP (Ver.38) Column List

No.	Packing Material	Recommended Columnn	Page
L1	Octadecyl silane chemically bonded to porous or non-porous silica or ceramic micro-particles, 1.5 to 10µm in diameter, or a monolithic rod	Silica C18M Silica C18P	16 16
L3	Porous silica particles, 1.5 to 10µm in diameter, or a monolithic silica rod.	Silica 5SIL	17
L7	Octylsilane chemically bonded to totally or superficially porous silica particles, 1.5 to 10µm in diameter, or a monolithic silica rod.	Silica 5C8	17
L8	An essentially monomolecular layer of aminopropylsilane chemically bonded to totally porous silica gel support, 1.5 to 10µm in diameter	Silica 5NH	17
L10	Nitrile groups chemically bonded to porous silica particles, 1.5 to 10µm in diameter, or a monolithic silica rod.	Silica 5CN	17
L11	Phenyl groups chemically bonded to porous silica particles, 1.5 to 10µm in diameter, or a monolithic silica rod.	Silica 5NPE	17
L17	Strong cation-exchange resin consisting of sulfonated cross-linked styrene-divinylbenzene copolymer in the hydrogen form, 6 to 12µm in diameter	SUGAR SH1011 SUGAR SH1821 RSpak KC-811 IC Y-521	28 28 28 32
L19	Strong cation-exchange resin consisting of sulfonated cross-linked styrene-divinylbenzene copolymer in the calcium form, about 9µm in diameter	SUGAR SC1011 SUGAR SC1821 SUGAR SC1211 ES SC1011-7F USPpak MN-431	24 24 24 25 25
L20	Dihydroxypropane groups chemically bonded to porous silica or hybrid particles, 1.5 to 10µm in diameter, or a monolithic silica rod.	PROTEIN KW-800 series KW400 series	36 36
L21	A rigid, spherical styrene-divinylbenzene copolymer, 3 to 30µm in diameter	RSpak RP18-415 RSpak DS-613 RSpak DS-413 GPC KF,K,KD,LF,HT,UT,AT,HFIP series	12 12 12 46, 48, 50, 52, 56, 58, 60
L22	A cation-exchange resin made of porous polystyrene gel with sulfonic acid groups, about 10µm in size	SUGAR SC1011 SUGAR SC1821 SUGAR SP0810 SUGAR KS-800 series RSpak DC-613 SUGAR SZ5532 SUGAR SC1211 EP SC1011-7F USPpak MN-431 SUGAR SH1011 SUGAR SH1821 RSpak KC-811 IC Y-521 CXpak P-421S	24 24 24 24 24 24 24 25 25 28 28 28 32 66
L23	An anion-exchange resin made of porous polymethacrylate or polyacrylate gel with quaternary ammonium groups, 7-12µm in size	IEC QA-825	64
L25	Packing having the capacity to separate compounds with a molecular weight range from 100-5000 (as determined by polyethylene oxide), applied to neutral, anionic, and cationic water-soluble polymers. A polymethacrylate resin base, cross-linked with polyhydroxylated ether (surface contained some residual carboxyl functional groups) was found suitable	OHpak SB-802 HQ OHpak SB-802.5 HQ	38 38
L26	Butyl silane chemically bonded to totally porous silica particles, 1.5 to 10µm in diameter	Silica 5C4	17
L33	Packing having the capacity to separate dextrans by molecular size over a range of 4,000 to 500,000 Da. It is spherical, silica-based, and processed to provide pH stability	PROTEIN KW-800 series KW400 series	36 36
L34	Strong cation-exchange resin consisting of sulfonated cross-linked styrene-divinylbenzene copolymer in the lead form, about 7 to 9µm in diameter	SUGAR SP0810	24
L37	Packing having the capacity to separate proteins by molecular size over a range of 2,000 to 40,000 Da. It is a polymethacrylate gel	OHpak SB-803 HQ OHpak LB-803	38 38
L38	A methacrylate-based size-exclusion packing for water-soluble samples	OHpak SB-800 HQ series OHpak LB-800 series	38 38
L39	A hydrophilic polyhydroxymethacrylate gel of totally porous spherical resin	ODP2 HP RSpak DM-614 OHpak SB-800 HQ series OHpak LB-800 series	8 12 38 38
L45	Beta cyclodextrin, R,S-hydroxypropyl ether derivative, bonded to porous silica particles, 5 to 10µm in diameter	ORpak CDBS-453	68
L58	Strong cation-exchange resin consisting of sulfonated cross-linked styrene-divinylbenzene copolymer in the sodium form, about 6 to 30µm diameter	SUGAR KS-800 series RSpak DC-613 CXpak P-421S	24 24 66
L59	Packing for the size-exclusion separations of proteins (separation by molecular weight) over the range of 5 to 7000 kDa. It is spherical (1.5-10µm), silica or hybrid packing with a hydrophilic coating.	PROTEIN KW-800 series KW400 series	36 36
L67	Porous vinyl alcohol copolymer with a C18 alkyl group attached to the hydroxyl group of the polymer, 2 to 10µm in diameter	Asahipak ODP-40 Asahipak ODP-50 ET-RP1	10 10 68
L71	A rigid, spherical polymetacrylate, 4 to 6µm in diameter	RSpak DE-613 RSpak DE-413 RSpak DE-213	12 12 12
L82	Polyamine chemically bonded to cross-linked polyvinyl alcohol polymer, 4-5µm in diameter	Asahipak NH2P-50 Asahipak NH2P-40	22 22

Column Cleaning Procedures

Change in peak shapes, elution timing, and the elevated column pressure may be resolved by cleaning the column. This section describes general indications of column deterioration and column cleaning procedures. For details of column cleaning procedures, refer to each column's specific operation manual.

Typical indicators of column deterioration possibility

- 1. Elevated column pressure
- 2. Abnormal peak shapes (broadening, leading, or tailing) and split peaks
- 3. Change in retention time
- 4. Unstable baseline

Selection guide to the cleaning solvent

Solvents capable of dissolving the adsorbed substances.

Solvents with high eluting power (variable depending on separation mode)

**Use the solvent specified in the operation manual.*

Standard cleaning procedures

For an efficient cleaning, reverse the direction and reduce the flow rate to 1/3 of the regular flow.

Columns for reversed phase chromatography	Clean the columns with solvent containing higher concentration of organic solvent such as methanol, acetonitrile, or THF. (In case of using buffer as a mobile phase, miscibility of the buffer solution and the organic solvents need to be checked)
Columns for sugar analysis chromatography	[Ligand exchange columns (SUGAR series)] • In case of counter ion detachment Flush or inject solvent containing the salt corresponding to the modified counter-ligand. [Polymer-base amino columns (NH2P series)] • In cases where an acidic substance has been bound to the amino functional group Flush with solvents in the following sequence: water, 0.1M perchloric acid (aq.), water, 0.1M NaOH (aq.), water, and mobile phase.
Columns for aqueous SEC(GFC) chromatography	• In cases where an ionic substance has been adsorbed Use a solvent with higher salt concentration or solvent with different pH from the mobile phase. • In cases where a hydrophobic substance has been adsorbed Use a solvent containing organic solvent. (In case of using buffer as a mobile phase, miscibility of the buffer solution and the organic solvents need to be checked)
Columns for ion exchange chromatography	• In cases where an ionic substance has been adsorbed Use a solvent with higher salt concentration or solvent with different pH from the mobile phase. • In cases where a hydrophobic substance has been adsorbed Use a solvent containing organic solvent. (In case of using buffer as a mobile phase, miscibility of the buffer solution and the organic solvents need to be checked) • In cases where protein have been adsorbed Inject 1-2 mL of 0.1 M NaOH (aq.) or 30% (v/v) acetic acid (aq.) several times.
Columns for hydrophobic interaction chromatography	• In cases where protein have been adsorbed Inject 1-2 mL of 0.1 M NaOH (aq.) or 30% (v/v) acetic acid (aq.) several times.

*The volume of the cleaning solvent required is 5-10 times the column volume.

*Avoid pressure elevation during the cleaning.

*The cleaning is limited and does not guarantee the full regeneration of the column to its original condition.

For your information

One typical cause of the column pressure elevation is the clogging of solid substances at the inlet filter of the column. In this case, reverse the direction and reduce the flow to 1/3 of the regular flow rate. This may remove the solid substance causing the elevated pressure.

**Use the solvent specified in the operation manual.*

General Precautions for Column Handling

For the best performance of the column, please follow the instructions given below.

Column mounting

- Before mounting the column, replace the eluent within all the HPLC system with the mobile phase used for the analysis. *If the mobile phase of the choice is not miscible with the eluent already in the system, use solvent that is miscible with both solvents first to clean the system. *Buffer or salt solution may precipitate when mixed with organic solvent of different concentrations.
- Attach the column in the direction as indicated by arrow marked on the column. Gradually increase the flow rate of the solvent introduced to the column.
- When heating the column, be sure to pump the eluent at a low flow rate until the specified temperature is reached, and then gradually increase the flow rate up to the requirement after the column has been heated sufficiently.

Column dismounting

- If the column is heated, turn off the heater while keeping the flow rate at 1/3 of the regular flow.
- Turn off the pump when the column is cooled to room temperature.
- Remove the column from the system securely tighten the end caps.

Column storage

- For long-term storage, replace the solvent with shipping solvent and securely tighten the end caps.
- Store the column in a location with stable temperature.
- For long-term storage of SEC columns, immersion method is recommended.
*Please refer to the immersion method on the operation manual.

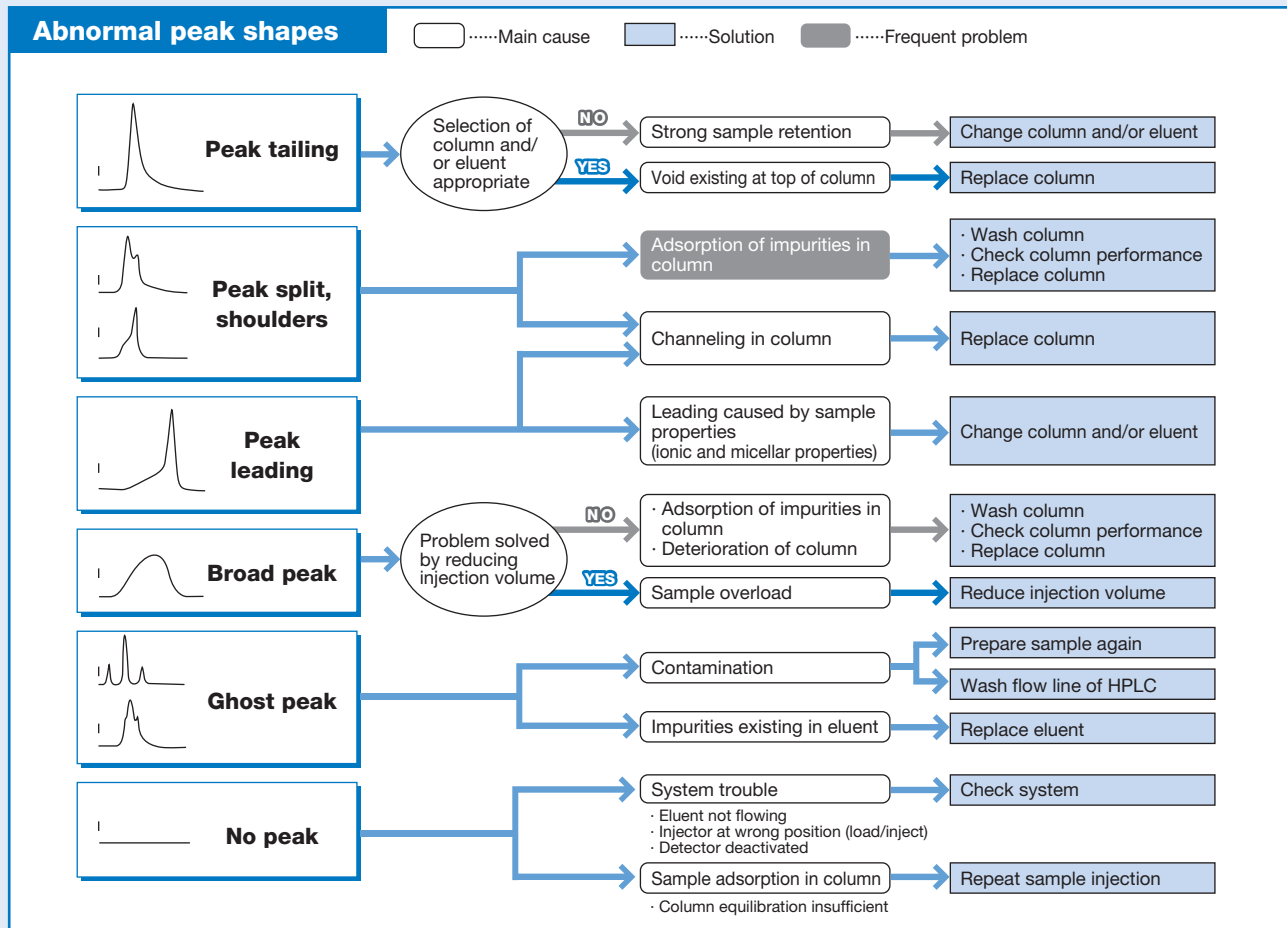
Other

- Avoid physical shock on the column. Be cautious not to drop the column from a high position.
- Do not bend the column.
- Avoid opening the column's end-fitting, it can cause alteration of column's performance.

** Read the operation manual before using the column.*

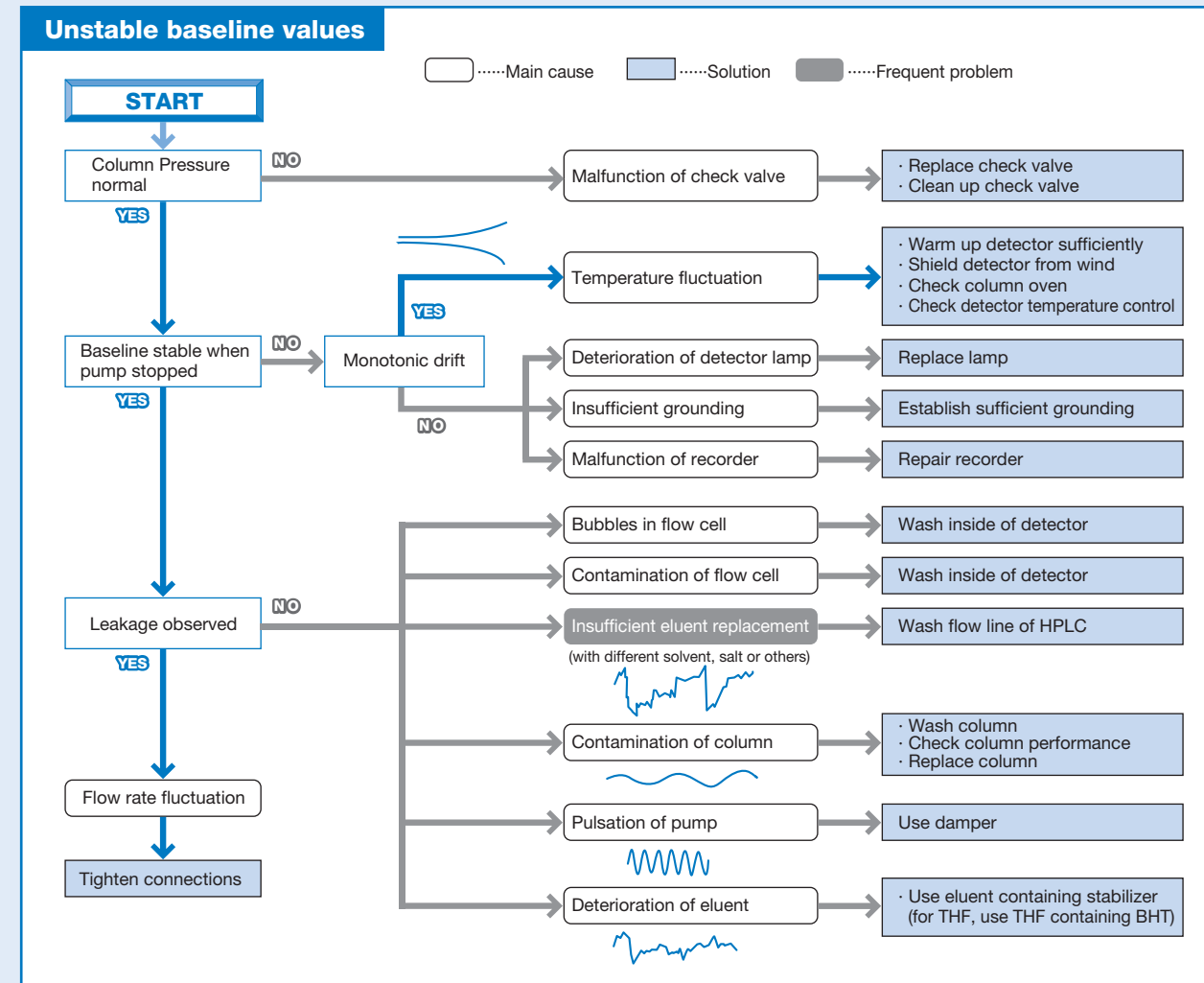
Column Trouble Shooting

Common causes for abnormal chromatograms

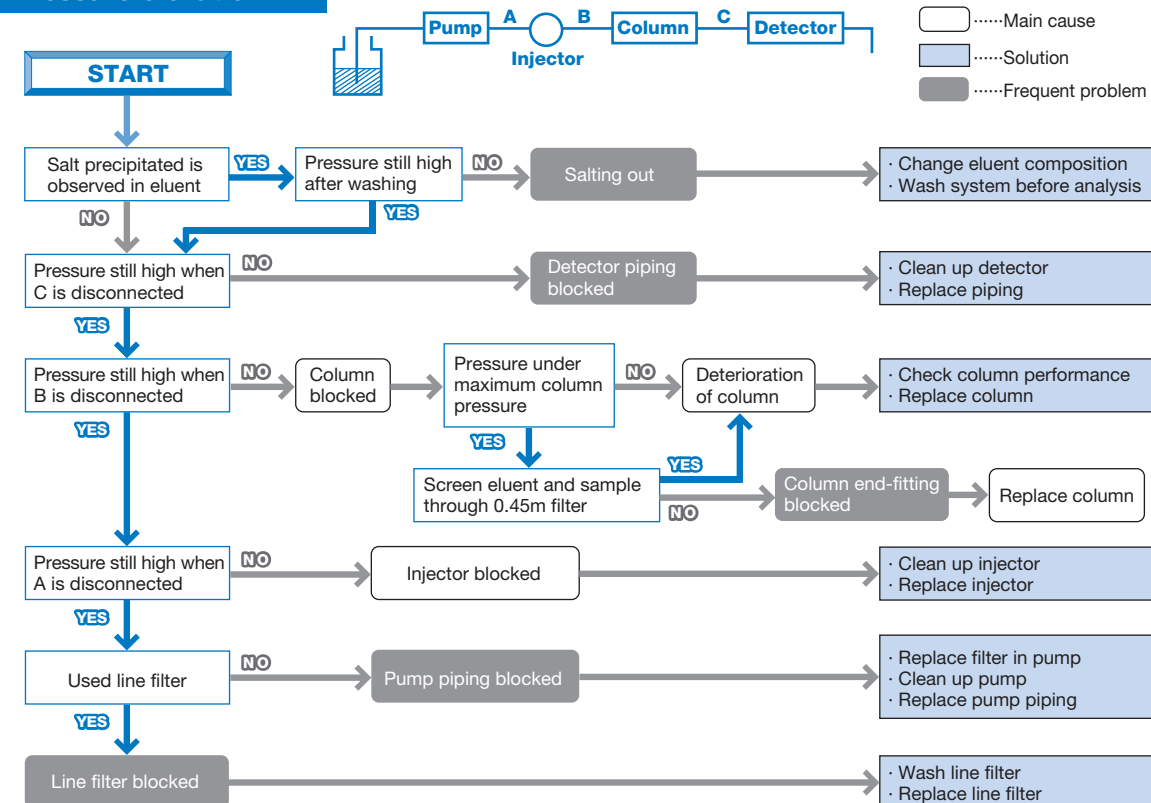


HPLC System Trouble Shooting

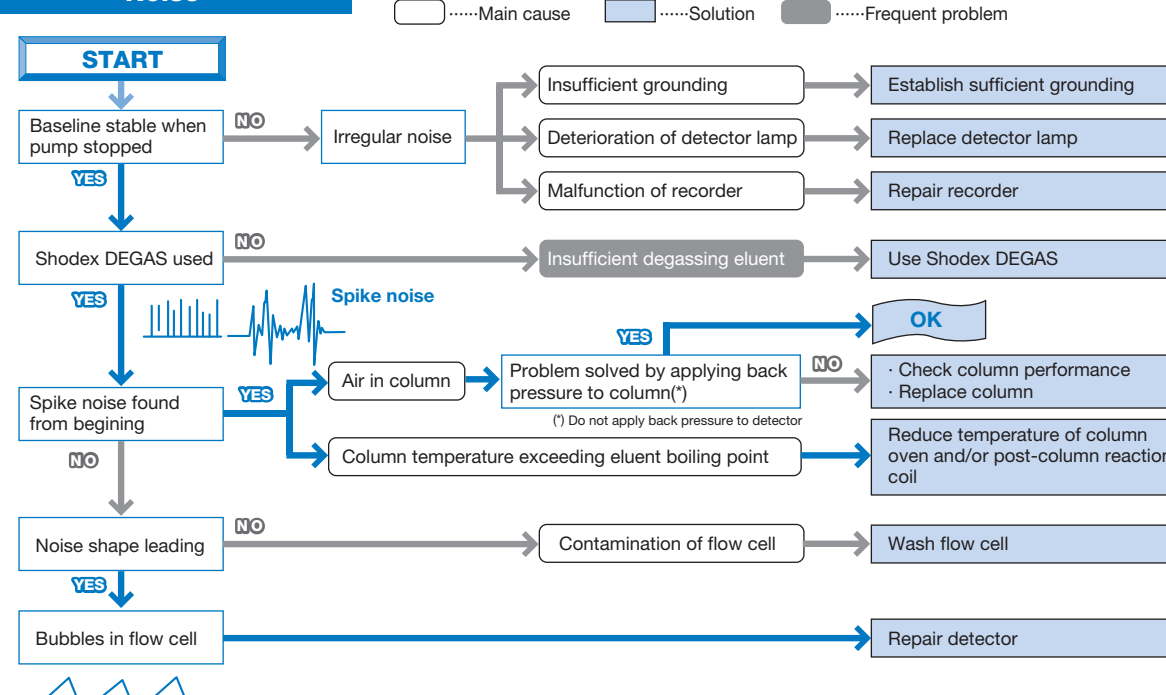
Common causes for abnormal chromatograms



Pressure elevation



Noise



Index by Product Name

Columns are listed in alphabetical order under the product name excluding series name.

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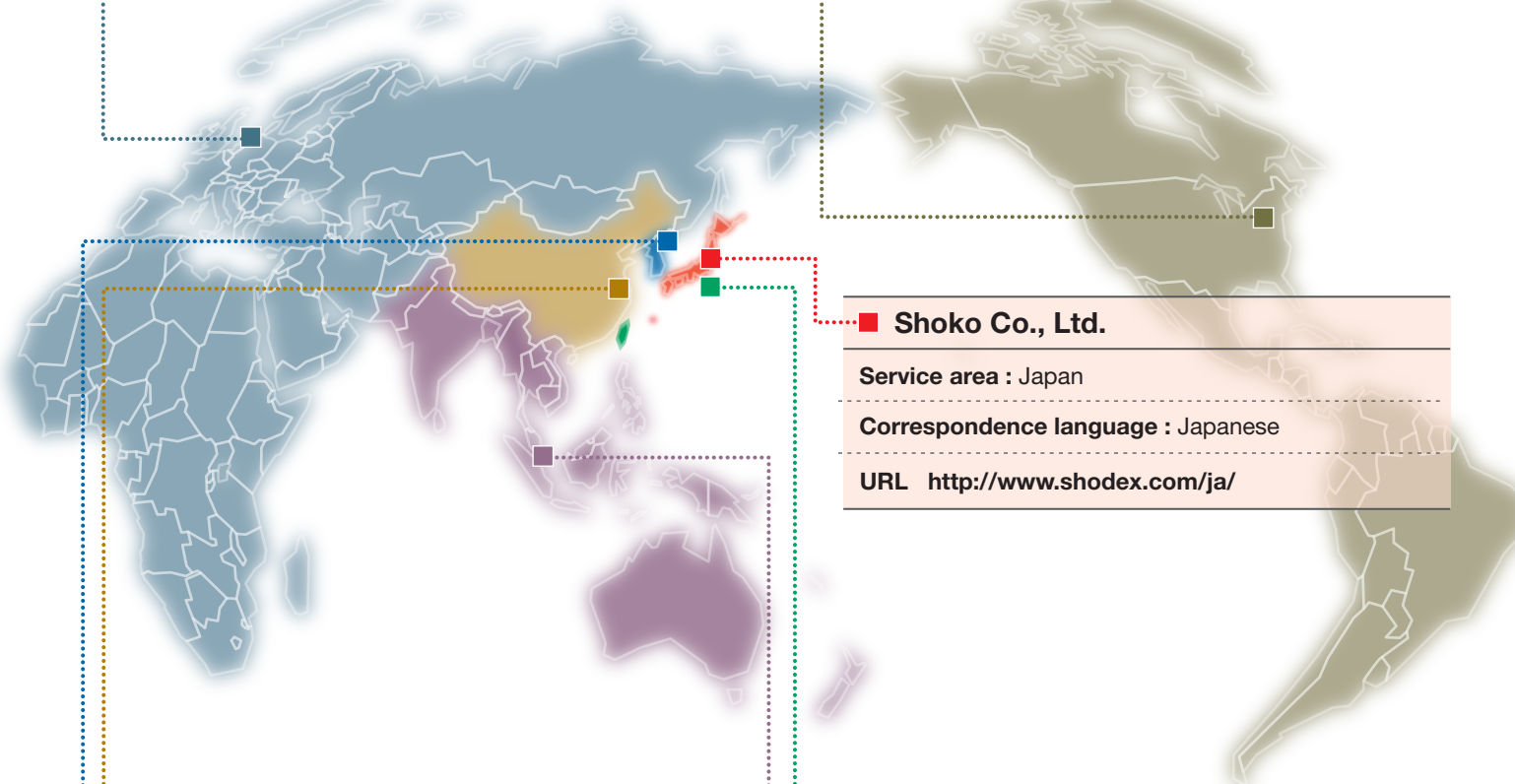
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