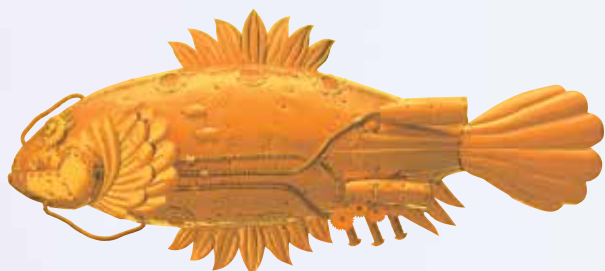
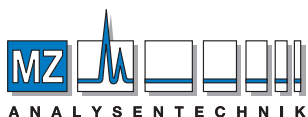


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[Caution]

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-40, ODP-50, ODP-90	Polyvinyl alcohol	Octadecyl	10
	Asahipak	C8P-50	Polyvinyl alcohol	Octyl	10
	Asahipak	C4P-50	Polyvinyl alcohol	Butyl	10
	RSpak	RP18-415, DS-613, DS-413	Styrene divinylbenzene copolymer	—	12
	RSpak	DE-613, DE-413, DE-213	Polymethacrylate	—	12
	RSpak	DM-614	Polyhydroxymethacrylate	—	12
	RSpak	NN-814, NN-614, NN-414	Polyhydroxymethacrylate	Sulfo	13
	RSpak	JJ-50	Polyvinyl alcohol	Quaternary ammonium	13
	HILICpak	VG-50	Polyvinyl alcohol	Amino	16
	HILICpak	VT-50	Polyvinyl alcohol	Quaternary ammonium	16
	HILICpak	VC-50	Polyvinyl alcohol	Carboxyl	16
	HILICpak	VN-50	Polyvinyl alcohol	Diol	16
	Asahipak	NH2P-40, NH2P-50, NH2P-90	Polyvinyl alcohol	Amino	20
		ET-RP1	Polyvinyl alcohol	Octadecyl	74
Reversed Phase, Normal Phase & HILIC (Silica-based)		C18	Silica	Octadecyl	22
	Silica	C18M, C18P	Silica	Octadecyl	22
	Silica	5C8	Silica	Octyl	22
	Silica	5CN	Silica	Cyanopropyl	22
	Silica	5NPE	Silica	Nitrophenylethyl	22
		C18U	Organic/inorganic hybrid silica	Octadecyl	23
	Silica	5SIL	Silica	—	23
	Silica	5NH	Silica	Aminopropyl	23
Ligand Exchange	SUGAR	SC1011, SC1821, SC1211	Styrene divinylbenzene copolymer	Sulfo (Ca ²⁺)	26
	SUGAR	SP0810	Styrene divinylbenzene copolymer	Sulfo (Pb ²⁺)	26
	SUGAR	KS-800	Styrene divinylbenzene copolymer	Sulfo (Na ⁺)	26
	SUGAR	KS-2000	Styrene divinylbenzene copolymer	Sulfo (Na ⁺)	27
	RSpak	DC-613	Styrene divinylbenzene copolymer	Sulfo (Na ⁺)	26
	SUGAR	SZ5532	Styrene divinylbenzene copolymer	Sulfo (Zn ²⁺)	26
	EP	SC1011-7F	Styrene divinylbenzene copolymer	Sulfo (Ca ²⁺)	27
USPpak	MN-431	Styrene divinylbenzene copolymer	Sulfo (Ca ²⁺)	27	
Ion Exclusion	SUGAR	SH1011, SH1821	Styrene divinylbenzene copolymer	Sulfo	30
	RSpak	KC-811	Styrene divinylbenzene copolymer	Sulfo	30
Ion Chromatography	IC	NI-424, I-524A	Polyhydroxymethacrylate	Quaternary ammonium	32
	IC	SI-90, SI-50, SI-52, SI-35, SI-36	Polyvinyl alcohol	Quaternary ammonium	32
	IC	YS-50	Polyvinyl alcohol	Carboxyl	34
	IC	YK-421	Silica	Carboxyl	34
	IC	Y-521, T-521	Styrene divinylbenzene copolymer	Sulfo	34
Aqueous SEC (GFC)	PROTEIN	KW-800	Silica	Hydrophilic polymer	38
		KW400	Silica	Hydrophilic polymer	38
	PROTEIN	KW-2000	Silica	Hydrophilic polymer	39
	PROTEIN	LW-803, LW-403 4D	Silica	Hydrophilic polymer	39
	OHpak	SB-800 HQ	Polyhydroxymethacrylate	—	42
	OHpak	SB-2000	Polyhydroxymethacrylate	—	43
OHpak	LB-800	Polyhydroxymethacrylate	—	42	
Multimode	Asahipak	GS-HQ	Polyvinyl alcohol	—	46
Aqueous/Organic SEC	Asahipak	GF-HQ	Polyvinyl alcohol	—	48
	MSPak	GF-310	Polyvinyl alcohol	—	48
Organic SEC (GPC)	GPC	KF-800, KF-2000, K-800, K-2000, KD-800, KF-600, KF-400HQ, HK-400, LF, HT-800, UT-800, AT-806MS, HFIP-800, HFIP-600, FP-2002, H-2000, KF-5000, K-5000	Styrene divinylbenzene copolymer	—	50 - 67
Ion Exchange	IEC	QA-825, QA-2025	Polyhydroxymethacrylate	Quaternary ammonium	70
	IEC	DEAE-825, DEAE-2025	Polyhydroxymethacrylate	Diethylaminoethyl	70
	Asahipak	ES-502N	Polyvinyl alcohol	Diethylaminoethyl	70
	AXpak	WA-624	Polyhydroxymethacrylate	Diethylaminoethyl	70
	IEC	SP-825, SP-2025	Polyhydroxymethacrylate	Sulfopropyl	72
	IEC	SP-FT 4A	Polyhydroxymethacrylate	Sulfopropyl	72
	IEC	CM-825, CM-2025	Polyhydroxymethacrylate	Carboxymethyl	72
	Asahipak	ES-502C	Polyvinyl alcohol	Carboxymethyl	72
CXpak	P-421S	Styrene divinylbenzene copolymer	Sulfo (Na ⁺)	72	
Hydrophobic Interaction	HIC	PH-814	Polyhydroxymethacrylate	Phenyl	74
Affinity	AFpak	APA-894	Polyhydroxymethacrylate	Protein A	74
	AFpak	ACH-494	Polyhydroxymethacrylate	Choline oxydase, Acetylcholine esterase	74
Chiral Separation	ORpak	CDBS-453	Silica	β-Cyclodextrin derivative	74
	ORpak	CRX-853	Polyhydroxymethacrylate	L-Amino acid derivative	74
Column Switching Pretreatment	MSPak	GF-4A	Polyvinyl alcohol	—	74
GPC Clean-up	CLNpak	EV	Styrene divinylbenzene copolymer	—	76
	CLNpak	PAE	Polyvinyl alcohol	—	76

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)	<ul style="list-style-type: none"> 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). Use of lower polarity mobile phases fasten the elution.
Hydrophilic Interaction Chromatography (HILIC)	<ul style="list-style-type: none"> 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)	<ul style="list-style-type: none"> 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)	<ul style="list-style-type: none"> 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)	<ul style="list-style-type: none"> 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)	<ul style="list-style-type: none"> Separation is based on electrostatic interaction (bonding) between the ion exchanger and ionic solutes. Electrical conductivity detector can be used with a mobile phase with low-salt concentration. Used mainly for the analysis of inorganic compounds.
Size Exclusion Chromatography (SEC)	<ul style="list-style-type: none"> 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 compounds 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)	<ul style="list-style-type: none"> 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)	<ul style="list-style-type: none"> 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)	<ul style="list-style-type: none"> 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 biologically active substances.
Chiral Separation Chromatography (CS)	<ul style="list-style-type: none"> Separation of optical isomers using chiral selectors. Highly selective.
Multimode Chromatography	<ul style="list-style-type: none"> 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			
	≤ 2,000	RPC		≤ 2,000	SEC
		HILIC			
		LEX			
		IEX			PRC
		IC			
		SEC			
		IEC			
AFC	NPC				
CS					

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, 22
		HILIC	16, 20
	Hydrophilic substances	IEC + RPC	12
		LEX + SEC	26, 27
	Substances in bio-fluid (serum-plasma-urine)	RPC	8
		SEC + RPC	46, 48
Polymer	SEC	38, 42, 48, 54, 60	
Moisturizers	Polyalcohols	RPC	12
		LEX + SEC	26
		LEX + HILIC	26
		SEC	42, 48
	Protein hydrolysates	RPC	10, 12, 23
		SEC	38, 39
Mucopolysaccharides	SEC	42	
Emulsifiers	Surfactants	RPC	8
		SEC + RPC	48
		SEC	50, 56, 58
Preservatives	Paraben Dehydroacetic acid	RPC	10, 12, 22, 23
Optical active materials		CS	74

Foods

		Separation Mode	Page
Nutritional ingredients	Monosaccharides Disaccharides Sugar alcohols	HILIC	16, 20
		LEX + SEC	26
		LEX + HILIC	26
	Oligosaccharides	HILIC	16, 20
		LEX + HILIC	26
		SEC	26, 42, 46
	Low molecular weight water-soluble dietary fiber	SEC	46
	Polysaccharides	SEC	26, 42
	Organic acids	RPC	8, 12
		IEC + RPC	30
		IC	32
	Water-soluble vitamins	RPC	8, 10, 12, 14
		IEC + RPC	12
		HILIC	16, 20
	Fat-soluble vitamins	RPC	10
NPC		23	
SEC		50, 54	
Fatty acids	RPC	12, 22	
	SEC	48, 50, 52, 54	
Nucleic acids (umami)	IEC+SEC	46	
Amino acids	IEC + IEX + RPC	12	
	HILIC	16	
	IC	34	
	IEC	72	
Food safety	Food additives	RPC	10, 12, 74
		HILIC	16, 20
	Pesticides	RPC	12, 22, 23
		IEC + RPC	12
		HILIC	16
	Mycotoxin	IC	32
		RPC	22, 23
Pretreatment of residual pesticides	SEC GPC (clean-up)	76	

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

New Materials

		Separation Mode	Page
Synthetic polymers	Organic solvent soluble	SEC	48, 50, 52, 54, 56, 58, 60
	Polar organic solvent soluble		42, 48, 54, 56, 58, 60
	High temperature/ Ultra high temperature		62
	Water-soluble		38, 42, 46, 48
Additives Oligomers		RPC	10, 12, 22, 23
	Organic solvent soluble	SEC	48, 50, 52, 56, 58
	Polar organic solvent soluble		42, 48, 54, 56, 58
	Water-soluble		38, 42, 46, 48

Biotechnology

		Separation Mode	Page	
Genomics	Nucleobases Nucleotides Nucleosides	RPC	12	
		IEC + SEC	12, 46	
		IEC	70	
	Oligo nucleic acids	HILIC	16	
		RPC	12	
		IEC + SEC	46	
		IEC	70	
	DNA/RNA	SEC	42, 46	
	Proteomics	Amino acids	RPC	10
			IEC + IEX + RPC	12
HILIC			16	
IEC			72	
IEC + SEC			46	
Peptides Proteins		RPC	10, 12, 23	
		SEC	38, 42, 46, 48	
		IEC	70, 72	
		HIC	74	
Glycomics		Glycoproteins	RPC	10, 12
	SEC		38, 42, 46, 48	
	IEC		70, 72	
	HIC		74	
	Sugar chains	HILIC	16, 20	
	Monosaccharides	HILIC	16, 20	
		LEX + SEC	26	
		LEX + HILIC	26	
	Sialic acids Uronic acids Aldonic acids	IEX + RPC	30	
	Hormones	Amines	RPC	8, 10, 12
IEC			72	
Steroids		RPC	10	
		HILIC	16, 20	
		SEC	42, 48	
Lipids	Phospholipids	NPC	23	
		SEC	48, 50, 54	
	Lipoproteins	SEC	38, 42	

Environment

		Separation Mode	Page	
Water quality	Anions	IC	32	
	Oxyhalides	IC	32	
		IEC+HILIC	16	
	Cyanide Cyanogen chloride	IEX	30	
	Cations	IC	34	
	Surfactants	RPC	10, 22, 23	
		SEC+RPC	48	
	Pesticides	RPC	12, 22, 23	
		IEC+RPC	12	
		HILIC	16	
IC		32		
Soil	Anions	IC	32	
	Heavy metals	IC	34	
	Humic substances	SEC	42	
	Organic arsenic	IEX+RPC	12	
	Pesticides	RPC	12, 22, 23	
		IEC+RPC	12	
		HILIC	16	
		IC	32	
	Environmental hormones	Pretreatment of Phthalates PCBs Benzo[a]pyrene	SEC GPC (clean-up)	76
	Bioethanols	Monosaccharides Oligosaccharides	HILIC	16, 20
LEX+SEC			26	
Oligosaccharides Alcohols Furfural		LEX+SEC	26	
Saccharides Organic acids Alcohols Furfural		IEX+RPC+SEC	30	
Hemicelluloses Celluloses		SEC	54, 62	
Biodiesels		Cations	IC	34
		Fatty acid glycerides	SEC	48
	Fatty acid methyl esters	RPC	12	
Organic acids	IC	32		

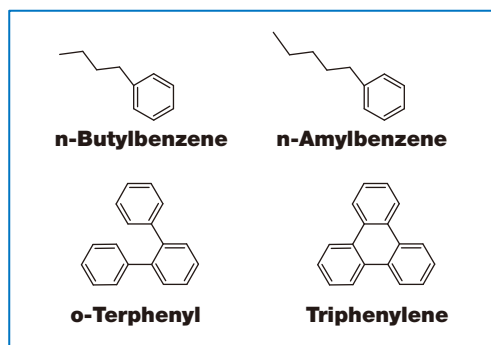
Comparison of Shodex Reversed Phase Chromatography (RPC) Column Features

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. Please use following descriptions about the column features as guidelines to select suitable columns for your application purposes.

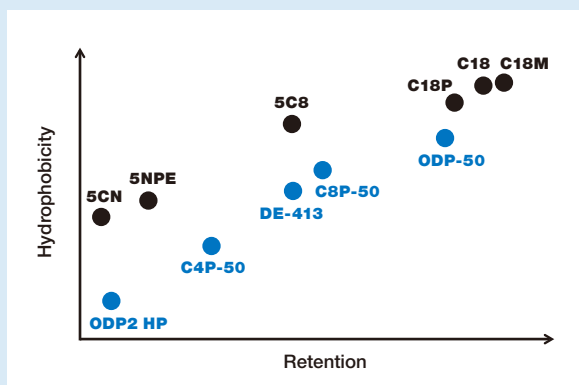
Features

ODP2 HP	<ul style="list-style-type: none"> Provides a large theoretical plate number nearly twice as much as generally available polymer-based reversed phase columns do 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 Fulfills USP L39 requirements
ODP-50	<ul style="list-style-type: none"> Relatively large pore size is suitable for the analysis of amino acids, peptides, and proteins
C8P-50	<ul style="list-style-type: none"> Usable in a wide pH range from pH 2 to 13
C4P-50	<ul style="list-style-type: none"> Usable in 100 % water and buffer solution Best used for the analysis of basic substances ODP-50 fulfills USP L67 requirements
ODP-40	<ul style="list-style-type: none"> Higher performance type of ODP-50 series Fulfills USP L67 requirements
RP18-415	<ul style="list-style-type: none"> Large pore size is suitable for the analysis of proteins and peptides Fulfills USP L21 requirements
DS-613	<ul style="list-style-type: none"> Suitable for reversed phase analysis of highly hydrophilic substances that are not well retained by ODS columns
DS-413	<ul style="list-style-type: none"> Fulfill USP L21 requirements
DE-613	<ul style="list-style-type: none"> General purpose polymer-based column having similar polarity as ODS columns
DE-413	<ul style="list-style-type: none"> Wide working pH range (from pH 2 to 12), usable in 100 % water and buffer solutions
DE-213	<ul style="list-style-type: none"> Fulfill USP L71 requirements
DM-614	<ul style="list-style-type: none"> Suitable for the analysis of amino acids and water-soluble vitamins Fulfills USP L39 requirements
NN-814	<ul style="list-style-type: none"> The packing material modified with sulfo groups supports multimode (reversed phase and cation exchange) analysis
NN-614	<ul style="list-style-type: none"> Ideal for the analysis of complex samples containing neutral and ionic substances
NN-414	<ul style="list-style-type: none"> Ideal for the analysis of complex samples containing neutral and ionic substances
JJ-50	<ul style="list-style-type: none"> The packing material is modified with 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
C18	<ul style="list-style-type: none"> Fully end capped ODS column available at very reasonable price Fulfills USP L1 requirements
C18M	<ul style="list-style-type: none"> Monomeric type ODS column, fully end capped high purity silica (99.99 % or higher) Fulfills USP L1 requirements
C18P	<ul style="list-style-type: none"> 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 Fulfills USP L1 requirements
New C18U	<ul style="list-style-type: none"> UHPLC column (Maximum pressure: 100 MPa) Achieves high performance analysis with sub-2 μm particles Organic/inorganic silica hybrid particles provide excellent resolution and mechanical stability and improved alkali durability (from pH 1 to 12) Usable in 100 % water and buffer solution Fulfills USP L1 requirements
5C8	<ul style="list-style-type: none"> Use when the retention capacity of C18 is too strong Rapid mass transfer and fast equilibration allow its use as an ion-pair chromatography Fulfills USP L7 requirements
5CN	<ul style="list-style-type: none"> Utilizes reversed phase interaction and π-electron interaction to separate regioisomers, which typically cannot be separated with ODS or C8 columns Fulfills USP L10 requirements
5NPE	<ul style="list-style-type: none"> Utilizes several types of interactions based on π-electrons to separate structural isomers

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-amylbenzene 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.

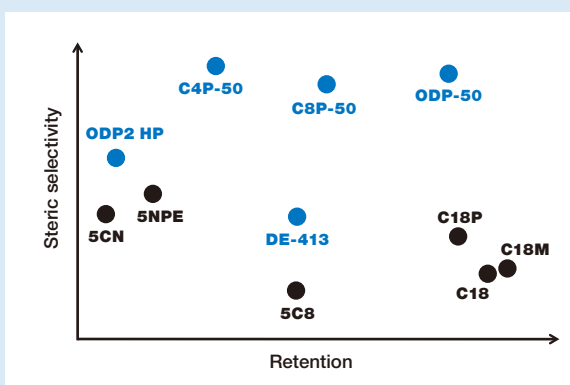


Hydrophobicity differences among Shodex RPCs



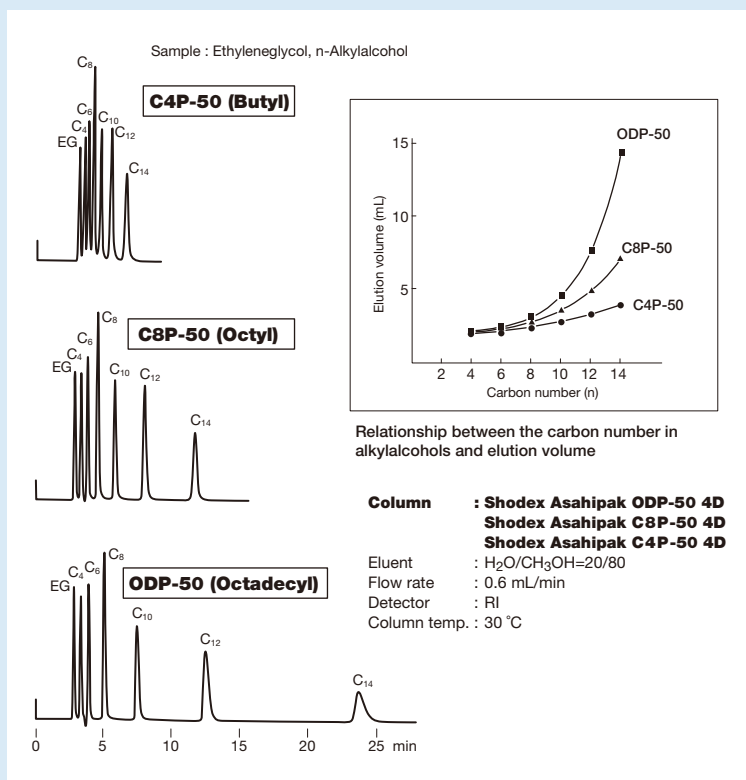
Column size : 4.6 mm I.D. x 150 mm each
 Eluent : H₂O/CH₃OH=20/80
 Flow rate : 1.0 mL/min
 Detector : UV (254 nm)
 Column temp. : 40 °C

Steric selectivity differences among Shodex RPCs

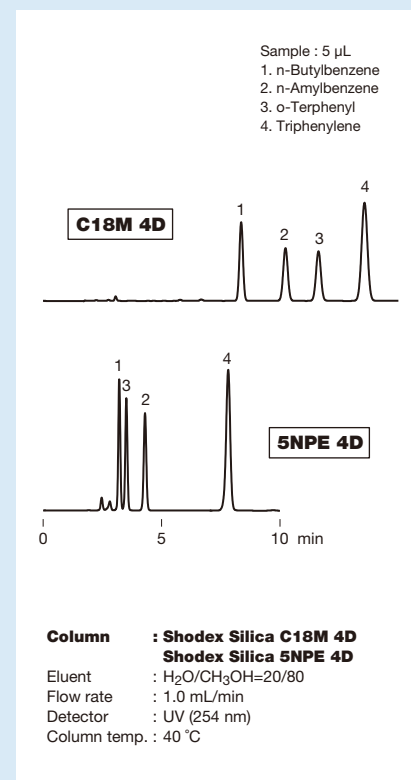


Column size : 4.6 mm I.D. x 150 mm each
 Eluent : H₂O/CH₃OH=20/80
 Flow rate : 1.0 mL/min
 Detector : UV (254 nm)
 Column temp. : 40 °C

Comparison of different functional groups on the separation of alkylalcohols



Effects of steric selectivity differences



Polymer-based Reversed Phase Chromatography Columns (ODP2 HP)

Please refer to “Comparison of Shodex Reversed Phase Chromatography (RPC) Column Features” 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 x 50	H ₂ O/CH ₃ CN=55/45
F7622002	ODP2 HP-4D	≥ 13,000	-	5	40	4.6 x 150	H ₂ O/CH ₃ CN=55/45
F7622003	ODP2 HP-4E	≥ 17,000	-	5	40	4.6 x 250	H ₂ O/CH ₃ CN=55/45
F6714010	ODP2 HPG-4A	(guard column)	-	5	-	4.6 x 10	H ₂ O/CH ₃ CN=55/45

Base Material: Polyhydroxymethacrylate

● Semi-micro 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
F7622004	ODP2 HP-2B	≥ 3,000	-	5	40	2.0 x 50	H ₂ O/CH ₃ CN=55/45
F7622005	ODP2 HP-2D	≥ 7,000	-	5	40	2.0 x 150	H ₂ O/CH ₃ CN=55/45
F6714011	ODP2 HPG-2A	(guard column)	-	5	-	2.0 x 10	H ₂ O/CH ₃ CN=55/45

Base Material: Polyhydroxymethacrylate

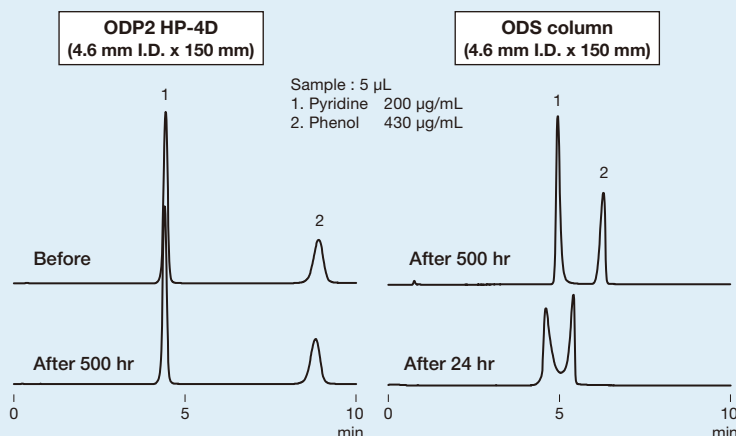
● Preparative columns [Preparative columns are made to order]

Product Code	Product Name	Plate Number (TP/column)	Particle Size (μm)	Column Size (mm) I.D. x Length	Standard Column
F6822001	ODP2 HP-10E	≥ 9,500	6	10.0 x 250	ODP2 HP
F6714015	ODP2 HPG-7B	(guard column)	6	7.5 x 50	(guard column)

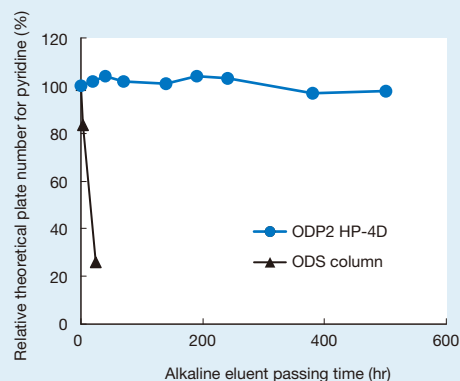
Base Material: Polyhydroxymethacrylate

● Comparison between ODP2 HP-4D and an ODS column for their alkaline tolerances

Chromatograms obtained before and after passing alkaline eluent



Correlation between alkaline eluent passing time and relative theoretical plate number

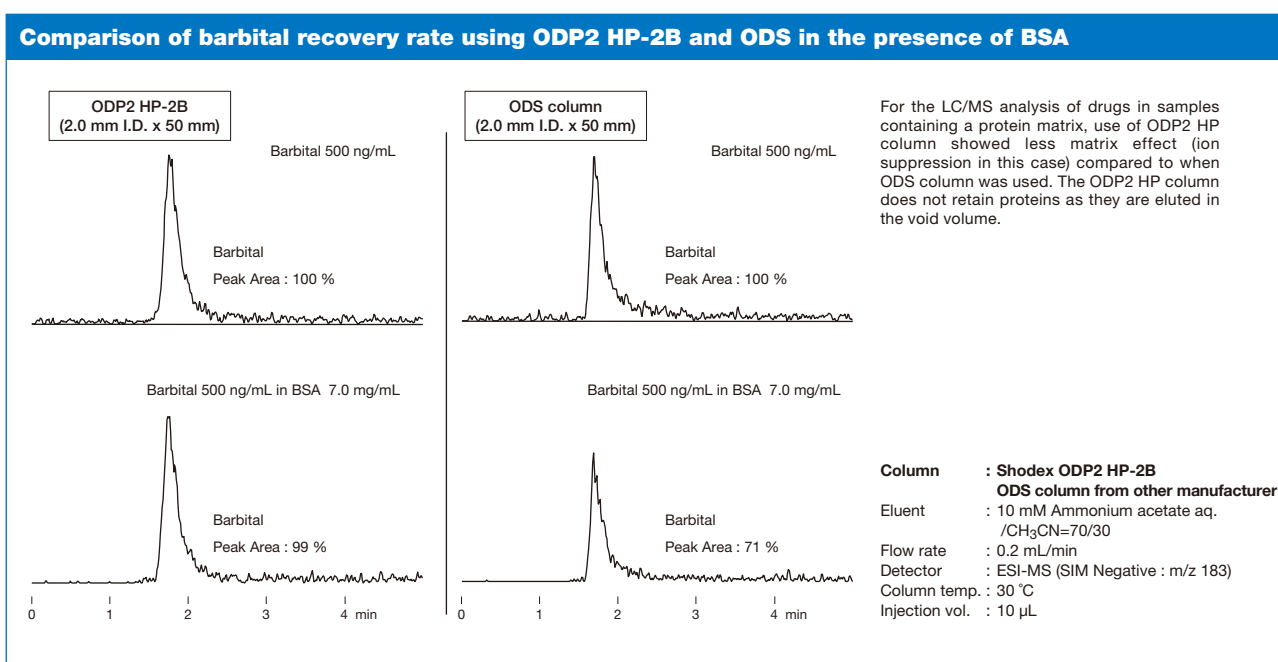
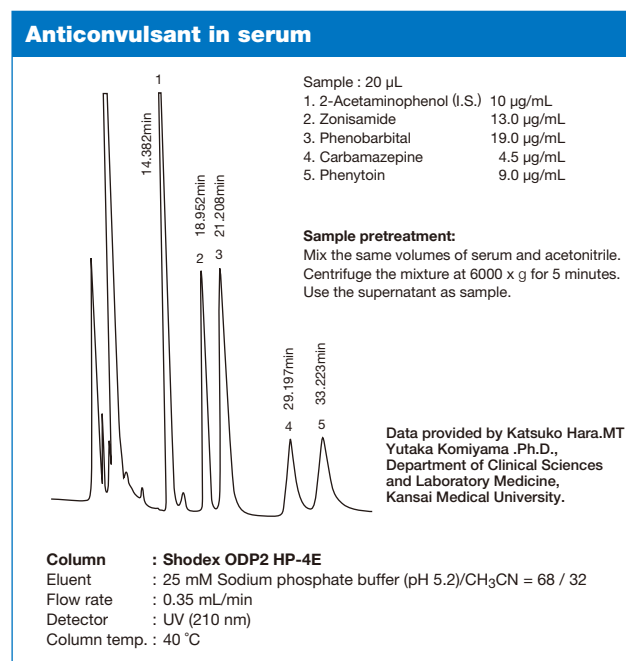
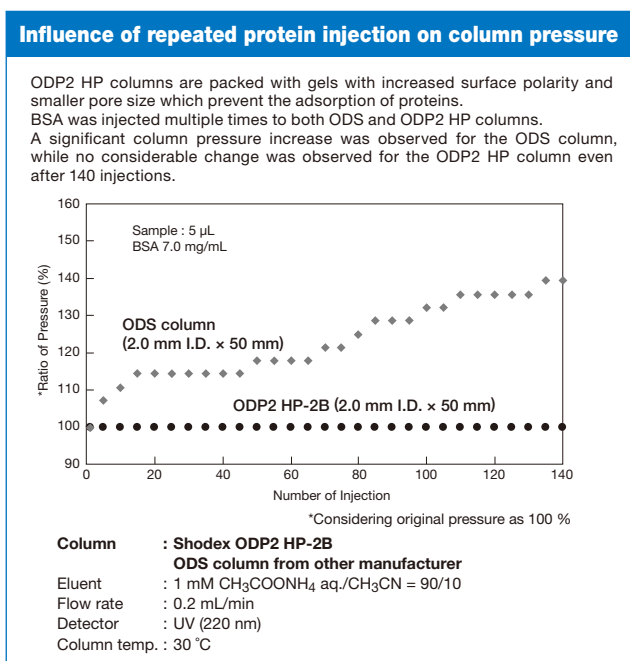
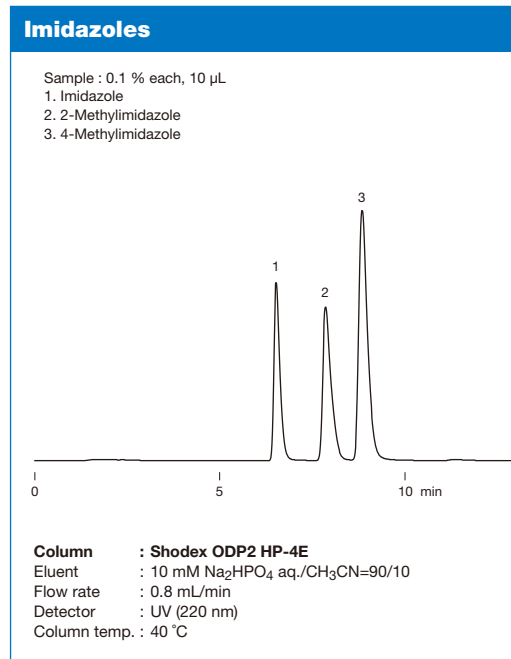
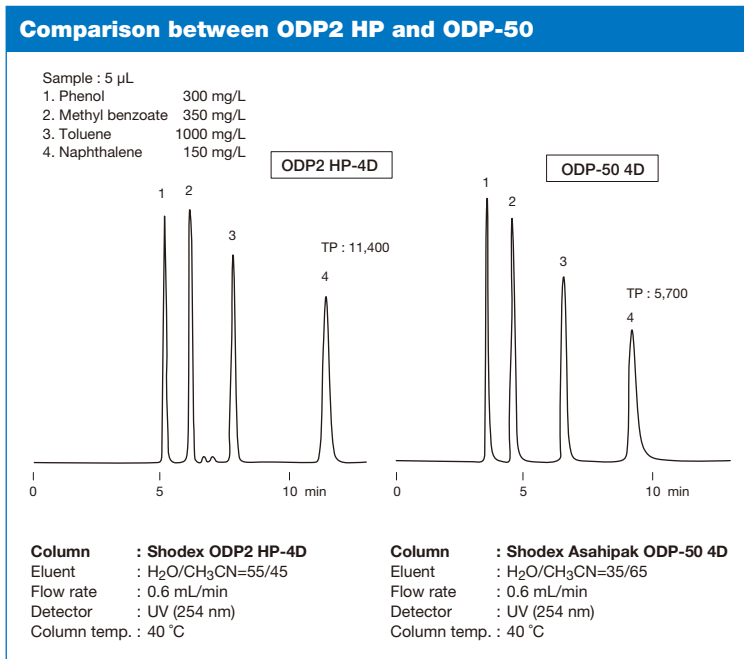


Analysis condition

Column : Shodex ODP2 HP-4D
 ODS column from other manufacturer
 Eluent : H₂O/CH₃OH=70/30
 Flow rate : 1.0 mL/min
 Detector : UV (254 nm)
 Column temp. : 40 °C

Eluent passing conditions for alkaline tolerance test

Column : Shodex ODP2 HP-4D
 ODS column from other manufacturer
 Eluent : 10 mM Sodium phosphate buffer (pH 12)
 /CH₃CN=45/55
 Flow rate : 0.6 mL/min
 Column temp. : 30 °C



Polymer-based Reversed Phase Chromatography Columns (Asahipak)

Please refer to “Comparison of Shodex Reversed Phase Chromatography (RPC) Column Features” 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 x 150	H ₂ O/CH ₃ CN=35/65
F7621002	Asahipak ODP-40 4E	≥ 17,000	Octadecyl	4	250	4.6 x 250	H ₂ O/CH ₃ CN=35/65
F7620002	Asahipak ODP-50 6D	≥ 9,000	Octadecyl	5	250	6.0 x 150	H ₂ O/CH ₃ CN=35/65
F7620001	Asahipak ODP-50 6E	≥ 14,000	Octadecyl	5	250	6.0 x 250	H ₂ O/CH ₃ CN=35/65
F6710001	Asahipak ODP-50G 6A	(guard column)	Octadecyl	5	–	6.0 x 10	H ₂ O/CH ₃ CN=35/65
F6710023	Asahipak ODP-50 4B	≥ 2,500	Octadecyl	5	250	4.6 x 50	H ₂ O/CH ₃ CN=35/65
F7620004	Asahipak ODP-50 4D	≥ 9,000	Octadecyl	5	250	4.6 x 150	H ₂ O/CH ₃ CN=35/65
F7620003	Asahipak ODP-50 4E	≥ 14,000	Octadecyl	5	250	4.6 x 250	H ₂ O/CH ₃ CN=35/65
F6710022	Asahipak ODP-50G 4A	(guard column)	Octadecyl	5	–	4.6 x 10	H ₂ O/CH ₃ CN=35/65
F7620006	Asahipak C8P-50 4D	≥ 7,000	Octyl	5	250	4.6 x 150	H ₂ O/CH ₃ CN=35/65
F7620005	Asahipak C8P-50 4E	≥ 11,000	Octyl	5	250	4.6 x 250	H ₂ O/CH ₃ CN=35/65
F6710002	Asahipak C8P-50G 4A	(guard column)	Octyl	5	–	4.6 x 10	H ₂ O/CH ₃ CN=35/65
F7620008	Asahipak C4P-50 4D	≥ 6,000	Butyl	5	250	4.6 x 150	H ₂ O/CH ₃ CN=35/65
F7620007	Asahipak C4P-50 4E	≥ 9,000	Butyl	5	250	4.6 x 250	H ₂ O/CH ₃ CN=35/65
F6710003	Asahipak C4P-50G 4A	(guard column)	Butyl	5	–	4.6 x 10	H ₂ O/CH ₃ CN=35/65

Base Material: Polyvinyl alcohol

● Semi-micro columns

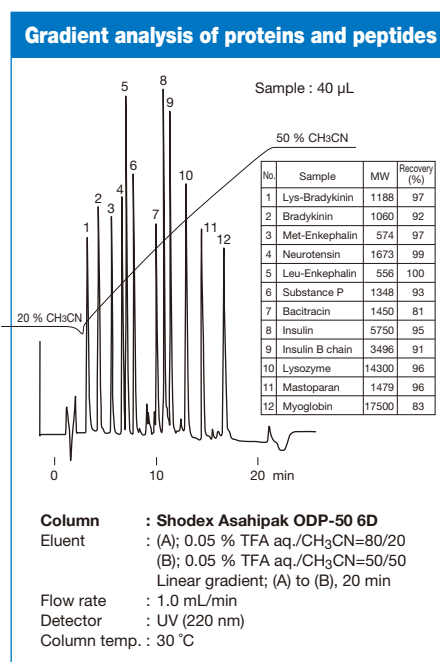
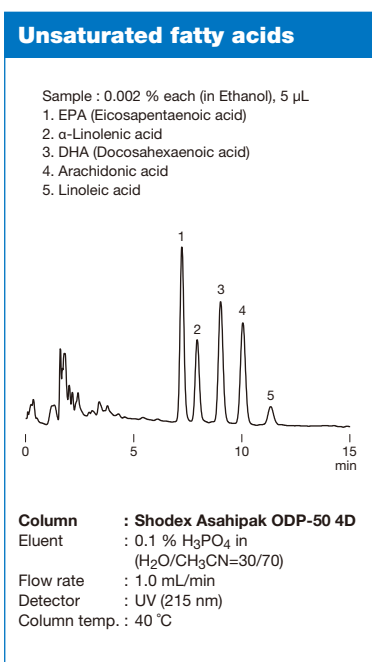
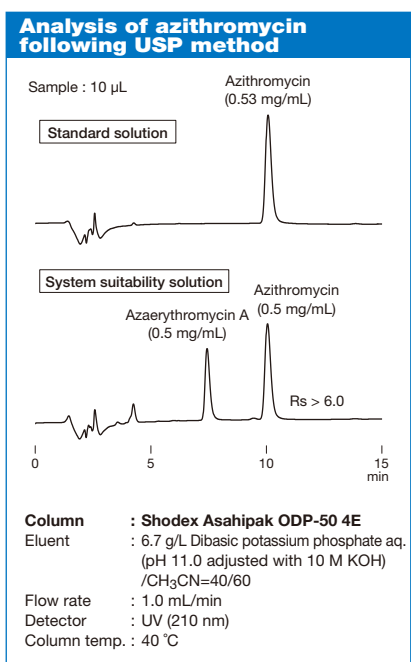
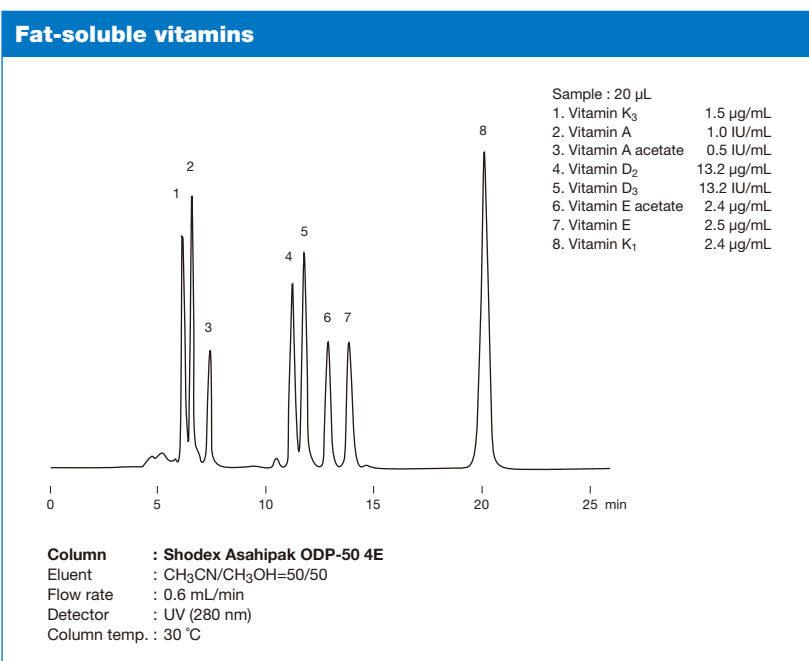
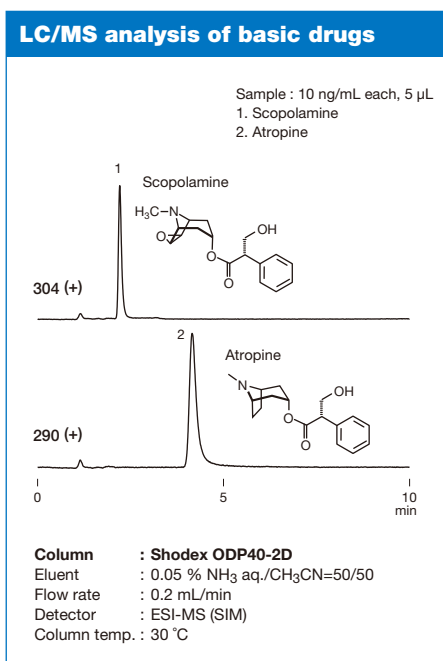
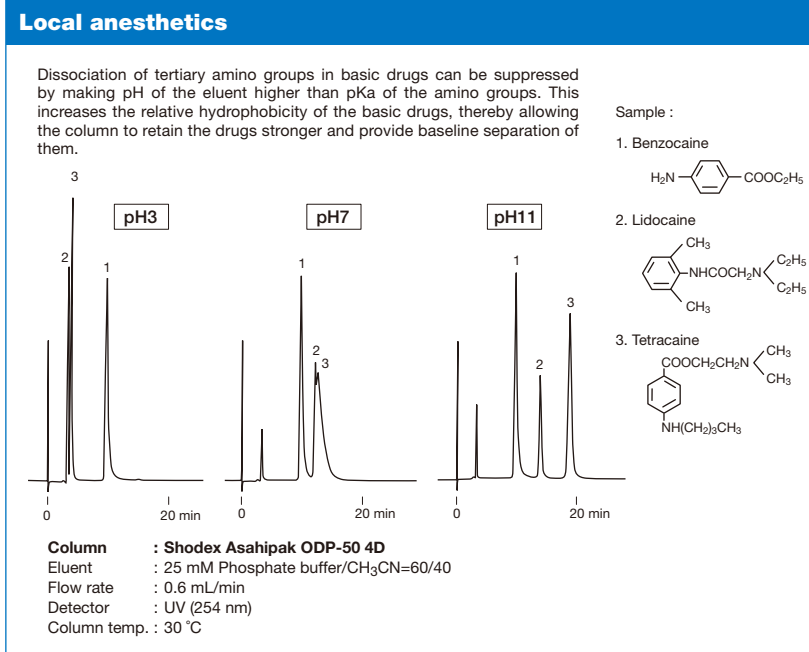
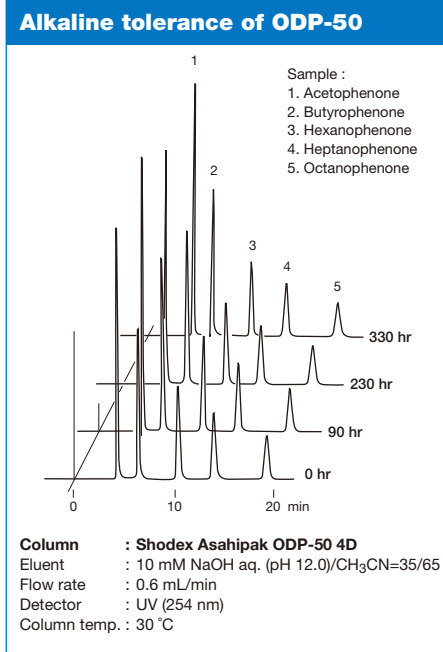
Product Code	Product Name	Plate Number (TP/column)	Functional Group	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length	Shipping Solvent
F7620009	Asahipak ODP-50 2D	≥ 5,000	Octadecyl	5	250	2.0 x 150	H ₂ O/CH ₃ CN=35/65
F6713001	Asahipak ODP-50G 2A	(guard column)	Octadecyl	5	–	2.0 x 10	H ₂ O/CH ₃ CN=35/65

Base Material: Polyvinyl alcohol

● 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 x 250	ODP-40, ODP-50
F6820035	Asahipak ODP-90 20F	≥ 9,000	9	20.0 x 300	ODP-40, ODP-50
F6710004	Asahipak ODP-130G 7B	(guard column)	13	7.5 x 50	(guard column)

Base Material: Polyvinyl alcohol



Polymer-based Reversed Phase Chromatography Columns (RSpak)

Please refer to “Comparison of Shodex Reversed Phase Chromatography (RPC) Column Features” on page 6 and 7 for features.

● Standard columns

Product Code	Product Name	Plate Number (TP/column)	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 x 150	H ₂ O/CH ₃ CN=5/95
F6709558	RSpak RP18-G	(guard column)	Styrene divinylbenzene copolymer	6	–	4.6 x 10	H ₂ O/CH ₃ CN/THF=40/30/30
F7001001	RSpak DS-613	≥ 6,500	Styrene divinylbenzene copolymer	6	200	6.0 x 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 x 150	H ₂ O/CH ₃ CN/THF=40/30/30
F6700140	RSpak DS-G	(guard column)	Styrene divinylbenzene copolymer	10	–	4.6 x 10	H ₂ O/CH ₃ CN/THF=30/40/30
F7001004	RSpak DE-613	≥ 7,000	Polymethacrylate	6	25	6.0 x 150	H ₂ O
F7001005	RSpak DE-413	≥ 11,000	Polymethacrylate	4	25	4.6 x 150	H ₂ O/CH ₃ CN=50/50
F7009030	RSpak DE-413L	≥ 17,000	Polymethacrylate	4	25	4.6 x 250	H ₂ O/CH ₃ CN=50/50
F6700150	RSpak DE-G 4A	(guard column)	Polymethacrylate	10	–	4.6 x 10	H ₂ O
F7001002	RSpak DM-614	≥ 4,500	Polyhydroxymethacrylate	10	200	6.0 x 150	5 mM H ₃ PO ₄ aq.
F6700160	RSpak DM-G 4A	(guard column)	Polyhydroxymethacrylate	12	–	4.6 x 10	5 mM H ₃ PO ₄ aq.

● Semi-micro columns

Product Code	Product Name	Plate Number (TP/column)	Base Material	Particle Size (µm)	Pore Size (Å)	Column Size (mm) I.D. x Length	Shipping Solvent
F7001007	RSpak DE-213	≥ 8,000	Polymethacrylate	4	25	2.0 x 150	H ₂ O/CH ₃ CN=50/50
F6700151	RSpak DE-G 2A	(guard column)	Polymethacrylate	6	–	2.0 x 10	H ₂ O/CH ₃ CN=50/50

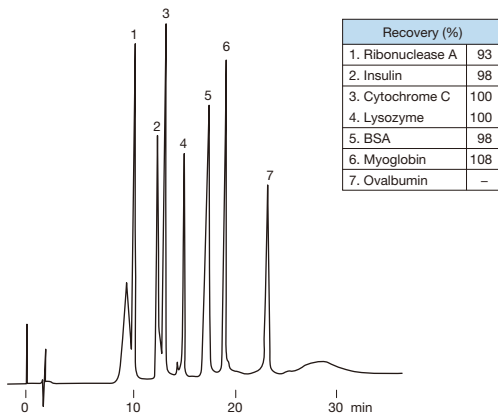
● Standard columns

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
F7008140	RSpak NN-814	≥ 9,000	Sulfo	Polyhydroxymethacrylate	10	200	8.0 x 250	0.1 M Sodium phosphate buffer (pH3.0)
F7008150	RSpak NN-614	≥ 4,000	Sulfo	Polyhydroxymethacrylate	10	200	6.0 x 150	0.1 M Sodium phosphate buffer (pH 3.0)
F6700510	RSpak NN-G	(guard column)	Sulfo	Polyhydroxymethacrylate	10	-	6.0 x 50	0.1 M Sodium phosphate buffer (pH 3.0)
F7008160	RSpak NN-414	≥ 6,000	Sulfo	Polyhydroxymethacrylate	10	200	4.6 x 150	0.1 M Sodium phosphate buffer (pH 3.0)
F7008240	RSpak JJ-50 4D	≥ 4,500	Quaternary ammonium	Polyvinyl alcohol	5	100	4.6 x 150	H ₂ O/CH ₃ CN=40/60

● Semi-micro columns

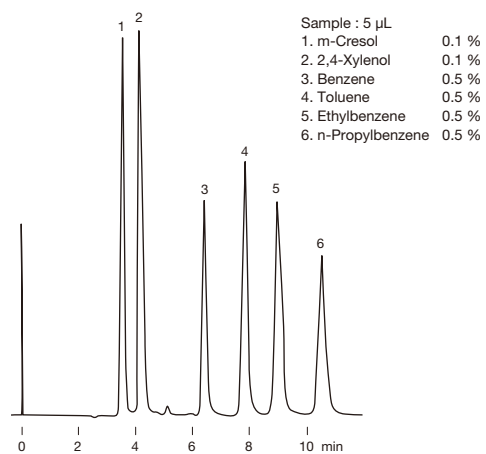
Product Code	Product Name	Plate Number (TP/column)	Functional Group	Base Material	Particle Size (µm)	Pore Size (Å)	Column Size (mm) I.D. x Length	Shipping Solvent
F7008220	RSpak JJ-50 2D	≥ 3,500	Quaternary ammonium	Polyvinyl alcohol	5	100	2.0 x 150	H ₂ O/CH ₃ CN=40/60

Separation and recovery rate of standard proteins



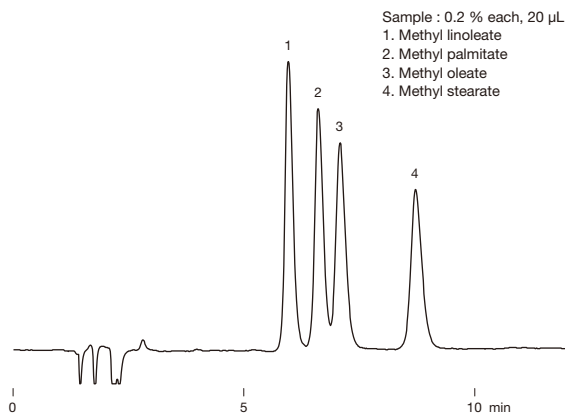
Column : Shodex RSpak RP18-415
Eluent : (A); 0.1 % TFA aq./CH₃CN=99/1
 (B); 0.1 % TFA aq./CH₃CN=5/95
 Linear gradient; (B %) 20 % to 60 %, 20 min
Flow rate : 1.0 mL/min
Detector : UV (220 nm)
Column temp. : Room temp.

Alkylbenzenes



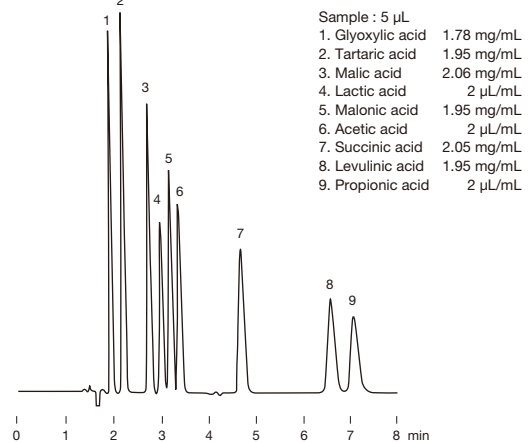
Column : Shodex RSpak DS-613
Eluent : H₂O/CH₃CN/THF=30/40/30
Flow rate : 1.0 mL/min
Detector : UV (254 nm)
Column temp. : 40 °C

Fatty acid methyl esters



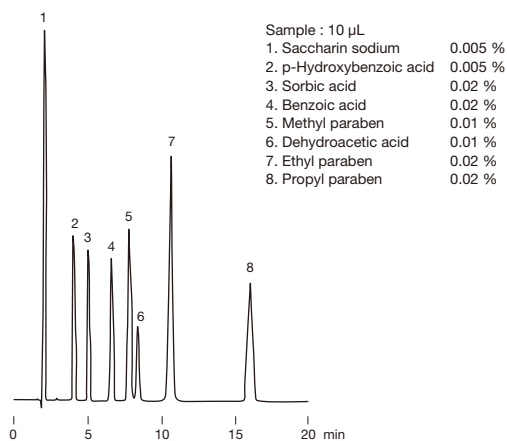
Column : Shodex RSpak DS-413
Eluent : H₂O/CH₃CN/THF=25/45/30
Flow rate : 1.0 mL/min
Detector : RI
Column temp. : 40 °C

Organic acids



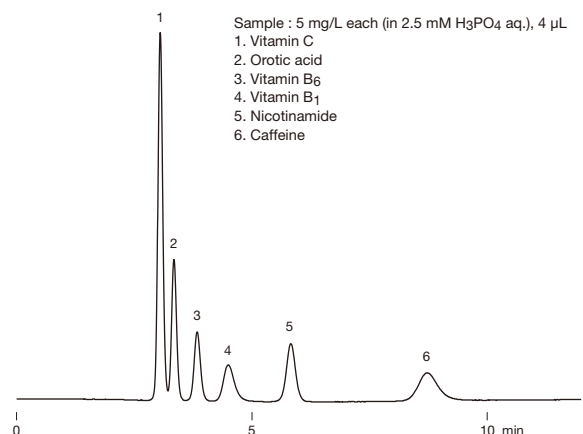
Column : Shodex RSpak DE-413
Eluent : 10 mM H₃PO₄ aq.
Flow rate : 1.0 mL/min
Detector : RI
Column temp. : 50 °C

Food additives (Preservatives)

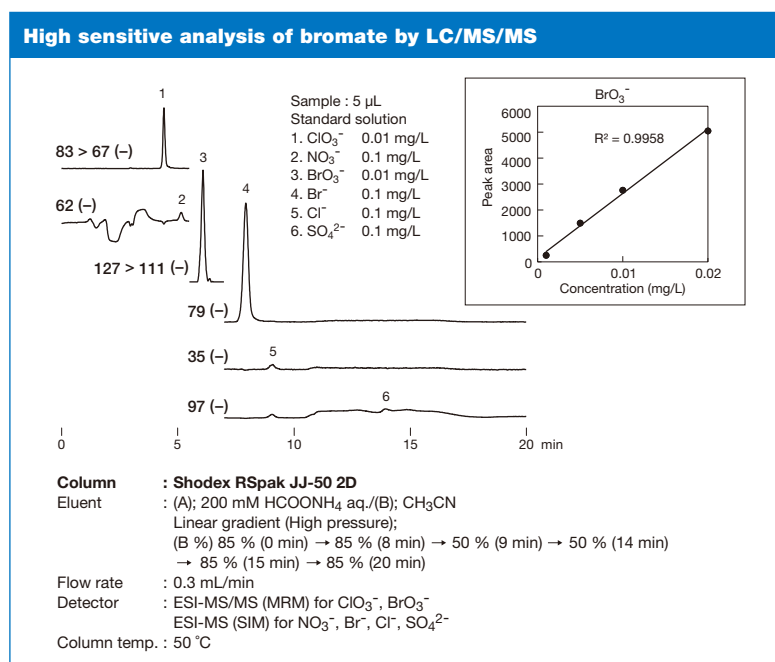
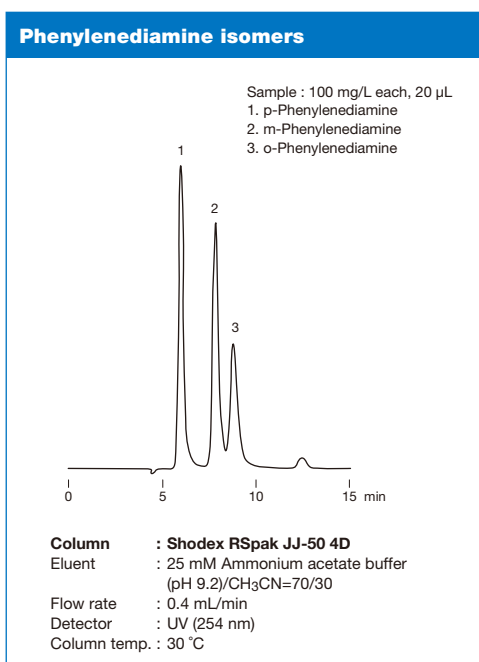
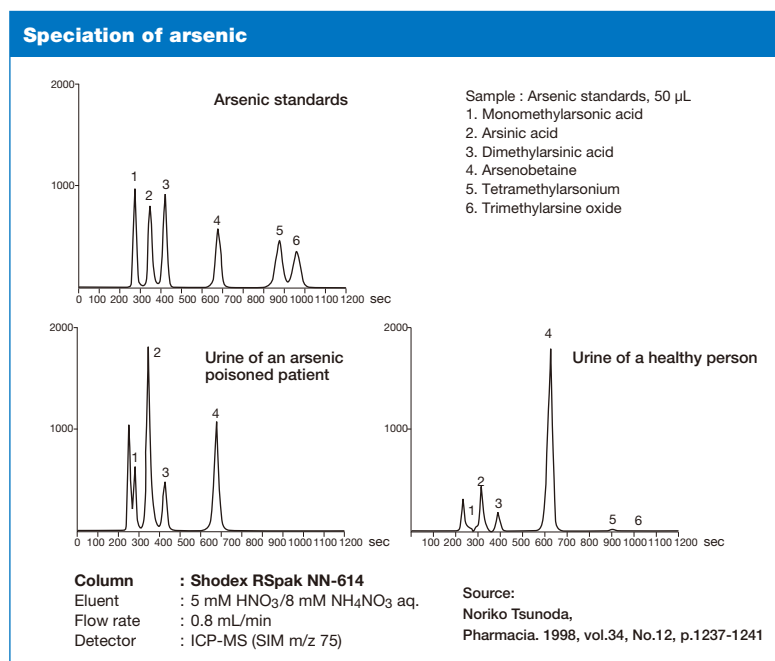
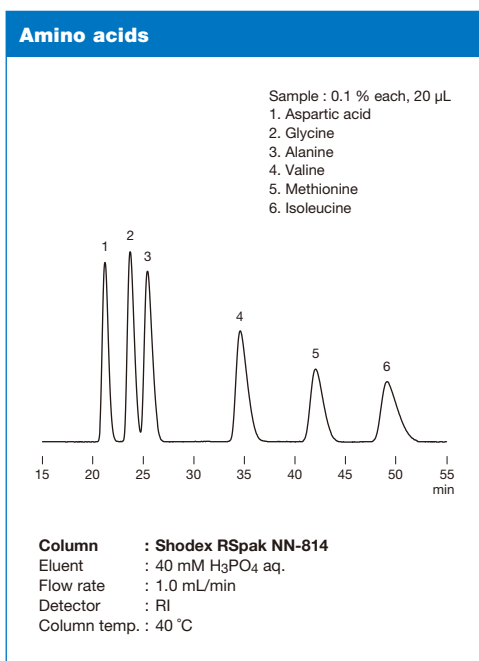
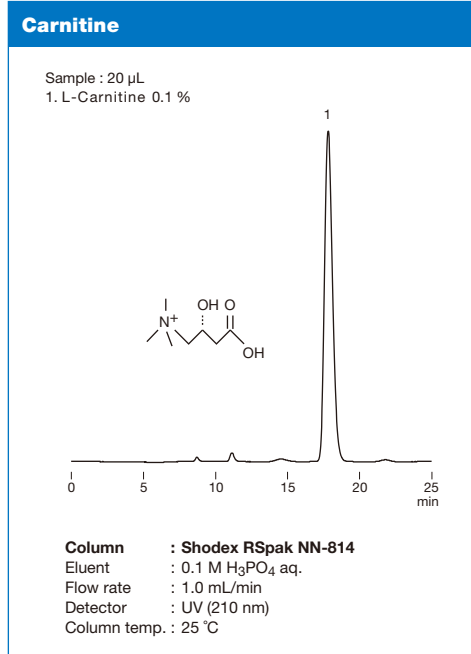
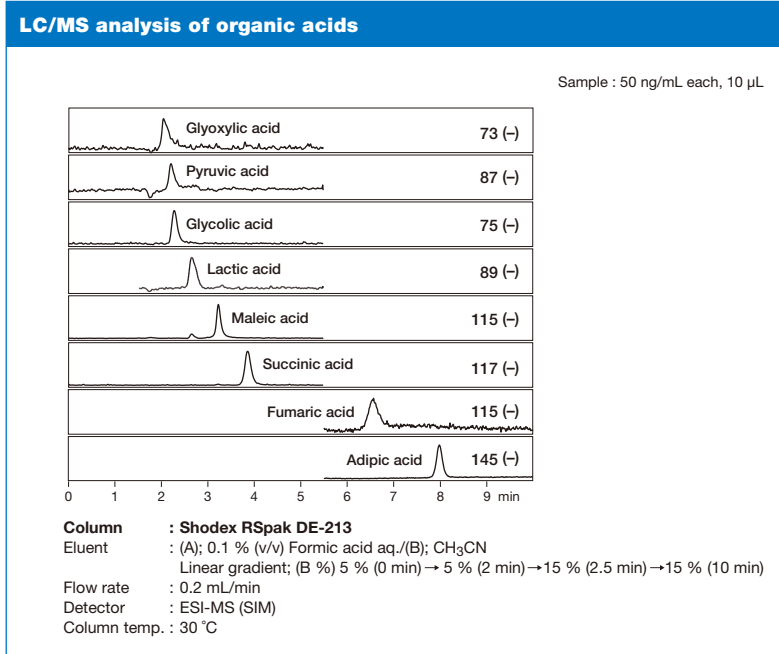


Column : Shodex RSpak DE-413
Eluent : 50 mM KH₂PO₄ + 0.1 % H₃PO₄ aq./CH₃CN
 =65/35
Flow rate : 1.0 mL/min
Detector : UV (210 nm)
Column temp. : 40 °C

Vitamins



Column : Shodex RSpak DM-614
Eluent : 0.055 M Na₂HPO₄ + 0.045 M KH₂PO₄ aq.
Flow rate : 1.0 mL/min
Detector : UV (254 nm)
Column temp. : 30 °C



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

Features

- VG-50**
- Suitable for saccharide analysis using HILIC mode
 - Recovers reducing saccharides with high ratio
 - Polymer-based packing material provides excellent chemical stability and minimum deterioration over an extended time period
 - Easily regenerated by washing in an alkaline solution
 - Appropriate for evaporative light scattering detector, corona charged aerosol detector, and LC/MS
- VT-50**
- Suitable for anionic substances (especially phosphate compounds) analysis using HILIC mode
 - Use of some eluents add ion exchange mode
 - Polymer-based packing material provides excellent chemical stability and minimum deterioration over an extended time period
 - Suitable for LC/MS analysis
- VC-50**
- Modified carboxyl group is suitable for cationic substance analysis including amines
 - The dominant separation mode is RP or IEX rather than HILIC mode
- VN-50**
- The modified diol groups on the packing material create the HILIC mode
 - Suitable for oligosaccharide and oligonucleotide separation which is not possible by SEC column or conventional HILIC columns

VG-50

● Standard columns (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	HILICpak VG-50 4D	≥ 5,500	Amino	5	100	4.6 x 150	H ₂ O/CH ₃ CN=20/80
F7630100	HILICpak VG-50 4E	≥ 7,500	Amino	5	100	4.6 x 250	H ₂ O/CH ₃ CN=20/80
F6711100	HILICpak VG-50G 4A	(guard column)	Amino	5	100	4.6 x 10	H ₂ O/CH ₃ CN=20/80

Base Material: Polyvinyl alcohol

● Semi-micro columns (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	HILICpak VG-50 2D	≥ 3,500	Amino	5	100	2.0 x 150	H ₂ O/CH ₃ CN=15/85
F6711200	HILICpak VG-50G 2A	(guard column)	Amino	5	100	2.0 x 10	H ₂ O/CH ₃ CN=15/85

Base Material: Polyvinyl alcohol

VT-50

● Semi-micro columns (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	HILICpak VT-50 2D	≥ 4,500	Quaternary ammonium	5	100	2.0 x 150	25 mM HCOONH ₄ aq./ CH ₃ CN=15/85
F6711300	HILICpak VT-50G 2A	(guard column)	Quaternary ammonium	5	100	2.0 x 10	25 mM HCOONH ₄ aq./ CH ₃ CN=15/85

Base Material: Polyvinyl alcohol

VC-50

● Semi-micro columns (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
F7630700	HILICpak VC-50 2D	≥ 3,500	Carboxyl	5	100	2.0 x 150	H ₂ O
F6711600	HILICpak VC-50G 2A	(guard column)	Carboxyl	5	100	2.0 x 10	H ₂ O

Base Material: Polyvinyl alcohol

VN-50

● Standard columns (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
F7630500	HILICpak VN-50 4D	≥ 10,000	Diol	5	100	4.6 x 150	H ₂ O/CH ₃ CN=25/75
F6711400	HILICpak VN-50G 4A	(guard column)	Diol	5	100	4.6 x 10	H ₂ O/CH ₃ CN=25/75

Base Material: Polyvinyl alcohol

● Semi-micro columns (Housing Material: PEEK)

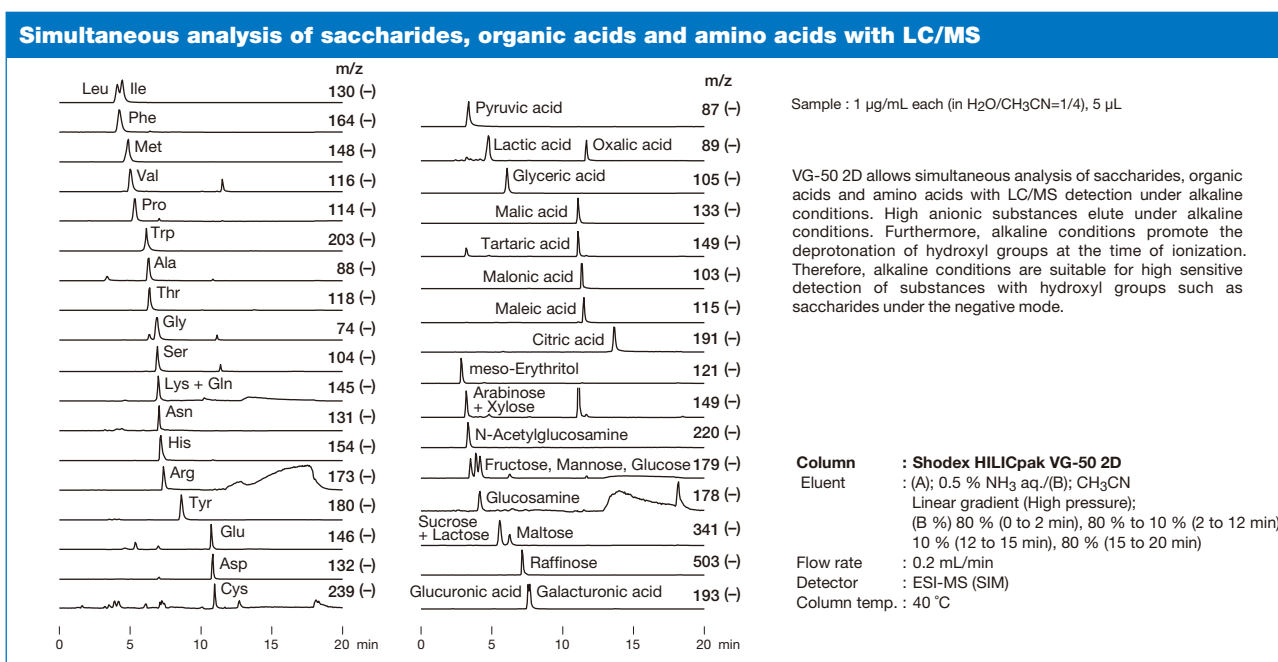
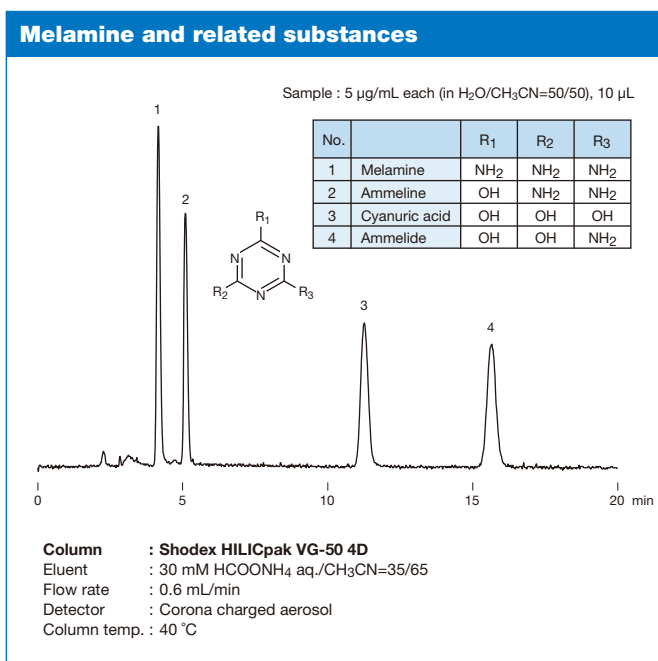
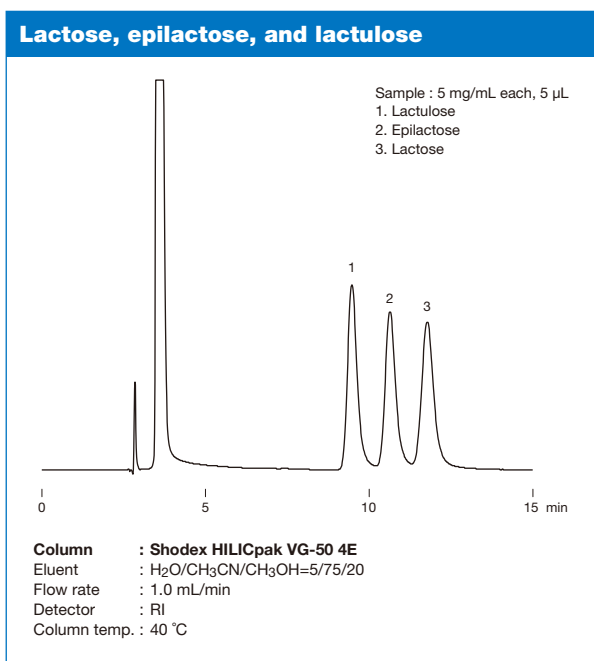
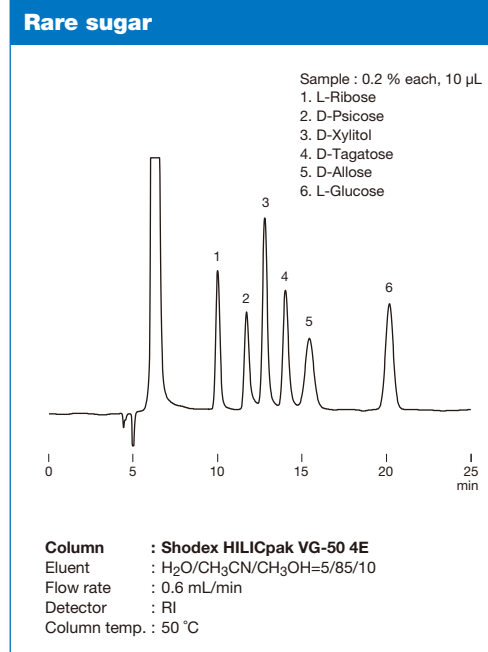
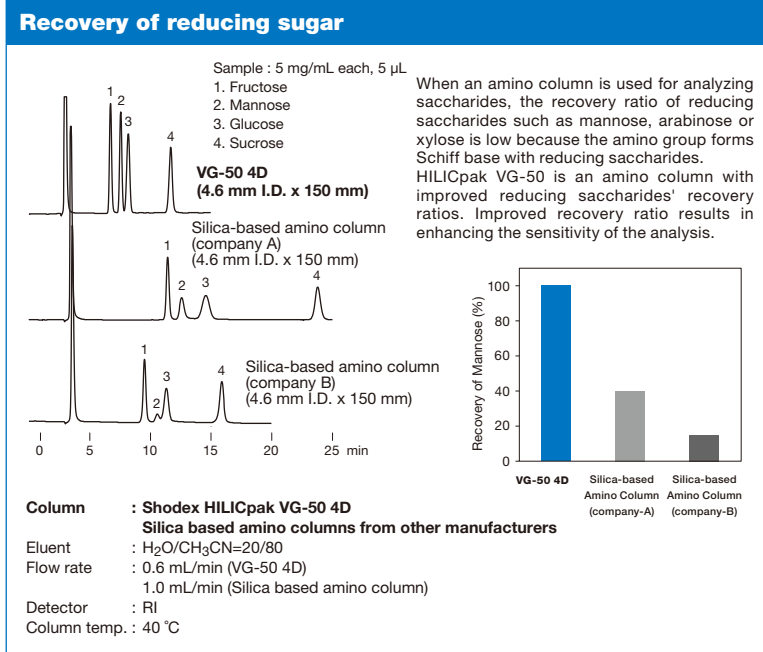
Product Code	Product Name	Plate Number (TP/column)	Functional Group	Particle Size (µm)	Pore Size (Å)	Column Size (mm) I.D. x Length	Shipping Solvent
F7630600	HILICpak VN-50 2D	≥ 3,500	Diol	5	100	2.0 x 150	H ₂ O/CH ₃ CN=25/75
F6711500	HILICpak VN-50G 2A	(guard column)	Diol	5	100	2.0 x 10	H ₂ O/CH ₃ CN=25/75

Base Material: Polyvinyl alcohol

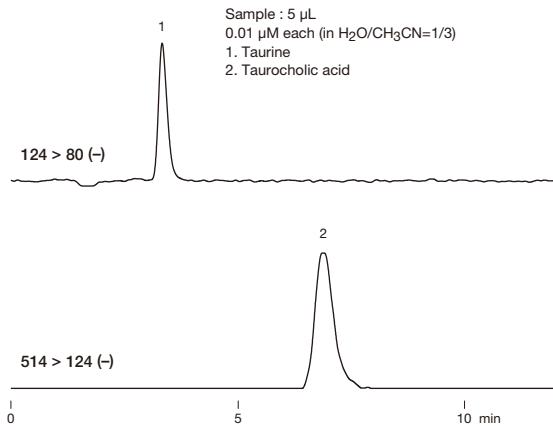
● Preparative columns (Housing Material: SUS) [Preparative columns are made to order.]

Product Code	Product Name	Plate Number (TP/column)	Particle Size (µm)	Column Size (mm) I.D. x Length	Standard Column
F6830100	HILICpak VN-50 10E	≥ 11,000	5	10.0 x 250	VN-50
F6711400	HILICpak VN-50G 4A	(guard column)	5	4.6 x 10	(guard column)

Base Material: Polyvinyl alcohol

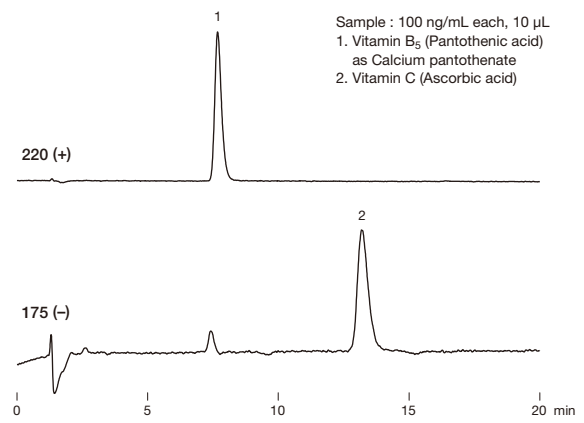


LC/MS/MS analysis of organic sulfonic acids



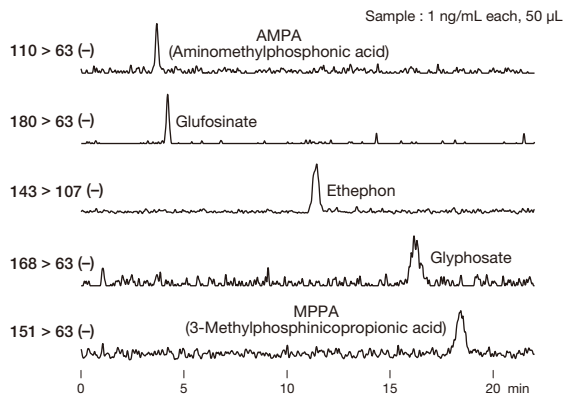
Column : Shodex HILICpak VT-50 2D
Eluent : 50 mM HCOONH₄ aq./CH₃CN=20/80
Flow rate : 0.3 mL/min
Detector : ESI-MS/MS (MRM)
Column temp. : 30 °C

LC/MS analysis of pantothenic acid and vitamin C



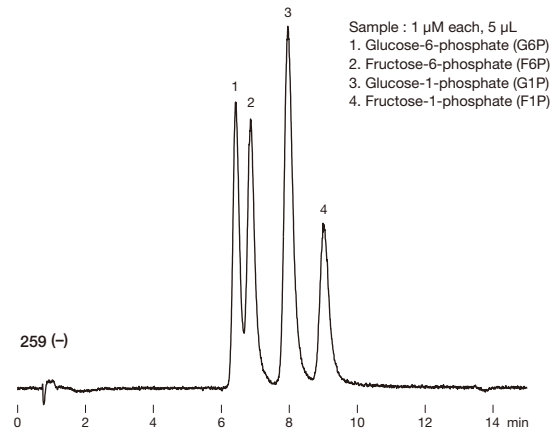
Column : Shodex HILICpak VT-50 2D
Eluent : 50 mM HCOONH₄ aq./CH₃CN=30/70
Flow rate : 0.2 mL/min
Detector : ESI-MS (SIM)
Column temp. : 30 °C

LC/MS/MS analysis of glyphosate and glufosinate



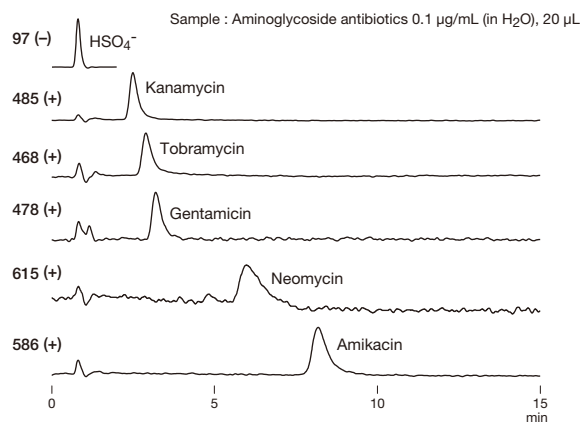
Column : Shodex HILICpak VT-50 2D
Eluent : 50 mM HNH₄CO₃ aq./CH₃CN=50/50
Flow rate : 0.3 mL/min
Detector : ESI-MS/MS (MRM)
Column temp. : 40 °C

LC/MS analysis of phosphorylated saccharides



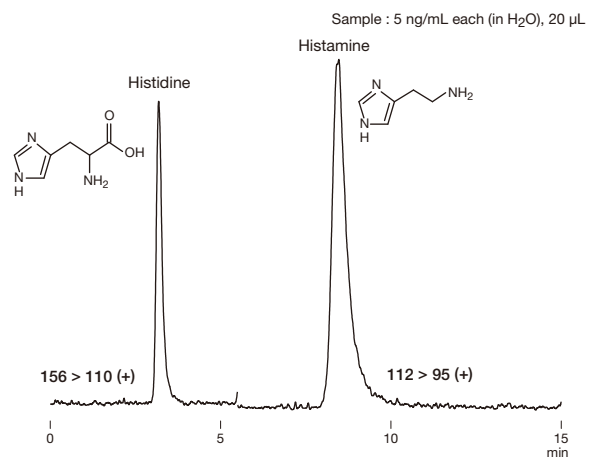
Column : Shodex HILICpak VT-50 2D
Eluent : 25 mM HCOONH₄ aq./CH₃CN=80/20
Flow rate : 0.3 mL/min
Detector : ESI-MS (SIM)
Column temp. : 60 °C

LC/MS analysis of aminoglycoside antibiotics

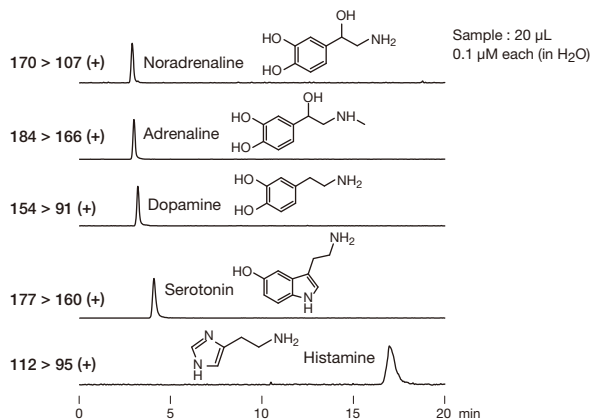


Column : Shodex HILICpak VC-50 2D
Eluent : (A); 1.5 % NH₃ aq./ (B); CH₃CN
Linear gradient (High pressure);
(B %) 30 % to 10 % (0 to 5 min), 10 % (5 to 15 min)
Flow rate : 0.3 mL/min
Detector : ESI-MS (SIM)
Column temp. : 40 °C

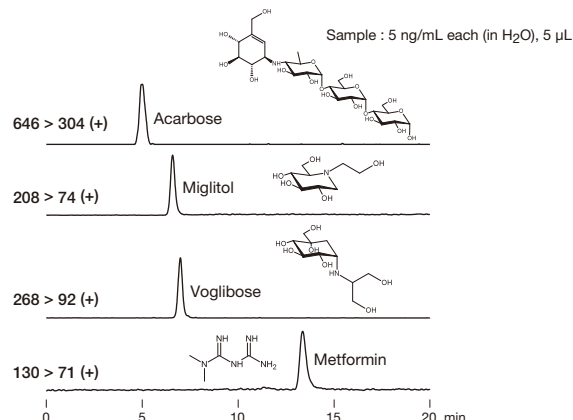
LC/MS/MS analysis of histamine and histidine



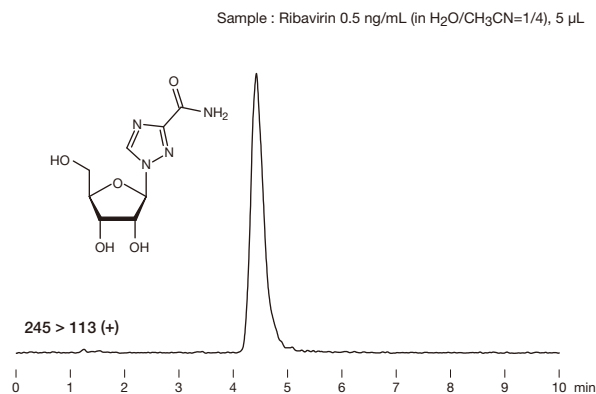
Column : Shodex HILICpak VC-50 2D
Eluent : 250 mM HCOOH aq./CH₃CN=70/30
Flow rate : 0.3 mL/min
Detector : ESI-MS/MS (MRM)
Column temp. : 40 °C

LC/MS/MS analysis of monoamine neurotransmitters


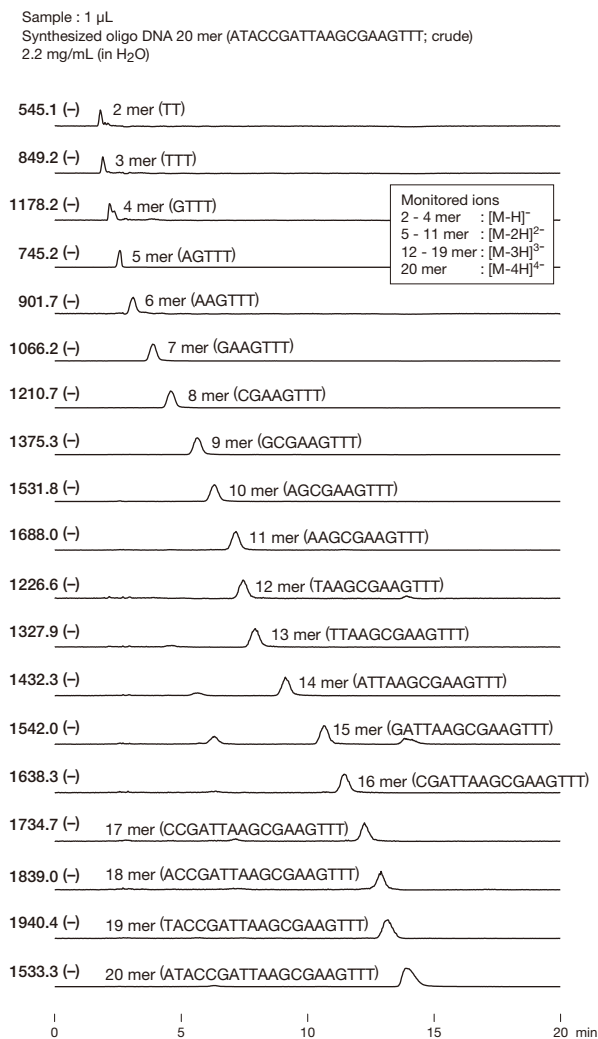
Column : Shodex HILICpak VC-50 2D
 Eluent : (A); 200 mM HCOOH aq./ (B); CH₃CN
 Linear gradient (High pressure);
 (B %) 60 % (0 to 5 min), 60 % to 10 % (5 to 6 min), 10 % (6 to 20 min)
 Flow rate : 0.3 mL/min
 Detector : ESI-MS/MS (MRM)
 Column temp. : 40 °C

LC/MS/MS analysis of oral anti-diabetes drugs


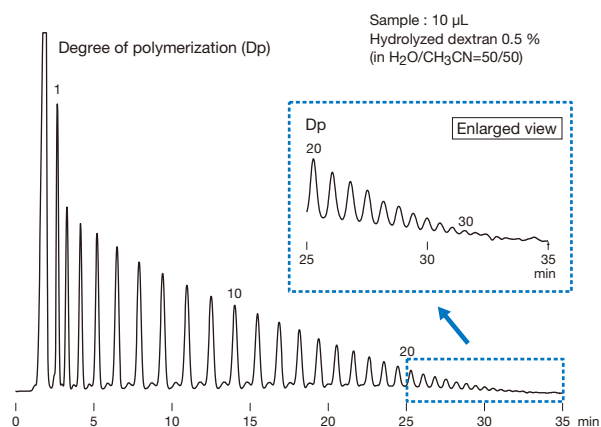
Column : Shodex HILICpak VC-50 2D
 Eluent : (A); 200 mM HCOOH aq./ (B); CH₃CN
 Linear gradient (High pressure);
 (B %) 60 % (0 to 5 min), 60 % to 20 % (5 to 6 min), 20 % (6 to 20 min)
 Flow rate : 0.3 mL/min
 Detector : ESI-MS/MS (MRM)
 Column temp. : 40 °C

LC/MS/MS analysis of ribavirin


Column : Shodex HILICpak VC-50 2D
 Eluent : 50 mM HCOOH aq./CH₃CN=10/90
 Flow rate : 0.25 mL/min
 Detector : ESI-MS/MS (MRM)
 Column temp. : 40 °C

LC/MS analysis of oligo DNA


Column : Shodex HILICpak VN-50 2D
 Eluent : (A); 50 mM HCOONH₄ aq./ (B); CH₃CN
 Linear gradient;
 (B %) 60 % (0 to 10 min), 60 % to 55 % (10 to 15 min),
 60 % (15 to 20 min)
 Flow rate : 0.2 mL/min
 Detector : ESI-MS (SIM)
 Column temp. : 40 °C

Hydrolyzed dextran


Column : Shodex HILICpak VN-50 4D
 Eluent : (A); H₂O/ (B); CH₃CN
 Linear gradient; (B %) 70 % to 50 % (0 to 40 min)
 Flow rate : 1.0 mL/min
 Detector : Corona charged aerosol
 Column temp. : 40 °C

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

Features

- NH2P-50**
- Suitable for saccharides analysis using HILIC mode
 - Polymer-based packing material provides excellent chemical stability and minimum deterioration over extended time period
 - Easily regenerated by washing in an alkaline solution
 - Appropriate for evaporative light scattering detector, corona charged aerosol detector, and LC/MS
 - Fulfills USP L82 requirements

- NH2P-40**
- Provides higher theoretical plate number than NH2P-50 series

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 x 50	CH ₃ CN
F7630002	Asahipak NH2P-50 4D	≥ 5,500	Amino	5	100	4.6 x 150	CH ₃ CN
F7630001	Asahipak NH2P-50 4E	≥ 7,500	Amino	5	100	4.6 x 250	CH ₃ CN
F6710016	Asahipak NH2P-50G 4A	(guard column)	Amino	5	–	4.6 x 10	CH ₃ CN
F7630007	Asahipak NH2P-40 3E	≥ 8,500	Amino	4	100	3.0 x 250	CH ₃ CN
F6710030	Asahipak NH2P-50G 3A	(guard column)	Amino	5	–	3.0 x 10	CH ₃ CN
F6710100	Asahipak NH2P-LF	(line filter)	Amino	–	–	8.0 x 75	CH ₃ CN

Base Material: Polyvinyl alcohol

Semi-micro columns

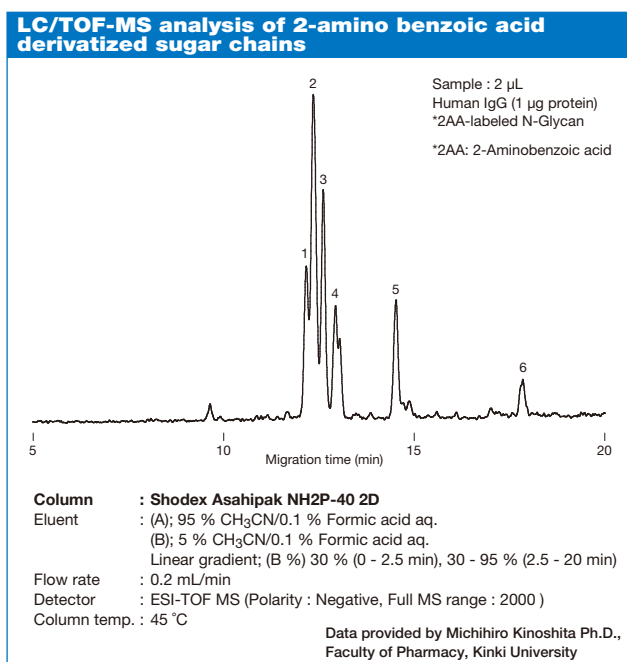
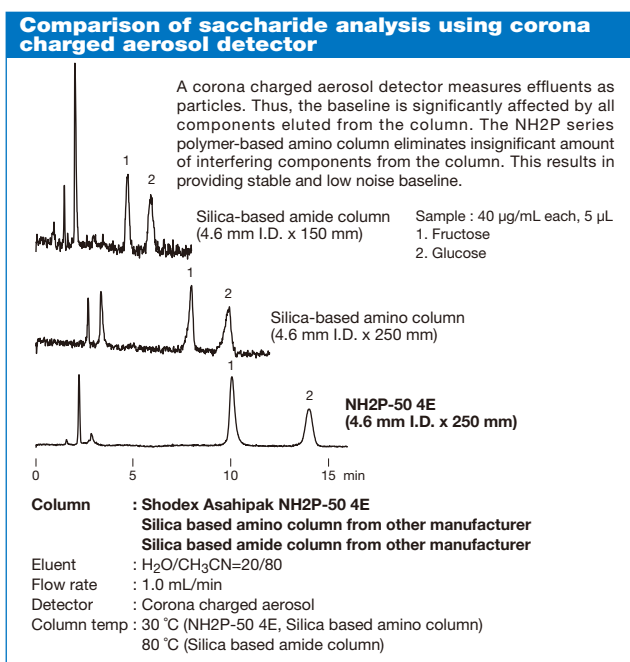
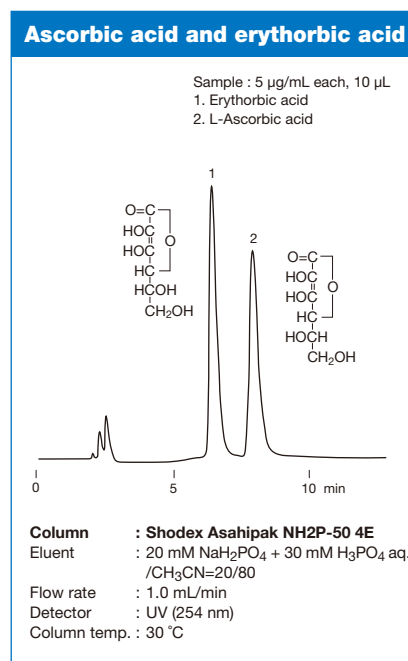
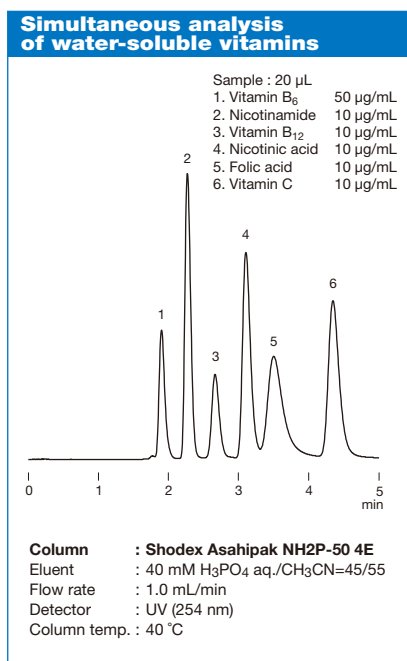
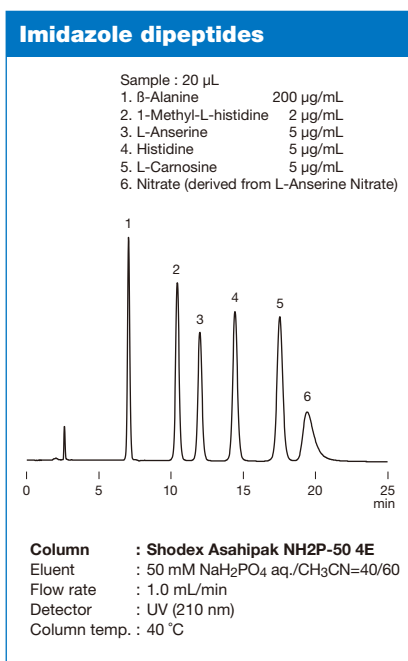
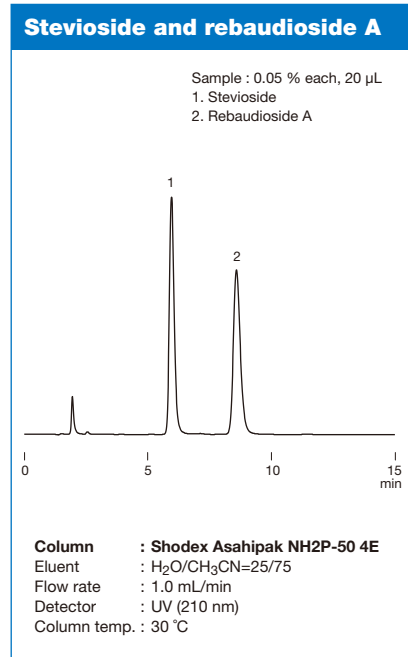
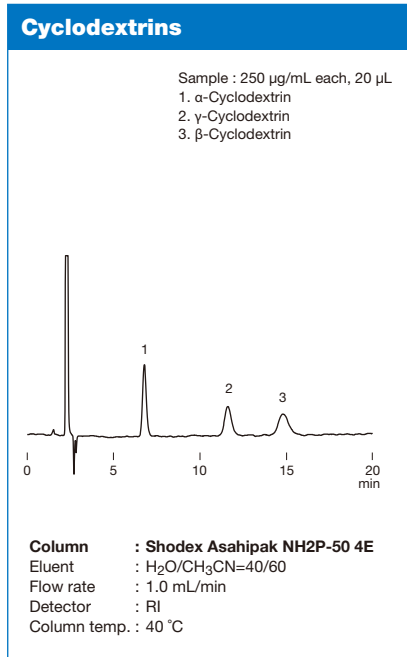
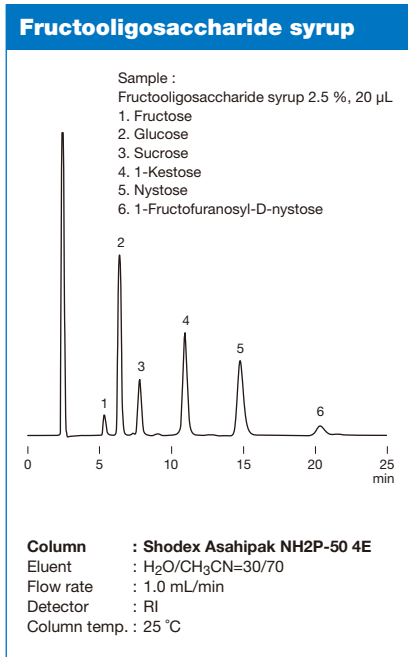
Product Code	Product Name	Plate Number (TP/column)	Functional Group	Particle Size (µm)	Pore Size (Å)	Column Size (mm) I.D. x Length	Shipping Solvent
F7630006	Asahipak NH2P-50 2D	≥ 3,500	Amino	5	100	2.0 x 150	CH ₃ CN
F6713000	Asahipak NH2P-50G 2A	(guard column)	Amino	5	–	2.0 x 10	CH ₃ CN
F7630008	Asahipak NH2P-40 2B	≥ 2,000	Amino	4	100	2.0 x 50	CH ₃ CN
F7630009	Asahipak NH2P-40 2D	≥ 5,500	Amino	4	100	2.0 x 150	CH ₃ CN
F7630010	Asahipak NH2P-40 2E	≥ 7,000	Amino	4	100	2.0 x 250	CH ₃ CN

Base Material: Polyvinyl alcohol

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	Shipping Solvent
F6830001	Asahipak NH2P-50 10E	≥ 10,000	5	10.0 x 250	NH2P-50
F6710016	Asahipak NH2P-50G 4A	(guard column)	5	4.6 x 10	(guard column)
F6830031	Asahipak NH2P-90 20F	≥ 10,000	9	20.0 x 300	NH2P-50
F6710017	Asahipak NH2P-130G 7B	(guard column)	13	7.5 x 50	(guard column)

Base Material: Polyvinyl alcohol



Silica-based Reversed Phase Chromatography Columns (ODS Columns)

Please refer to “Comparison of Shodex Reversed Phase Chromatography (RPC) Column Features” 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
F6651010	C18-4D	≥ 13,000	Octadecyl	5	17	120	4.6 x 150	H ₂ O/CH ₃ OH=25/75
F6651011	C18-4E	≥ 21,000	Octadecyl	5	17	120	4.6 x 250	H ₂ O/CH ₃ OH=25/75
F6650040	Silica C18M 4D	≥ 10,000	Octadecyl	5	16	100	4.6 x 150	H ₂ O/CH ₃ OH=30/70
F6650041	Silica C18M 4E	≥ 16,000	Octadecyl	5	16	100	4.6 x 250	H ₂ O/CH ₃ OH=30/70
F6650045	Silica C18P 4D	≥ 10,000	Octadecyl	5	17	100	4.6 x 150	H ₂ O/CH ₃ OH=30/70
F6650046	Silica C18P 4E	≥ 16,000	Octadecyl	5	17	100	4.6 x 250	H ₂ O/CH ₃ OH=30/70

Base Material: Silica

● Semi-micro 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
F6650042	Silica C18M 2D	≥ 9,000	Octadecyl	5	16	100	2.0 x 150	H ₂ O/CH ₃ CN=40/60
F6650047	Silica C18P 2D	≥ 9,000	Octadecyl	5	17	100	2.0 x 150	H ₂ O/CH ₃ CN=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 x 250	C18M
F7560041	Silica C18M 20E	≥ 16,000	5	20.0 x 250	C18M

Base Material: Silica

Silica-based Reversed Phase Chromatography Columns (Other Columns)

Please refer to “Comparison of Shodex Reversed Phase Chromatography (RPC) Column Features” 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 x 150	H ₂ O/CH ₃ OH=34/66
F6650053	Silica 5C8 4E	≥ 15,000	Octyl	5	10	100	4.6 x 250	H ₂ O/CH ₃ OH=34/66
F6650058	Silica 5CN 4D	≥ 7,000	Cyanopropyl	5	–	100	4.6 x 150	H ₂ O/CH ₃ OH=60/40
F6650059	Silica 5CN 4E	≥ 12,000	Cyanopropyl	5	–	100	4.6 x 250	H ₂ O/CH ₃ OH=60/40
F6650062	Silica 5NPE 4D	≥ 8,000	Nitrophenylethyl	5	–	100	4.6 x 150	H ₂ O/CH ₃ OH=45/55

Base Material: Silica

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

Please refer to "Comparison of Shodex Reversed Phase Chromatography (RPC) Column Features" on page 6 and 7 for features.

● Semi-micro columns

Product Code	Product Name	Functional Group	Particle Size (µm)	Carbon Load (%)	Pore Size (Å)	Column Size (mm) I.D. x Length	Shipping Solvent
F6654011	New C18U 2B	Octadecyl	1.9	20*	120	2.0 x 50	CH ₃ CN
F6654012	New C18U 2D	Octadecyl	1.9	20*	120	2.0 x 150	CH ₃ CN

*Containing 8 % for hybrid silica base material.

Base Material: Organic/inorganic hybrid silica

● Guard column for C18 series

Product Code	Product Name	Contents
F6709801	New EXP® cartridges	3 Cartridges
F6709802	New EXP® direct connect holder	One holder (2 titanium hybrid ferrules and 1 nut included)

EXP is registered trademark of Optimize Technologies, Inc.



Allows direct attachment to the analytical column

Silica-based Normal Phase Chromatography and HILIC Columns

Features

- 5SIL**
- Packed with high purity silica (99.99 % or higher)
 - Suitable used with nonpolar organic solvents for normal phase analysis
 - Fulfills USP L3 requirements

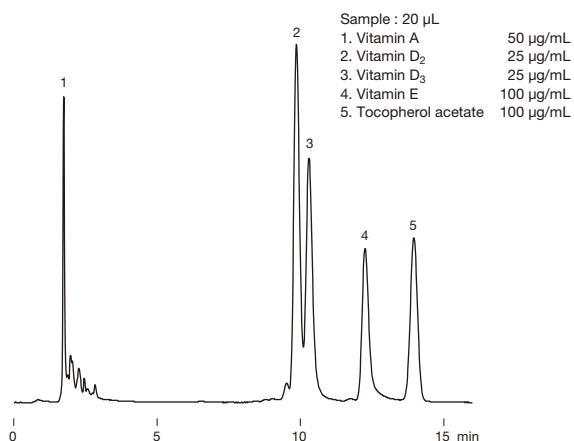
- 5NH**
- Suitable for saccharides analysis using HILIC mode
 - Fulfills USP L8 requirements

● 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 x 150	C ₆ H ₁₄ /C ₂ H ₅ OH=95/5
F6650051	Silica 5SIL 4E	≥ 15,000	-	5	-	100	4.6 x 250	C ₆ H ₁₄ /C ₂ H ₅ OH=95/5
F6650060	Silica 5NH 4D	≥ 5,000	Aminopropyl	5	-	100	4.6 x 150	H ₂ O/CH ₃ CN=5/95
F6650061	Silica 5NH 4E	≥ 8,000	Aminopropyl	5	-	100	4.6 x 250	H ₂ O/CH ₃ CN=5/95

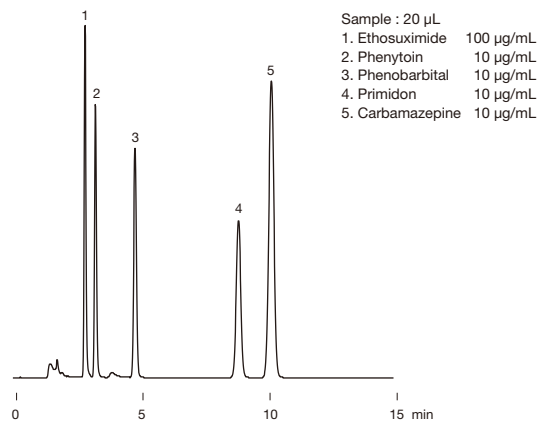
Base Material: Silica

Fat-soluble vitamins



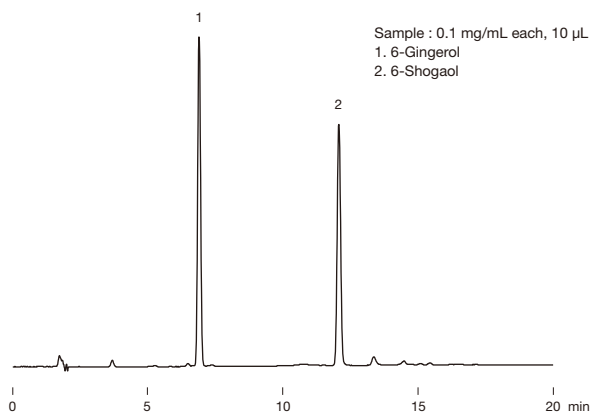
Column : Shodex C18-4D
 Eluent : CH₃CN
 Flow rate : 1.0 mL/min
 Detector : UV (280 nm)
 Column temp. : 40 °C

Anticonvulsant



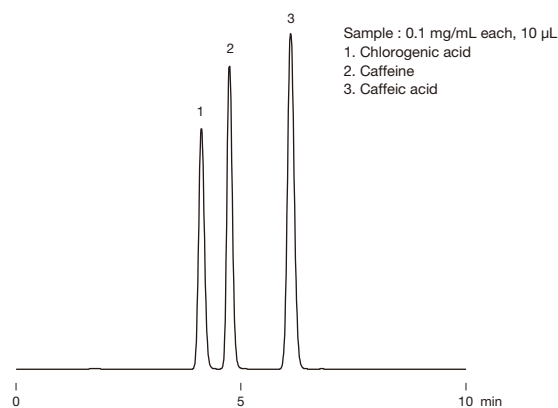
Column : Shodex C18-4D
 Eluent : 100 mM Phosphate buffer (pH 2.1) /CH₃OH/CH₃CN=4/2/1
 Flow rate : 1.0 mL/min
 Detector : UV (210 nm)
 Column temp. : 40 °C

Gingerol and shogaol



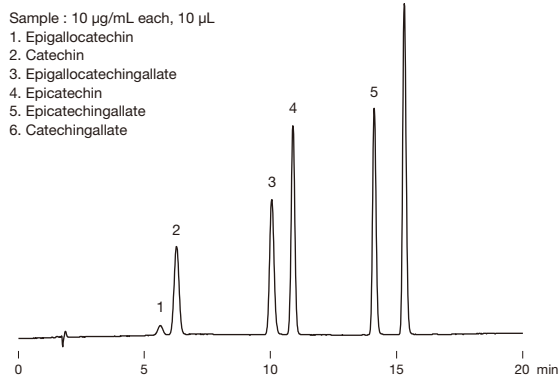
Column : Shodex Silica C18M 4D
 Eluent : (A) ; H₂O/(B) ; CH₃CN
 Linear gradient : (B %) 40 % to 70 % (15 min)
 Flow rate : 1.0 mL/min
 Detector : UV (280 nm)
 Column temp. : 40 °C

Chlorogenic acid



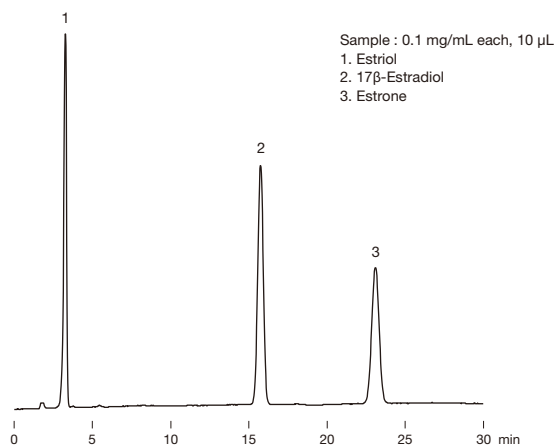
Column : Shodex Silica C18M 4D
 Eluent : 20 mM H₃PO₄ aq./CH₃OH=70/30
 Flow rate : 1.0 mL/min
 Detector : UV (280 nm)
 Column temp. : 30 °C

Catechins

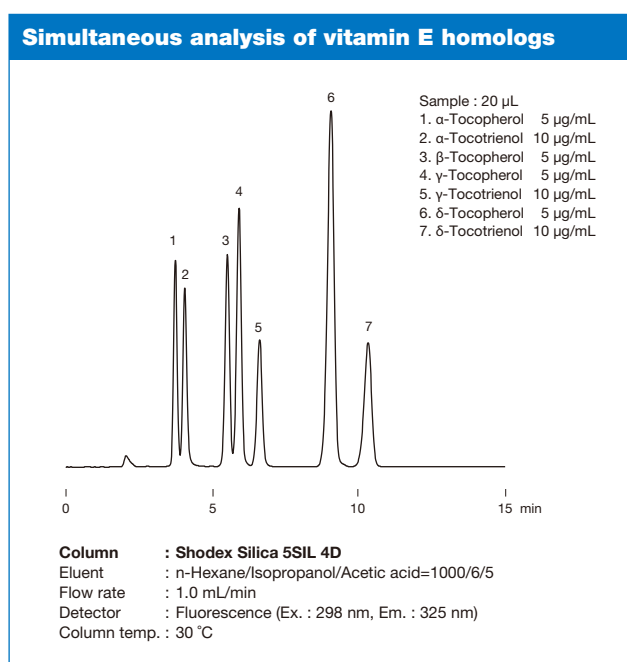
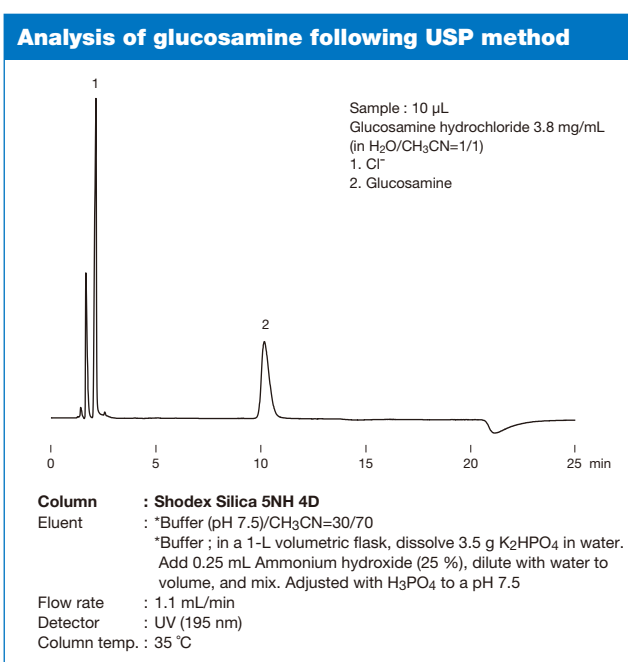
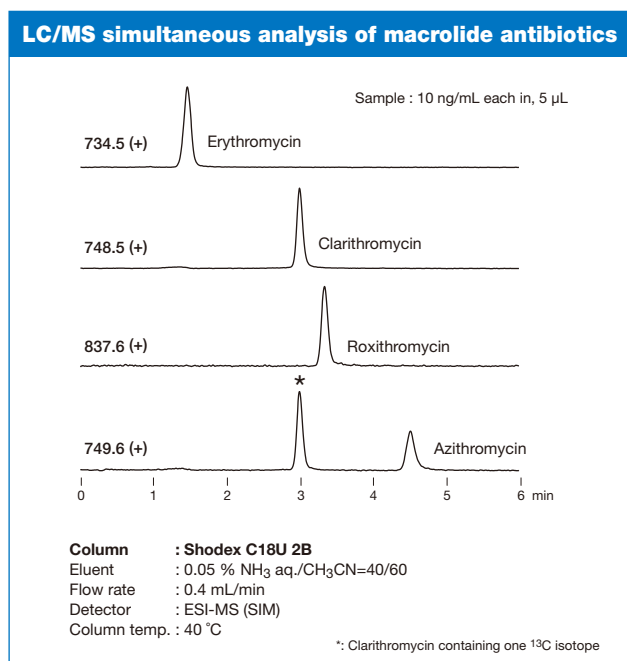
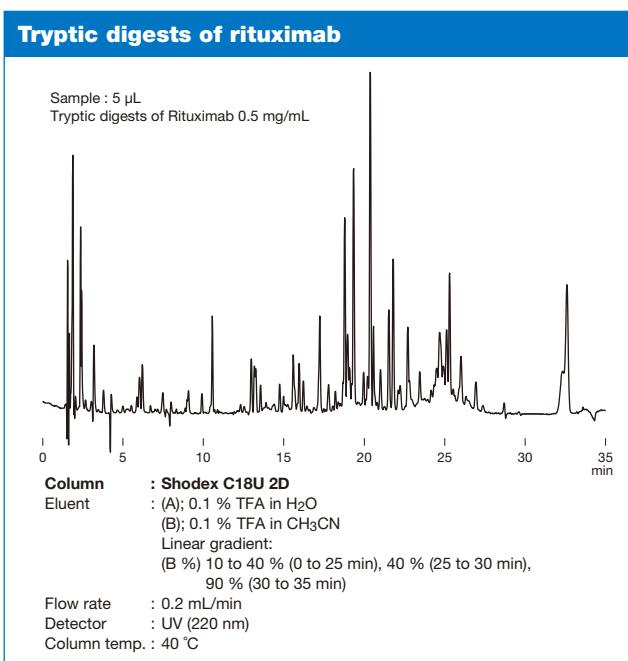
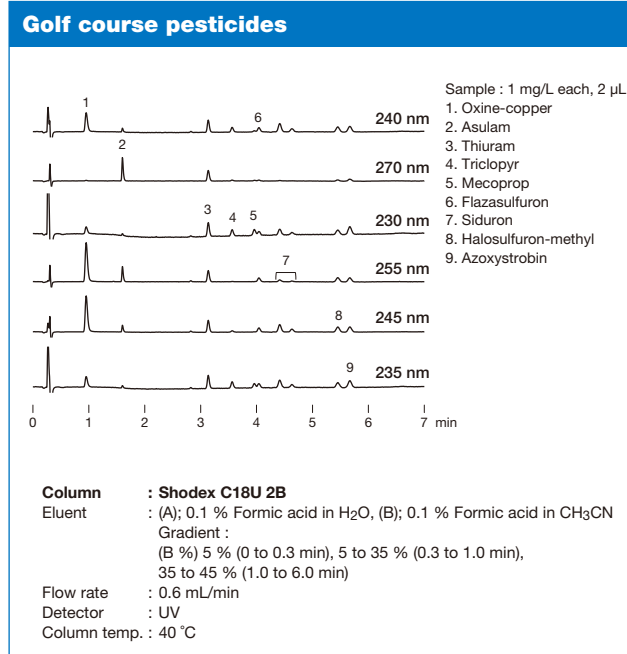
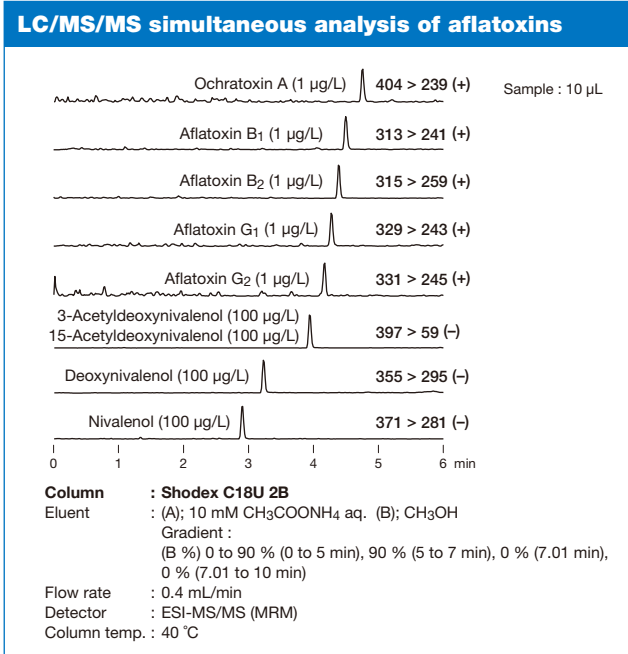


Column : Shodex Silica C18P 4D
 Eluent : (A) ; 20 mM H₃PO₄ aq./ (B) ; CH₃CN
 Linear gradient:
 (B %) 20 % (0 to 5 min), 20 to 40 % (5 to 15 min),
 40 % (15 to 20 min)
 Flow rate : 1.0 mL/min
 Detector : UV (280 nm)
 Column temp. : 30 °C

Estrogens



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



Ligand Exchange Chromatography Columns

*Lists with elution volumes of various saccharides using Shodex columns are available. Please refer to our website (www.shodex.de) or technical notebook No. 2 and 3.

Features

- SC1011** • Separates saccharides by combination of ligand exchange and size exclusion modes
SC1821 • Three types of counter ions are available: Ca²⁺, Pb²⁺ and Na⁺
SP0810 • Only water is required for the analysis of neutral sugars
KS-801 • SC1011 and SC1821 fulfill USP L19 and L22 requirements
KS-802 • SP0810 fulfills USP L22 and L34 requirements
 • KS-801 and KS-802 fulfill USP L22 and L58 requirements

- KS-803 to 806** • 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
 • Fulfill USP L22 and L58 requirements

- DC-613** • Separates elements by combination of ligand exchange and HILIC modes
SZ5532 • DC-613 can analyze sugars without removing sodium salts in the sample
SC1211 • SZ5532 is recommended for the separation of disaccharides or trisaccharides
 • SC1211 is suitable for separating sugar alcohols
 • DC-613 fulfills USP L22 and L58 requirements
 • SZ5532 fulfills USP L22 requirements
 • SC1211 fulfills USP L19 and L22 requirements

- SC1011-7F** • Fulfills mannitol analysis requirements of JP, USP, and EP methods
 • Ca²⁺ modified ligand exchange chromatography column
 • Only water is required for the analysis of neutral sugars
 • Fulfills USP L19 and L22 requirements

● 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 x 300	H ₂ O
F6378103	SUGAR SC1821	≥ 13,000	Sulfo (Ca ²⁺)	10,000	6	8.0 x 300	H ₂ O
F6700090	SUGAR SC-G 6B	(guard column)	Sulfo (Ca ²⁺)	–	10	6.0 x 50	H ₂ O
F6378105	SUGAR SP0810	≥ 11,000	Sulfo (Pb ²⁺)	1,000	7	8.0 x 300	H ₂ O
F6700081	SUGAR SP-G 6B	(guard column)	Sulfo (Pb ²⁺)	–	10	6.0 x 50	H ₂ O
F6378106	SUGAR SP0810 8C	≥ 3,000	Sulfo (Pb ²⁺)	1,000	7	8.0 x 100	H ₂ O
F6378010	SUGAR KS-801	≥ 17,000	Sulfo (Na ⁺)	1,000	6	8.0 x 300	H ₂ O
F6378020	SUGAR KS-802	≥ 17,000	Sulfo (Na ⁺)	10,000	6	8.0 x 300	H ₂ O
F6378025	SUGAR KS-803	≥ 17,000	Sulfo (Na ⁺)	50,000	6	8.0 x 300	H ₂ O
F6378035	SUGAR KS-804	≥ 17,000	Sulfo (Na ⁺)	400,000	7	8.0 x 300	H ₂ O
F6378050	SUGAR KS-805	≥ 9,000	Sulfo (Na ⁺)	5,000,000	17	8.0 x 300	H ₂ O
F6378060	SUGAR KS-806	≥ 9,000	Sulfo (Na ⁺)	(50,000,000)*	17	8.0 x 300	H ₂ O
F6700020	SUGAR KS-G 6B	(guard column)	Sulfo (Na ⁺)	–	10	6.0 x 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 x 150	H ₂ O/CH ₃ CN=30/70
F6700170	RSpak DC-G 4A	(guard column)	Sulfo (Na ⁺)	10	–	4.6 x 10	H ₂ O/CH ₃ CN=30/70
F7001300	SUGAR SZ5532	≥ 5,500	Sulfo (Zn ²⁺)	6	–	6.0 x 150	H ₂ O/CH ₃ CN=30/70
F6700110	SUGAR SZ-G	(guard column)	Sulfo (Zn ²⁺)	6	–	4.6 x 10	H ₂ O/CH ₃ CN=30/70
F7001400	SUGAR SC1211	≥ 5,500	Sulfo (Ca ²⁺)	6	50	6.0 x 250	H ₂ O/CH ₃ CN=75/25
F6700120	SUGAR SC1211G 4A	(guard column)	Sulfo (Ca ²⁺)	10	–	4.6 x 10	H ₂ O/CH ₃ CN=75/25

Base Material: Styrene divinylbenzene copolymer

● For mannitol analysis following JP, USP, and EP methods

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 x 300	H ₂ O
F6700090	SUGAR SC-G 6B (guard column)	Sulfo (Ca ²⁺)	10	6.0 x 50	H ₂ O
F6379230	USPpak MN-431	Sulfo (Ca ²⁺)	8	4.0 x 250	H ₂ O

See page 82 for USP42-NF37 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 x 300	KS-801
F6502008	SUGAR KS-2002	≥ 7,000	13	20.0 x 300	KS-802
F6502009	SUGAR KS-2003	≥ 8,000	13	20.0 x 300	KS-803
F6502010	SUGAR KS-2004	≥ 6,000	18	20.0 x 300	KS-804
F6502011	SUGAR KS-2005	≥ 6,000	18	20.0 x 300	KS-805
F6502012	SUGAR KS-2006	≥ 6,000	18	20.0 x 300	KS-806
F6700002	SUGAR KS-G 8B	(guard column)	13	8.0 x 50	(guard column)

Elution volumes of saccharides analyzed by Shodex 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

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	*
Palatinin	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-Xylose	10.64	9.02	8.04	4.06	5.41	5.07

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

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

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

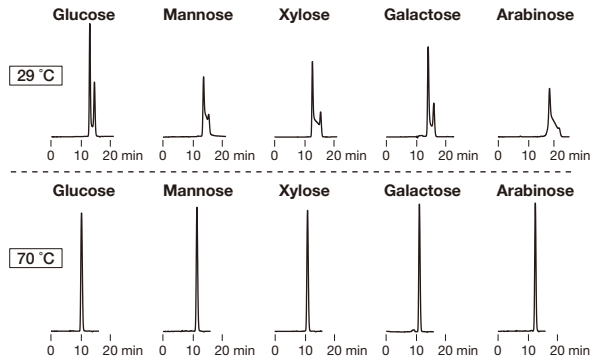
Column : SUGAR SZ5532
Eluent : H₂O/CH₃CN=25/75
Flow rate : 1.0 mL/min
Detector : RI
Column temp. : 60 °C

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

Saccharides anomer separation

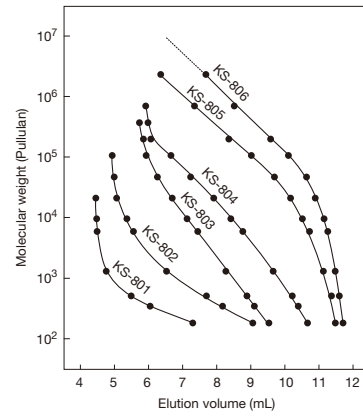
Saccharides may present their anomers at lower temperatures. By using the SUGAR series columns at higher temperatures will prevent the anomer separation and this results in providing better chromatograms of each saccharide.

Sample : 0.5 % each, 10 μ L



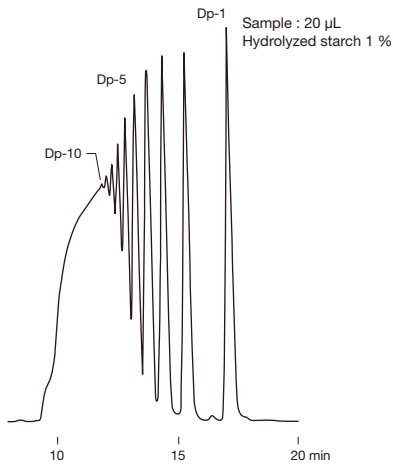
Column : Shodex SUGAR SC1011
 Eluent : H₂O
 Flow rate : 0.7 mL/min
 Detector : RI
 Column temp. : 29 °C, 70 °C

Calibration curves for KS-800 series using pullulan



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

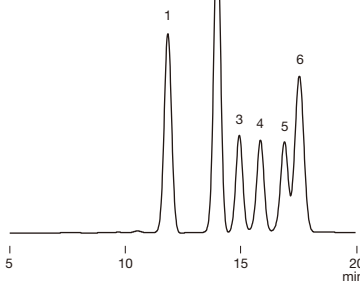
Hydrolyzed starch



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

Biomass sugars

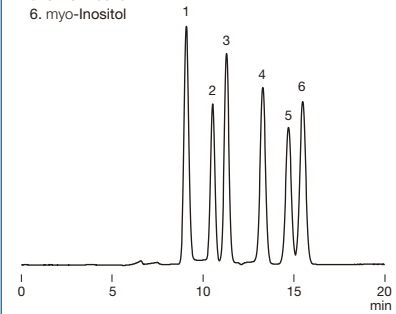
Sample : 5 μ L
 1. Cellobiose 1.0 %
 2. Glucose 1.5 %
 3. Xylose 0.5 %
 4. Galactose 0.5 %
 5. Arabinose 0.5 %
 6. Mannose 1.0 %



Column : Shodex SUGAR SP0810
 Eluent : H₂O
 Flow rate : 0.6 mL/min
 Detector : RI
 Column temp. : 85 °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 : 0.8 mL/min
 Detector : RI
 Column temp. : 85 °C

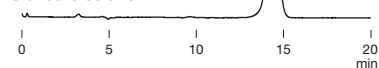
Analysis of sorbitol following USP method

Sample : 10 μ L
 (System suitability solution) Mannitol, Sorbitol 4.8 mg/g each
 (Standard solution) Sorbitol 4.8 mg/g

1. Mannitol
 2. Sorbitol

System suitability solution

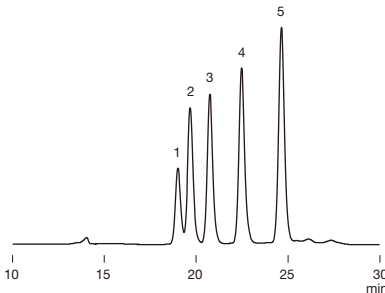
Standard solution



Column : Shodex SUGAR SP0810 8C
 Eluent : H₂O
 Flow rate : 0.7 mL/min
 Detector : RI (35 °C)
 Column temp. : 50 °C

Oligosaccharides in soybean

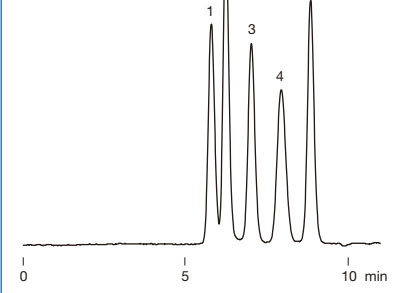
Sample : 0.1 % each, 20 μ L
 1. Verbascose
 2. Stachyose
 3. Raffinose
 4. Sucrose
 5. Pinitol



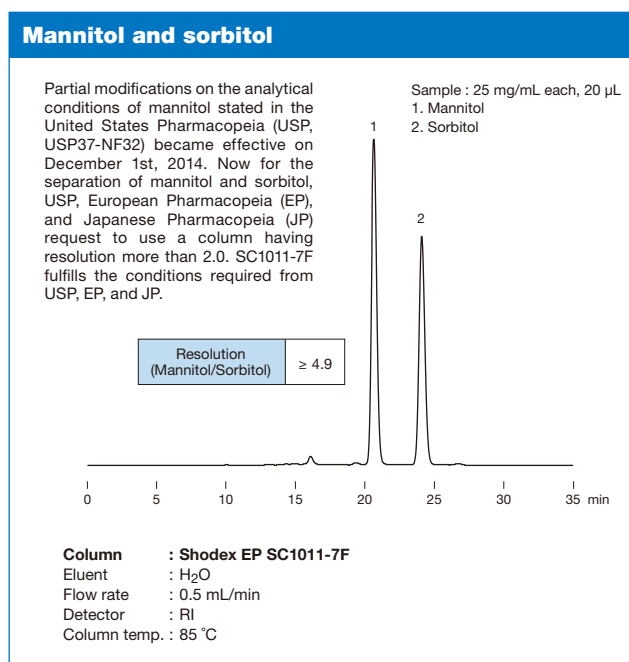
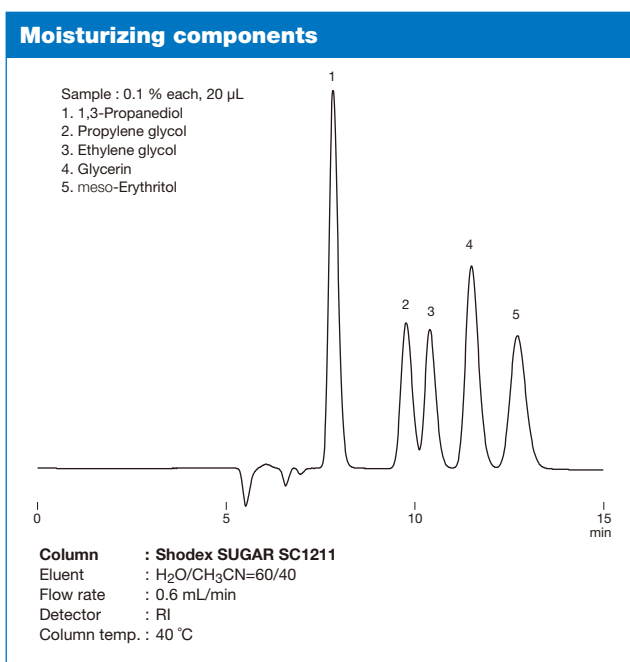
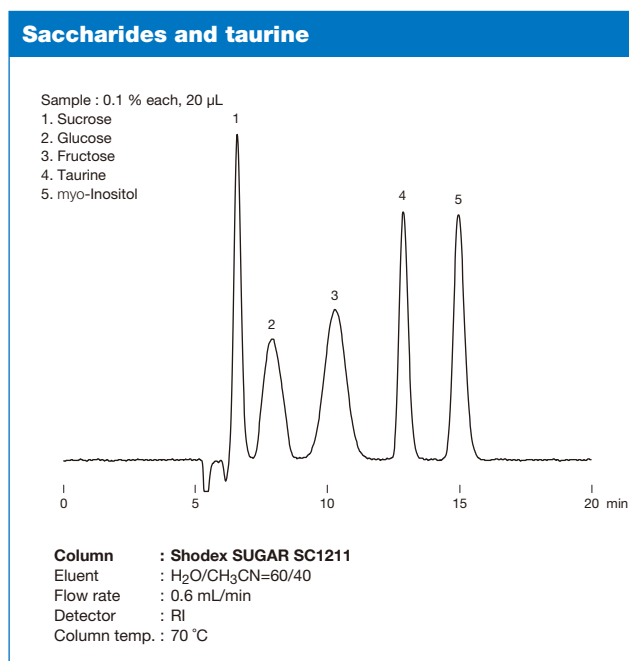
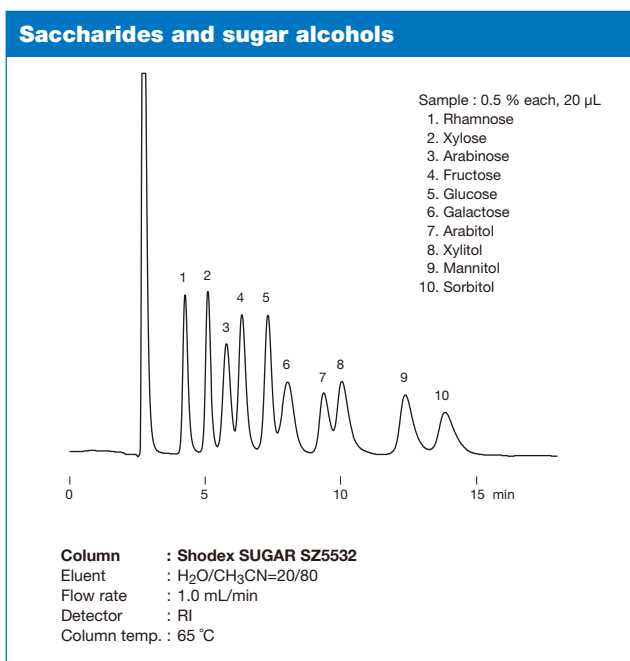
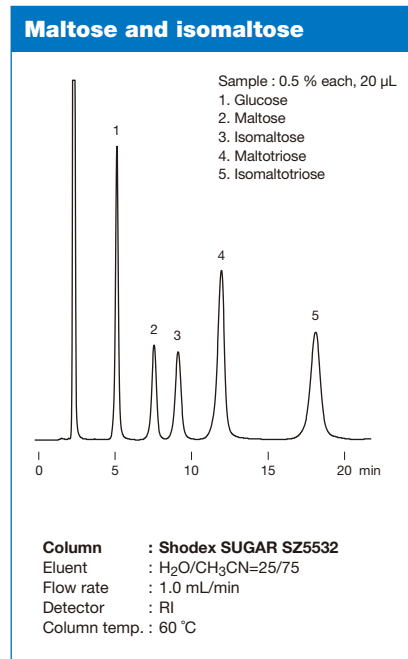
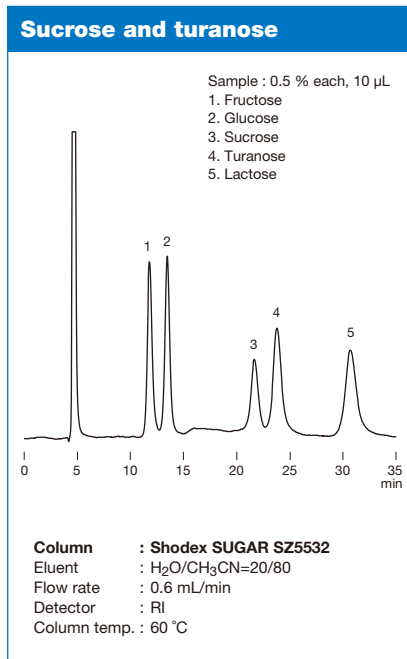
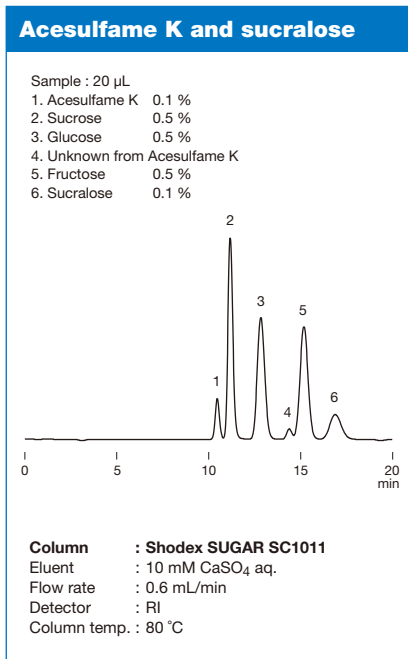
Column : Shodex SUGAR KS-802 + KS-801
 Eluent : H₂O
 Flow rate : 0.6 mL/min
 Detector : RI
 Column temp. : 85 °C

Saccharides related to raffinose biosynthesis

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



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



Ion Exclusion Chromatography Columns

Features

- | | |
|--------------------------------|---|
| SH1011
SH1821 | <ul style="list-style-type: none"> • 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 • Fulfill USP L17 and L22 requirements |
| KC-811 | <ul style="list-style-type: none"> • Columns suitable for the analysis of organic acids • Separates compounds by ion exclusion mode and reversed phase mode • Highly selective when used 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 • Fulfills USP L17 and L22 requirements |

● 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 x 300	H ₂ O
F6378101	SUGAR SH1821	≥ 17,000	Sulfo	10,000	6	8.0 x 300	H ₂ O
F6700080	SUGAR SH-G	(guard column)	Sulfo	–	10	6.0 x 50	H ₂ O
F6378104	SUGAR SH1011 8C	≥ 5,000	Sulfo	1,000	6	8.0 x 100	H ₂ O

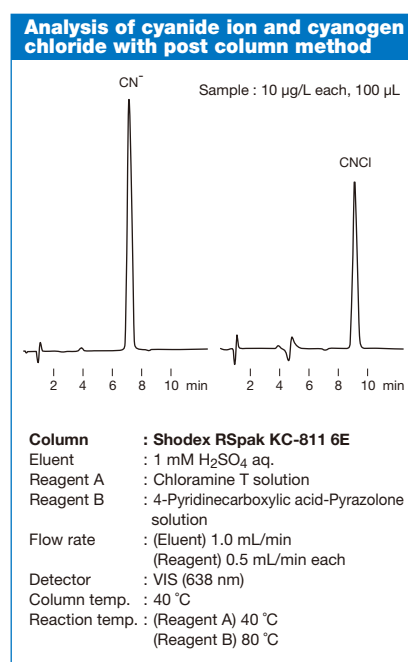
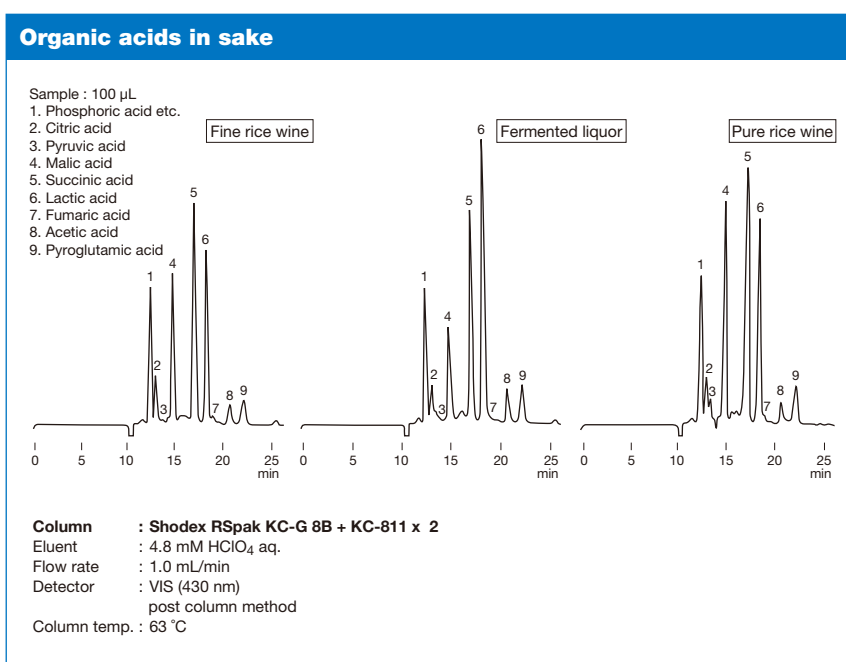
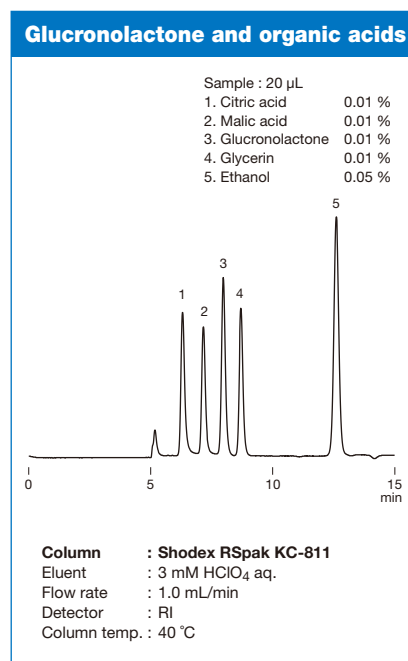
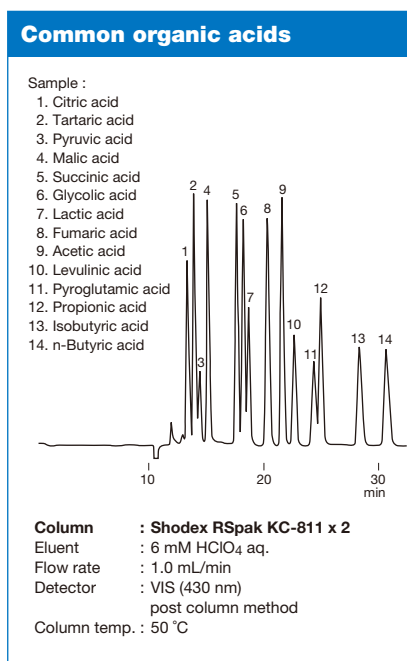
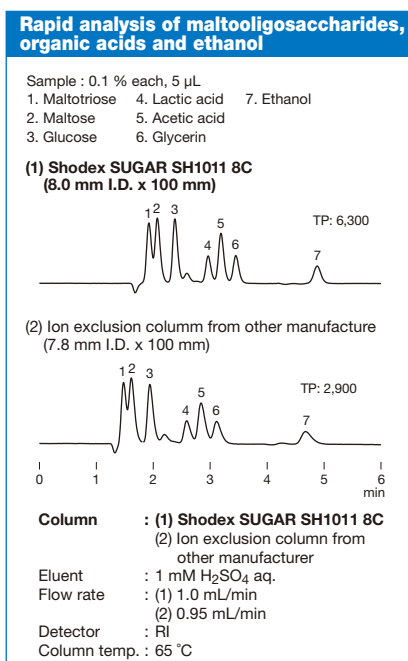
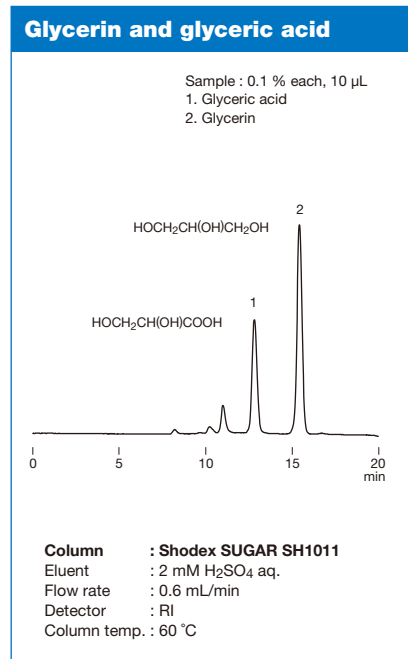
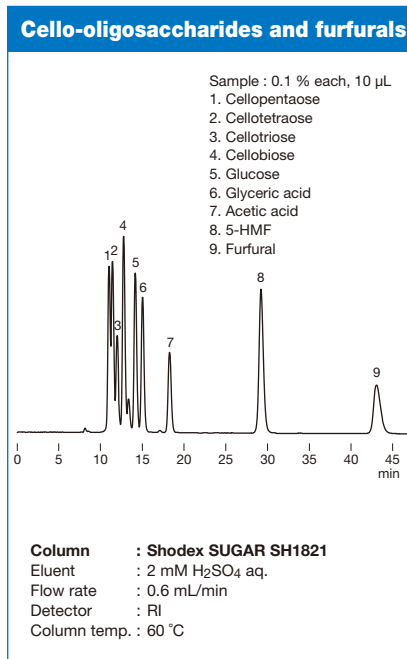
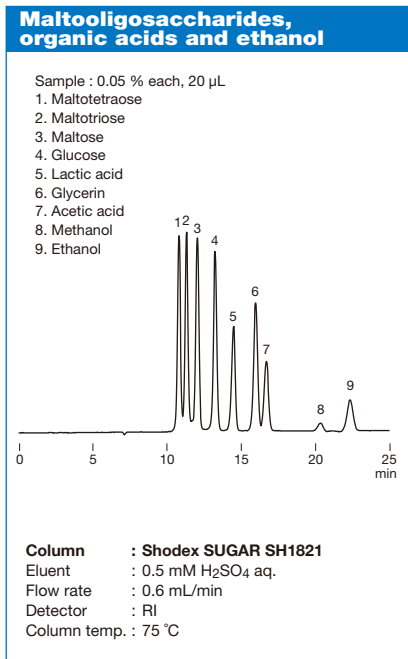
Base Material: Styrene divinylbenzene copolymer

[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 x 300	0.1 % H ₃ PO ₄ aq.
F6378033	RSpak KC-811 6E	≥ 13,000	Sulfo	6	6.0 x 250	0.1 % H ₃ PO ₄ aq.
F6700030	RSpak KC-G 6B	(guard column)	Sulfo	10	6.0 x 50	0.1 % H ₃ PO ₄ aq.
F6700010	RSpak KC-G 8B	(guard column)	Sulfo	13	8.0 x 50	0.1 % H ₃ PO ₄ aq.

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



Ion Chromatography Columns (Anion Analysis)

Features

NI-424 I-524A	<ul style="list-style-type: none"> • Ideal for anion non-suppressor methods • NI-424 provides simultaneous analysis of fluoride and phosphate ions
SI-90 4E SI-50 4E SI-52 4E	<ul style="list-style-type: none"> • Suitable for anion suppressor methods with sodium carbonate eluent • Suitable for the quantitative analysis of fluoride ion • SI-50 4E separates target inorganic anions from organic acids • SI-52 4E provides simultaneous analysis of oxyhalides and general inorganic ions • Carbonate peak does not interfere with analysis
SI-35	<ul style="list-style-type: none"> • Columns for rapid analysis with suppressor method with sodium carbonate eluent • SI-35 4D provides rapid analysis of oxyhalides and general inorganic ions • SI-35 2B provides rapid analysis of general inorganic ions
New SI-36 4D	<ul style="list-style-type: none"> • A column using potassium hydroxide as eluent for anion analysis with suppressor method • Good separation of sulfite ion / sulfate ion • Analysis of seven general inorganic anions within 30 minutes under isocratic conditions

For anion non-suppressor method

● Standard columns

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 x 100	8 mM 4-Hydroxybenzoic acid + 2.8 mM Bis-Tris + 2 mM Phenylboronic acid + 0.005 mM CyDTA aq.
F6709616	IC NI-G	(guard column)	Quaternary ammonium	5	4.6 x 10	8 mM 4-Hydroxybenzoic acid + 2.8 mM Bis-Tris + 2 mM Phenylboronic acid + 0.005 mM CyDTA aq.
F6995240	IC I-524A	≥ 2,000	Quaternary ammonium	12	4.6 x 100	2.5 mM Phthalic acid aq.
F6700400	IC IA-G	(guard column)	Quaternary ammonium	12	4.6 x 10	2.5 mM Phthalic acid aq.

Base Material: Polyhydroxymethacrylate Housing Material: SUS

For anion suppressor method (Sodium carbonate eluent)

● Standard columns

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 x 250	1.8 mM Na ₂ CO ₃ + 1.7 mM NaHCO ₃ aq.
F6709620	IC SI-90G	(guard column)	Quaternary ammonium	9	4.6 x 10	1.8 mM Na ₂ CO ₃ + 1.7 mM NaHCO ₃ aq.
F6995245	IC SI-50 4E	≥ 10,000	Quaternary ammonium	5	4.0 x 250	3.2 mM Na ₂ CO ₃ + 1.0 mM NaHCO ₃ aq.
F6709625	IC SI-50G	(guard column)	Quaternary ammonium	5	4.6 x 10	3.2 mM Na ₂ CO ₃ + 1.0 mM 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
F6995260	IC SI-52 4E	≥ 14,000	Quaternary ammonium	5	4.0 x 250	3.6 mM Na ₂ CO ₃ aq.
F6709626	IC SI-92G	(guard column)	Quaternary ammonium	9	4.6 x 10	3.6 mM Na ₂ CO ₃ aq.

Base Material: Polyvinyl alcohol Housing Material: PEEK

[For rapid analysis]

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 x 150	3.6 mM Na ₂ CO ₃ aq.
F6709627	IC SI-95G	(guard column)	Quaternary ammonium	9	4.6 x 10	3.6 mM Na ₂ CO ₃ aq.

Base Material: Polyvinyl alcohol Housing Material: PEEK

● Semi-micro columns

[For rapid analysis]

Product Code	Product Name	Plate Number (TP/column)	Functional Group	Particle Size (µm)	Column Size (mm) I.D. x Length	Shipping Solvent
F6995291	IC SI-35 2B	≥ 4,000	Quaternary ammonium	3.5	2.0 x 50	1.0 mM Na ₂ CO ₃ + 2.0 mM NaHCO ₃ aq.

Base Material: Polyvinyl alcohol Housing Material: PEEK

For anion suppressor method (Potassium hydroxide eluent)

● Standard columns

Product Code	Product Name	Plate Number (TP/column)	Functional Group	Particle Size (µm)	Column Size (mm) I.D. x Length	Shipping Solvent
F6999361	New IC SI-36 4D	≥ 8,500	Quaternary ammonium	3.5	4.0 x 150	25 mM KOH aq.

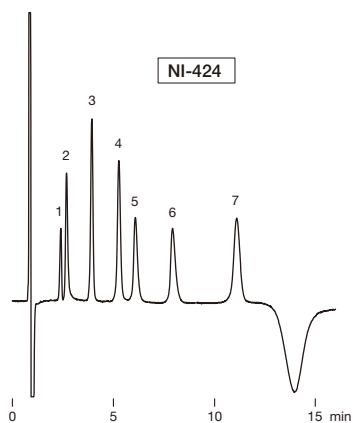
Base Material: Polyvinyl alcohol Housing Material: PEEK

[Guard filter for SI-35 2B]

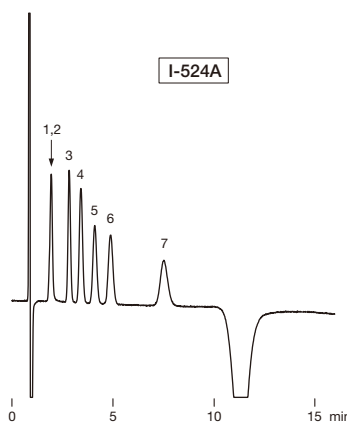
Product Code	Product Name	Contents
F6709720	IC SI-2GF	One holder and one filter
F6709730	IC SI-2GF filter	3 filters

Removes insoluble components in the sample

Anion analysis using NI-424 and I-524A (non-suppressor methods)



Sample : 20 μ L
 1. H_2PO_4^- 10 mg/L
 2. F^- 1 mg/L
 3. Cl^- 1 mg/L
 4. NO_2^- 5 mg/L
 5. Br^- 5 mg/L
 6. NO_3^- 5 mg/L
 7. SO_4^{2-} 5 mg/L



Column : Shodex IC I-524A
 Eluent : 2.5 mM Phthalic acid
 + 2.3 mM Tris(hydroxymethyl)aminomethane aq.
 Flow rate : 1.2 mL/min
 Detector : Non-suppressed conductivity
 Column temp. : 40 $^\circ\text{C}$

With twice increased theoretical plate number, NI-424 provides a higher performance compared to I-524A.

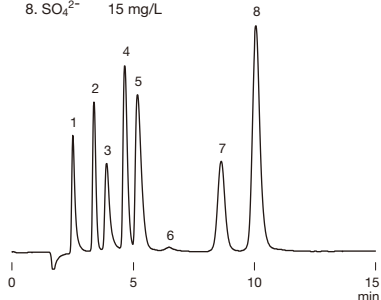
- [Features of NI-424]
 (1) Enables the separation of H_2PO_4^- and F^- which were difficult to separate with I-524A.
 (2) Provides sharper peaks, and resolution between all peaks are well defined. Especially, the separation of Cl^- and NO_2^- is improved.

Column : Shodex IC NI-424
 Eluent : 8 mM 4-Hydroxybenzoic acid + 2.8 mM Bis-Tris
 + 2 mM Phenylboronic acid + 0.005 mM CyDTA* aq.
 Flow rate : 1.0 mL/min
 Detector : Non-suppressed conductivity
 Column temp. : 40 $^\circ\text{C}$

*CyDTA : trans-1,2-Diaminocyclohexane-N,N,N',N'-tetra acetic acid

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

Sample : 20 μ L
 1. F^- 2 mg/L
 2. Cl^- 3 mg/L
 3. NO_2^- 5 mg/L
 4. Br^- 10 mg/L
 5. NO_3^- 10 mg/L
 6. HCO_3^- 300 mg/L
 7. HPO_4^{2-} 15 mg/L
 8. SO_4^{2-} 15 mg/L

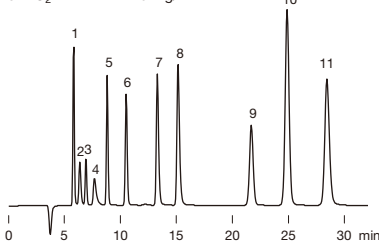


Column : Shodex IC SI-90 4E
 Eluent : 1.8 mM Na_2CO_3 + 1.7 mM NaHCO_3 aq.
 Flow rate : 1.5 mL/min
 Detector : Suppressed conductivity
 Column temp. : Room temp. (25 $^\circ\text{C}$)

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

SI-50 4E is a high performance type of SI-90 4E. Acetic acid, formic acid, and methacrylic acid eluted between F^- and Cl^- . The carbonate system peak appears between NO_2^- and Br^- peaks.

Sample : 20 μ L
 1. F^- 2 mg/L
 2. Acetic acid 10 mg/L
 3. Formic acid 2 mg/L
 4. Methacrylic acid 10 mg/L
 5. Cl^- 3 mg/L
 6. NO_2^- 5 mg/L
 7. Br^- 10 mg/L
 8. NO_3^- 10 mg/L
 9. HPO_4^{2-} 15 mg/L
 10. SO_4^{2-} 15 mg/L
 11. Oxalic acid 15 mg/L

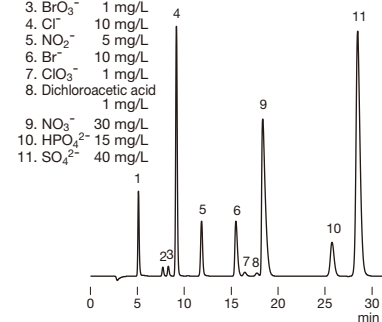


Column : Shodex IC SI-50 4E
 Eluent : 3.2 mM Na_2CO_3 + 1.0 mM NaHCO_3 aq.
 Flow rate : 0.7 mL/min
 Detector : Suppressed conductivity
 Column temp. : 25 $^\circ\text{C}$

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

SI-52 4E is a high resolution column offering 14,000 or higher theoretical plate number. It supports simultaneous analysis of oxyhalides and inorganic anions. It is recommended to set the column temperature at 45 $^\circ\text{C}$.

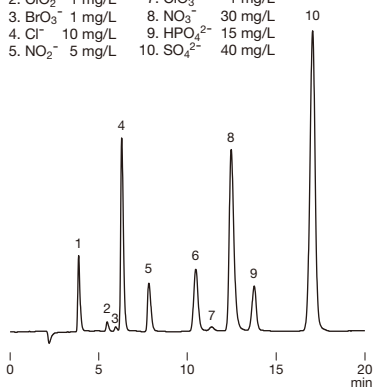
Sample : 50 μ L
 1. F^- 2 mg/L
 2. ClO_2^- 1 mg/L
 3. BrO_3^- 1 mg/L
 4. Cl^- 10 mg/L
 5. NO_2^- 5 mg/L
 6. Br^- 10 mg/L
 7. ClO_3^- 1 mg/L
 8. Dichloroacetic acid 1 mg/L
 9. NO_3^- 30 mg/L
 10. HPO_4^{2-} 15 mg/L
 11. SO_4^{2-} 40 mg/L



Column : Shodex IC SI-52 4E
 Eluent : 3.6 mM Na_2CO_3 aq.
 Flow rate : 0.8 mL/min
 Detector : Suppressed conductivity
 Column temp. : 45 $^\circ\text{C}$

Rapid analysis of oxyhalides and anions using SI-35 4D (suppressor method)

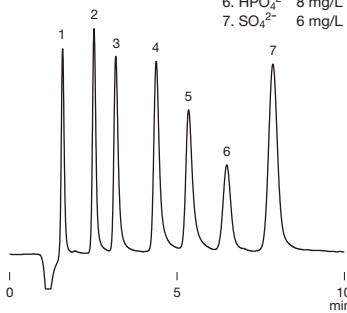
Sample : 20 μ L
 1. F^- 2 mg/L
 2. ClO_2^- 1 mg/L
 3. BrO_3^- 1 mg/L
 4. Cl^- 10 mg/L
 5. NO_2^- 5 mg/L
 6. Br^- 10 mg/L
 7. ClO_3^- 1 mg/L
 8. NO_3^- 30 mg/L
 9. HPO_4^{2-} 15 mg/L
 10. SO_4^{2-} 40 mg/L



Column : Shodex IC SI-35 4D
 Eluent : 2.0 mM Na_2CO_3 +
 4.5 mM NaHCO_3 aq.
 Flow rate : 0.6 mL/min
 Detector : Suppressed conductivity
 Column temp. : 45 $^\circ\text{C}$

Rapid analysis of anions using SI-35 2B (suppressor method)

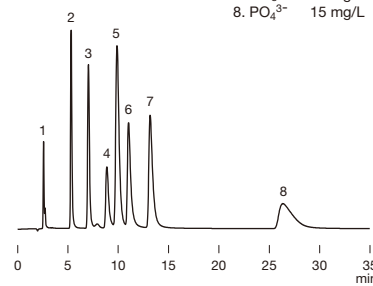
Sample : 2 μ L
 1. F^- 1 mg/L
 2. Cl^- 2 mg/L
 3. NO_2^- 3 mg/L
 4. Br^- 5 mg/L
 5. NO_3^- 5 mg/L
 6. HPO_4^{2-} 8 mg/L
 7. SO_4^{2-} 6 mg/L



Column : Shodex IC SI-35 2B
 Eluent : 1.0 mM Na_2CO_3
 + 2.0 mM NaHCO_3 aq.
 Flow rate : 0.2 mL/min
 Detector : Suppressed conductivity
 Column temp. : 30 $^\circ\text{C}$

Anions and sulfite ion analysis using SI-36 4D (suppressor method)

Sample : 25 μ L
 1. F^- 0.5 mg/L
 2. Cl^- 3 mg/L
 3. NO_2^- 5 mg/L
 4. SO_3^{2-} 5 mg/L
 5. SO_4^{2-} 10 mg/L
 6. Br^- 10 mg/L
 7. NO_3^- 10 mg/L
 8. PO_4^{3-} 15 mg/L



Column : Shodex IC SI-36 4D
 Eluent : 25 mM KOH aq.
 Flow rate : 0.7 mL/min
 Detector : Suppressed conductivity
 Column temp. : 30 $^\circ\text{C}$

Eluent source : Dionex™ EGC 500 KOH

Ion Chromatography Columns (Cation Analysis)

Features

- YS-50**
- High performance type of YK-421
 - Applicable to both suppressor and non-suppressor methods
 - Provides sharp peaks; more significant 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 separating of alkylamines
 - Fulfills USP L76 requirements
-
- Y-521**
- Column for cation analysis with non-suppressor method
 - Separates monovalent cations or divalent cations
 - Fulfills USP L17 and L22 requirements
-
- T-521**
- Column for transition metal ion analysis
 - Highly sensitive analysis achievable using post column color reaction method
 - Fulfills USP L17 and L22 requirements

● 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	5 mM Tartaric acid + 1 mM Dipicolinic acid + 1.5 g/L Boric acid aq.
F6709608	IC YK-G	(guard column)	Carboxyl	Silica	5	4.6 × 10	5 mM Tartaric acid + 1 mM Dipicolinic acid + 1.5 g/L Boric acid aq.
F6995210	IC Y-521	≥ 3,000	Sulfo	Styrene divinylbenzene copolymer	12	4.6 × 150	4 mM HNO ₃ aq.
F6700230	IC Y-G	(guard column)	Sulfo	Styrene divinylbenzene copolymer	12	4.6 × 10	4 mM HNO ₃ aq.

Housing Material: SUS

● Standard columns

[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	3 mM HNO ₃ aq.
F6700412	IC T-G	(guard column)	Sulfo	12	4.6 × 10	3 mM HNO ₃ aq.

Base Material: Styrene divinylbenzene copolymer Housing Material: PEEK

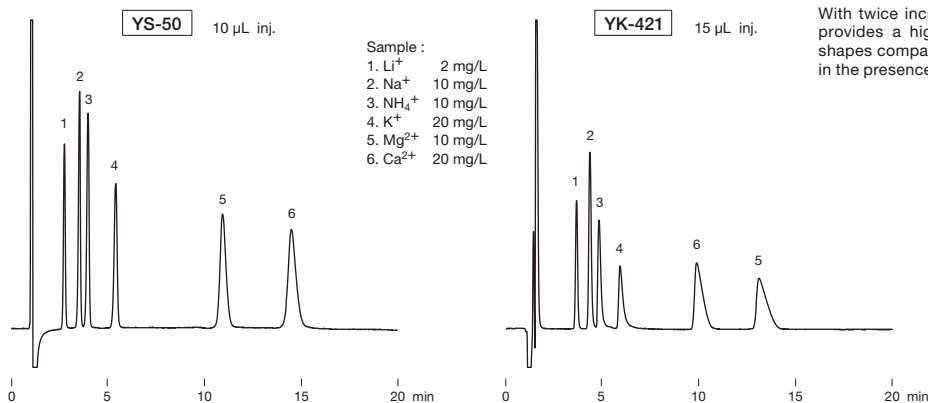
● Line filters for IC

[Shareable for anion analysis and cation analysis]

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

Removes insoluble components in the eluent by installing it upstream of the injector

Cation analysis using YS-50 and YK-421



Sample :
 1. Li⁺ 2 mg/L
 2. Na⁺ 10 mg/L
 3. NH₄⁺ 10 mg/L
 4. K⁺ 20 mg/L
 5. Mg²⁺ 10 mg/L
 6. Ca²⁺ 20 mg/L

With twice increased theoretical plate number, YS-50 provides a higher performance with improved peak shapes compared to YK-421. The quantitation of NH₄⁺ in the presence of high Na⁺ content is also improved.

TP	YS-50	YK-421
Mg ²⁺	6,900	3,000
Ca ²⁺	6,600	3,000

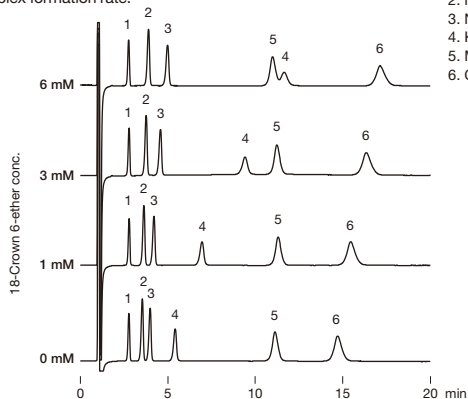
Resolution (Na ⁺ and NH ₄ ⁺)	YS-50	YK-421
	2.5	2.1

Column : Shodex IC YS-50
Eluent : 4 mM Methanesulfonic acid aq.
Flow rate : 1.0 mL/min
Detector : Non-suppressed conductivity
Column temp. : 40 °C

Column : Shodex IC YK-421
Eluent : 5 mM Tartaric acid + 1 mM Dipicolinic acid + 1.5 g/L Boric acid aq.
Flow rate : 1.0 mL/min
Detector : Non-suppressed conductivity
Column temp. : 40 °C

Effects of added crown ether in the eluent

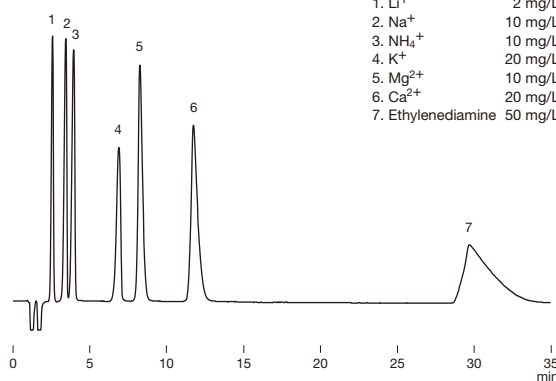
Crown ether forms complex with cations. The elution of cations (particularly K⁺) can be well controlled by the difference in complex formation rate.



Sample : 10 µL
 1. Li⁺ 2 mg/L
 2. Na⁺ 10 mg/L
 3. NH₄⁺ 10 mg/L
 4. K⁺ 20 mg/L
 5. Mg²⁺ 10 mg/L
 6. Ca²⁺ 20 mg/L

Column : Shodex IC YS-50
Eluent : 4 mM Methanesulfonic acid + 18-Crown 6-ether aq.
Flow rate : 1.0 mL/min
Detector : Non-suppressed conductivity
Column temp. : 40 °C

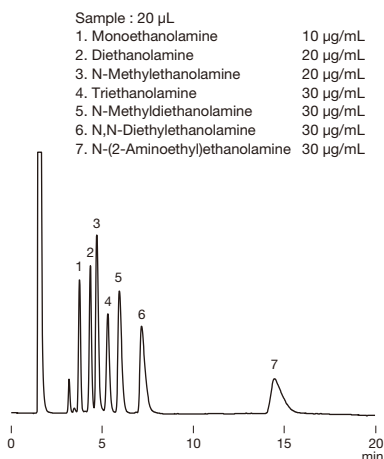
Simultaneous analysis of cations and ethylenediamine



Sample : 50 µL
 1. Li⁺ 2 mg/L
 2. Na⁺ 10 mg/L
 3. NH₄⁺ 10 mg/L
 4. K⁺ 20 mg/L
 5. Mg²⁺ 10 mg/L
 6. Ca²⁺ 20 mg/L
 7. Ethylenediamine 50 mg/L

Column : Shodex IC YS-50
Eluent : 4 mM HNO₃ + 1.5 mM 18-Crown 6-ether aq. / CH₃CN=90/10
Flow rate : 1.0 mL/min
Detector : Non-suppressed conductivity
Column temp. : 40 °C

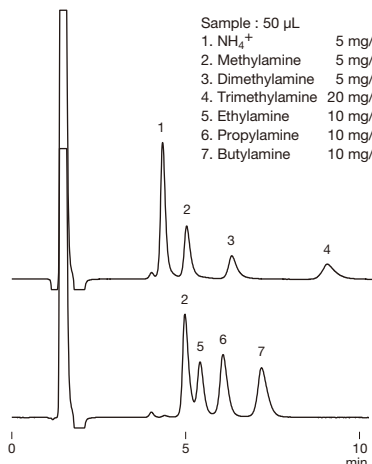
Amino alcohols



Sample : 20 µL
 1. Monoethanolamine 10 µg/mL
 2. Diethanolamine 20 µg/mL
 3. N-Methylethanolamine 20 µg/mL
 4. Triethanolamine 30 µg/mL
 5. N-Methyldiethanolamine 30 µg/mL
 6. N,N-Diethylethanolamine 30 µg/mL
 7. N-(2-Aminoethyl)ethanolamine 30 µg/mL

Column : Shodex IC YK-421
Eluent : 4 mM HNO₃ aq.
Flow rate : 1.0 mL/min
Detector : Non-suppressed conductivity
Column temp. : 40 °C

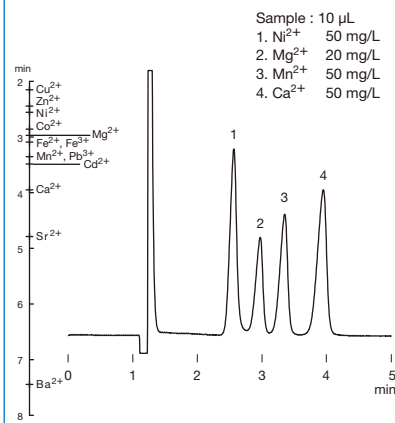
Alkylamines



Sample : 50 µL
 1. NH₄⁺ 5 mg/L
 2. Methylamine 5 mg/L
 3. Dimethylamine 5 mg/L
 4. Trimethylamine 20 mg/L
 5. Ethylamine 10 mg/L
 6. Propylamine 10 mg/L
 7. Butylamine 10 mg/L

Column : Shodex IC YK-421
Eluent : 4 mM H₃PO₄ aq./CH₃CN=90/10
Flow rate : 1.0 mL/min
Detector : Non-suppressed conductivity
Column temp. : 25 °C

Alkaline earth metal ions



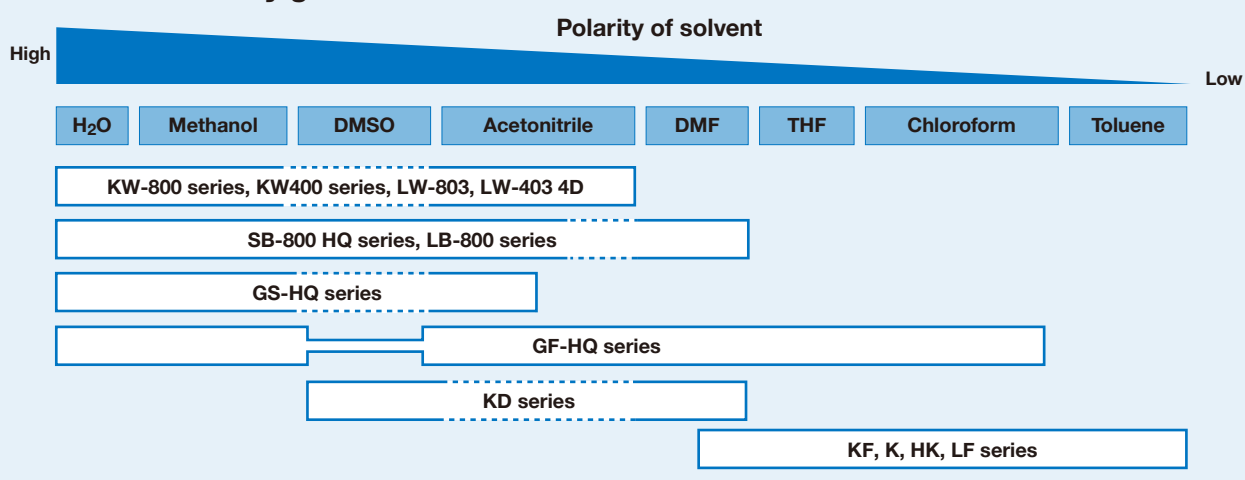
Sample : 10 µL
 1. Ni²⁺ 50 mg/L
 2. Mg²⁺ 20 mg/L
 3. Mn²⁺ 50 mg/L
 4. Ca²⁺ 50 mg/L

Column : Shodex IC Y-521
Eluent : 4 mM Tartaric acid + 2 mM Ethylenediamine aq.
Flow rate : 1.0 mL/min
Detector : Non-suppressed conductivity
Column temp. : 40 °C

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	38	
			KW400 series	High performance (solvent-saving)	38
			LW-803	High performance	39
			LW-403 4D	High performance (Rapid analysis)	39
	Biological macromolecules (high MW range)	Buffer etc.	SB-800 HQ series	42	
			LB-800 series	For light scattering detector	42
	Water-soluble polymers (polyacrylamide, polyethylenimine, etc.) Polysaccharides	Water, Buffer, Aqueous solution, etc.	SB-800 HQ series	42	
			LB-800 series	For light scattering detector	42
	Oligosaccharide, polysaccharides	Water, Aqueous solution, etc.	KS-800 series	26	
			GS-HQ series	46	
Organic SEC (GPC)	General polymers	THF	KF-800 series	50	
			KF-600 series	Rapid analysis (solvent-saving)	56
			KF-400HQ series	High performance (solvent-saving)	56
			HK-400 series	Ultra-rapid Analysis (solvent-saving)	58
		LF series	High-linear calibration curves	60	
		Chloroform	K-800 series	52	
			HK-400 series	Ultra-rapid Analysis (solvent-saving)	58
			LF series	High-linear calibration curves	60
	Polar polymers (polyimides, polyvinylpyrrolidones etc.)		DMF	KD-800 series	54
		HK-400 series		Ultra-rapid Analysis (solvent-saving)	58
		LF series		High-linear calibration curves	60
		SB-800 HQ series		42	
		LB-800 series	For light scattering detector	42	
		Analysis at high temperature (polyethylene, polypropylene etc.)	ODCB etc.	HT-800 series	62
				UT-800 series	62
				AT-806MS	62
Engineering resin analysis at room temperature [polyamide (Nylon), polyethylene terephthalate (PET) etc.]	HFIP			HFIP-800 series	64
		HFIP-600 series	Rapid analysis (solvent-saving)	64	
		HK-400 series	Ultra-rapid Analysis (solvent-saving)	58	
		LF series	High-linear calibration curves	60	
Aqueous/Organic SEC			GF-HQ series	48	

Solvent usability guideline for the Shodex SEC columns



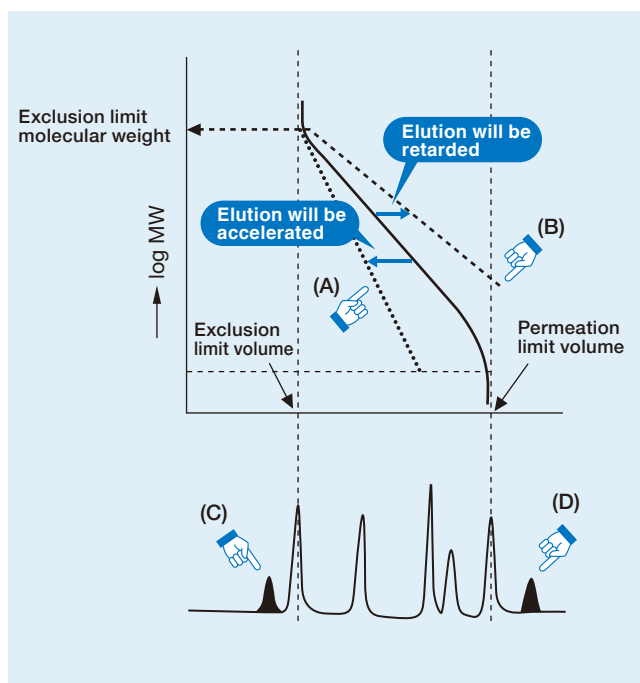
Precautions for Polar Polymer Analysis

Unexpected interactions in the column can affect the size exclusion chromatography analysis of polar polymers. These interactions may change elution patterns and results in an invalid molecular weight calculation. It is important to reduce these interfering interactions 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 on the packing material. This delays the analyte elution and results in under estimating the analyte's molecular weight. See (B) and (D).
- **Ionic interaction**
 - (1) Ion Exclusion
 - The analyte is repelled from the packing material. This accelerates the analyte elution and results in over estimating the analyte's molecular weight. See (A) and (C).
 - (2) Ion Exchange
 - The analyte is adsorbed on the packing material. This delays the analyte elution and results in under estimating the analyte's molecular weight. See (B) and (D).



Interaction within and between the analyte

- **Ionic repulsion effects observed within the multivalent macromolecules causes structure expansion**
 - This accelerates the analyte elution and results in over estimating the analyte's molecular weight. See (A).
- **Association between the molecules**
 - This accelerates the analyte elution and results in over estimating the analyte's molecular weight. See (A).

Interactions between the analyte and the solvent

- The multivalent ion in 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 the analyte dissociation
 - Cationic polymer → Lower the pH
 - Anionic polymer → Higher the pH
- Lower the eluent polarity
 - (Example) Add acetonitrile or methanol

Organic SEC (GPC)

Ionic interaction

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

Hydrophobic interaction

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

Hydrophilic interaction

- Increase the eluent polarity
 - (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
- Fulfills USP L20, L33, and L59 requirements

KW400

- Reduced packing material particle size enhances column performance
- Three to four-fold higher sensitivity than KW-800 series
- KW405-4F is applicable analyzing samples with molecular weight above 1,000,000
- Fulfills USP L20, L33, and L59 requirements

LW-803

- Pore size specifically controlled for analyzing proteins with a molecular weight of several hundred of thousand
- High performance analysis of antibody drugs and various proteins
- High lot-to-lot reproducibility
- Fulfills USP L20, L33, and L59 requirements

New

LW-403 4D

- Rapid analysis column for LW-803
- Achieves approximately half the analysis time compared with standard column
- Fulfills USP L20, L33, and L59 requirements

Standard columns

Product Code	Product Name	Plate Number* (TP/column)	Particle Size (μm)	Pore Size (\AA) (max / average)	Column Size (mm) I.D. x Length	Shipping Solvent
F6989000	PROTEIN KW-802.5	$\geq 21,000$	5	400 / 150	8.0 x 300	H ₂ O
F6989103	PROTEIN KW-803	$\geq 21,000$	5	1,000 / 300	8.0 x 300	H ₂ O
F6989104	PROTEIN KW-804	$\geq 16,000$	7	1,500 / 500	8.0 x 300	H ₂ O
F6700131	PROTEIN KW-G 6B	(guard column)	7	-	6.0 x 50	H ₂ O

*Measured with ethylene glycol

Base Material: Silica
Usable pH range: pH 3.0 - 7.5
Usable concentration of methanol and acetonitrile is up to 100 %

High performance semi-micro columns

© KW400 series is recommended to be used with semi-micro type devices.

Product Code	Product Name	Plate Number* (TP/column)	Particle Size (μm)	Pore Size (\AA) (max / average)	Column Size (mm) I.D. x Length	Shipping Solvent
F6989201	KW402.5-4F	$\geq 35,000$	3	400 / 150	4.6 x 300	H ₂ O
F6989202	KW403-4F	$\geq 35,000$	3	800 / 250	4.6 x 300	H ₂ O
F6989203	KW404-4F	$\geq 25,000$	5	1,500 / 500	4.6 x 300	H ₂ O
F6989204	KW405-4F	$\geq 25,000$	5	2,000 / 1,000	4.6 x 300	H ₂ O
F6700132	KW400G-4A	(guard column)	5	-	4.6 x 10	H ₂ O

*Measured with uridine

Base Material: Silica
Usable pH range: pH 3.0 - 7.5
Usable concentration of methanol and acetonitrile is up to 100 %

For antibody drugs analysis

● Standard columns

Product Code	Product Name	Plate Number* (TP/column)	Particle Size (μm)	Pore Size (\AA)	Column Size (mm) I.D. x Length	Shipping Solvent
F6989303	PROTEIN LW-803	$\geq 12,000$	3	1,000	8.0 x 300	H ₂ O
F6700133	PROTEIN LW-G 6B	(guard column)	3	–	6.0 x 50	H ₂ O

*Measured with bovine serum albumin

Base Material: Silica
Usable pH range: pH 3.0 - 7.5
Usable concentration of methanol and acetonitrile is up to 100 %

● Semi-micro columns

© LW-403 is recommended to be used with semi-micro type devices.

Product Code	Product Name	Plate Number* (TP/column)	Particle Size (μm)	Pore Size (\AA)	Column Size (mm) I.D. x Length	Shipping Solvent
F6989403	New PROTEIN LW-403 4D	$\geq 11,000$	1.9	1,000	4.6 x 150	H ₂ O
F6700134	New PROTEIN LS-G 4J	(guard column)	1.9	–	4.6 x 20	H ₂ O

*Measured with bovine serum albumin

Base Material: Silica
Usable pH range: pH 3.0 - 7.5
Usable concentration of methanol and acetonitrile is up to 100 %

● 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
F6505020	PROTEIN KW-2002.5	$\geq 17,000$	5	20.0 x 300	KW-802.5
F6505021	PROTEIN KW-2003	$\geq 17,000$	5	20.0 x 300	KW-803
F6505022	PROTEIN KW-2004	$\geq 14,000$	7	20.0 x 300	KW-804
F6709556	PROTEIN KW-G 8B	(guard column)	7	8.0 x 50	(guard column)

*Measured with ethylene glycol

Base Material: Silica

Target molecular weight range and exclusion limit

● Measured 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)
LW-803, LW-403 4D	10,000 – 700,000	*(1,000,000)

Please use the above table for reference purposes only when selecting columns.

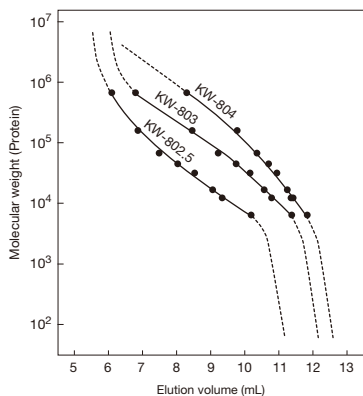
*() Estimated value

● Measured 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

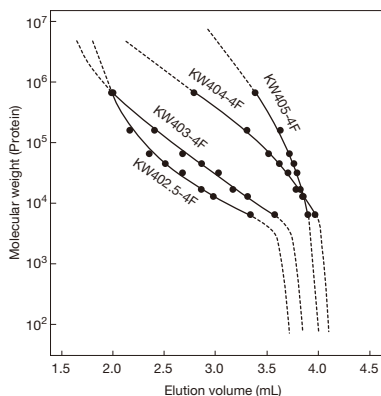
Please use the above table for reference purposes only when selecting columns.

Calibration curves for KW-800 series using protein



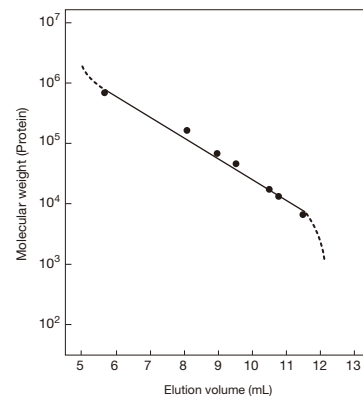
Column : Shodex PROTEIN KW-800 series
Eluent : 50 mM Sodium phosphate buffer (pH 7.0) + 0.3 M NaCl
Flow rate : 1.0 mL/min
Detector : UV (280 nm)
Column temp. : 30 °C

Calibration curves for KW400 series using protein



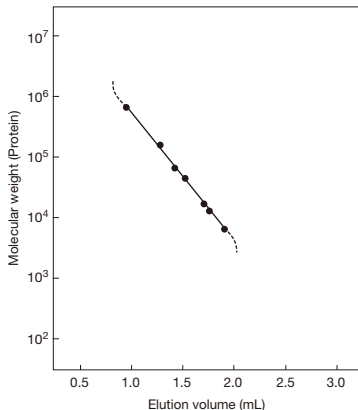
Column : Shodex KW400-4F series
Eluent : 50 mM Sodium phosphate buffer (pH 7.0) + 0.3 M NaCl
Flow rate : 0.33 mL/min
Detector : UV (280 nm) (small cell volume)
Column temp. : 30 °C

Calibration curve for LW-803 using protein



Column : Shodex PROTEIN LW-803
Eluent : 50 mM Sodium phosphate buffer (pH 7.0) + 0.3 M NaCl
Flow rate : 1.0 mL/min
Detector : UV (280 nm)
Column temp. : Room temp.

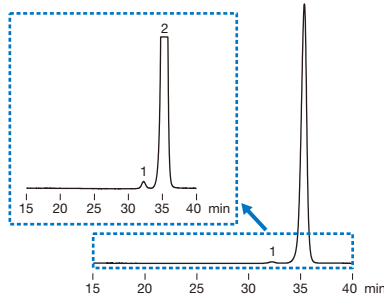
Calibration curve for LW-403 4D using protein



Column : Shodex PROTEIN LW-403 4D
Eluent : 50 mM Sodium phosphate buffer (pH 7.0) + 0.3 M NaCl
Flow rate : 0.35 mL/min
Detector : UV (280 nm) (small cell volume)
Column temp. : 30 °C

Analysis of impurities (high molecular weight proteins) in insulin glargine following USP method

Sample : 100 µL
System suitability solution (prepared following USP method)
 1. High molecular weight proteins
 2. Insulin glargine



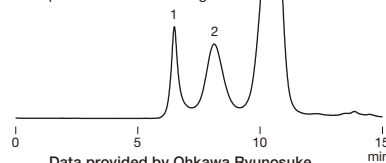
Column : Shodex PROTEIN KW-802.5 x 2
Eluent : CH₃COOH/CH₃CN/H₂O=20/30/50 (pH to 3.0 adjusted with 25 % NH₃ aq.)
Flow rate : 0.5 mL/min
Detector : UV (276 nm)
Column temp. : Ambient

Lipoproteins in serum

Sample : 40 µL
 Whole lipoproteins from serum of a healthy person 1.0 mg/mL
 1. VLDL 2. LDL 3. HDL

[Preparation of sample]

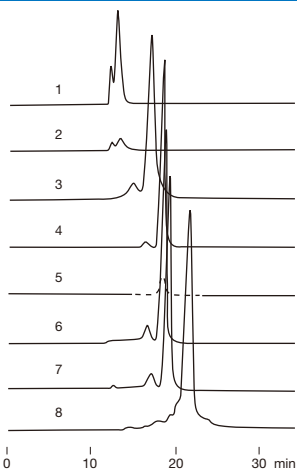
1. Use potassium bromide to adjust the specific gravity of serum from a healthy person to 1.210 g/mL. Ultracentrifuge for 24 hours.
2. Dialyze the supernatant and then substitute the solvent with PBS*.
3. Measure protein concentration by Lowry method and dilute the sample with PBS* to 1.0 mg/mL.



Data provided by Ohkawa Ryunosuke, Graduate School of Health Care Sciences, Analytical Laboratory Chemistry, Tokyo Medical and Dental University

Column : Shodex PROTEIN KW-G + KW-804
Eluent : 10-fold diluted x 10 PBS* with H₂O
Flow rate : 1.0 mL/min
Detector : UV (280 nm)
Column temp. : 30 °C
 x 10 PBS* : 80 g NaCl + 29 g Na₂HPO₄·12H₂O + 2 g KCl + 2 g KH₂PO₄ in 1000 mL of H₂O

Proteins in human blood serum

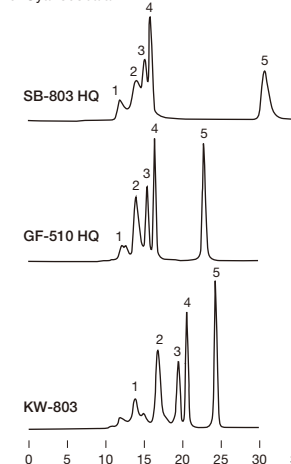


Sample : 0.1 % each
 1. Fibrinogen 50 µL
 2. α₂-Macroglobulin 50 µL
 3. IgG 50 µL
 4. Transferrin 50 µL
 5. Plasminogen 50 µL
 6. Albumin 100 µL
 7. Antitrypsin 100 µL
 8. Hemoglobin 100 µL

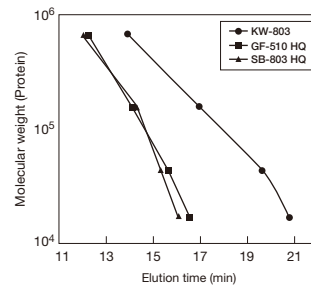
Column : Shodex PROTEIN KW-803
Eluent : 50 mM Sodium phosphate buffer (pH 7.0) + 0.3 M NaCl
Flow rate : 1.0 mL/min
Detector : UV (280 nm)
Column temp. : Room temp.

Comparing three GFC columns for the separation of common proteins

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



Separation performances of three aqueous SEC columns (SB-803 HQ, GF-510 HQ, and KW-803) were compared. 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 : 0.2 M Phosphate buffer (pH 6.9)
Flow rate : 0.5 mL/min
Detector : UV (280 nm)
Column temp. : 30 °C

Comparison of LW-803, conventional column, and other manufacturer's column

PROTEIN LW-803 is suitable for analyzing proteins with molecular weight of several hundreds of thousands. Compared to our conventional columns and other manufacturer's columns, LW-803 has improved separation performance in the molecular weight range around 160,000 (about the size of γ -Globulin). This improvement is advantageous for the separation of monomer and dimer of IgG which is a mainstream antibody drug.

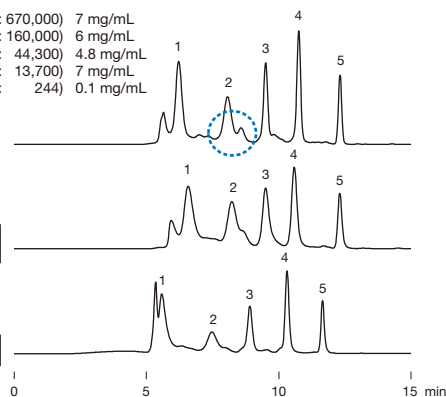
Sample : 5 μ L

1. Thyroglobulin (MW : 670,000) 7 mg/mL
2. γ -Globulin (MW : 160,000) 6 mg/mL
3. Ovalbumin (MW : 44,300) 4.8 mg/mL
4. Ribonuclease A (MW : 13,700) 7 mg/mL
5. Uridine (MW : 244) 0.1 mg/mL

LW-803

(conventional type)
KW-803

Company A



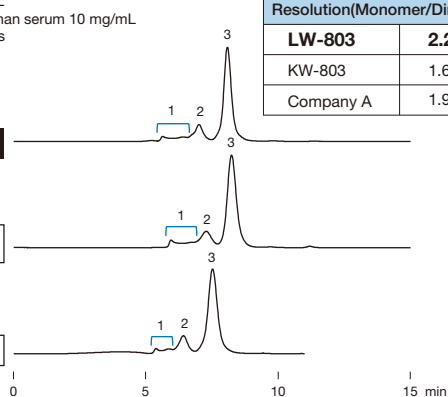
Sample : 5 μ L

- IgG from human serum 10 mg/mL
1. Aggregates
 2. Dimer
 3. Monomer

LW-803

(conventional type)
KW-803

Company A

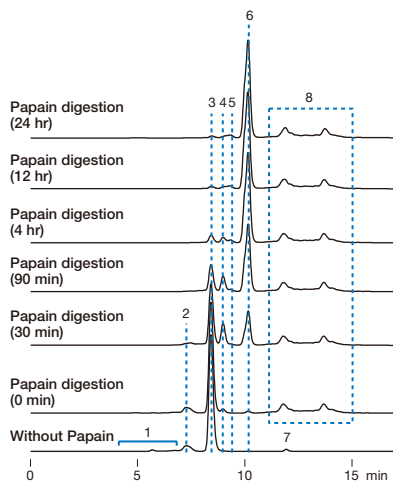


Resolution(Monomer/Dimer)	
LW-803	2.2
KW-803	1.6
Company A	1.9

Column : Shodex PROTEIN LW-803, Shodex PROTEIN KW-803, Silica-based SEC column from other manufacturer
Eluent : 50 mM Sodium phosphate buffer (pH 7.0) + 0.3 M NaCl
Flow rate : 1.0 mL/min
Detector : UV (280 nm)
Column temp. : Room temp.

Monitoring papain digestion of humanized monoclonal IgG

Papain digestion of humanized monoclonal IgG was monitored using PROTEIN LW-803, an aqueous SEC (GFC) column. During the papain digestion of IgG, Fc and Fab fragments from the IgG and their decomposition intermediates are expected to be observed. LW-803 separates IgG and decomposed fragments and intermediates well from each other, thus it is suitable for the monitoring of papain digestion of IgG.



Sample : 10 μ L

- Humanized monoclonal IgG
1. Aggregates of IgG
 2. Dimer of IgG
 3. Monomer of IgG
 - 4 - 6. Fragments of IgG from papain digestion
 7. Citric acid
 8. Papain

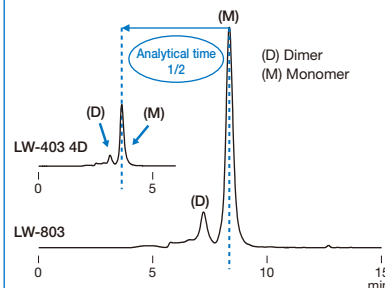
[Procedure of papain digestion]

- (1) Dissolve 3 mg of humanized monoclonal IgG in 500 μ L of the eluent. (6 mg/mL conc.)
- (2) Dissolve 1 mg of papain in 500 μ L of the eluent. (1 mg/mL conc.)
- (3) Pass (1) and (2) through 0.2 μ m membrane filter.
- (4) Mix each solution in equal amounts.
- (5) Keep temperature at 25 $^{\circ}$ C.
- (6) Takes a sample with time and analyze it by HPLC.

Column : Shodex PROTEIN LW-803
Eluent : 0.1 M Sodium phosphate buffer (pH 7.0) + 0.3 M NaCl
Flow rate : 1.0 mL/min
Detector : UV (280 nm)
Column temp. : 25 $^{\circ}$ C

Comparison of separation of IgG between LW-403 4D and LW-803

Sample : IgG from human serum 10 mg/mL
 (LW-403 4D) 0.5 μ L
 (LW-803) 5 μ L



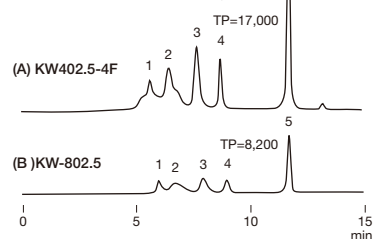
Column : Shodex PROTEIN LW-403 4D
 Shodex PROTEIN LW-803
Eluent : 50 mM Sodium phosphate buffer (pH 7.0) + 0.3 M NaCl
Flow rate : (LW-403 4D) 0.35 mL/min
 (LW-803) 1.0 mL/min
Detector : (LW-403 4D) UV (280 nm) (small cell volume)
 (LW-803) UV (280 nm) (conventional type)
Column temp. : Room temp.

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

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

Sample : 10 μ L

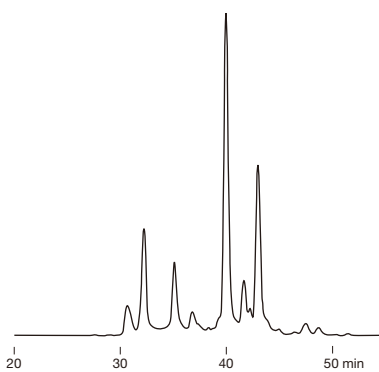
1. Blue dextran 2000 0.2 mg/mL
2. γ -Globulin 0.8 mg/mL
3. Ovalbumin 0.8 mg/mL
4. Myoglobin 0.56 mg/mL
5. Uridine 0.04 mg/mL



Column : Shodex KW402.5-4F
 Shodex PROTEIN KW-802.5
Eluent : 50 mM Sodium phosphate buffer (pH 7.0) + 0.3 M NaCl
Flow rate : (A) 0.33 mL/min, (B) 1.0 mL/min
Detector : UV (280 nm) (small cell volume)
Column temp. : 25 $^{\circ}$ C

Why in yogurt

Sample : Whey, 5 μ L

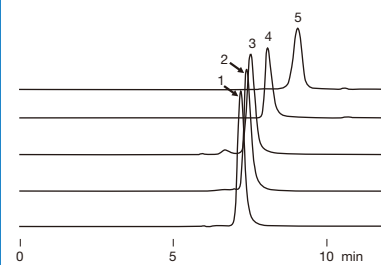


Column : Shodex KW403-4F + KW402.5-4F
Eluent : 50 mM Sodium phosphate buffer (pH 7.0) + 0.3 M NaCl
Flow rate : 0.20 mL/min
Detector : UV (280 nm) (small cell volume)
Column temp. : 30 $^{\circ}$ C

Lectins

Sample : 5 μ L

1. Lectin from soybean 0.6 mg/mL
2. Lectin from arachis hypogaea 1.1 mg/mL
3. Lectin from canavalia ensiformis (Con A) 0.9 mg/mL
4. Lectin from lens culinaris (LCA) 0.7 mg/mL
5. Lectin from triticum vulgaris (WGA) 0.8 mg/mL



Column : Shodex KW402.5-4F
Eluent : 50 mM Sodium phosphate buffer (pH 7.0) + 0.3 M NaCl
Flow rate : 0.33 mL/min
Detector : UV (220 nm) (small cell volume)
Column temp. : 30 $^{\circ}$ C

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)
 - Fulfills USP L38 and L39 requirements
 - SB-802 and 802.5 HQ fulfill USP L25 requirements
 - SB-803 HQ fulfills USP L37 requirements

- SB-807 HQ**
- Column for the analysis of water-soluble ultra high molecular weight polymers
 - Large particle-size gel prevents shear degradation of polymers
 - Fulfills USP L38 and L39 requirements

- LB-800**
- Polymer-based packed columns for aqueous SEC (GFC) analysis
 - Low column bleeding allows its use with light scattering detectors
 - The eluent can be replaced with DMF enabling the analysis of polar polymers
 - LB-804 (exclusion limit: about 1,000,000) and LB-806 (exclusion limit: about 20,000,000) newly added to the series
 - Fulfills USP L38 and L39 requirements
 - LB-803 fulfills USP L37 requirements

● 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 x 300	0.02% NaN ₃ aq.
F6429101	OHpak SB-802.5 HQ	≥ 16,000	6	200	8.0 x 300	0.02% NaN ₃ aq.
F6429102	OHpak SB-803 HQ	≥ 16,000	6	800	8.0 x 300	0.02% NaN ₃ aq.
F6429103	OHpak SB-804 HQ	≥ 16,000	10	2,000	8.0 x 300	0.02% NaN ₃ aq.
F6429104	OHpak SB-805 HQ	≥ 12,000	13	7,000	8.0 x 300	0.02% NaN ₃ aq.
F6429105	OHpak SB-806 HQ	≥ 12,000	13	15,000	8.0 x 300	0.02% NaN ₃ aq.
F6429106	OHpak SB-806M HQ	≥ 12,000	13	15,000	8.0 x 300	0.02% NaN ₃ aq.
F6709430	OHpak SB-G 6B	(guard column)	10	–	6.0 x 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: pH 3 - 10

[Aqueous high molecular weight analysis column]

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 x 300	H ₂ O
F6709431	OHpak SB-807G	(guard column)	35	–	8.0 x 50	H ₂ O

Base Material: Polyhydroxymethacrylate
Usable pH range: pH 3 - 10

[GFC columns to be used with light scattering detector]

Product Code	Product Name	Plate Number (TP/column)	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length	Shipping Solvent
F6429211	New OHpak LB-802.5	≥ 16,000	6	200	8.0 x 300	H ₂ O
F6429201	OHpak LB-803	≥ 16,000	6	800	8.0 x 300	H ₂ O
F6429204	New OHpak LB-804	≥ 16,000	10	2,000	8.0 x 300	H ₂ O
F6429203	OHpak LB-805	≥ 12,000	13	7,000	8.0 x 300	H ₂ O
F6429205	New OHpak LB-806	≥ 12,000	13	15,000	8.0 x 300	H ₂ O
F6429202	OHpak LB-806M	≥ 12,000	13	15,000	8.0 x 300	H ₂ O
F6709434	OHpak LB-G 6B	(guard column)	13	–	6.0 x 50	H ₂ O

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

Base Material: Polyhydroxymethacrylate
Usable pH range: pH 3 - 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 x 300	SB-802 HQ
F6516012	OHpak SB-2002.5	≥ 12,000	10	20.0 x 300	SB-802.5 HQ
F6516013	OHpak SB-2003	≥ 12,000	10	20.0 x 300	SB-803 HQ
F6516014	OHpak SB-2004	≥ 12,000	18	20.0 x 300	SB-804 HQ
F6516015	OHpak SB-2005	≥ 12,000	20	20.0 x 300	SB-805 HQ
F6516016	OHpak SB-2006	≥ 12,000	20	20.0 x 300	SB-806 HQ
F6516017	OHpak SB-2006M	≥ 12,000	20	20.0 x 300	SB-806M HQ
F6709555	OHpak SB-G 8B	(guard column)	18	8.0 x 50	(guard column)

Base Material: Polyhydroxymethacrylate

● 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 SB-2000 series, preparative columns of SB-800 series, is 50 % methanol, acetonitrile, or DMF (SB-2002 is not tolerant to organic solvents).

Target molecular weight range and exclusion limit

● Measured with pullulan (eluent: ultrapure water)

Product Name	Target Molecular Weight Range	Exclusion Limit
SB-802 HQ	200 - 1,000	1000
SB-802.5 HQ	500 - 10,000	10000
SB-803 HQ	1,000 - 100,000	100000
SB-804 HQ	5,000 - 400,000	1000000
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	100000
LB-804	5,000 - 400,000	1,000,000
LB-805	100,000 - 1,000,000	*(4,000,000)
LB-806	100,000 - *(20,000,000)	*(20,000,000)
LB-806M	500 - *(20,000,000)	*(20,000,000)

Please use the above table for reference purposes only when selecting columns.

*() Estimated value

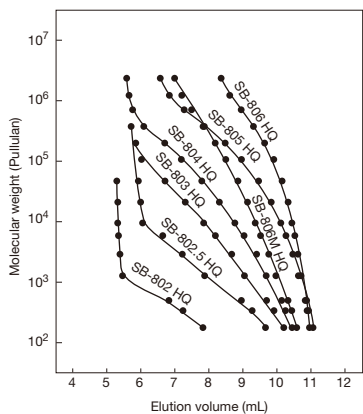
● Measured with PEG/PEO (eluent: DMF)

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-804	500 - 300,000
LB-805	50,000 - 700,000
LB-806	70,000 - *(20,000,000)
LB-806M	200 - *(20,000,000)

Please use the above table for reference purposes only when selecting columns.

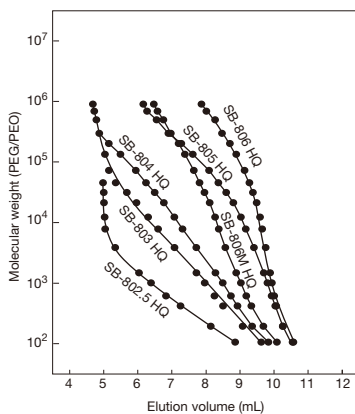
PEG: polyethylene glycol
PEO: polyethylene oxide
*() Estimated value

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



Column : Shodex OHpak SB-800 HQ series
Eluent : H₂O
Flow rate : 1.0 mL/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 : 1.0 mL/min
Detector : RI
Column temp. : 40 °C

Carboxymethylcellulose

Sample : Carboxymethylcellulose 0.1 % each, 50 µL

1,500-3,000 cP
 Mn : 201,300
 Mw : 6,940,500
 Mw/Mn : 34.47

400-800 cP
 Mn : 105,400
 Mw : 2,126,000
 Mw/Mn : 20.18

50-200 cP
 Mn : 64,600
 Mw : 402,000
 Mw/Mn : 6.22

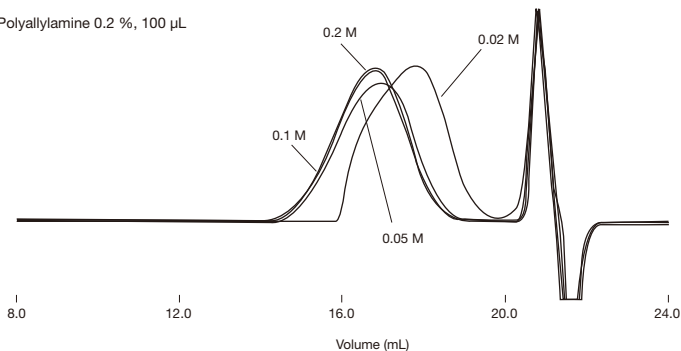
Molecular weight was determined from the calibration curve of pullulan.

Column : Shodex OHpak SB-806M HQ x 2
Eluent : 0.1 M NaCl aq.
Flow rate : 1.0 mL/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, the polymer is observed to adsorb on the column or delayed in elution when low sodium nitrate eluent was used. These phenomena can be suppressed by increasing the concentration of sodium nitrate in the eluent. In the case of polyallylamine, a good shape chromatogram is obtained when sodium nitrate concentration is 0.1 M or higher.

Sample : Polyallylamine 0.2 %, 100 µL



Column : Shodex OHpak SB-806M HQ x 2
Eluent : 0.5 M CH₃COOH + NaNO₃ aq.
Flow rate : 1.0 mL/min
Detector : RI
Column temp. : 40 °C

Gelatin

Sample : 0.1 % each, 100 µL
 Gelatin from bovine skin (Acid treatment, Gel strength : 225 g)
 Gelatin from porcine skin (Alkali treatment, Gel strength : 90-100 g)

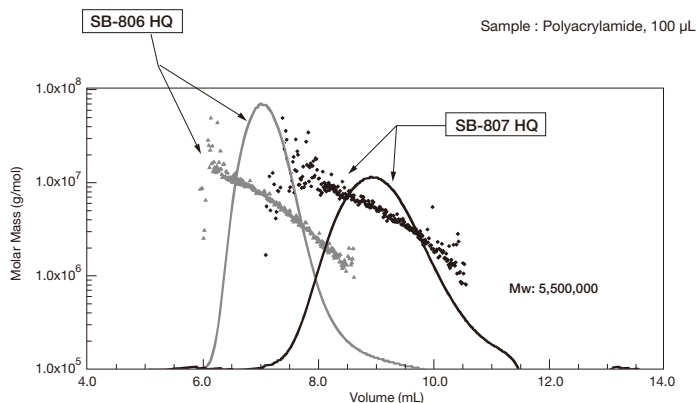
From bovine skin
 Mn : 21,400
 Mw : 108,100
 Mw/Mn : 5.05

From porcine skin
 Mn : 11,500
 Mw : 83,700
 Mw/Mn : 7.28

Molecular weight was determined from the calibration curve of pullulan.

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

Polyacrylamide



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

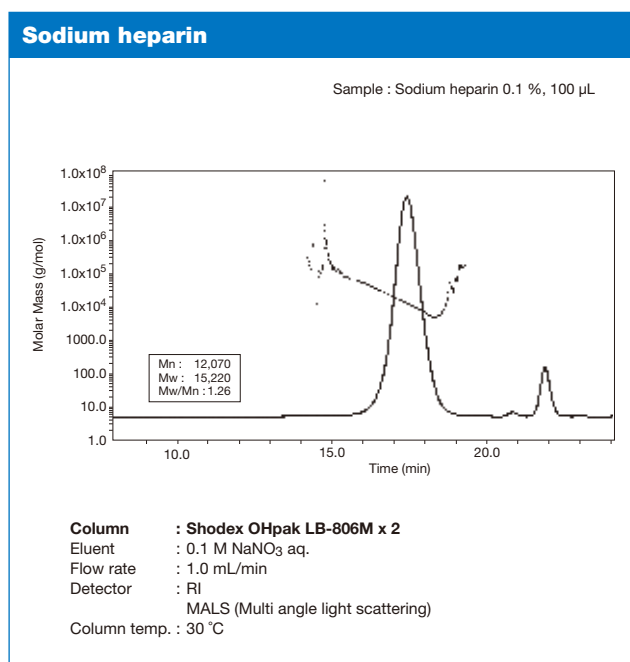
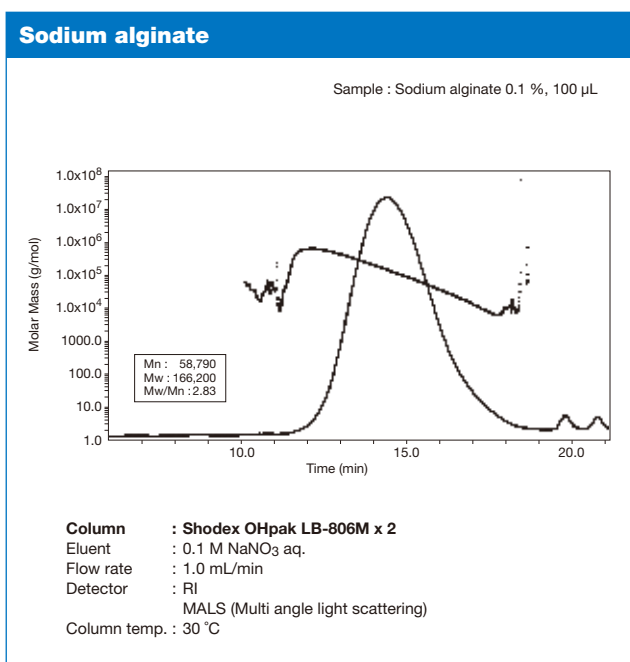
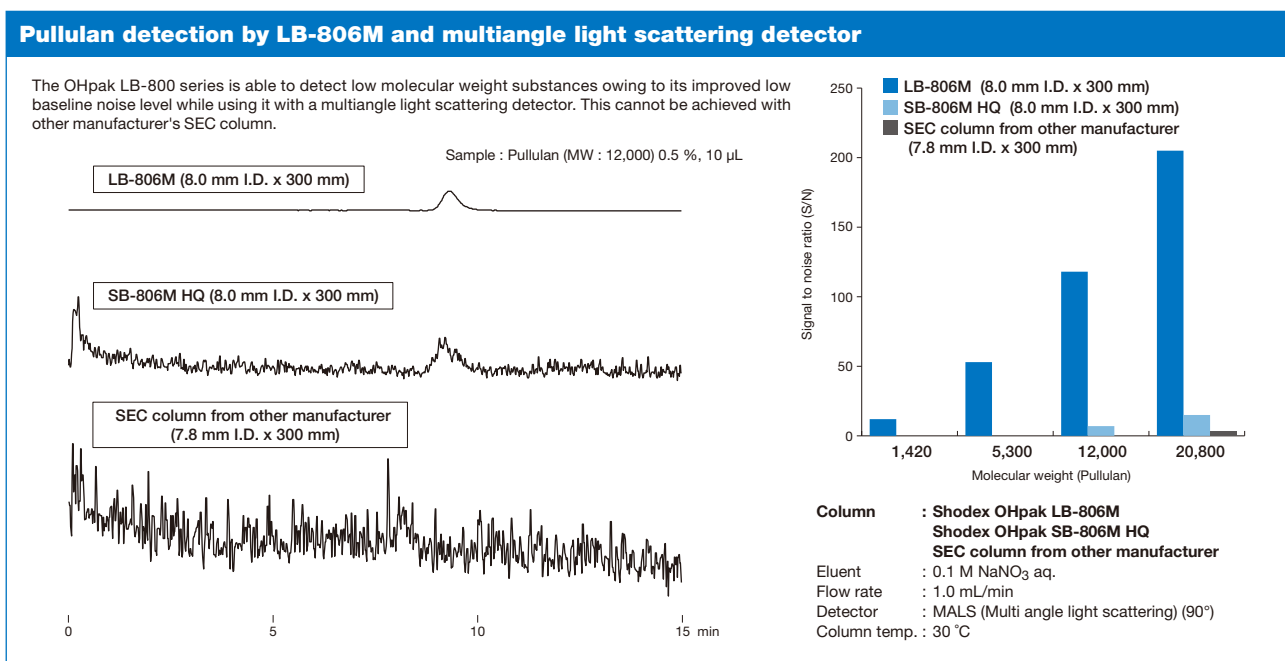
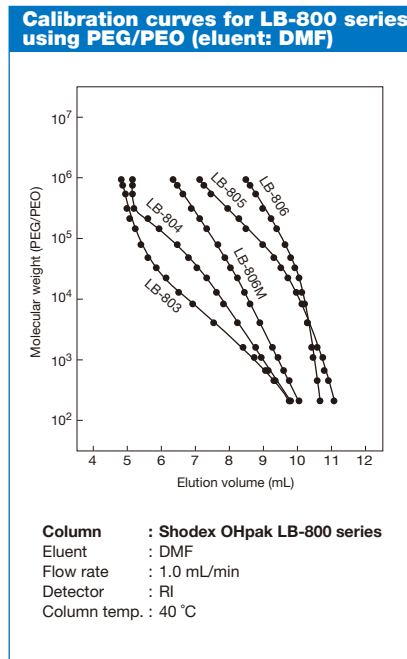
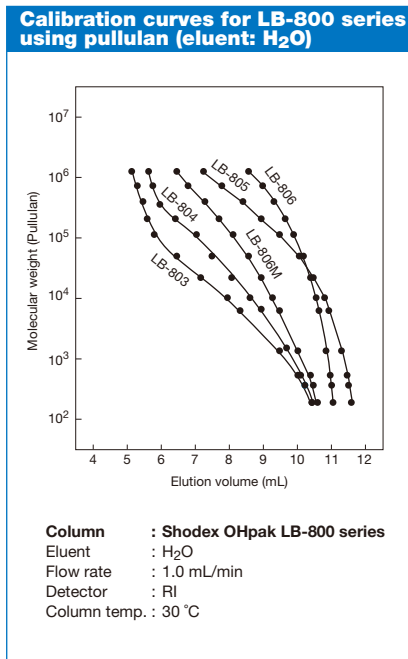
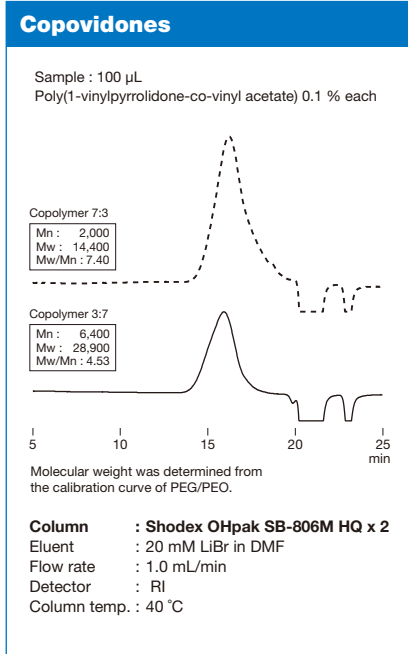
Cellulose acetate

Sample : Cellulose acetate 0.1 % each, 100 µL

Mn-30,000

Mn-50,000

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



Multimode Columns

Features

- GS-HQ**
 - SEC is the main separation mode
 - With the choice of eluent, the column provides 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 x 300	H ₂ O/CH ₃ OH=70/30
F7600006	Asahipak GS-320 HQ	≥ 19,000	6	400	7.5 x 300	H ₂ O/CH ₃ OH=70/30
F7600007	Asahipak GS-520 HQ	≥ 18,000	7	2,000	7.5 x 300	H ₂ O/CH ₃ OH=70/30
F7600008	Asahipak GS-620 HQ	≥ 18,000	7	7,000	7.5 x 300	H ₂ O/CH ₃ OH=70/30
F6710019	Asahipak GS-2G 7B	(guard column)	9	-	7.5 x 50	H ₂ O/CH ₃ OH=70/30

Base Material: Polyvinyl alcohol
 Usable pH range: pH 2 - 12 (GS-220 HQ: pH 2 - 9)
 Usable concentration of methanol is up to 100 % (GS-220 HQ: up to 30 %)
 Usable concentration of acetonitrile is up to 50 %

● 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	400	4.6 x 150
F7750311	GS320A-4E	6	400	4.6 x 250

Base Material: Polyvinyl alcohol

● 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 x 300	GS-220 HQ
F6810018	Asahipak GS-320 20F	≥ 8,000	13	20.0 x 300	GS-320 HQ
F6810019	Asahipak GS-520 20F	≥ 8,000	13	20.0 x 300	GS-520 HQ
F6810034	Asahipak GS-220 20G	≥ 14,000	13	20.0 x 500	GS-220 HQ
F6810035	Asahipak GS-320 20G	≥ 14,000	13	20.0 x 500	GS-320 HQ
F6810036	Asahipak GS-520 20G	≥ 14,000	13	20.0 x 500	GS-520 HQ
F6710021	Asahipak GS-20G 7B	(guard column)	20	7.5 x 50	(guard column)

Base Material: Polyvinyl alcohol

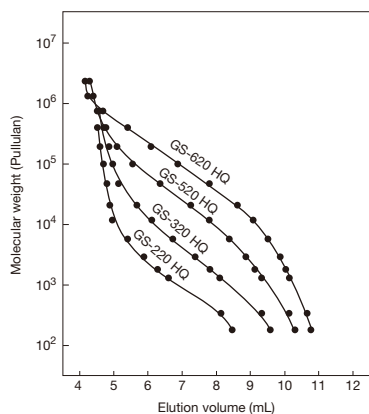
Target molecular weight range and exclusion limit

● Measured 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 for reference purposes only when selecting columns.

Calibration curves for GS-HQ series using pullulan



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

Peptides

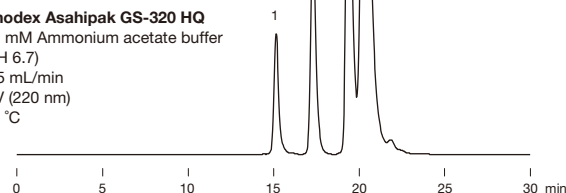
GS-HQ columns work not only under SEC (GFC) mode, but also under multimode, adding hydrophobic and ionic interactions. By carefully selecting the eluent, they provide separation mode that was not available with other types of columns. GS-320 HQ shows excellent performance separating hydrophilic peptides, particularly for acidic and basic peptides.

	MW	pI	Σf
Glu-Ala-Glu	347	3.12	0.39
Arg-Asp	289	6.75	0.68
Gly-His-Lys	340	9.95	0.29
Arg-Pro-Lys-Pro	497	11.44	3.24

Σf: Hydrophobic parameter
 pI: Isoelectric point

Column : Shodex Asahipak GS-320 HQ
Eluent : 30 mM Ammonium acetate buffer (pH 6.7)
Flow rate : 0.5 mL/min
Detector : UV (220 nm)
Column temp. : 30 °C

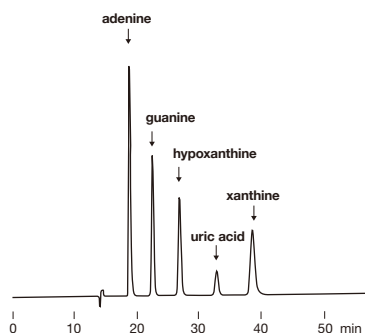
Sample : 20 µL
 1. Glu-Ala-Glu 0.025 %
 2. Arg-Asp 0.05 %
 3. Gly-His-Lys 0.025 %
 4. Arg-Pro-Lys-Pro 0.025 %



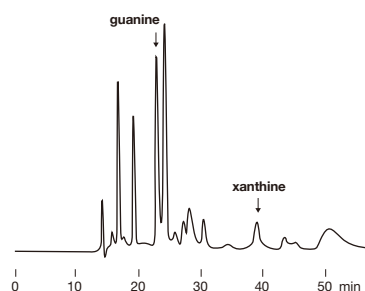
Purine bases in beer

Purine present in food is detected as its purine base form after sample preparation including: homogenization, freeze drying, hydrolyzation with 70 % perchloric acid, and neutralization. The example below shows the analysis of purine in regular beer and beer treated with guanase (an enzyme that degrades guanine to xanthine). The following data indicate that guanine was decreased and xanthine was increased by guanase.

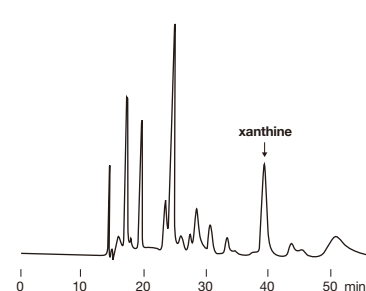
Purine bases in beer



Normal beer



Guanase treated beer

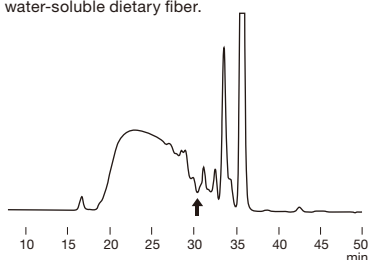


Column : Shodex Asahipak GS-320 HQ
Eluent : 150 mM Sodium phosphate buffer (pH 2.5)
Flow rate : 0.6 mL/min
Detector : UV (260 nm)
Column temp. : 35 °C

Data provided by Kiyoko Kaneko Ph.D.,
 Faculty of Pharmaceutical Sciences, Teikyo University

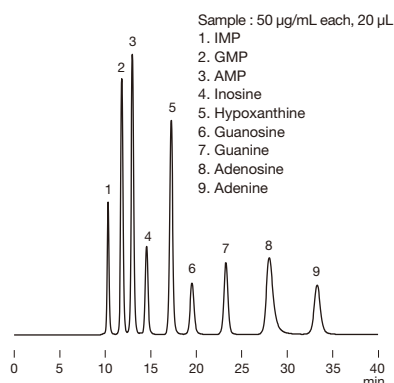
Low molecular weight water-soluble dietary fiber

By using the GS-220 HQ, monosaccharides, disaccharides, and sugar alcohols can elute after the indigestible component fraction (indicated by an arrow on the chromatogram). This separation makes the method preferable for the quantification of low molecular weight water-soluble dietary fiber.



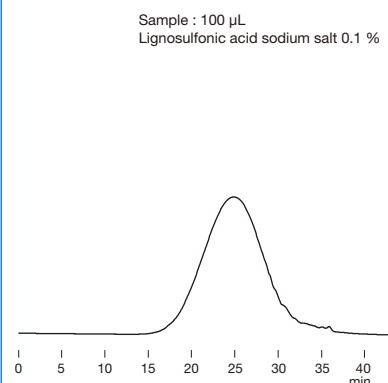
Column : Shodex Asahipak GS-220 HQ x 2
Eluent : H₂O
Flow rate : 0.5 mL/min
Detector : RI
Column temp. : 60 °C

"Umami"



Column : Shodex Asahipak GS-320 HQ
Eluent : 10 mM NaH₂PO₄ aq./10 mM Na₂HPO₄ aq. =1000/31
Flow rate : 1.0 mL/min
Detector : UV (260 nm)
Column temp. : 40 °C

Lignosulfonic acid



Column : Shodex Asahipak GS-520 HQ x 2
Eluent : 20 mM Na₂HPO₄ aq.
Flow rate : 0.6 mL/min
Detector : UV (254 nm)
Column temp. : 40 °C

Aqueous/Organic SEC Columns

Features

- GF-HQ**
 - Polymer-based SEC columns with high solvent durability
 - Works well with 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 x 300	H ₂ O
F7600001	Asahipak GF-310 HQ	≥ 19,000	5	400	7.5 x 300	H ₂ O/CH ₃ OH=70/30
F7600002	Asahipak GF-510 HQ	≥ 19,000	5	2,000	7.5 x 300	H ₂ O/CH ₃ OH=70/30
F7600003	Asahipak GF-710 HQ	≥ 11,000	9	10,000	7.5 x 300	H ₂ O/CH ₃ OH=70/30
F7600004	Asahipak GF-7M HQ	≥ 13,000	9	10,000	7.5 x 300	H ₂ O/CH ₃ OH=70/30
F6710018	Asahipak GF-1G 7B	(guard column)	9	–	7.5 x 50	H ₂ O/CH ₃ OH=70/30
F7600100	MSpak GF-310 4B	≥ 3,000	5	400	4.6 x 50	H ₂ O
F7600110	MSpak GF-310 4D	≥ 10,000	5	400	4.6 x 150	H ₂ O
F7600024	MSpak GF-310 4E	≥ 16,000	5	400	4.6 x 250	H ₂ O
F7600120	MSpak GF-310 2D	≥ 5,500	5	400	2.0 x 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: pH 2 - 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 x 150

Base Material: Polyvinyl alcohol

● 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
F6810030	Asahipak GS-310 20F	≥ 8,000	13	20.0 x 300	GF-310 HQ
F6810031	Asahipak GS-510 20F	≥ 8,000	13	20.0 x 300	GF-510 HQ
F6810038	Asahipak GS-310 20G	≥ 14,000	13	20.0 x 500	GF-310 HQ
F6810039	Asahipak GS-510 20G	≥ 14,000	13	20.0 x 500	GF-510 HQ
F6710020	Asahipak GS-10G 7B	(guard column)	20	7.5 x 50	(guard column)

Base Material: Polyvinyl alcohol

Target molecular weight range and exclusion limit

● Measured 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 for reference purposes only when selecting columns.

*() Estimated value

● Measured 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 for reference purposes only when selecting columns.

PEG: polyethylene glycol
PEO: polyethylene oxide
*() Estimated value

Usable solvents

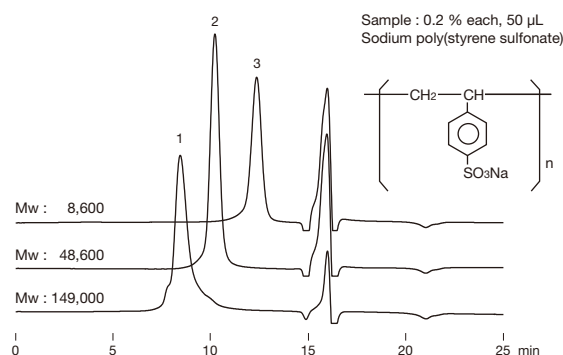
Solvent	GF-210	GF-310 GF-510 GF-710 GF-7M
Water (0 - 0.5 M salt concentration)	○	○
Methanol	○	○
Ethanol	○	○
Acetonitrile	*○	○
THF	○	○
DMF	○	○
Acetone	○	○
Chloroform	*○	○
Ethylacetate	*○	○
DMSO	○	(0 ~ 50 %) ○

*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.

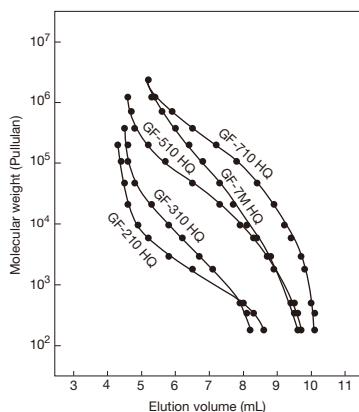
Sodium polystyrene sulfonates

Polymers having both hydrophobic and hydrophilic functional groups may exhibit hydrophobic interactions with packing materials. When analyzing such polymers, addition of organic solvents to the eluent can suppress the hydrophobic interaction.



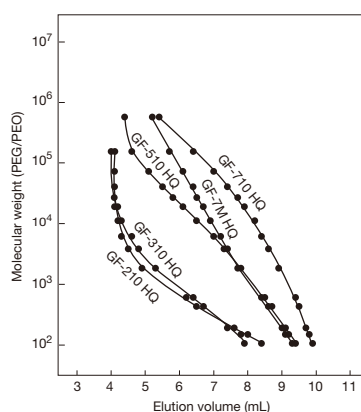
Column : Shodex Asahipak GF-510 HQ
 Eluent : 50 mM LiCl aq./CH₃CN=60/40
 Flow rate : 0.6 mL/min
 Detector : UV (254 nm)
 Column temp. : 30 °C

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



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

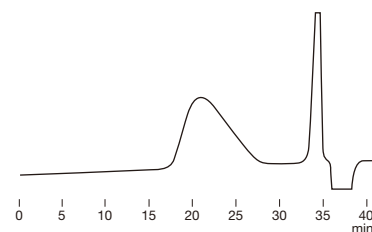
Calibration curves for GF-HQ series using PEG/PEO (eluent: DMF)



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

Polyacrylonitrile

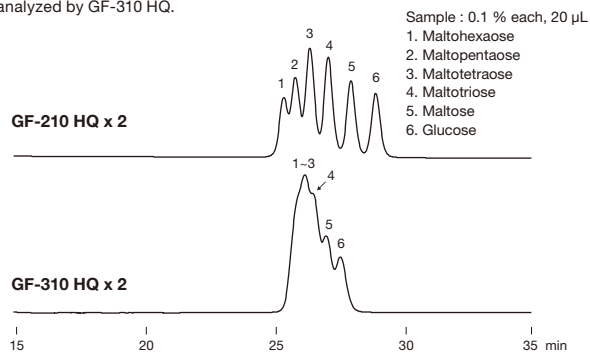
Sample : Polyacrylonitrile 0.1 %, 100 µL



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

Comparison of two GF column performances for the separation of maltooligosaccharides

GF-210 HQ demonstrates an improved separation of low molecular substances. The chromatograms below show 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.

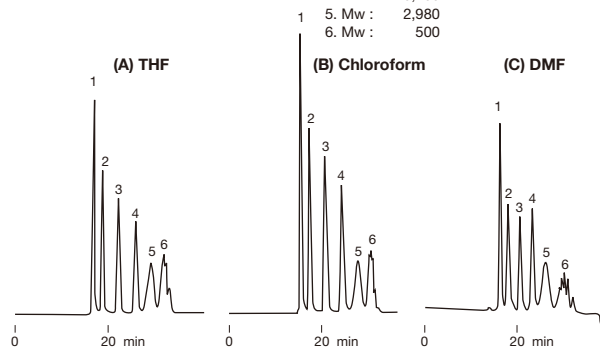


Sample : 0.1 % each, 20 µL
 1. Maltohexaose
 2. Maltopentaose
 3. Maltotetraose
 4. Maltotriose
 5. Maltose
 6. Glucose

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

Comparison of polystyrene separation under three different solvent conditions

Sample : Polystyrene 1 mg/mL each, 50 µL
 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 : 0.5 mL/min
 Detector : (A),(B); UV (254 nm), (C); UV (270 nm)
 Column temp. : 30 °C

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

Features

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

● Standard columns

[**KF-800 series**] Shipping Solvent: Tetrahydrofuran (THF)

Product Code	Product Name	Plate Number (TP/column)	Particle Size (µm)	Pore Size (Å)	Column Size (mm) I.D. x Length
F6028010	GPC KF-801	≥ 18,000	6	50	8.0 x 300
F6028020	GPC KF-802	≥ 18,000	6	150	8.0 x 300
F6028025	GPC KF-802.5	≥ 18,000	6	300	8.0 x 300
F6028030	GPC KF-803	≥ 18,000	6	500	8.0 x 300
F6027030	GPC KF-803L	≥ 18,000	6	500	8.0 x 300
F6028040	GPC KF-804	≥ 18,000	7	1,500	8.0 x 300
F6027040	GPC KF-804L	≥ 18,000	7	1,500	8.0 x 300
F6028050	GPC KF-805	≥ 11,000	10	5,000	8.0 x 300
F6027050	GPC KF-805L	≥ 11,000	10	5,000	8.0 x 300
F6028060	GPC KF-806	≥ 11,000	10	10,000	8.0 x 300
F6028090	GPC KF-806M	≥ 13,000	10	10,000	8.0 x 300
F6027060	GPC KF-806L	≥ 11,000	10	10,000	8.0 x 300
F6028070	GPC KF-807	≥ 6,000	18	20,000	8.0 x 300
F6027070	GPC KF-807L	≥ 6,000	18	20,000	8.0 x 300
F6700300	GPC KF-G 4A	(guard column)	8	–	4.6 x 10
F6709350	GPC KF-800D	(solvent-peak separation column)	10	–	8.0 x 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 54 for details of the solvent-peak separation columns. See page 68 for applicability of SEC (GPC) columns to solvent replacement.

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
F6102401	GPC KF-2001	≥ 18,000	6	20.0 x 300	KF-801
F6102402	GPC KF-2002	≥ 18,000	6	20.0 x 300	KF-802
F6102425	GPC KF-2002.5	≥ 18,000	6	20.0 x 300	KF-802.5
F6102403	GPC KF-2003	≥ 18,000	6	20.0 x 300	KF-803
F6102404	GPC KF-2004	≥ 14,000	7	20.0 x 300	KF-804
F6102405	GPC KF-2005	≥ 10,000	10	20.0 x 300	KF-805
F6102406	GPC KF-2006	≥ 10,000	10	20.0 x 300	KF-806
F6102409	GPC KF-2006M	≥ 10,000	10	20.0 x 300	KF-806M
F6700406	GPC KF-G 8B	(guard column)	15	8.0 x 50	(guard column)

See page 67 for other preparative columns.

Base Material: Styrene divinylbenzene copolymer

Target molecular weight range and exclusion limit

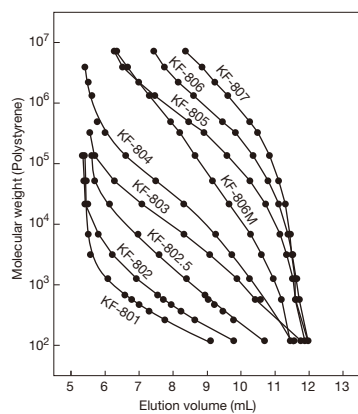
● Measured with polystyrene (eluent: THF)

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

Please use the above tables for reference purposes only when selecting columns.

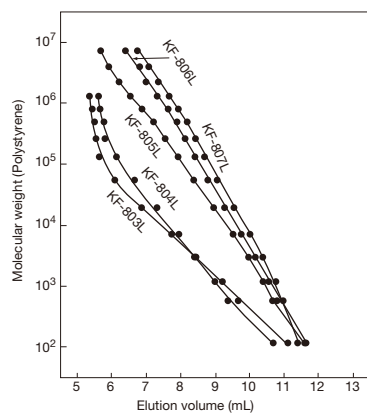
*() Estimated value

Calibration curves for KF-800 series using polystyrene



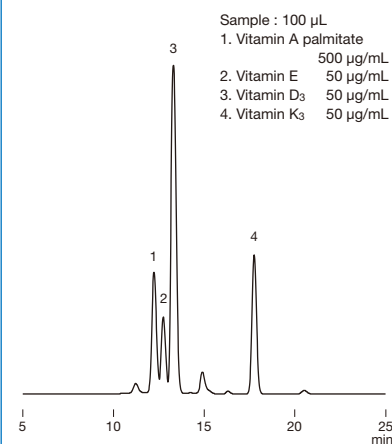
Column : Shodex GPC KF-800 series
 Eluent : THF
 Flow rate : 1.0 mL/min
 Detector : RI
 Column temp. : 40 °C

Calibration curves for KF-800L series using polystyrene (linear type)



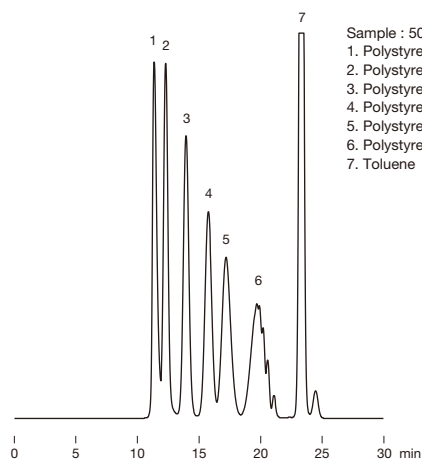
Column : Shodex GPC KF-800L series
 Eluent : THF
 Flow rate : 1.0 mL/min
 Detector : RI
 Column temp. : 40 °C

Fat-soluble vitamins

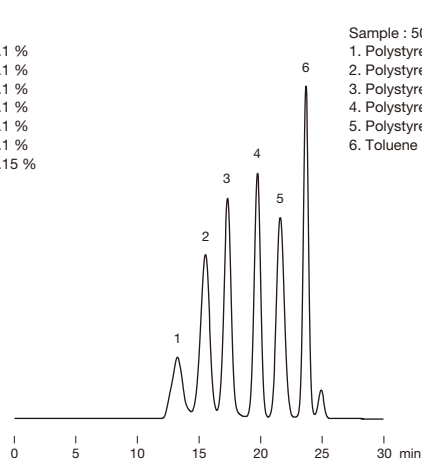


Column : Shodex GPC KF-801 x 2
 Eluent : THF
 Flow rate : 1.0 mL/min
 Detector : UV (280 nm)
 Column temp. : 40 °C

Polystyrene standards



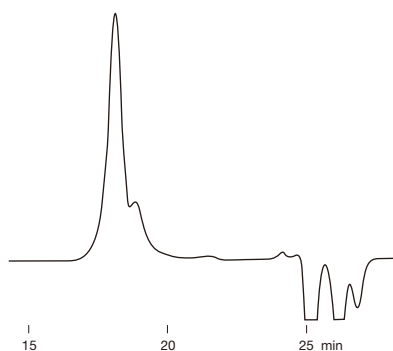
Column : Shodex GPC KF-803L x 2
 Eluent : THF
 Flow rate : 1.0 mL/min
 Detector : UV (254 nm)
 Column temp. : 40 °C



Column : Shodex GPC KF-807L x 2
 Eluent : THF
 Flow rate : 1.0 mL/min
 Detector : UV (254 nm)
 Column temp. : 40 °C

Styrene isoprene ABA block copolymer

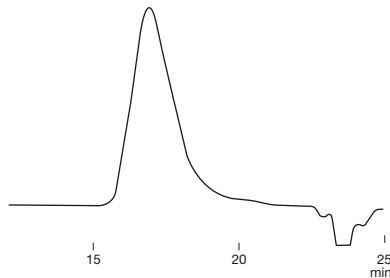
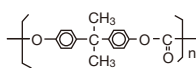
Sample : Styrene isoprene ABA block copolymer



Column : Shodex GPC KF-806M x 2
 Eluent : THF
 Flow rate : 1.0 mL/min
 Detector : RI
 Column temp. : 30 °C

Polycarbonate resin

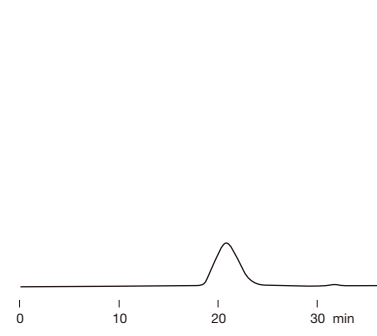
Sample : Polycarbonate resin 0.1 %, 100 µL



Column : Shodex GPC KF-806L x 2
 Eluent : THF
 Flow rate : 1.0 mL/min
 Detector : RI
 Column temp. : 40 °C

Raw rubber

Sample : Rubber 0.1 %, 300 µL



Column : Shodex GPC KF-806M x 2
 + KF-802
 Eluent : Toluene
 Flow rate : 1.0 mL/min
 Detector : RI
 Column temp. : Room temp.

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
 - Fulfills USP L21 requirements

● 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	6	50	8.0 x 300
F6028120	GPC K-802	≥ 18,000	6	150	8.0 x 300
F6028125	GPC K-802.5	≥ 18,000	6	300	8.0 x 300
F6028130	GPC K-803	≥ 18,000	6	500	8.0 x 300
F6028194	GPC K-803L	≥ 18,000	6	500	8.0 x 300
F6028140	GPC K-804	≥ 18,000	7	1,500	8.0 x 300
F6028195	GPC K-804L	≥ 18,000	7	1,500	8.0 x 300
F6028150	GPC K-805	≥ 11,000	10	5,000	8.0 x 300
F6028196	GPC K-805L	≥ 11,000	10	5,000	8.0 x 300
F6028160	GPC K-806	≥ 11,000	10	10,000	8.0 x 300
F6028190	GPC K-806M	≥ 13,000	10	10,000	8.0 x 300
F6028197	GPC K-806L	≥ 11,000	10	10,000	8.0 x 300
F6028198	GPC K-807L	≥ 6,000	18	20,000	8.0 x 300
F6700401	GPC K-G 4A	(guard column)	8	–	4.6 x 10
F6709450	GPC K-800D	(solvent-peak separation column)	10	–	8.0 x 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.

Base Material: Styrene divinylbenzene copolymer

See page 54 for details of the solvent-peak separation columns.

See page 68 for applicability of SEC (GPC) columns to solvent replacement.

● 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
F6102301	GPC K-2001	≥ 18,000	6	20.0 x 300	K-801
F6102312	GPC K-2002	≥ 18,000	6	20.0 x 300	K-802
F6102315	GPC K-2002.5	≥ 18,000	6	20.0 x 300	K-802.5
F6102303	GPC K-2003	≥ 18,000	6	20.0 x 300	K-803
F6102304	GPC K-2004	≥ 14,000	7	20.0 x 300	K-804
F6102305	GPC K-2005	≥ 10,000	10	20.0 x 300	K-805
F6102306	GPC K-2006	≥ 10,000	10	20.0 x 300	K-806
F6102309	GPC K-2006M	≥ 10,000	10	20.0 x 300	K-806M
F6700407	GPC K-G 8B	(guard column)	15	8.0 x 50	(guard column)

See page 66 and 67 for other preparative columns in chloroform.

Base Material: Styrene divinylbenzene copolymer

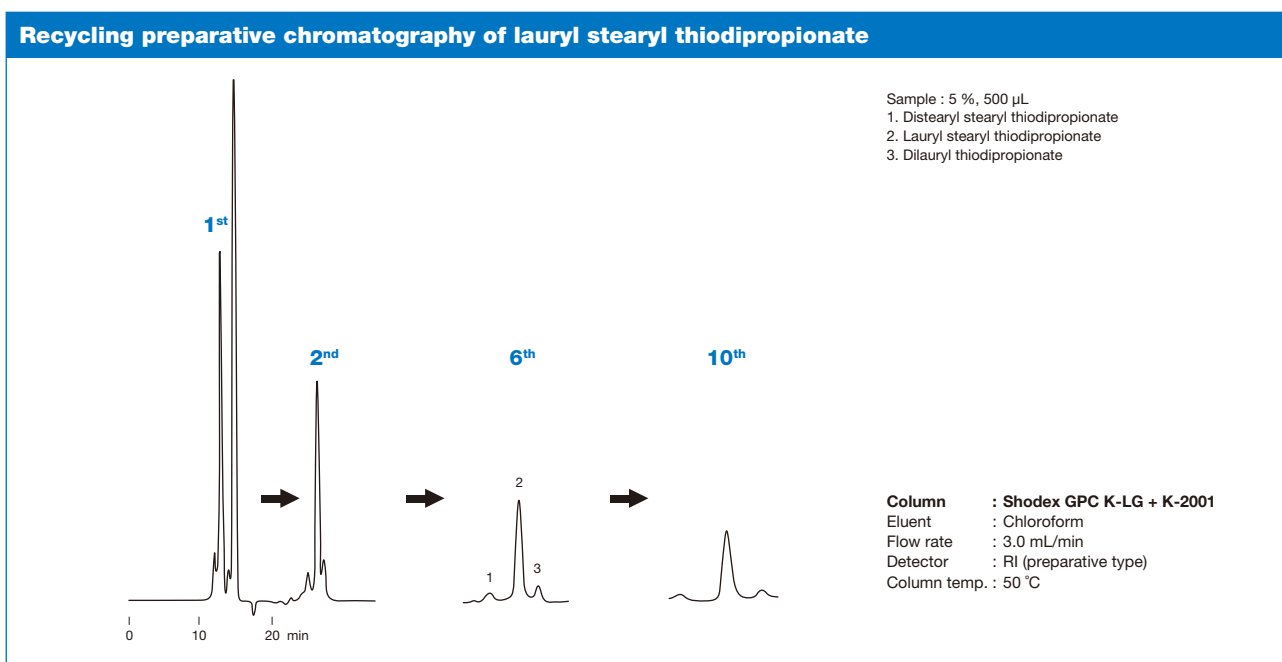
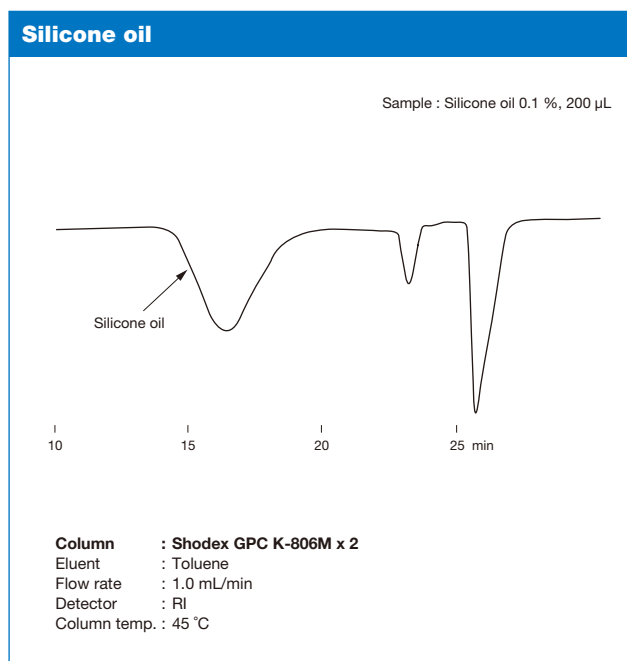
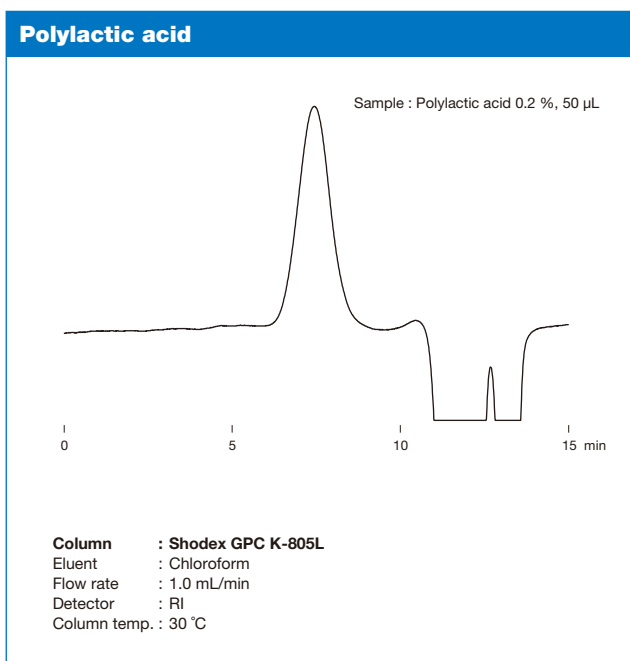
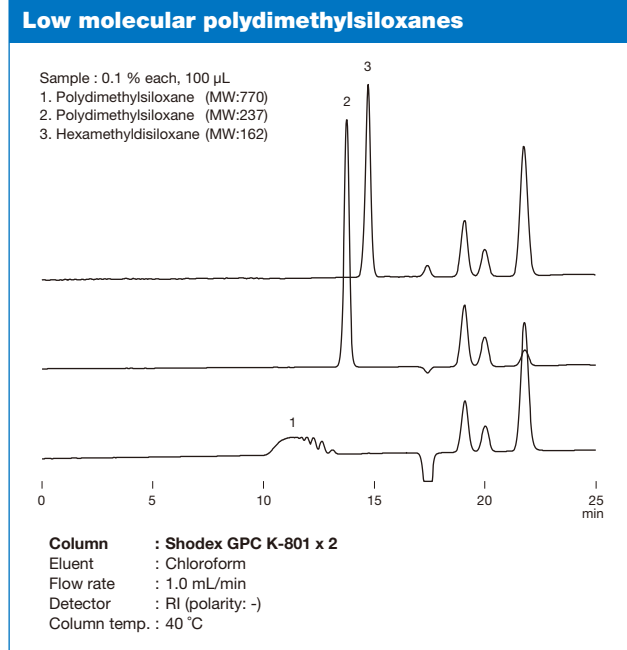
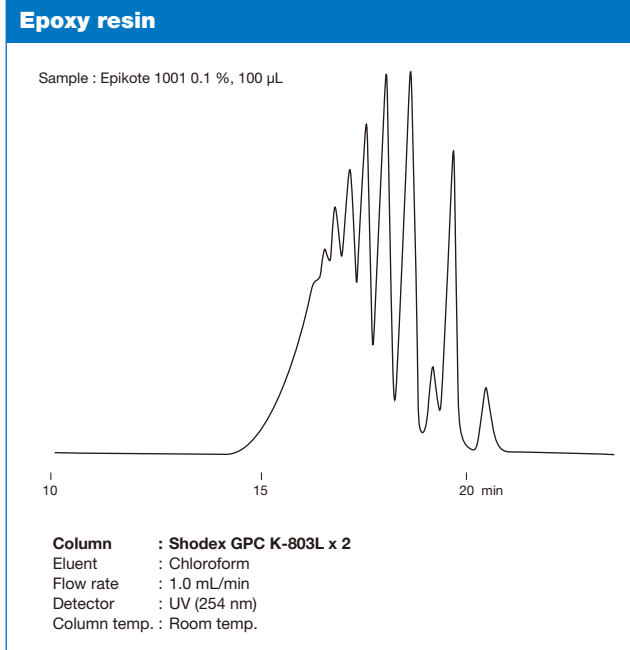
Target molecular weight range and exclusion limit

● Measured 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-807L	300 – *(200,000,000)	*(200,000,000)
K-804L	100 – 300,000	400,000			

Please use the above tables for reference purposes only when selecting columns.

*() Estimated value



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
 - Fulfills USP L21 requirements

● 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 x 300
F6028220	GPC KD-802	≥ 17,000	6	150	8.0 x 300
F6028225	GPC KD-802.5	≥ 17,000	6	300	8.0 x 300
F6028230	GPC KD-803	≥ 17,000	6	500	8.0 x 300
F6028240	GPC KD-804	≥ 17,000	7	1,500	8.0 x 300
F6028250	GPC KD-805	≥ 11,000	10	5,000	8.0 x 300
F6028260	GPC KD-806	≥ 11,000	10	10,000	8.0 x 300
F6028290	GPC KD-806M	≥ 13,000	10	10,000	8.0 x 300
F6028270	GPC KD-807	≥ 6,000	18	20,000	8.0 x 300
F6700411	GPC KD-G 4A	(guard column)	8	–	4.6 x 10

KD-806M is mixed-gel column capable of analyzing samples over a wide range of molecular weight distribution.
See page 68 for applicability of SEC (GPC) columns to solvent replacement.

Base Material: Styrene divinylbenzene copolymer

Target molecular weight range and exclusion limit

● Measured 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 tables for reference purposes only when selecting columns.

PEG: polyethylene glycol
PEO: polyethylene oxide
(*) Estimated value

Solvent-peak Separation Columns for Organic SEC (GPC)

Features

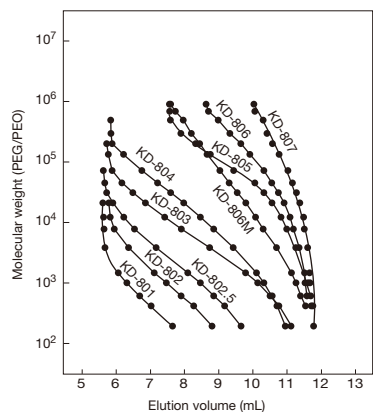
- KF-800D**
- Use this column in combination with a linear column
- K-800D**
- Accurate molecular weight distribution of polymers and oligomers are achieved by shifting the elutions of monomers, polymer additives, and solvent-peak in the lower molecular region

● 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 x 100	THF
F6709450	GPC K-800D	K-805L, 806L, 806M, 807L	10	8.0 x 100	Chloroform

Base Material: Styrene divinylbenzene copolymer

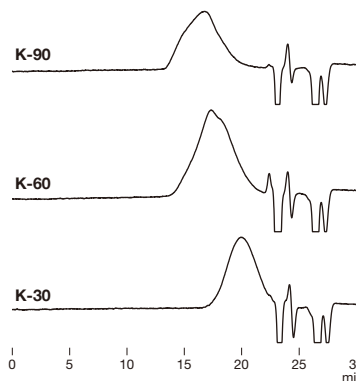
Calibration curves for KD-800 series using PEG/PEO



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

Polyvinylpyrrolidones

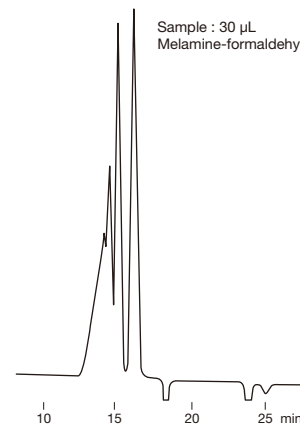
Sample : Polyvinylpyrrolidone 0.1 % each, 100 μ L



Column : Shodex GPC KD-806M x 2
Eluent : 10 mM LiBr in DMF
Flow rate : 1.0 mL/min
Detector : RI
Column temp. : 50 °C

Melamine formaldehyde resin

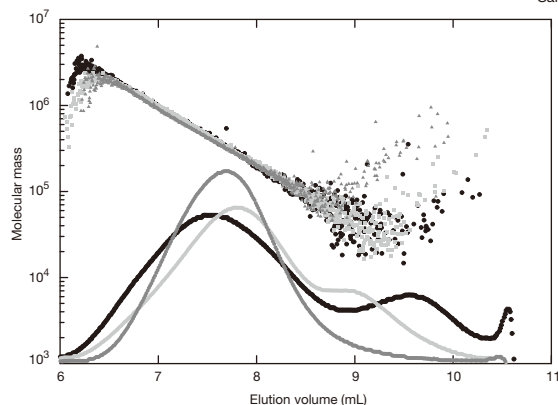
Sample : 30 μ L
 Melamine-formaldehyde resin 1 %



Column : Shodex GPC KD-802 x 2
Eluent : 10 mM LiBr in DMF
Flow rate : 1.0 mL/min
Detector : RI
Column temp. : 50 °C

Celluloses

Sample : Cellulose ca. 0.05 % each, 100 μ L



Cellulose is difficult to dissolve and repeated solvent replacement is required to prepare the cellulose solution. The time required to completely dissolve cellulose depends on the solvent type, crystallinity and molecular weight of the cellulose. This can be 1 to 60 days.

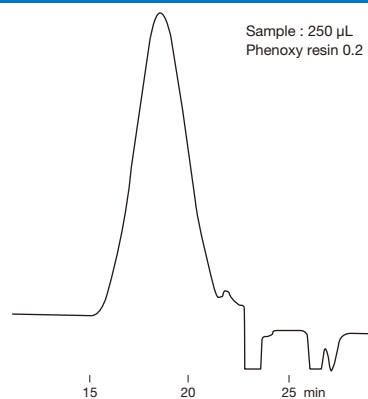
Column : Shodex GPC KD-806M
Eluent : 1 % LiCl in DMI*
Flow rate : 0.5 mL/min
Detector : RI, MALS (Multi angle light scattering)
Column temp. : 60 °C

*DMI 1,3-dimethyl-2-imidazolidinone

Data provided by Dr. Masahiko Yanagisawa,
 Isogai group, Graduate School of Agricultural and
 Life Sciences, The University of Tokyo

Phenoxy resin

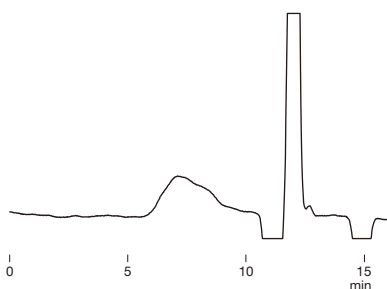
Sample : 250 μ L
 Phenoxy resin 0.2 %



Column : Shodex GPC KD-806M x 2
Eluent : 10 mM LiBr in DMF
Flow rate : 1.0 mL/min
Detector : RI
Column temp. : 50 °C

Potato starch

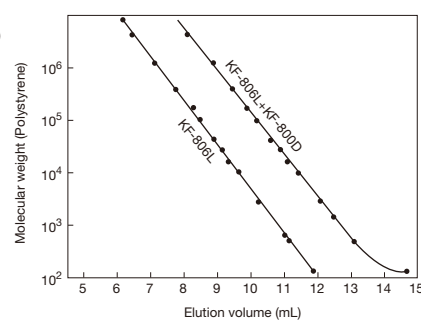
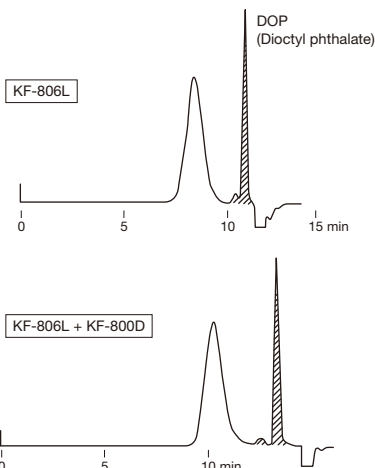
Sample : 100 μ L
 Potato starch in DMSO 0.1 %
 (dissolved at 80 °C)



Column : Shodex GPC KD-806M
Eluent : 10 mM LiBr in DMSO/DMF=75/25
Flow rate : 1.0 mL/min
Detector : RI
Column temp. : 50 °C

Effects of solvent-peak separation column

Sample : Poly(vinyl chloride)



Column : Shodex GPC KF-806L
 Shodex GPC KF-806L + KF-800D
Eluent : THF
Flow rate : 1.0 mL/min
Detector : RI

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

Features

- KF-600**
- Achieves approximately half the analysis time compared with standard columns
 - The amount of solvent used is reduced to about a third
 - Improved applicability of solvent replacement
 - Fulfills USP L21 requirements
-
- 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
 - Fulfills USP L21 requirements

● Rapid analysis downsized columns

[KF-600 series] Shipping Solvent: Tetrahydrofuran (THF)

© KF-600 series is recommended to be used with semi-micro type devices.

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 x 150
F6028092	GPC KF-602	≥ 17,000	3	150	6.0 x 150
F6028093	GPC KF-602.5	≥ 17,000	3	300	6.0 x 150
F6028094	GPC KF-603	≥ 17,000	3	500	6.0 x 150
F6028095	GPC KF-604	≥ 16,000	3	1,500	6.0 x 150
F6028096	GPC KF-605	≥ 7,000	10	5,000	6.0 x 150
F6028097	GPC KF-606	≥ 7,000	10	10,000	6.0 x 150
F6028098	GPC KF-606M	≥ 8,000	10	10,000	6.0 x 150
F6700300	GPC KF-G 4A	(guard column)	8	–	4.6 x 10

● High performance semi-micro columns

[KF-400HQ series] Shipping Solvent: Tetrahydrofuran (THF)

© KF-400HQ series is recommended to be used with semi-micro type devices.

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 x 250
F6028112	GPC KF-402HQ	≥ 25,000	3	150	4.6 x 250
F6028114	GPC KF-402.5HQ	≥ 25,000	3	300	4.6 x 250
F6028116	GPC KF-403HQ	≥ 25,000	3	500	4.6 x 250
F6028118	GPC KF-404HQ	≥ 25,000	3	1,500	4.6 x 250
F6028119	GPC KF-405LHQ	≥ 10,000	10	5,000	4.6 x 250
F6028122	GPC KF-406LHQ	≥ 10,000	10	10,000	4.6 x 250
F6700300	GPC KF-G 4A	(guard column)	8	–	4.6 x 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 68 for applicability of SEC (GPC) columns to solvent replacement.

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

Base Material: Styrene divinylbenzene copolymer

Target molecular weight range and exclusion limit

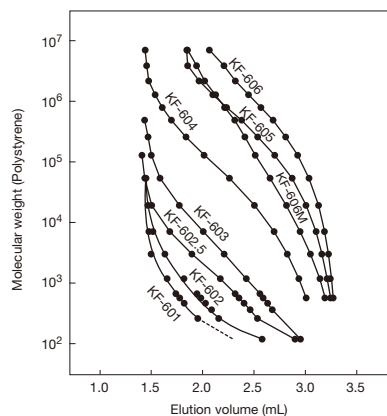
● Measured with polystyrene (eluent: THF)

Product Name	Target Molecular Weight Range	Exclusion Limit	Product Name	Target Molecular Weight Range	Exclusion Limit
KF-601	100 – 700	1,500	KF-401HQ	100 – 700	1,500
KF-602	200 – 1,500	4,000	KF-402HQ	200 – 1,500	4,000
KF-602.5	300 – 10,000	20,000	KF-402.5HQ	300 – 10,000	20,000
KF-603	600 – 50,000	70,000	KF-403HQ	600 – 50,000	70,000
KF-604	7,000 – 500,000	1,000,000	KF-404HQ	7,000 – 500,000	1,000,000
KF-605	50,000 – 2,000,000	4,000,000	KF-405LHQ	300 – 2,000,000	4,000,000
KF-606	150,000 – *(20,000,000)	*(20,000,000)	KF-406LHQ	300 – *(20,000,000)	*(20,000,000)
KF-606M	1,000 – *(20,000,000)	*(20,000,000)			

Please use the above tables for reference purposes only when selecting columns.

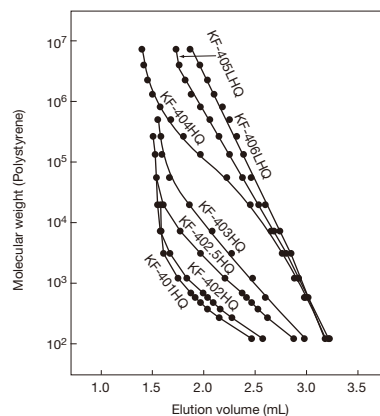
*() Estimated value

Calibration curves for KF-600 series using polystyrene



Column : Shodex GPC KF-600 series
 Eluent : THF
 Flow rate : 0.5 mL/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 : 0.3 mL/min
 Detector : RI (small cell volume)
 Column temp. : 40 °C

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

Standard type

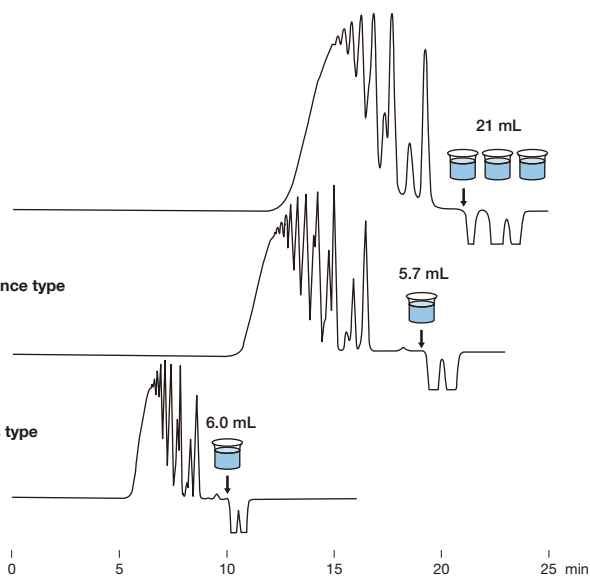
KF-802.5 x 2
 50 μ L injection

High performance type

KF-402.5HQ x 2
 10 μ L injection

Rapid analysis type

KF-602.5 x 2
 10 μ L injection



Sample : EPON1001 0.2 %

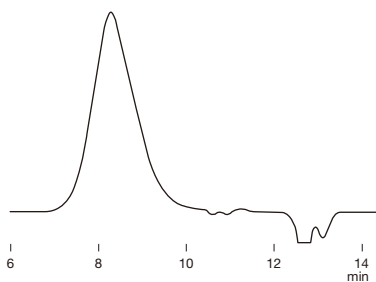
KF-602.5 provides rapid analysis by reducing the analysis time less than half of the analysis time of KF-802.5. Having 1.5 times more theoretical plate number than standard column, KF-402.5HQ provides improved resolution especially for the separation of small to medium molecular weight substances. Rapid analysis and high performance type columns use less than one third of solvent per analysis compared to standard type columns do.

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 : 1.0 mL/min (KF-802.5)
 0.3 mL/min (KF-402.5HQ)
 0.6 mL/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

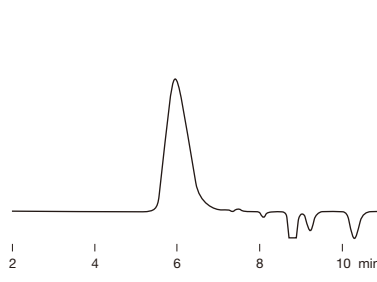
Sample : Styrene-Acrylonitrile (30:70) copolymer



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

Liquid paraffin

Sample : Liquid paraffin 1 %, 5 μ L

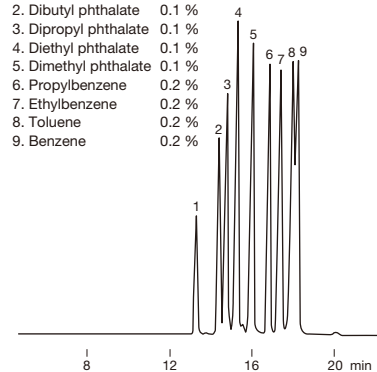


Column : Shodex GPC KF-401HQ
 Eluent : Chloroform
 Flow rate : 0.3 mL/min
 Detector : RI (small cell volume)
 Column temp. : 40 °C

Phthalates

Sample : 10 μ L

1. Dioctyl phthalate 0.1 %
 2. Dibutyl phthalate 0.1 %
 3. Dipropyl phthalate 0.1 %
 4. Diethyl phthalate 0.1 %
 5. Dimethyl phthalate 0.1 %
 6. Propylbenzene 0.2 %
 7. Ethylbenzene 0.2 %
 8. Toluene 0.2 %
 9. Benzene 0.2 %



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

Organic SEC (GPC) Columns: Ultra-Rapid Analysis

Features

- HK-400**
- Newly developed styrene divinylbenzene copolymer monodisperse particles
 - Analysis time is reduced to about a sixth of conventional column's analysis time
 - Low column pressure even under high flow rate does not require a UHPLC system
 - The amount of solvent used is reduced to about a sixth
 - HK-403 (exclusion limit: 100,000) newly added to the series
 - HK-HFIP404L is filled with HFIP
 - Fulfills USP L21 requirements

● Ultra-Rapid analysis semi-micro columns

Shipping Solvent: Tetrahydrofuran (THF)

© HK-400 series is recommended to be used with semi-micro type devices.

Product Code	Product Name	Plate Number (TP/column)	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length
F6025010	GPC HK-401	≥ 9,000	3	50	4.6 x 150
F6025030	New GPC HK-403	≥ 9,000	3.5	550	4.6 x 150
F6026040	GPC HK-404L	≥ 9,000	3.5	2,000	4.6 x 150
F6025050	GPC HK-405	≥ 7,000	3	5,000	4.6 x 150

HK-404L is mixed-gel column capable of analyzing samples over a wide range of molecular weight distribution.

Base Material: Styrene divinylbenzene copolymer

Shipping Solvent: hexafluoroisopropanol (HFIP)

© HK-HFIP404L is recommended to be used with semi-micro type devices.

Product Code	Product Name	Plate Number (TP/column)	Particle Size (μm)	Pore Size (Å)	Column Size (mm) I.D. x Length
F6026140	GPC HK-HFIP404L	≥ 9,000	3.5	800	4.6 x 150

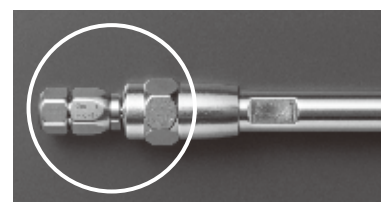
HK-HFIP404L is mixed-gel column capable of analyzing samples over a wide range of molecular weight distribution.
See page 64 for details of other columns filled with HFIP.

Base Material: Styrene divinylbenzene copolymer

● Guard filter for HK series

Product Code	Product Name	Contents
F6700200	GPC HK-G	One holder and one filter
F6700100	GPC HK-G filter	3 filters

Removes insoluble components in the sample



Allows direct attachment to the analytical column

Target molecular weight range and exclusion limit

● Measured with polystyrene (eluent: THF)

Product Name	Target Molecular Weight Range	Exclusion Limit
HK-401	100 – 1,500	2,000
HK-403	2,000 – 70,000	100,000
HK-404L	100 – 1,000,000	1,000,000
HK-405	10,000 – 2,500,000	4,000,000

Please use the above table for reference purposes only when selecting columns.

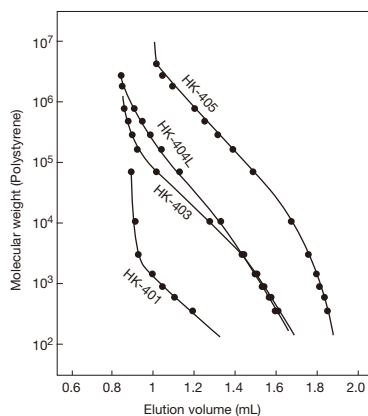
● Measured with PMMA (eluent: HFIP)

Product Name	Target Molecular Weight Range	Exclusion Limit
HK-HFIP404L	5,000 – 200,000	200,000

Please use the above table for reference purposes only when selecting columns.

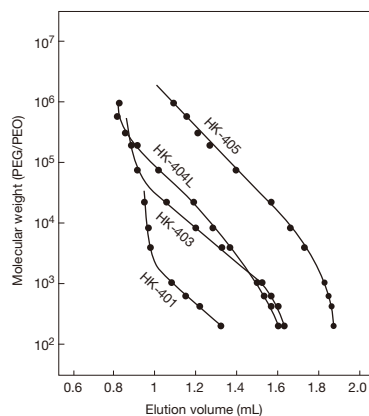
PMMA: Polymethylmethacrylate

Calibration curves for HK-400 series using polystyrene (eluent : THF)



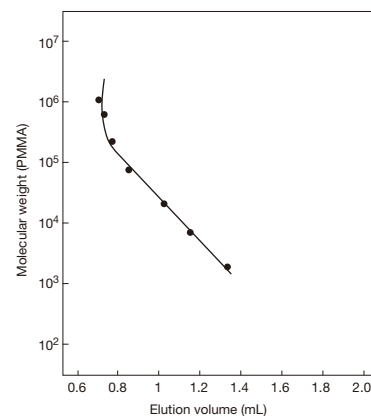
Column : Shodex GPC HK-400 series
 Eluent : THF
 Flow rate : 1.0 mL/min
 Detector : RI (small cell volume)
 Column temp. : 40 °C

Calibration curves for HK-400 series using PEG/PEO (eluent : DMF)



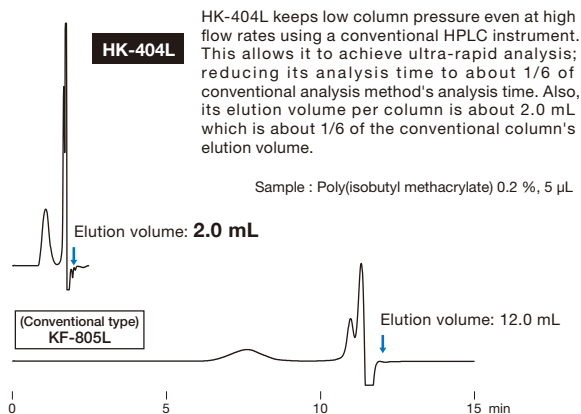
Column : Shodex GPC HK-400 series
 Eluent : DMF
 Flow rate : 1.0 mL/min
 Detector : RI (small cell volume)
 Column temp. : 40 °C

Calibration curve for HK-HFIP404L using PMMA (eluent : HFIP)



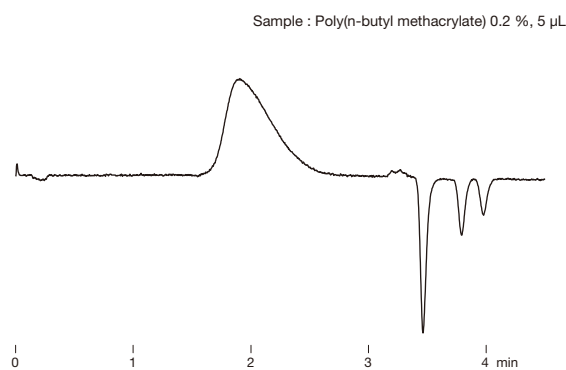
Column : Shodex GPC HK-HFIP404L
 Eluent : 5 mM CF₃COONa in HFIP
 Flow rate : 0.3 mL/min
 Detector : RI (small cell volume)
 Column temp. : 40 °C

Comparison of HK-404L and conventional column (KF-805L)



Column : Shodex GPC HK-404L, KF-805L
 Eluent : THF
 Flow rate : 1.0 mL/min
 Detector : RI (small cell volume)
 Column temp. : 40 °C

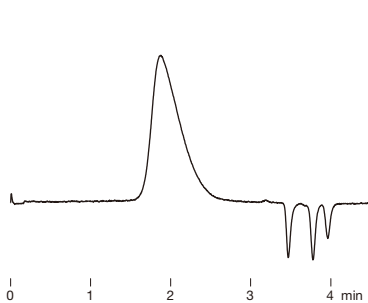
Poly(butyl methacrylate)



Column : Shodex GPC HK-404L x 2
 Eluent : THF
 Flow rate : 1.0 mL/min
 Detector : RI (small cell volume)
 Column temp. : 40 °C

Styrene butyl methacrylate copolymer

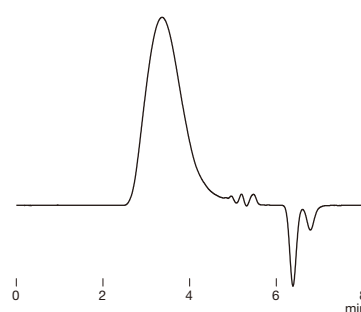
Sample : Styrene butyl methacrylate copolymer 0.2 %, 5 µL



Column : Shodex GPC HK-404L x 2
 Eluent : THF
 Flow rate : 1.0 mL/min
 Detector : RI (small cell volume)
 Column temp. : 40 °C

Polyamide (Nylon 6/9)

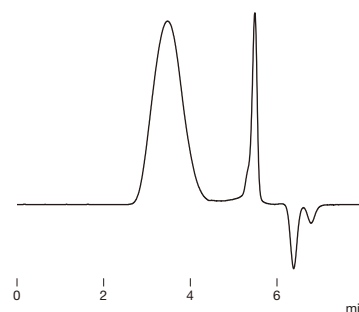
Sample : Nylon 6/9 0.23 %, 5 µL



Column : Shodex GPC HK-HFIP404L
 Eluent : 5 mM CF₃COONa in HFIP
 Flow rate : 0.3 mL/min
 Detector : RI (small cell volume)
 Column temp. : 40 °C

Polyamide (Nylon 11)

Sample : Nylon 11 0.25 %, 5 µL



Column : Shodex GPC HK-HFIP404L
 Eluent : 5 mM CF₃COONa in HFIP
 Flow rate : 0.3 mL/min
 Detector : RI (small cell volume)
 Column temp. : 40 °C

Organic SEC (GPC) Columns: Linear Calibration Type

Features

- LF**
- Packed with unique multi-pore gels with a wide pore-size distribution
 - Highly linear calibration curve without inflection points
 - Achieves highly precise molecular weight distribution determination
 - Enables analysis over a broad range of molecular weights
 - Rapid analysis column (LF-604) and high performance analysis column (LF-404) are also available
 - LF-604 and LF-404 enables reduction of solvent use
 - Fulfills USP L21 requirements

● Standard column

Shipping Solvent: Tetrahydrofuran (THF)

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 x 300
F6709621	GPC LF-G	(guard column)	6	–	4.6 x 10

See page 68 for applicability of SEC (GPC) columns to solvent replacement.

Base Material: Styrene divinylbenzene copolymer

● Rapid analysis downsized column

Shipping Solvent: Tetrahydrofuran (THF)

© LF-604 is recommended to be used with semi-micro type devices.

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 x 150
F6709621	GPC LF-G	(guard column)	6	–	4.6 x 10

See page 68 for applicability of SEC (GPC) columns to solvent replacement.

Base Material: Styrene divinylbenzene copolymer

● High performance semi-micro column

Shipping Solvent: Tetrahydrofuran (THF)

© LF-404 is recommended to be used with semi-micro type devices.

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 x 250
F6709621	GPC LF-G	(guard column)	6	–	4.6 x 10

See page 68 for applicability of SEC (GPC) columns to solvent replacement.

Base Material: Styrene divinylbenzene copolymer

Target molecular weight range and exclusion limit

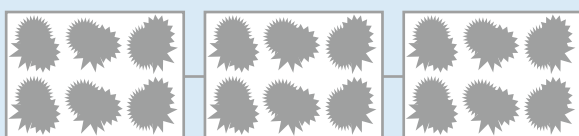
● Measured with polystyrene (eluent: THF)

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 for reference purposes only when selecting columns.

Schematic diagram of linear calibration type packing

Connecting linear calibration type columns (LF series)



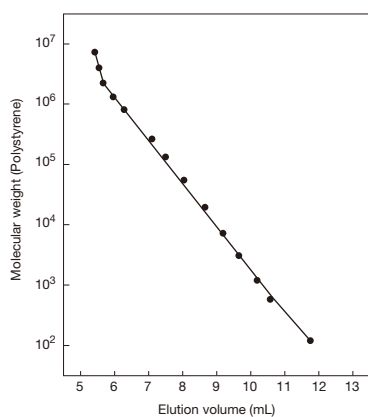
The linear calibration type column covers a broad range of molecular weights with only one kind of packing material.

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

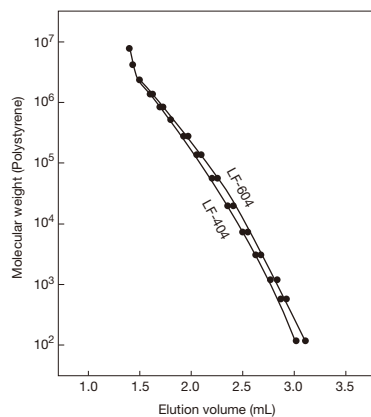


Connecting different single pore-size columns (KF-804 + KF-803 + KF-802, etc.)

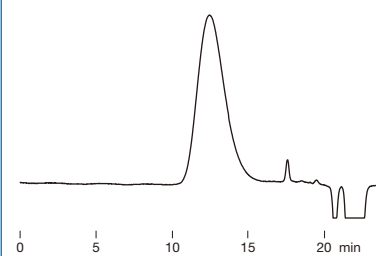


Calibration curve for LF-804 using polystyrene

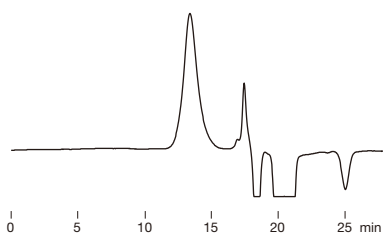
Column : Shodex GPC LF-804
 Eluent : THF
 Flow rate : 1.0 mL/min
 Detector : RI
 Column temp. : 40 °C

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

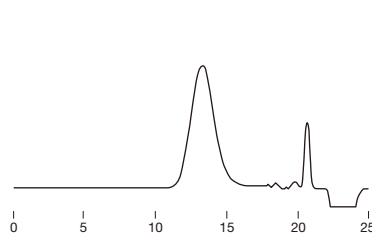
Column : Shodex GPC LF-604, LF-404
 Eluent : THF
 Flow rate : 0.5 mL/min (LF-604)
 0.3 mL/min (LF-404)
 Detector : RI (small cell volume)
 Column temp. : 40 °C

PolyurethaneSample : Polyurethane 0.1 %, 20 μ L

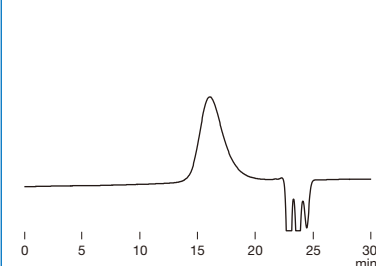
Column : Shodex GPC LF-404 x 2
 Eluent : THF
 Flow rate : 0.3 mL/min
 Detector : RI (small cell volume)
 Column temp. : 40 °C

XylanSample : Xylan 0.1 %, 100 μ L

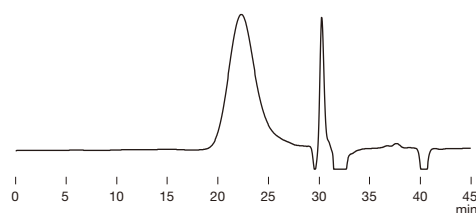
Column : Shodex GPC LF-804
 Eluent : 20 mM H₃PO₄ + 20 mM LiBr
 in DMSO/DMF=80/20
 Flow rate : 0.6 mL/min
 Detector : RI
 Column temp. : 50 °C

Polyamide (Nylon 6/6)Sample : Nylon 6/6 0.1 %, 20 μ L

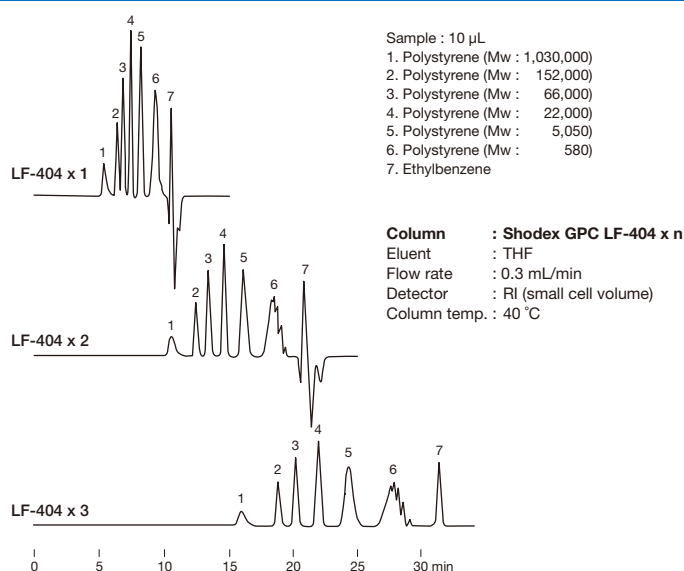
Column : Shodex GPC LF-404
 Eluent : 5 mM CF₃COONa in HFIP
 Flow rate : 0.15 mL/min
 Detector : RI (small cell volume)
 Column temp. : 40 °C

Polymethyl methacrylateSample : Polymethyl methacrylate, 100 μ L

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

Polyamic acidSample : Poly(pyromellitic dianhydride-co-4,4'-oxydianiline), 100 μ L

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

Effects of using multiple LF-404 columns for the separation of polystyrenes

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

Features

- HT-800**
- Wide product lineup to support a broad range of molecular weight analysis
 - Fulfills USP L21 requirements

- 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
 - Fulfills USP L21 requirements

● Standard columns

Shipping Solvent: Toluene

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 x 300
F6208710	GPC HT-804	≥ 7,000	100 ~ 150	13	1,500	8.0 x 300
F6208720	GPC HT-805	≥ 7,000	100 ~ 150	13	5,000	8.0 x 300
F6208730	GPC HT-806	≥ 7,000	100 ~ 150	13	10,000	8.0 x 300
F6208740	GPC HT-806M	≥ 7,000	100 ~ 150	13	10,000	8.0 x 300
F6208770	GPC HT-807	≥ 4,000	100 ~ 150	18	20,000	8.0 x 300
F6709410	GPC HT-G	(guard column)	100 ~ 150	13	–	8.0 x 50
F6208600	GPC UT-802.5	≥ 4,400	100 ~ 210	30	300	8.0 x 300
F6208610	GPC UT-806M	≥ 4,400	100 ~ 210	30	10,000	8.0 x 300
F6208620	GPC UT-807	≥ 3,300	100 ~ 210	30	20,000	8.0 x 300
F6709400	GPC UT-G	(guard column)	100 ~ 210	30	–	8.0 x 50
F6208390	GPC AT-806MS	≥ 6,000	RT ~ 150	12	10,000	8.0 x 250
F6700280	GPC AT-G	(guard column)	RT ~ 150	15	–	8.0 x 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
RT: Ambient room temperature

Target molecular weight range and exclusion limit

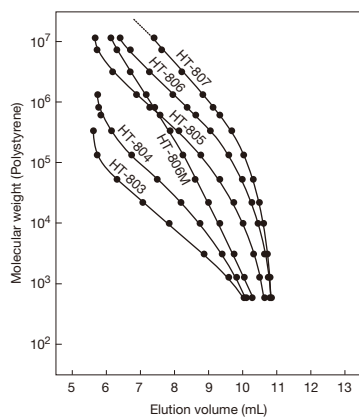
● Measured with polystyrene (eluent: o-Dichlorobenzene (ODCB))

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 for reference purposes only when selecting columns.

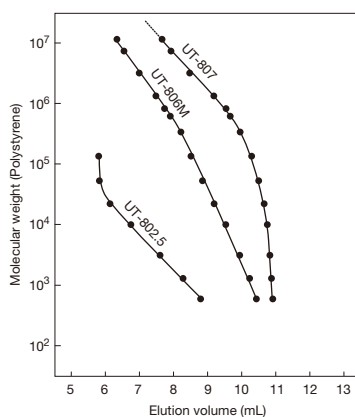
*() Estimated value

Calibration curves for HT-800 series using polystyrene



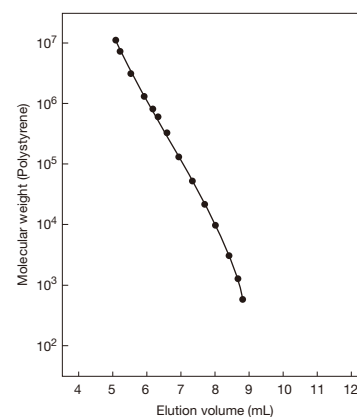
Column : Shodex GPC HT-800 series
 Eluent : 0.1 % BHT in ODCB
 Flow rate : 1.0 mL/min
 Detector : RI
 Column temp. : 140 °C

Calibration curves for UT-800 series using polystyrene



Column : Shodex GPC UT-800 series
 Eluent : 0.1 % BHT in ODCB
 Flow rate : 1.0 mL/min
 Detector : RI
 Column temp. : 140 °C

Calibration curve for AT-806MS using polystyrene

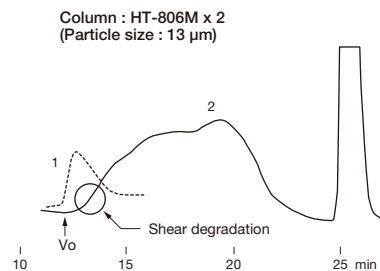
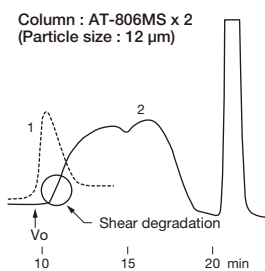
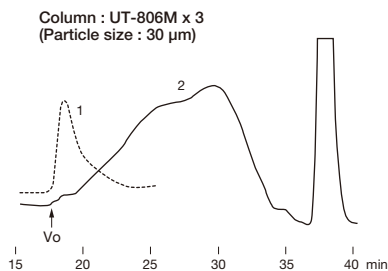


Column : Shodex GPC AT-806MS
 Eluent : 0.1 % BHT in ODCB
 Flow rate : 1.0 mL/min
 Detector : RI
 Column temp. : 140 °C

Effects of gel particle size in high temperature GPC columns

High temperature GPC columns are suitable for the analysis of high molecular weight polymers that are difficult to be dissolved in ambient temperature solvents; examples of such polymers are polyethylene and polypropylene. The GPC UT-800 series packed with large particle size (30 μm) are recommended for the analysis of macromolecules. The large particle size prevents potential molecular shear degradation of the sample.

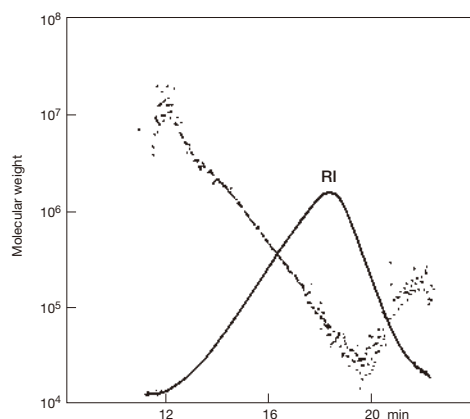
Sample :
 1. Polystyrene (MW : 20,000,000)
 2. High density polyethylene (HDPE-A)



Column : Shodex GPC UT-806M
 Shodex GPC HT-806M
 Shodex GPC AT-806MS
 Eluent : 0.1 % BHT in ODCB
 Flow rate : 1.0 mL/min
 Detector : RI
 Column temp. : 140 °C

High density polyethylene

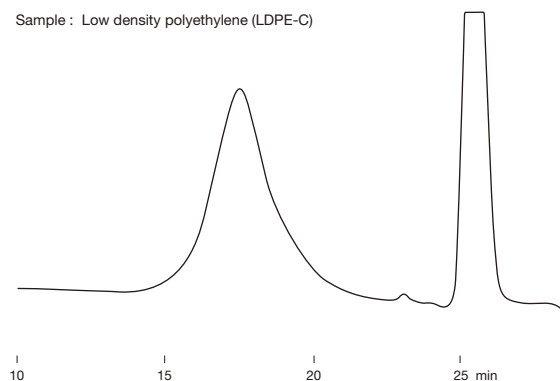
Sample : High density polyethylene (HDPE-B)



Column : Shodex GPC UT-806M x 2
 Eluent : 0.1 % BHT in ODCB
 Flow rate : 1.0 mL/min
 Detector : RI, MALS (Multi angle light scattering)
 Column temp. : 145 °C

Low density polyethylene

Sample : Low density polyethylene (LDPE-C)



Column : Shodex GPC HT-806M x 2
 Eluent : 0.1 % BHT in ODCB
 Flow rate : 1.0 mL/min
 Detector : RI
 Column temp. : 140 °C

Organic SEC (GPC) Columns: HFIP

Features

- HFIP-800**
- Columns exclusively used with hexafluoroisopropanol (HFIP)
 - Fulfills USP L21 requirements

- HFIP-600**
- Rapid analysis, solvent saving type
 - Fulfills USP L21 requirements

● Standard columns

[HFIP-800 series] Shipping Solvent: Hexafluoroisopropanol (HFIP)

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 x 300
F6028540	GPC HFIP-804	≥ 12,000	7	1,500	8.0 x 300
F6028550	GPC HFIP-805	≥ 10,000	10	5,000	8.0 x 300
F6028560	GPC HFIP-806	≥ 10,000	10	10,000	8.0 x 300
F6028590	GPC HFIP-806M	≥ 10,000	10	10,000	8.0 x 300
F6700500	GPC HFIP-G 8B	(guard column)	15	–	8.0 x 50

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

Base Material: Styrene divinylbenzene copolymer

● Rapid analysis downsized columns

[HFIP-600 series] Shipping Solvent: Hexafluoroisopropanol (HFIP)

○ HFIP-600 series is recommended to be used with semi-micro type devices.

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 x 150
F6021040	GPC HFIP-604	≥ 12,000	3	1,500	6.0 x 150
F6021050	GPC HFIP-605	≥ 5,000	10	5,000	6.0 x 150
F6021080	GPC HFIP-606M	≥ 6,000	10	10,000	6.0 x 150
F6700511	GPC HFIP-G 4A	(guard column)	8	–	4.6 x 10

HFIP-606M is mixed-gel column capable of analyzing samples over a wide range of molecular weight distribution.

Base Material: Styrene divinylbenzene copolymer

See page 58 for details of a column enclosed with HFIP.

Target molecular weight range and exclusion limit

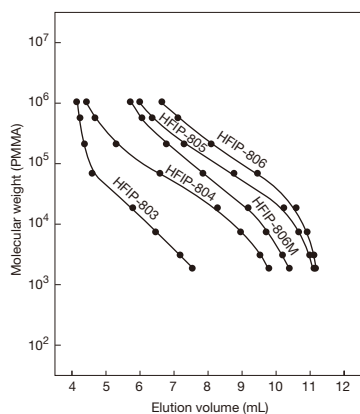
● Measured with PMMA (eluent: HFIP)

Product Name	Target Molecular Weight Range	Exclusion Limit	Product Name	Target Molecular Weight Range	Exclusion Limit
HFIP-803	1,000 – 30,000	60,000	HFIP-603	1,000 – 30,000	60,000
HFIP-804	20,000 – 200,000	300,000	HFIP-604	20,000 – 200,000	300,000
HFIP-805	20,000 – 600,000	1,000,000	HFIP-605	20,000 – 600,000	1,000,000
HFIP-806	70,000 – *(8,000,000)	*(8,000,000)	HFIP-606M	1,000 – *(8,000,000)	*(8,000,000)
HFIP-806M	1,000 – *(8,000,000)	*(8,000,000)			

Please use the above tables for reference purposes only when selecting columns.

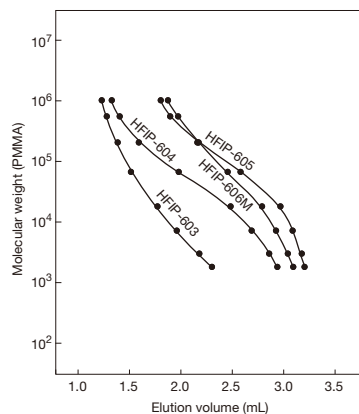
PMMA: Polymethylmethacrylate
*() Estimated value

Calibration curves for HFIP-800 series using PMMA



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

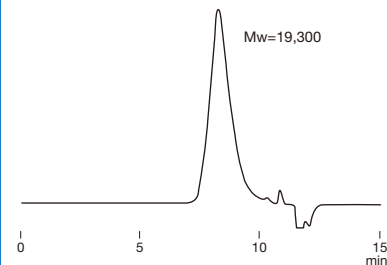
Calibration curves for HFIP-600 series using PMMA



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

Polyethylene terephthalate (PET)

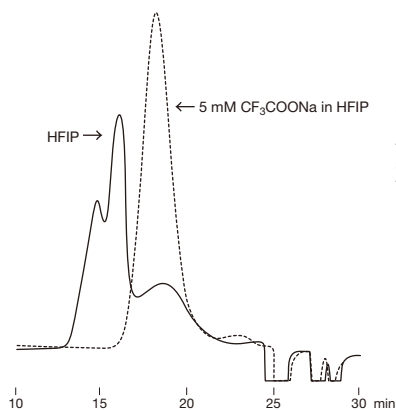
Sample : Polyethylene terephthalate 0.2 %, 20 μ L



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

Polyamide (added salt)

Sample : Polycaprolactum (Nylon 6)

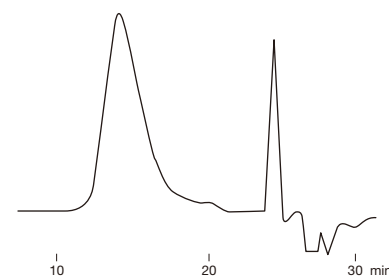


Some samples analyzed under SEC mode with HFIP solvent may show abnormal peaks resulting from the ionic interaction. This interaction can be suppressed by adding sodium trifluoroacetate to the HFIP eluent.

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

Polybutylene terephthalate (PBT)

Sample : Polybutylene terephthalate 0.05 %, 500 μ L

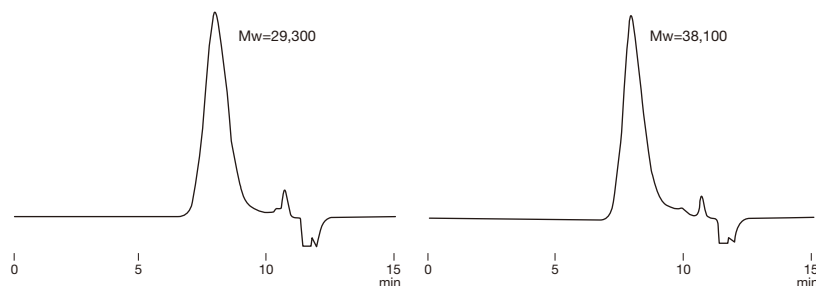


Column : Shodex GPC HFIP-805 + HFIP-803
 Eluent : 5 mM CF₃COONa in HFIP
 Flow rate : 1.0 mL/min
 Detector : RI
 Column temp. : 40 °C

Polyamides (Nylon 6/10 and Nylon 6)

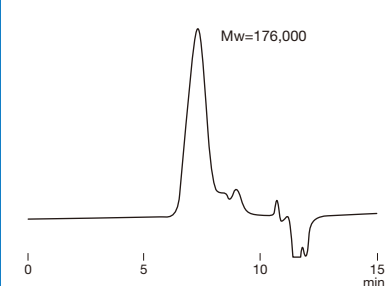
Sample : Nylon 6/10 0.2 %, 20 μ L

Sample : Nylon 6 0.2 %, 20 μ L



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

Sample : Polyacetal 0.2 %, 20 μ L



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

Organic SEC (GPC) Column: Rapid Preparation

Features

New

FP-2002

- Newly developed styrene divinylbenzene copolymer monodisperse particles
- Can deliver at four times higher flow rate (10 mL/min or more) compared with conventional products
- Achieves rapid recycling separation
- Suitable for the separation of samples in a wide molecular weight range due to its wide linear range and large pore volume
- Usable with various organic solvents used in GPC analysis in addition to chloroform

Preparative columns [Preparative columns are made to order.]

Shipping Solvent: Chloroform

Product Code	Product Name	Plate Number (TP/column)	Particle Size (μm)	Column Size (mm) I.D. x Length
F6102520	New GPC FP-2002	≥ 30,000	8	20.0 × 600
F6700340	New GPC FP-G 8B	(guard column)	8	8.0 × 50

Base Material: Styrene divinylbenzene copolymer

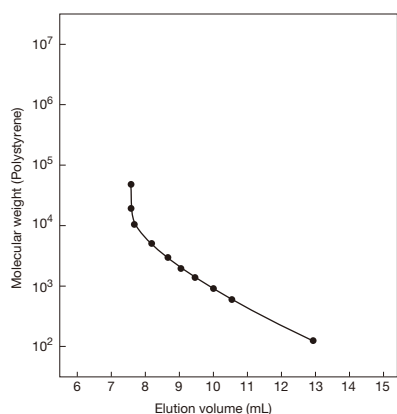
Target molecular weight range and exclusion limit

Measured with polystyrene (eluent: Chloroform)

Product Name	Target Molecular Weight Range	Exclusion Limit
FP-2002	100 – 5,000	8,000

Please use the above tables for reference purposes only when selecting columns.

Calibration curve for FP-2002 using polystyrene

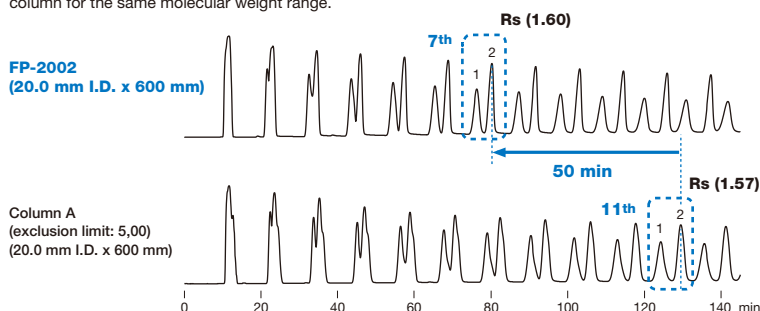


Column : Shodex GPC FP-2002
 Eluent : Chloroform
 Flow rate : 10 mL/min
 Detector : UV (254 nm)
 (preparative type)
 Column temp. : 30 °C

Comparison of recycling separation

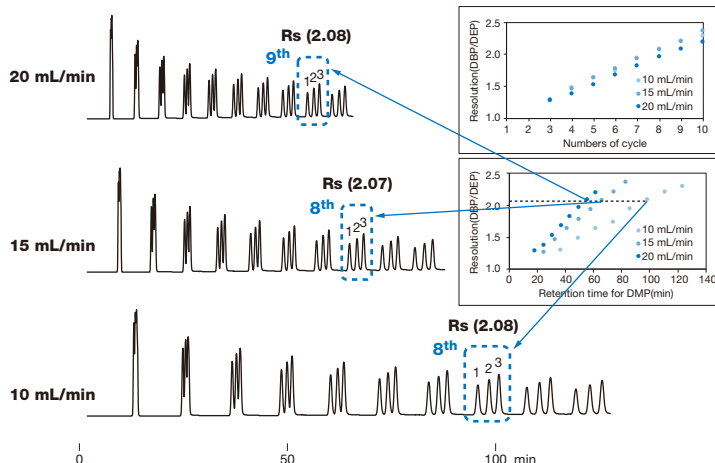
GPC FP-2002 is a column suitable for rapid organic solvent SEC (GPC) separation. Phthalate esters were used to compare recycled separations with other manufacturer's rapid preparative column (exclusion limit: 5,000). The recycling separation using FP-2002 can be made faster than other column for the same molecular weight range.

Sample : 10 % each, 2 mL
 1. Ditridecyl Phthalate (MW: 530)
 2. Bis (trans-3,3,5-trimethylcyclohexyl) phthalate (MW: 414)



Column : Shodex GPC FP-2002
 Column A from other manufacturer
 Eluent : Chloroform
 Flow rate : 10 mL/min
 Detector : UV (254 nm) (preparative type)
 Column temp. : 30 °C

Effects of flow rate for recycling separation



The standard flow rate of the packed column GPC FP-2002 for organic solvent-based SEC (GPC) is 10 mL/min. We have investigated the flow rate dependency of phthalate esters recycling separation. Even at the maximum usable flow rate of 20 mL/min, there is no extreme drop in column efficiency and further speeding up is possible.

(Note) In the case of a polymer sample, shear degradation of the polymer tends to occur as the molecular weight increases. It is recommended to lower the flow rate, if there is a possibility that shear degradation occurred.

Sample : 3 % each, 1 mL
 1. Dibutyl phthalate (DBP) (MW: 278)
 2. Diethyl phthalate (DEP) (MW: 222)
 3. Dimethyl phthalate (DMP) (MW: 194)

Column : Shodex GPC FP-2002
 Eluent : Chloroform
 Detector : UV (254 nm) (preparative type)
 Column temp. : 30 °C

Organic SEC (GPC) Columns: [Customized columns]

● 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 Column
F6102001	GPC H-2001	≥ 13,000	15	20.0 x 500	K-801
F6102002	GPC H-2002	≥ 13,000	15	20.0 x 500	K-802
F6102025	GPC H-2002.5	≥ 13,000	15	20.0 x 500	K-802.5
F6102003	GPC H-2003	≥ 13,000	15	20.0 x 500	K-803
F6102004	GPC H-2004	≥ 13,000	15	20.0 x 500	K-804
F6102005	GPC H-2005	≥ 13,000	15	20.0 x 500	K-805
F6102006	GPC H-2006	≥ 13,000	15	20.0 x 500	K-806
F6102009	GPC H-2006M	≥ 12,000	15	20.0 x 500	K-806M
F6700310	GPC H-G 8B	(guard column)	15	8.0 x 50	(guard column)

See page 52 for details of GPC K-800 series.

Base Material: Styrene divinylbenzene copolymer

[KF-5000 series] Shipping Solvent: Tetrahydrofuran (THF)

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

See page 50 for details of GPC KF-800 series.

Base Material: Styrene divinylbenzene copolymer

[K-5000 series] Shipping Solvent: Chloroform

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

See page 52 for details of GPC K-800 series.

Base Material: Styrene divinylbenzene copolymer

Solvent Replacement Applicability of SEC (GPC) Columns

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-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-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	×	×	○	○				×	○	○
Quinoline	×	×	○	○				×	○	○
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)]

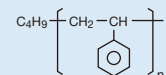
Features

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

Standard kit

Product Code	Product Name	Contents	Molecular weights (Mp) Range
F8601105	STANDARD SL-105	0.5 g x 10 kinds	580 – 19,900
F8602105	STANDARD SM-105	0.5 g x 10 kinds	1,150 – 2,380,000
F8603075	STANDARD SH-75	0.5 g x 7 kinds	508,000 – 6,870,000

Structural formula of S series



SL-105

Std. No.	Mp	Mw/Mn
S-18	18,000	1.02
S-13	13,000	1.02
S-9.8	9,820	1.02
S-6.7	6,660	1.03
S-4.9	4,910	1.03
S-2.8	2,790	1.04
S-1.9	1,890	1.05
S-1.3	1,300	1.06
S-1.1	1,140	1.06
S-0.6	580	1.18

SM-105

Std. No.	Mp	Mw/Mn
S-2630	2,630,000	1.05
S-1700	1,700,000	1.03
S-602	602,000	1.02
S-277	277,000	1.04
S-136	136,000	1.04
S-46	46,400	1.02
S-18	18,000	1.02
S-6.7	6,660	1.03
S-2.8	2,790	1.04
S-1.3	1,300	1.06

SH-75

Std. No.	Mp	Mw/Mn
S-6870	6,870,000	1.09
S-5190	5,190,000	1.03
S-3750	3,750,000	1.05
S-2350	2,350,000	1.04
S-2000	2,000,000	1.03
S-991	991,000	1.05
S-508	508,000	1.05

(Note)
Molecular weights (Mp, Mw/Mn) of each standard 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)

Standard kit

Product Code	Product Name	Contents	Molecular weights (Mp) Range
F8604075	STANDARD M-75	0.5 g x 7 kinds	2,870 – 965,000

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

Std. No.	Mp	Mw/Mn
M-965	965,000	1.07
M-505	505,000	1.02
M-224	224,000	1.02
M-67	66,700	1.03
M-20	20,100	1.03
M-6.1	6,140	1.11
M-2.9	2,870	1.06

[Pullulan]

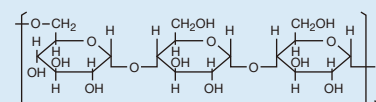
Features

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

Standard kit

Product Code	Product Name	Contents	Molecular weights (Mp) Range
F8400000	STANDARD P-82	0.2 g x 8 kinds	6,300 – 642,000

Structural formula of P series



Single type

Product Code	Product Name	Contents	Mp	Mw/Mn
F8400800	STD P-800	0.5 g	642,000	1.23
F8400400	STD P-400	0.5 g	334,000	1.30
F8400200	STD P-200	0.5 g	201,000	1.31
F8400100	STD P-100	0.5 g	106,000	1.11
F8400050	STD P-50	0.5 g	49,400	1.09
F8400020	STD P-20	0.5 g	22,000	1.08
F8400010	STD P-10	0.5 g	9,800	1.07
F8400005	STD P-5	0.5 g	6,300	1.09

Std. No.	Mp	Mw/Mn
STD P-800	642,000	1.23
STD P-400	334,000	1.30
STD P-200	201,000	1.31
STD P-100	106,000	1.11
STD P-50	49,400	1.09
STD P-20	22,000	1.08
STD P-10	9,800	1.07
STD P-5	6,300	1.09

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

Anion Exchange Chromatography Columns

Features

QA-825 DEAE-825	<ul style="list-style-type: none"> Suitable for analyzing relatively high molecular weight compounds: proteins, peptides, DNA, and RNA Usable in a wide pH range from pH 2 to 12 QA-825 fulfills USP L23 requirements
ES-502N 7C	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Suitable for anion exchange analysis of low molecular weight compounds such as nucleotides

● Standard columns

[Strong anion exchange resin] Functional Group: Quaternary ammonium

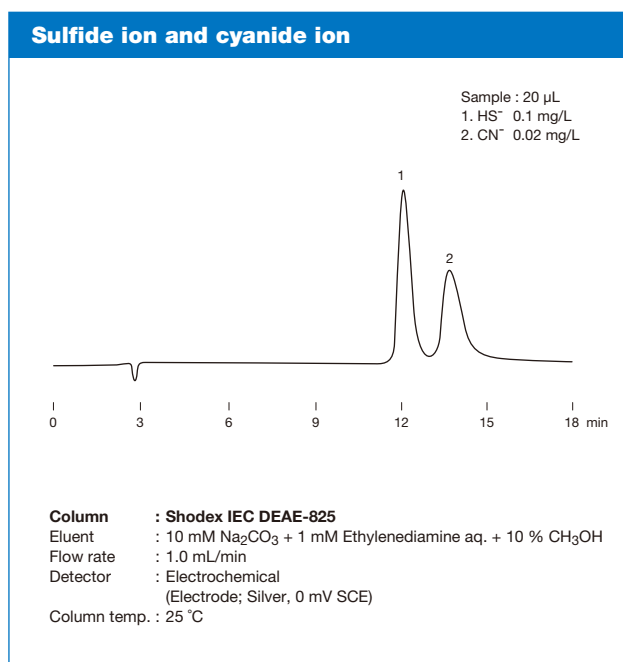
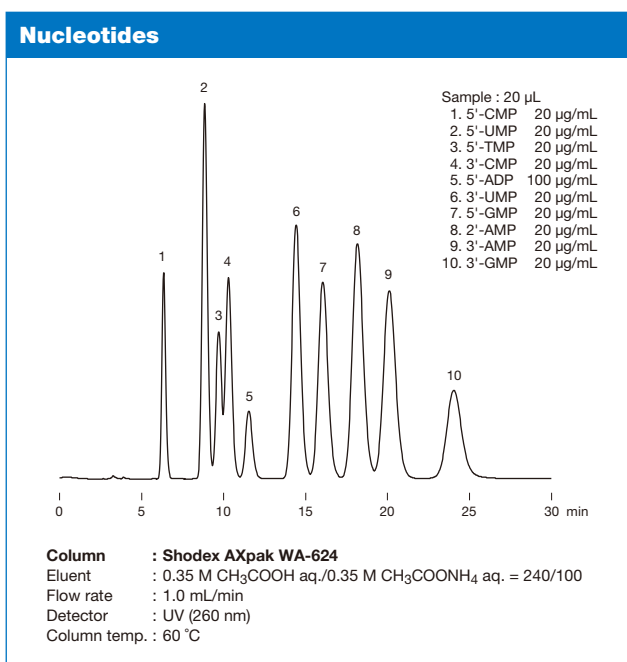
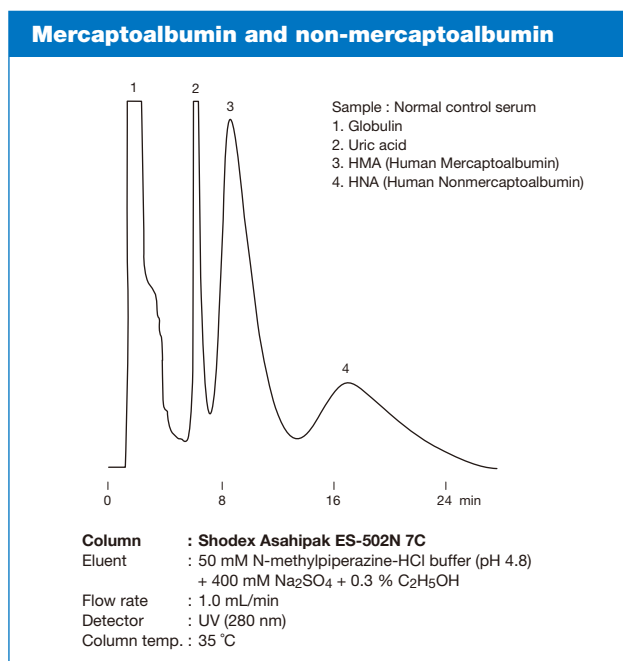
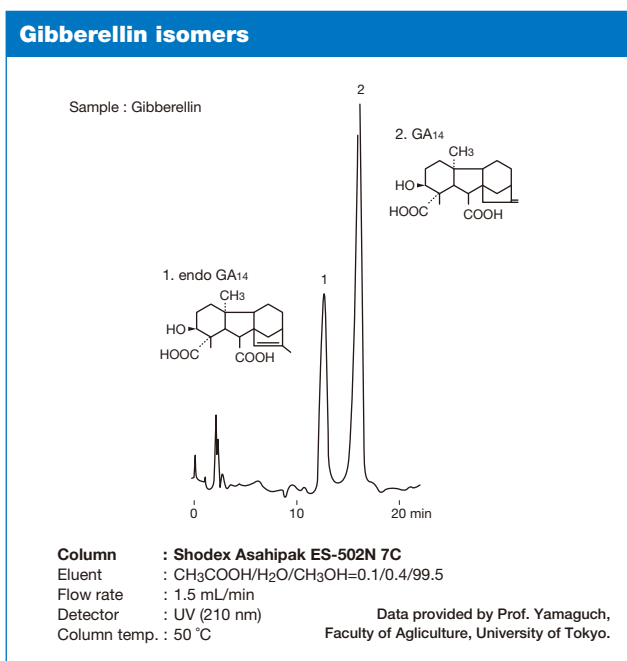
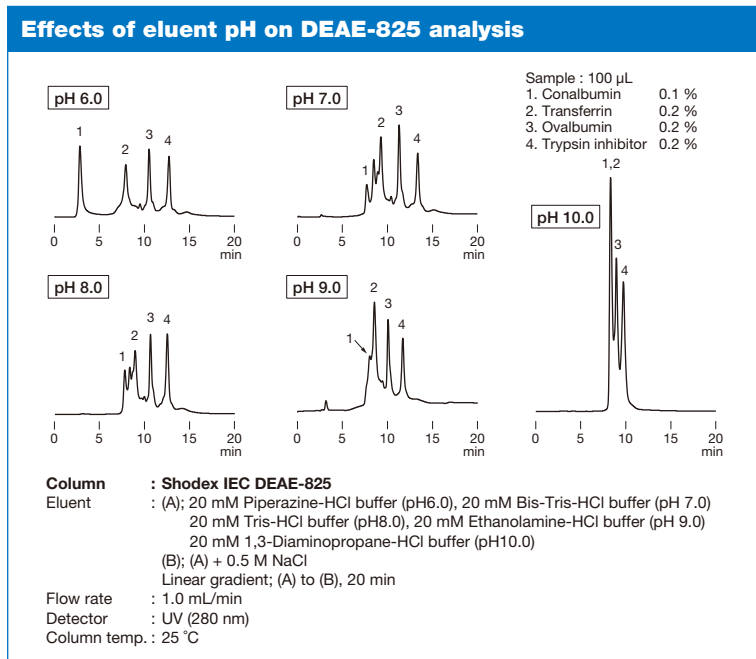
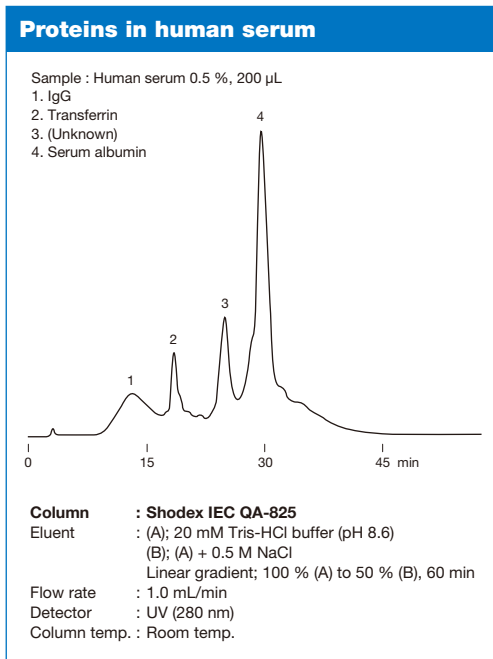
Product Code	Product Name	Ion Exchange Capacity (meq/g)	Base Material	Particle Size (µm)	Pore Size (Å)	Column Size (mm) I.D. x Length	Shipping Solvent
F6110011	IEC QA-825	0.45	Polyhydroxymethacrylate	12	5,000	8.0 x 75	50 mM Na ₂ SO ₄ aq.

[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 x 75	50 mM Na ₂ SO ₄ aq.
F7640002	Asahipak ES-502N 7C	0.55	Polyvinyl alcohol	9	2,000	7.5 x 100	50 mM 1,3-Diaminopropane + 50 mM NaCl (pH10.0)
F6356240	AXpak WA-624	1.2	Polyhydroxymethacrylate	10	2,000	6.0 x 150	0.1 M Sodium phosphate buffer (pH3.0)/CH ₃ CN =80/20
F6700245	AXpak WA-G (guard column)	–	Polyhydroxymethacrylate	10	–	4.6 x 10	0.1 M Sodium phosphate buffer (pH3.0)/CH ₃ CN =80/20

● Preparative columns [Preparative columns are made to order.]

Product Code	Product Name	Particle Size (µm)	Column Size (mm) I.D. x Length	Standard column
F6548000	IEC QA-2025	20	20.0 x 150	QA-825
F6709602	IEC QA-G 8B	20	8.0 x 50	(guard column)
F6548001	IEC DEAE-2025	20	20.0 x 150	DEAE-825
F6709603	IEC DEAE-G 8B	20	8.0 x 50	(guard column)
F6840004	Asahipak ES-502N 20C	13	20.0 x 100	ES-502N 7C
F6710021	Asahipak GS-20G 7B	20	7.5 x 50	(guard column)



Cation Exchange Chromatography Columns

Features

- SP-825**
CM-825
- Suitable for analyzing relatively high molecular weight compounds: proteins, peptides, DNA, and RNA
 - Usable in a wide pH range from pH 2 to 12

- SP-FT 4A**
- Non-porous base material
 - Provides ultra-rapid analysis using conventional devices

- 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
 - Provides simultaneous analysis of different amino acids
 - Fulfills USP L22 and L58 requirements

● 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 x 75	50 mM Na ₂ SO ₄ aq.
F6113100	IEC SP-FT 4A	0.2	Polyhydroxymethacrylate	2.7	–	4.6 x 10	20 mM MES* buffer (pH 5.6)

Housing Material of SP-FT 4A: PEEK
*MES: 2-(N-Morpholino)ethanesulfonic acid

[Weak cation exchange resin] Functional Group: Carboxymethyl

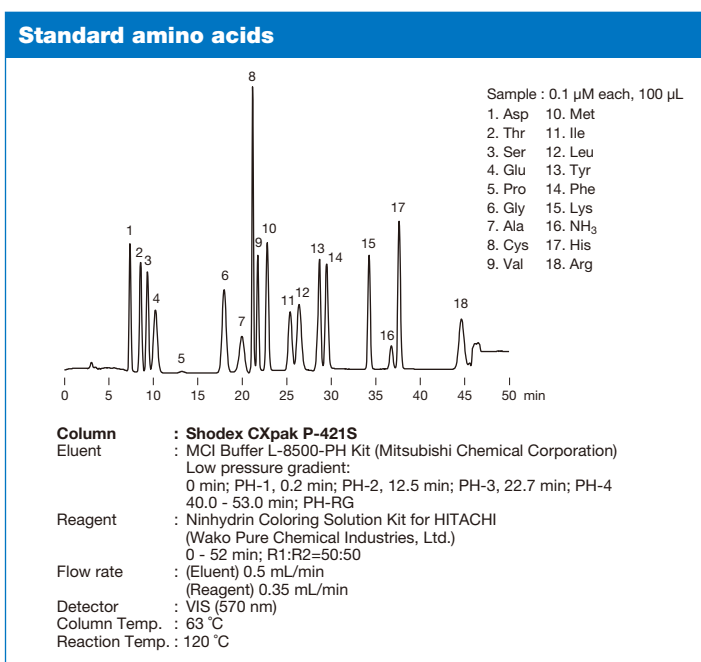
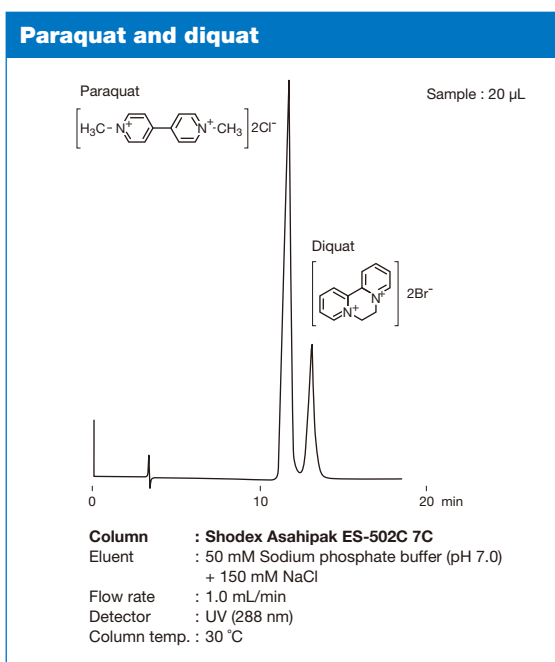
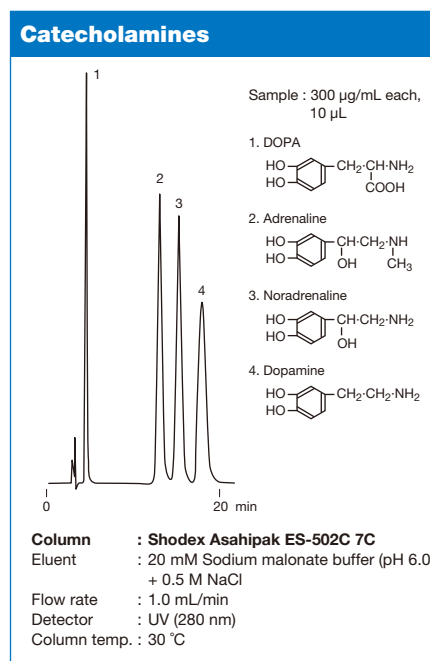
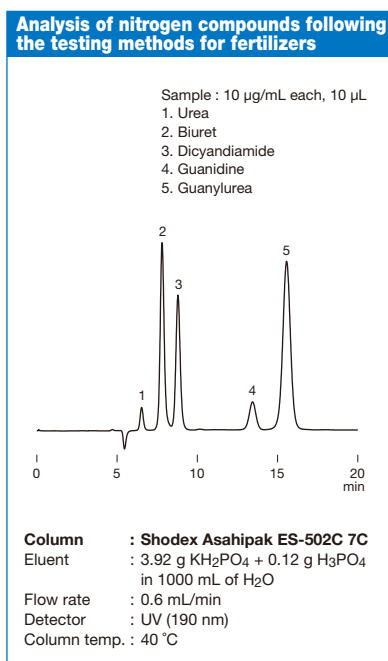
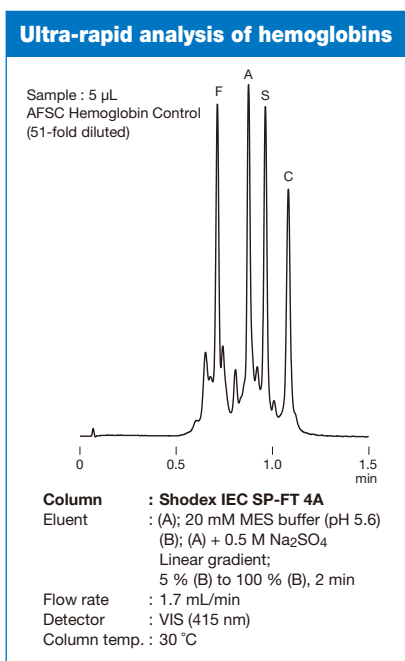
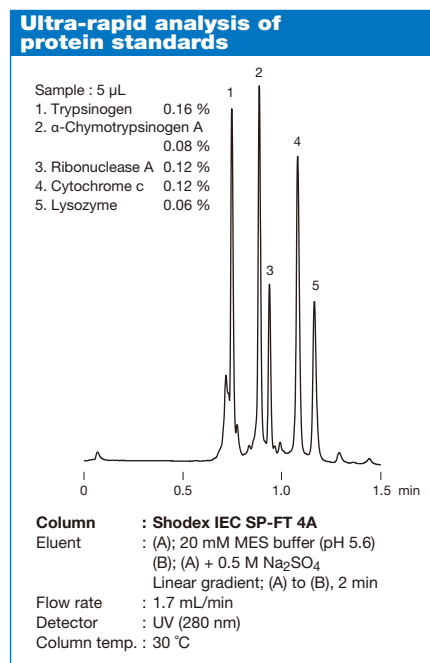
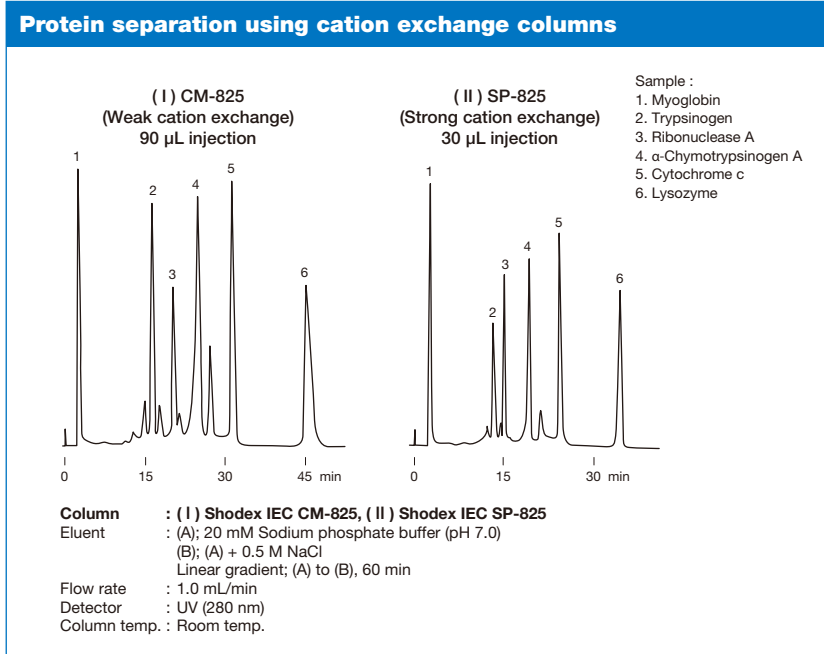
Product Code	Product Name	Ion Exchange Capacity (meq/g)	Base Material	Particle Size (µm)	Pore Size (Å)	Column Size (mm) I.D. x Length	Shipping Solvent
F6110002	IEC CM-825	0.4	Polyhydroxymethacrylate	8	5,000	8.0 x 75	50 mM Na ₂ SO ₄ aq.
F7640001	Asahipak ES-502C 7C	0.55	Polyvinyl alcohol	9	2,000	7.5 x 100	0.1 M Sodium phosphate buffer (pH 4.4)

[For amino acid analysis] 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 x 150	H ₂ O
F6700210	CXpak P-G	(guard column)	Styrene divinylbenzene copolymer	6	4.6 x 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 column
F6548002	IEC SP-2025	20	20.0 x 150	SP-825
F6709604	IEC SP-G 8B	20	8.0 x 50	(guard column)
F6548003	IEC CM-2025	20	20.0 x 150	CM-825
F6709605	IEC CM-G 8B	20	8.0 x 50	(guard column)
F6840003	Asahipak ES-502C 20C	13	20.0 x 100	ES-502C 7C
F6710021	Asahipak GS-20G 7B	20	7.5 x 50	(guard column)



Special Separation Modes Columns

Hydrophobic Interaction Chromatography Column

Features

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

Standard column

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 x 75	H ₂ O

Base Material: Polyhydroxymethacrylate

Affinity Chromatography Columns

Features

- AFpak**
- Rigid polymer-based packing materials enable high speed analysis
 - Functional group 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
F7118946	AFpak APA-894	Protein A	4 mg	18	8.0 x 50	0.1 M Sodium phosphate buffer + 0.5 M NaCl + 0.02 % NaN ₃ (pH 7.0)
F7118964	AFpak ACH-494	Choline oxydase, Acetylcholine esterase	-	18	4.6 x 10	10 mM Sodium Phosphate buffer + 1.0 M NaCl (pH 7.4)

Base Material: Polyhydroxymethacrylate

Chiral Separation Columns

Features

- CDBS-453**
- Separates optical isomers by using their conformational compatibility differences
 - Versatile column for chiral separation
 - Fulfills USP L45 requirements

- CRX-853**
- Separates optical isomers by using their differences in metal complex formation capacities
 - 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 x 150	1.0 % CH ₃ COOH + 0.2 M NaCl aq. /CH ₃ CN=70/30
F7140040	ORpak CRX-853	L-Amino acid derivative	Polyhydroxymethacrylate	6	8.0 x 50	0.25 mM CuSO ₄ aq.
F6709300	ORpak CRX-G	(guard column)	Polyhydroxymethacrylate	6	4.6 x 10	0.25 mM CuSO ₄ aq.

High Temperature Reversed Phase Chromatography Column

Features

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

Standard column

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 x 150	H ₂ O/CH ₃ CN=35/65

Base Material: Polyvinyl alcohol

Pretreatment Column for Column Switching Method

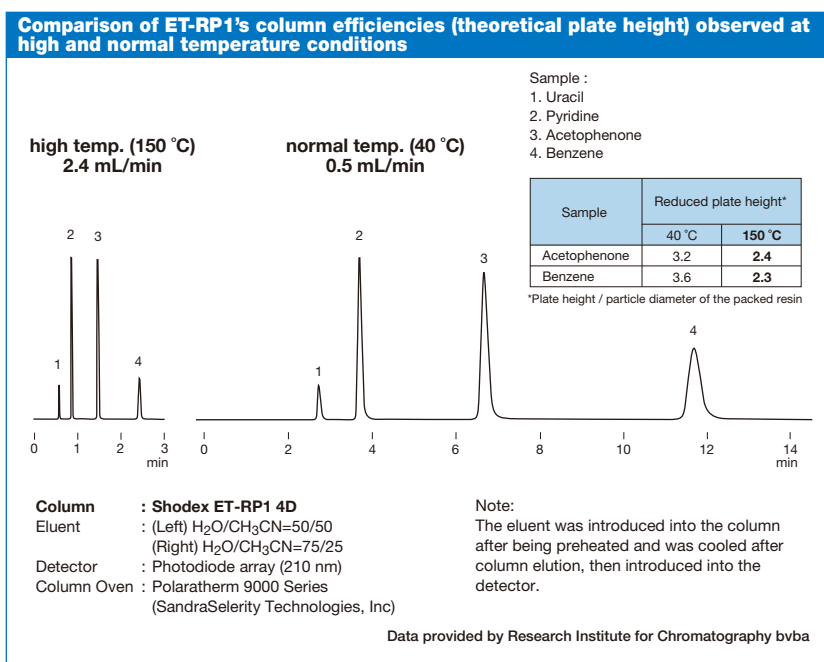
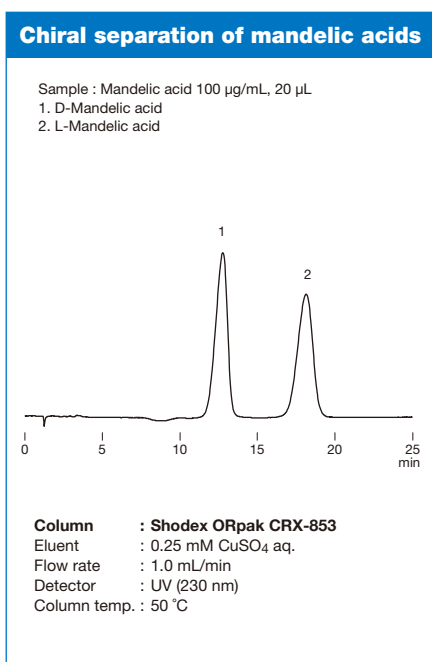
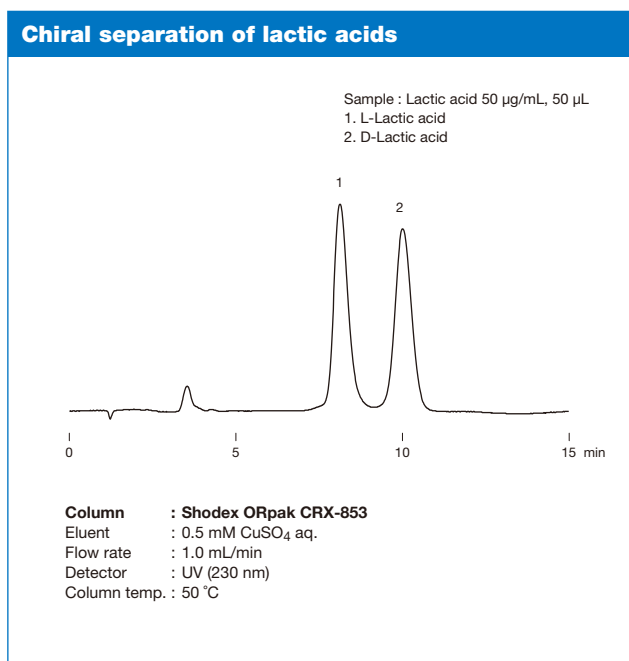
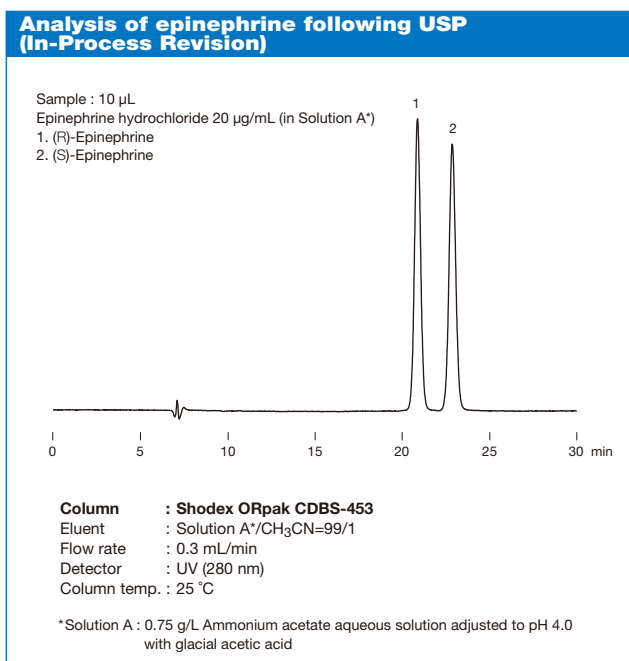
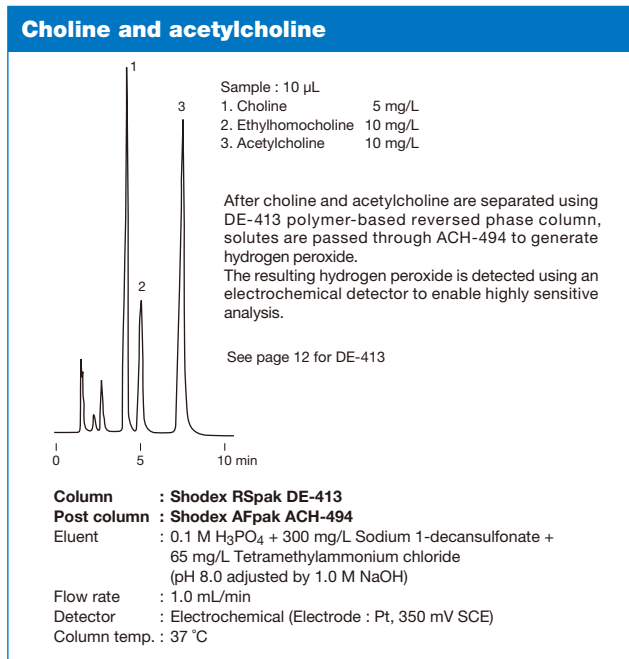
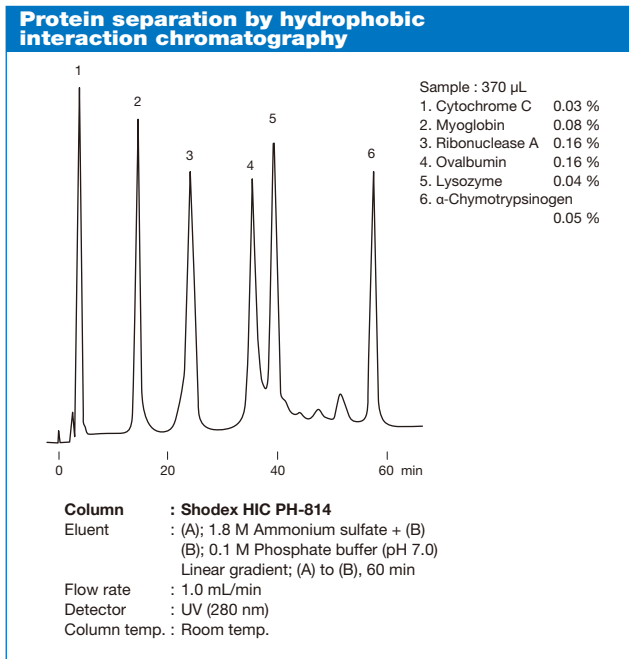
Feature

- GF-4A**
- High protein removal rate
 - Removes surfactants well but is not suitable for trapping hydrophilic substances

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 x 10	H ₂ O

Base Material: Polyvinyl alcohol

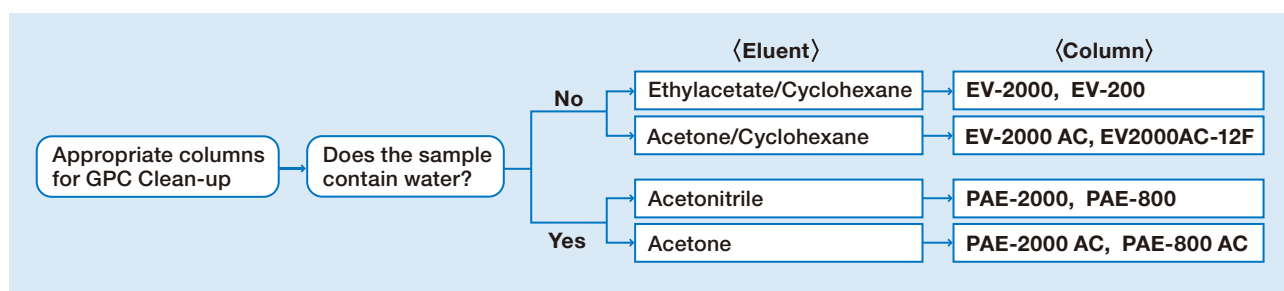


GPC Clean-up Columns

Features

- EV**
- Suitable for fractionation of residual pesticides in foods
 - EV-2000 AC is used in Shoku-An No. 0124001 (January 24th, 2005, 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 x 300	Acetone/Cyclohexane=3/7
F6090007	CLNpak EV-G AC12C	16	(guard column)	12.0 x 100	Acetone/Cyclohexane=3/7
F6090003	CLNpak EV-2000 AC	16	30	20.0 x 300	Acetone/Cyclohexane=3/7
F6090004	CLNpak EV-G AC	16	(guard column)	20.0 x 100	Acetone/Cyclohexane=3/7
F6090001	CLNpak EV-2000	16	30	20.0 x 300	Ethylacetate/Cyclohexane=3/7
F6090002	CLNpak EV-G	16	(guard column)	20.0 x 100	Ethylacetate/Cyclohexane=3/7
F6090005	CLNpak EV-200	16	30	2.0 x 150	Ethylacetate/Cyclohexane=3/7

Base Material: Styrene divinylbenzene copolymer

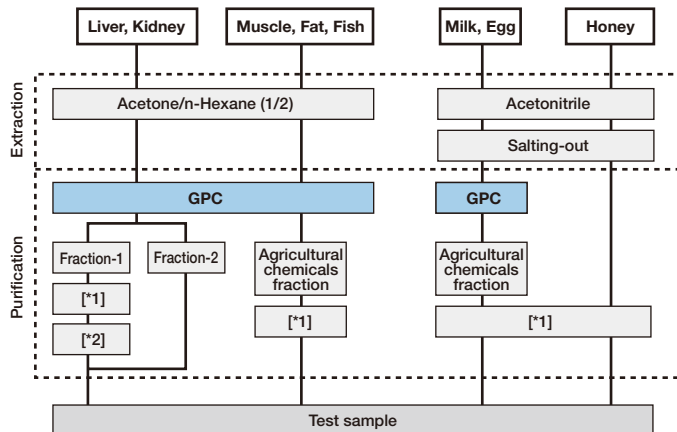
● GPC Clean-up for phthalic acid esters in sediments, biological samples, blood, etc.

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 x 300	Acetonitrile
F6714007	CLNpak PAE-G	9	(guard column)	8.0 x 50	Acetonitrile
F7600025	CLNpak PAE-800	5	400	8.0 x 300	Acetonitrile
F6810023	CLNpak PAE-2000 AC	5	400	20.0 x 300	Acetone
F6714008	CLNpak PAE-G AC	9	(guard column)	8.0 x 50	Acetone
F7600026	CLNpak PAE-800 AC	5	400	8.0 x 300	Acetone

Base Material: Polyvinyl alcohol

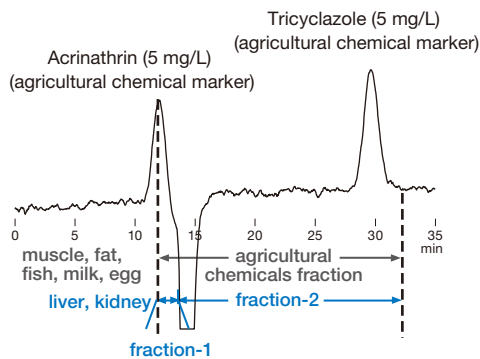
Sample preparation outline for simultaneous GC/MS and LC/MS analysis of agricultural chemicals in livestock and marine products (part 1)

[Outline]



GPC column : Shodex CLNpak EV-2000 AC + EV-G AC
 *1 Purification with ethylenediamine-N-propylsilyled silica gel mini-column
 *2 Purification with silica gel mini-column

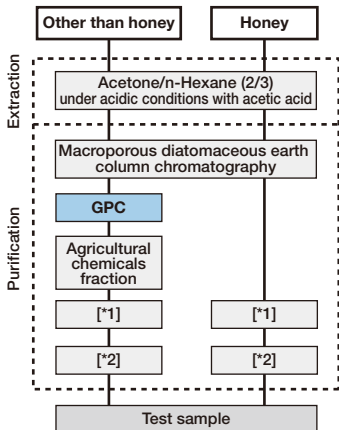
Preparation range of agricultural chemicals using EV-2000 AC



Column : Shodex CLNpak EV-G AC + EV-2000 AC
 Eluent : Acetone/Cyclohexane=1/4
 Flow rate : 5.0 mL/min
 Detector : UV (254 nm) (preparative type)
 Column temp. : 40 °C
 Injection vol. : 5 mL

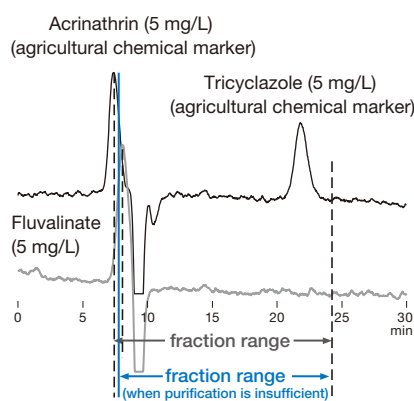
Sample preparation outline for simultaneous LC/MS analysis of agricultural chemicals in livestock and marine products (part 2)

[Outline]



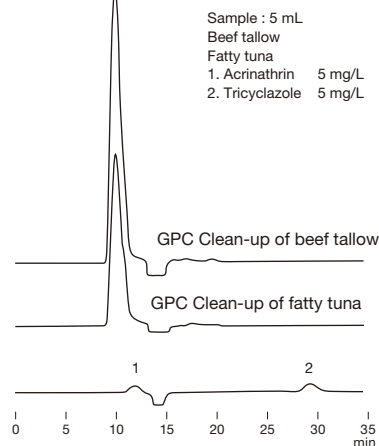
GPC column : Shodex CLNpak EV2000AC-12F + EV-G AC12C
 *1 Purification with trimethyl aminopropylsilyled silica gel mini-column
 *2 Purification with ethylenediamine-N-propylsilyled silica gel mini-column

Preparation range of agricultural chemicals using EV2000AC-12F



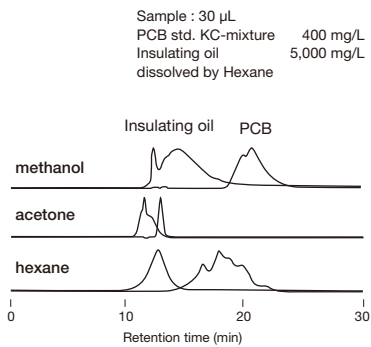
Column : Shodex CLNpak EV-G AC12C + EV2000AC-12F
 Eluent : Acetone/Cyclohexane=3/17
 Flow rate : 3.0 mL/min
 Detector : UV (254 nm) (preparative type)
 Column temp. : 45 °C
 Injection vol. : 2 mL

GPC clean-up of fatty tuna and beef tallow



Sample : 5 mL
 Beef tallow
 Fatty tuna
 1. Acrinathrin 5 mg/L
 2. Tricyclazole 5 mg/L
 Column : Shodex CLNpak EV-G AC + EV-2000 AC
 Eluent : Acetone/Cyclohexane=1/4
 Flow rate : 5.0 mL/min
 Detector : UV (254 nm) (preparative type)
 Column temp. : 40 °C
 Injection vol. : 5 mL

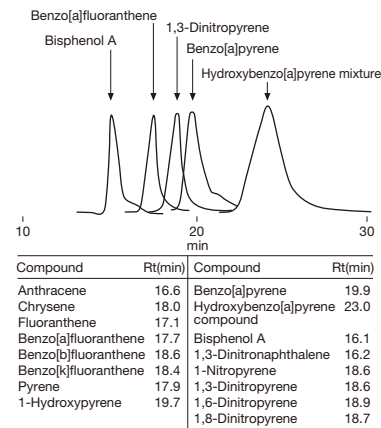
Separation of PCB and insulating oil using PAE-800



Column : Shodex CLNpak PAE-800
 Eluent : Methanol, Acetone, Hexane
 Flow rate : 0.8 mL/min
 Detector : Photodiode array (209 nm)
 Column temp. : 40 °C

Source: Mr. Tetsuya Sawatsubashi (Mitsubishi Heavy Industries, Ltd.) et al., Search of Liquid Chromatographic Clean-up Materials for Rapid PCB Analysis and Evaluation of Their Separation Characteristics. Journal of Environmental Chemistry, 2007, Vol. 17, No. 3, p. 471-481.

GPC clean-up of carcinogens in diesel dust measured using PAE-800 AC

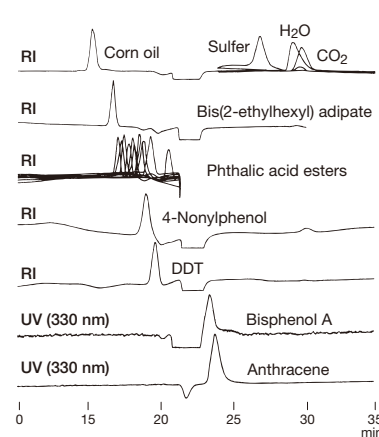


Compound	Rt(min)	Compound	Rt(min)
Anthracene	16.6	Benzo[a]pyrene	19.9
Chrysene	18.0	Hydroxybenzo[a]pyrene	23.0
Fluoranthene	17.1	compound	
Benzo[a]fluoranthene	17.7	Bisphenol A	16.1
Benzo[b]fluoranthene	18.6	1,3-Dinitronaphthalene	16.2
Benzo[k]fluoranthene	18.4	1-Nitropyrene	18.6
Pyrene	17.9	1,3-Dinitropyrene	18.6
1-Hydroxypyrene	19.7	1,6-Dinitropyrene	18.9
		1,8-Dinitropyrene	18.7

Column : Shodex CLNpak PAE-800 AC
 Eluent : Acetone
 Flow rate : 0.8 mL/min
 Detector : UV (210 nm)
 Column temp. : Room temp.

Data provided by Kazuichi Hayakawa Ph.D., Faculty of Pharmaceutical Sciences, Kanazawa University.

Eluting positions of phthalic acid esters using PAE-800 AC



Column : Shodex CLNpak PAE-800 AC
 Eluent : Acetone
 Flow rate : 0.5 mL/min
 Detector : UV (330 nm), RI
 Column temp. : Room temp.

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 detailed column cleaning procedures, refer to operating manual packaged with each column.

Typical indicators of column deterioration

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

Cleaning solvent selection guide

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 at half of the recommended flow rate. Disconnect any guard column.

Reversed phase chromatography columns	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)
Sugar analysis columns	<p>[Ligand exchange columns (SUGAR series)]</p> <ul style="list-style-type: none"> • In case of counter ion detachment Flush or inject solvent containing the salt corresponding to the modified counter-ligand. <p>[Polymer-base amino columns (NH2P series, VG-50 series)]</p> <ul style="list-style-type: none"> • In cases where an acidic substance has been bound to the amino functional group Flush with solvents in the following sequence: water, 0.1 M perchloric acid (aq.), water, 0.1 M NaOH (aq.), water, and mobile phase.
Aqueous SEC (GFC) chromatography columns	<ul style="list-style-type: none"> • 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)
Ion exchange chromatography columns	<ul style="list-style-type: none"> • 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) <hr/> <ul style="list-style-type: none"> • 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.
Hydrophobic interaction chromatography columns	<ul style="list-style-type: none"> • 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

Elevated column pressure are often caused by insoluble components that block the column inlet.

In this case, reverse the direction and reduce the flow rate at half of the recommended flow rate. This may remove the insoluble components 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 and securely tighten the end caps.
-

■ Column storage

- For long-term storage, remove the column from the system after replacing the in-column solvent with the shipping solvent.
 - Securely tighten the end caps and store the column in a location with stable temperature.
(A cool and dark space is recommended)
-

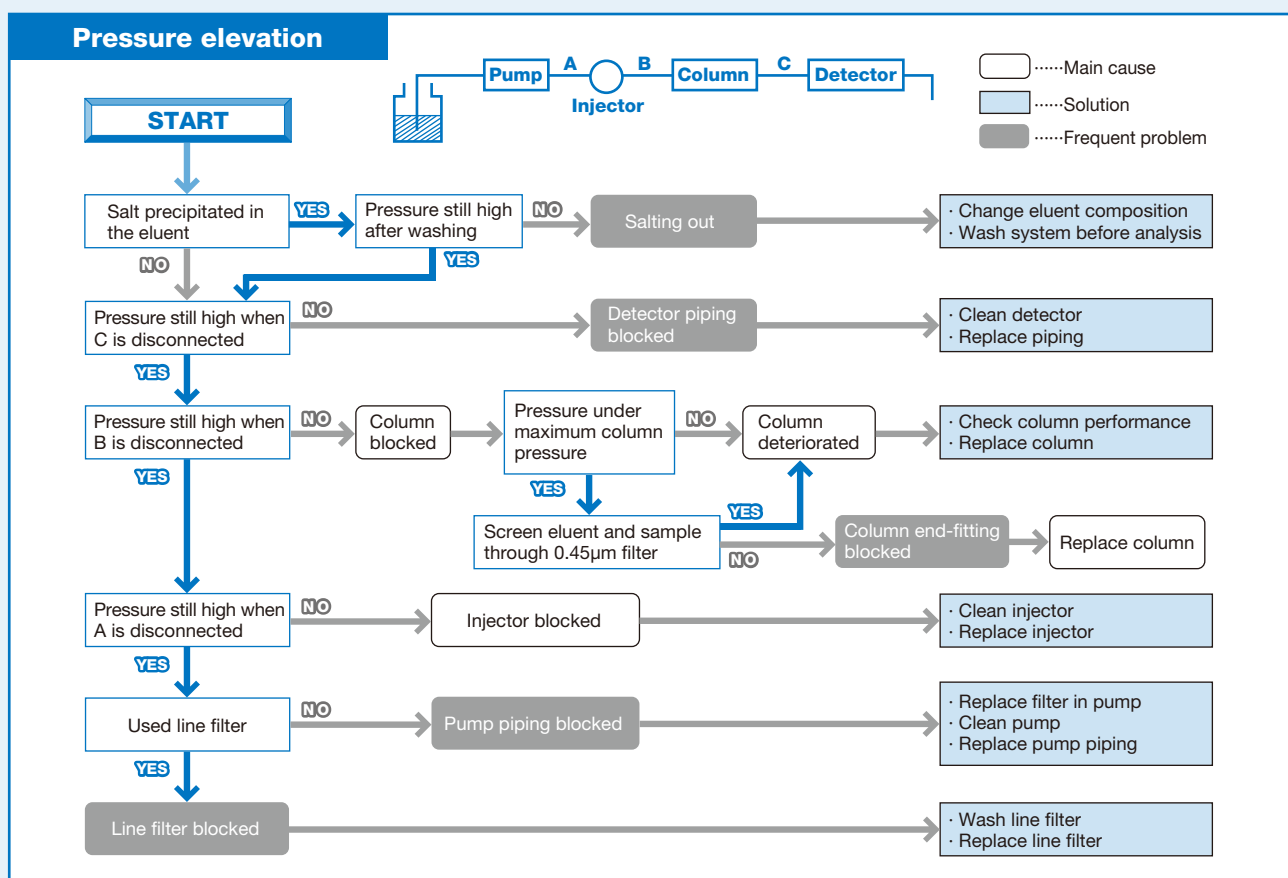
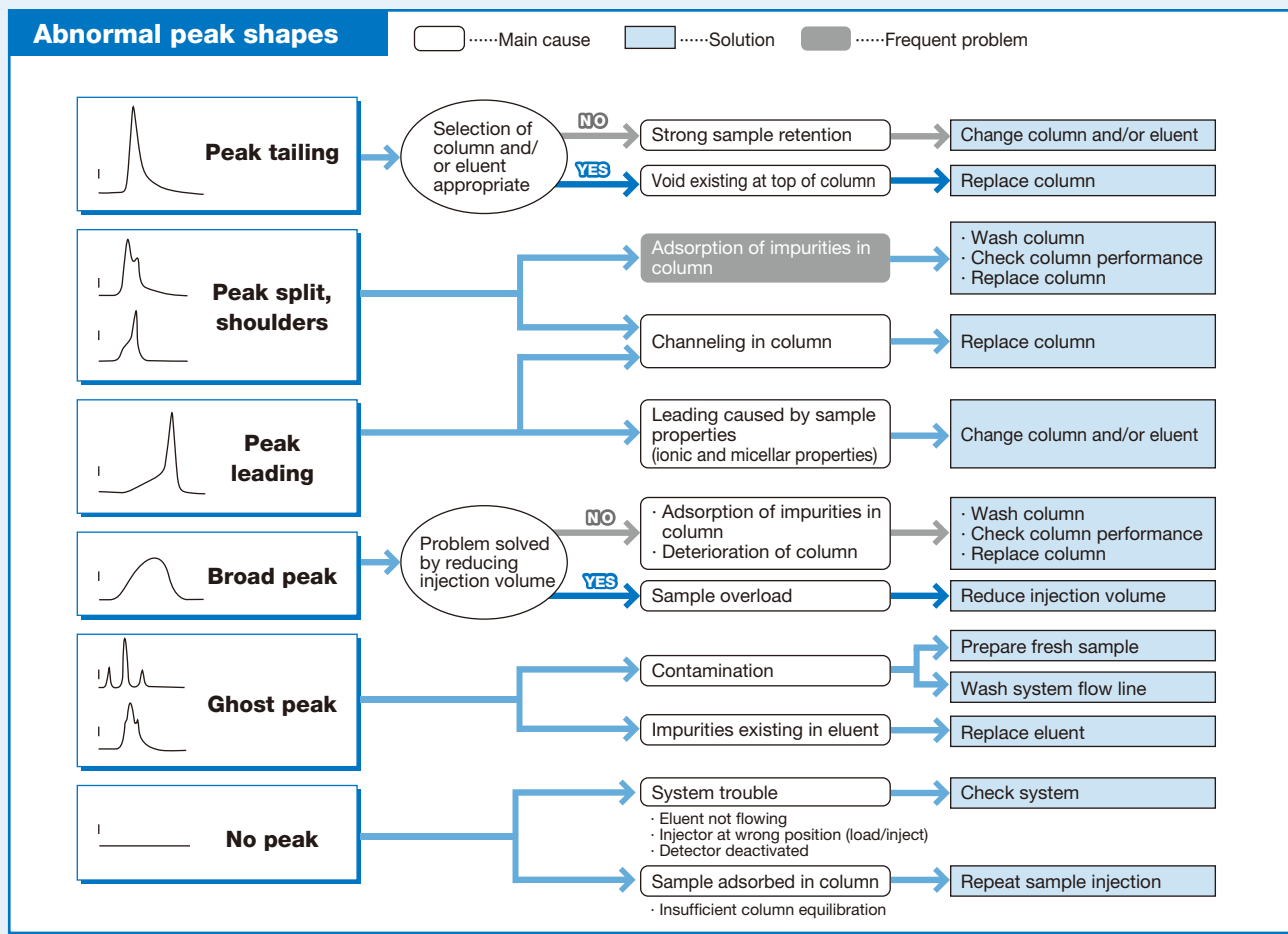
■ Other

- Do not remove end fittings.
 - Do not make a strong impact on the column. Do not drop or hit the column on a hard surface.
-

[Read the operation manual before using the column.](#)

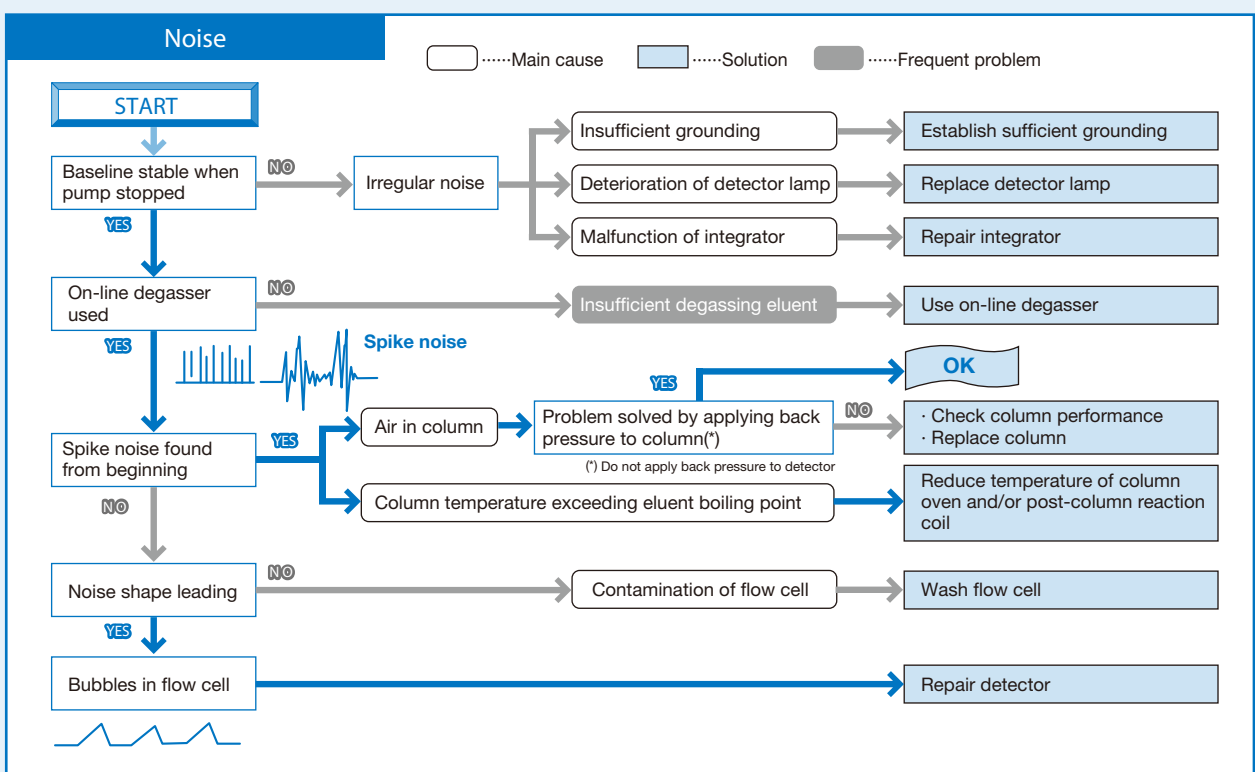
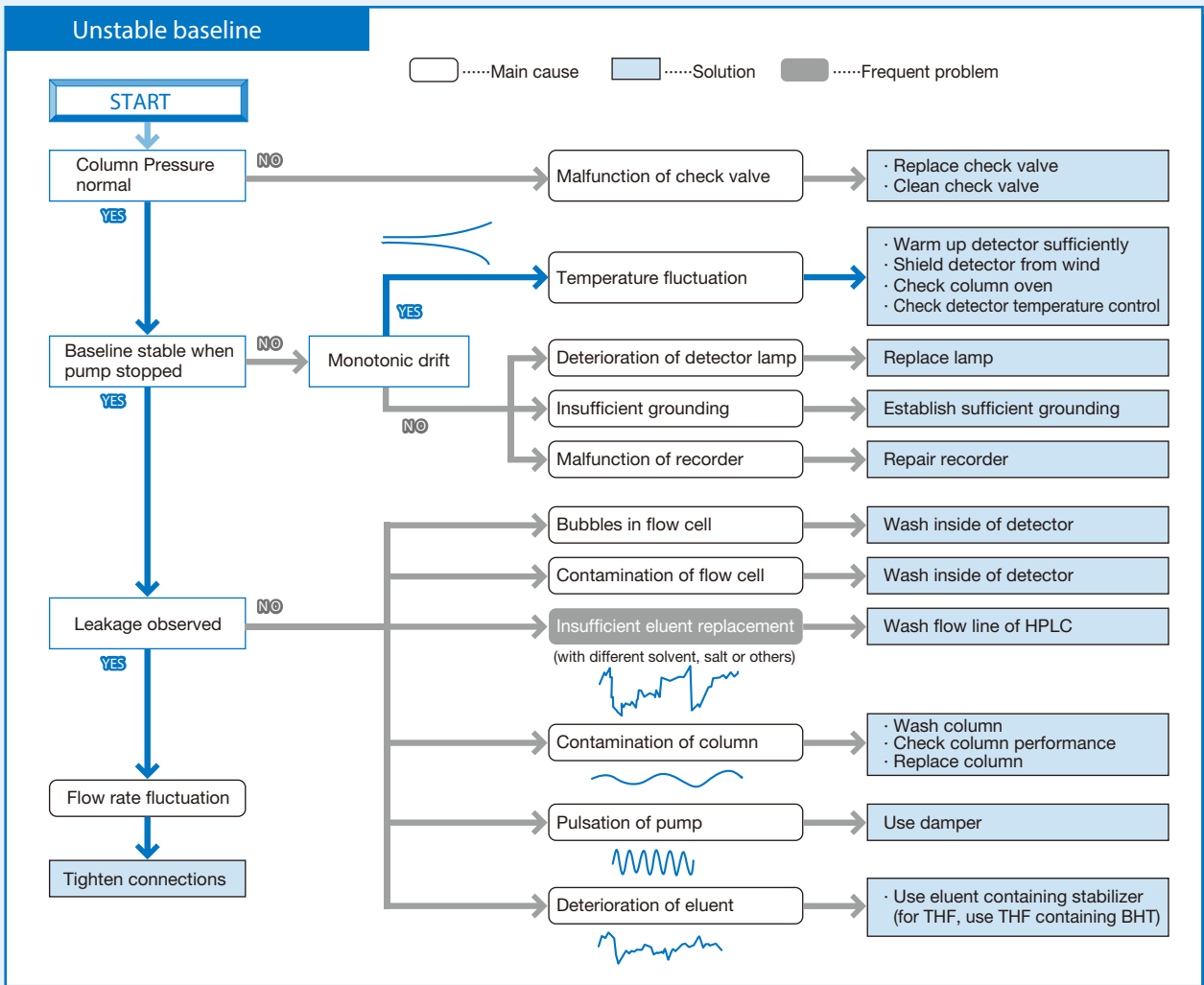
Column Trouble Shooting

Common causes for abnormal chromatograms



HPLC System Trouble Shooting

Common causes for abnormal chromatograms



USP Column List (42-NF37)

No.	Packing material	Recommended Column	Page
L1	Octadecyl silane chemically bonded to porous or non-porous silica or ceramic micro-particles, 1.5 to 10 µm in diameter, or a monolithic rod.	C18	22
		Silica C18M	22
		Silica C18P	22
		C18U	23
L3	Porous silica particles, 1.5 to 10 µm in diameter, or a monolithic silica rod.	Silica 5SIL	23
L7	Octylsilane chemically bonded to totally or superficially porous silica particles, 1.5 to 10 µm in diameter, or a monolithic silica rod.	Silica 5C8	22
L8	An essentially monomolecular layer of aminopropylsilane chemically bonded to totally porous silica gel support, 1.5 to 10 µm in diameter, or a monolithic silica rod.	Silica 5NH	23
L10	Nitrile groups chemically bonded to porous silica particles, 1.5 to 10 µm in diameter, or a monolithic silica rod.	Silica 5CN	22
L17	Strong cation-exchange resin consisting of sulfonated cross-linked styrene-divinylbenzene copolymer in the hydrogen form, 6 to 12 µm in diameter.	SUGAR SH1011	30
		SUGAR SH1821	30
		RSpak KC-811	30
		IC Y-521	34
L19	Strong cation-exchange resin consisting of sulfonated cross-linked styrene-divinylbenzene copolymer in the calcium form, 5 - 15 µm in diameter.	ICT-521	34
		SUGAR SC1011	26
		SUGAR SC1821	26
		SUGAR SC1211	26
L20	Dihydroxypropane groups chemically bonded to porous silica or hybrid particles, 1.5 to 10 µm in diameter, or a monolithic silica rod.	EP SC1011-7F	27
		USPpak MN-431	27
		PROTEIN KW-800 series	38
		KW400 series	38
L21	A rigid, spherical styrene-divinylbenzene copolymer, 3 to 30 µm in diameter.	PROTEIN LW-803	39
		PROTEIN LW-403 4D	39
		RSpak RP18-415	12
		RSpak DS-613	12
L22	A cation-exchange resin made of porous polystyrene gel with sulfonic acid groups, 5 - 15 µm in diameter.	RSpak DS-413	12
		GPC KF, K, KD, HK, LF, HT, UT, AT, HFIP series	50, 52, 54, 56, 58, 60, 62, 64
		SUGAR SC1011	26
		SUGAR SC1821	26
		SUGAR SP0810	26
		SUGAR KS-800 series	26
		RSpak DC-613	26
		SUGAR SZ5532	26
		SUGAR SC1211	26
		EP SC1011-7F	27
		USPpak MN-431	27
		SUGAR SH1011	30
L23	An anion-exchange resin made of porous polymethacrylate or polyacrylate gel with quaternary ammonium groups, 7 - 12 µm in size.	SUGAR SH1821	30
		RSpak KC-811	30
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.	IC Y-521	34
		ICT-521	34
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.	CXpak P-421S	72
		IEC QA-825	70
L34	Strong cation-exchange resin consisting of sulfonated cross-linked styrene-divinylbenzene copolymer in the lead form, 7 to 9 µm in diameter	OHpak SB-802 HQ	42
		OHpak SB-802.5, OHpak LB-802.5	42
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.	PROTEIN KW-800 series	38
		KW400 series	38
L38	A methacrylate-based size-exclusion packing for water-soluble samples.	PROTEIN LW-803	39
		PROTEIN LW-403 4D	39
L39	A hydrophilic polyhydroxymethacrylate gel of totally porous spherical resin.	SUGAR SP0810	26
		OHpak SB-803 HQ	42
L45	Beta cyclodextrin, R,S-hydroxypropyl ether derivative, bonded to porous silica particles, 3 to 10 µm in diameter.	OHpak LB-803	42
		OHpak SB-800 HQ series	42
L58	Strong cation-exchange resin consisting of sulfonated cross-linked styrene-divinylbenzene copolymer in the sodium form, about 6 to 30 µm in diameter.	OHpak LB-800 series	42
		ODP2 HP	8
L59	Packing for the size-exclusion separations of proteins (separation by molecular weight) over the range of 5 to 7000 kDa. The packing is spherical 1.5 - 10 µm, silica or hybrid packing with a hydrophilic coating.	RSpak DM-614	12
		OHpak SB-800 HQ series	42
L67	Porous vinyl alcohol copolymer with a C18 alkyl group attached to the hydroxyl group of the polymer, 2 to 10 µm in diameter.	OHpak LB-800 series	42
		ORpak CDBS-453	74
L71	A rigid, spherical polymethacrylate, 4 to 6 µm in diameter.	RSpak DC-613	26
		SUGAR KS-800 series	26
L76	Silica based, weak cation-exchange material, 5 µm in diameter. Substrate is surface polymerized polybutadiene-maleic acid to provide carboxylic acid functionalities. Capacity not less than 29 µEq/column.	CXpak P-421S	72
		PROTEIN KW-800 series	38
L82	Polyamine chemically bonded to cross-linked polyvinyl alcohol polymer, 4 - 5 µm in diameter.	KW400 series	38
		PROTEIN LW-803	39
L89	Packing having the capacity to separate compounds with a molecular weight range from 100 - 3000 (as determined by polyethylene oxide), applied to neutral and anionic water-soluble polymers. A polymethacrylate resin base, cross-linked with polyhydroxylated ether (surface contains some residual cationic functional groups).	PROTEIN LW-403 4D	39
		Asahipak ODP-40	10
L92	A rigid, spherical polymethacrylate, 4 to 6 µm in diameter.	Asahipak ODP-50	10
		ET-RP1	74
L95	A rigid, spherical polymethacrylate, 4 to 6 µm in diameter.	RSpak DE-613	12
		RSpak DE-413	12
L98	A rigid, spherical polymethacrylate, 4 to 6 µm in diameter.	RSpak DE-213	12
		IC YK-421	34
L102	Polyamine chemically bonded to cross-linked polyvinyl alcohol polymer, 4 - 5 µm in diameter.	Asahipak NH2P-50	20
		Asahipak NH2P-40	20
L105	Packing having the capacity to separate compounds with a molecular weight range from 100 - 3000 (as determined by polyethylene oxide), applied to neutral and anionic water-soluble polymers. A polymethacrylate resin base, cross-linked with polyhydroxylated ether (surface contains some residual cationic functional groups).	OHpak SB-802.5, OHpak LB-802.5	42

Index by Product Name

Columns are listed in alphabetical order without their series names.

[Series name]

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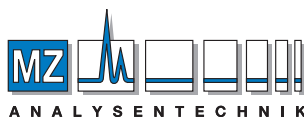
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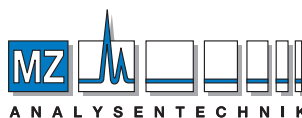
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