SELECTOSIL™

- **For Availability and Ordering Information please contact your Phenomenex Technical Consultant.**

SHODEX®

by Showa Denko K.K.

- **High efficiency polymer columns**
- **Excellent mechanical and chemical stability**
- **Wide application range**
- **High temperature GPC applications**

Nomenclature of Packing Materials

PHM	polyhydroxymethacrylate
PMM	polymethylmethacrylate
PS	polystyrene
PVA	polyvinyl alcohol
S-DVB	styrene-divinylbenzene co-polymer

Separation Modes

AFC	affinity chromatography
GPC	gel permeation chromatography (organic-soluble SEC)
GFC	gel filtration chromatography (water-soluble SEC)
HIC	hydrophobic interaction chromatography
IC	ion chromatography
IEC	ion-exchange chromatography
IEX	ion-exclusion chromatography
LEX	ligand-exchange chromatography
NPC	normal phase chromatography
P & A	partition and adsorption chromatography
RPC	reversed phase chromatography
SEC	size-exclusion chromatography (includes GPC & GFC)

Guide for Shodex Column Selection

Solubility	Molecular Weight	Separation Mode	Column	Page
Water-insoluble	over 2000	SEC	GPC KF-802.5-807, K-802.5-807, KD-802.5-807, KF-602.5-607, KF-402.5 HQ-406L HQ	222, 223
	under 2000	SEC	GPC KF-801-802.5, K-801-802.5, KD-801-802.5, LF-804, KF-601-602.5, KF-401 HQ-402.5L HQ	222, 223
		RPC	RSpak DE-413, 413L, DM-614	227
Water-soluble	over 2000	SEC	OHpak SB-803-806HQ, SUGAR KS-803-806, PROTEIN KW-802.5-804	224
		IEC	IEC QA-825, DEAE-825, SP-825, CM-825	225
			AXpak WA-624	225
		HIC	HIC PH-814	225
		RPC	RSpak RP18-415	227
		AFFINITY	AFpak	225
	under 2000	SEC	SB-802-802.5HQ, SUGAR KS-801-802	224
		LEC	SUGAR SC1011, SP0810	225
		IEX	RSpak KC-811, SUGAR SH1011, SUGAR SH1821	226, 225
		IEC	AXpak WA-624	225
		IC	IC SI-90 4E, SI-50 4E, IC I-524A, Y-521, YK-421, T-521	226
		RPC	RSpak DE-613, 413, DS-613	227
		NPC	SUGAR SZ5532, RSpak DC-613	225, 227
		AFFINITY	AFpak	225
		CHIRAL	ORpak CDBS, CDA, CDB, CDC HQ	228

SHODEX®

by Showa Denko K.K.

ORGANIC GPC COLUMNS

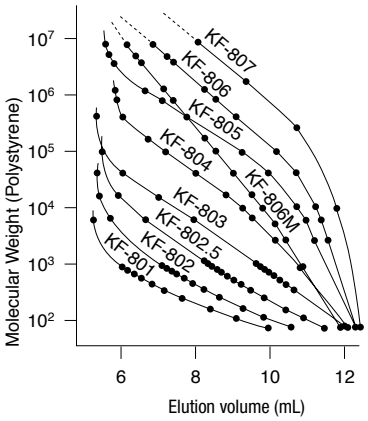
Shodex has a wide variety of columns for GPC (or SEC) using organic solvents. The columns are packed with porous S-DVB gels specially developed for GPC use. Five types of GPC columns packed in different solvents are available. Custom columns packed in other solvents, such as quinoline, o-dichlorobenzene, ethyl acetate, tetrachloroethane and dimethylacetamide are available upon request.

Series name	In-column solvent	Applications
GPC KF-800 series	THF (tetrahydrofuran)	General purpose GPC
GPC K-800 series	Chloroform	General purpose GPC
GPC KD-800 series	DMF (dimethylformamide)	Polar compounds such as melamine resin, phenolic resin, polyurethane and polyvinylpyrrolidone
GPC LF-804	THF	Wide linear molecular weight
GPC HFIP-800 series	HFIP (hexafluoroisopropanol)	Engineering plastics such as polyamide (Nylon) and polybutylterephthalate at ordinary temperature
GPC HT-800 series	Toluene	High temperature GPC up to 140 °C
GPC UT-800 series	Toluene	Ultra high temperature GPC up to 210 °C. Polymer samples in which ultra-high molecular weight portion is included
GPC KF-600 series	THF	Semi-micro GPC
GPC KF-400HQ series	THF	Semi-micro GPC for organic polymer analysis

App ID 10766

Calibration Curves for GPC KF-800 Series

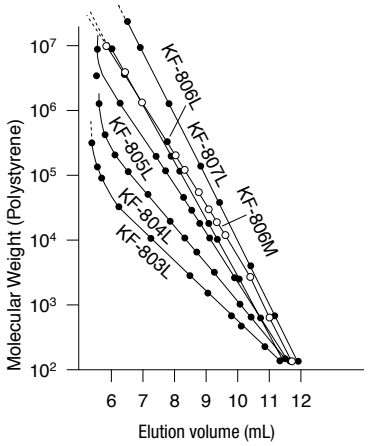
Column: Shodex GPC KF-800 series
Dimensions: 8 x 300 mm



App ID 10768

Calibration Curves for GPC Mixed Bed Columns

Column: Shodex GPC KF-800L series and KF-806M
Dimensions: 8 x 300 mm

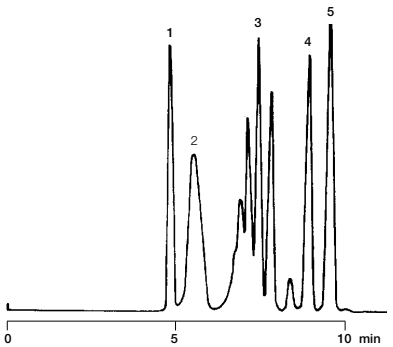


App ID 5519

Polystyrene Standards

Column: Shodex GPC KF-802
Dimensions: 8 x 300 mm
Eluent: THF
Flow Rate: 1.0 mL/min
Detector: Shodex UV @ 254 nm
Temperature: Ambient
Sample:

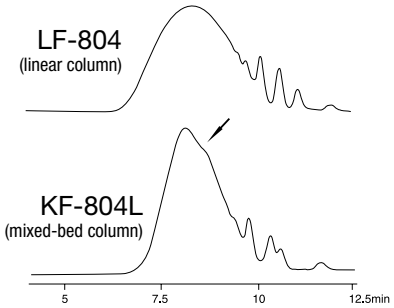
1. PS	42,800	0.05 %
2. PS	2,800	0.12 %
3. PS	300	0.25 %
4. n-Propylbenzene	120	0.15 %
5. Benzene	78	0.15 %



App ID 14173

Phenol Resin

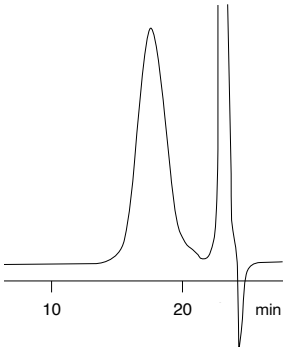
Dimensions: 8 x 300 mm
Eluent: THF
Flow Rate: 1.0 mL/min
Detector: UV @ 254 nm
Temperature: 40 °C



App ID 5521

PEEK Resin

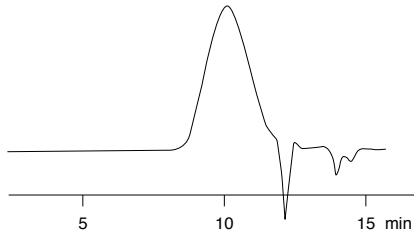
Column: Shodex GPC K-806M x 2
Dimensions: 8 x 300 mm
Eluent: $CHCl_3/Cl_2CHCOOH$=90/10
Flow Rate: 1.0 mL/min
Detector: Shodex RI
Temperature: Ambient
Sample: PEEK 0.2 %, 50 µL



App ID 5522

Polyvinylpyrrolidone

Column: Shodex GPC KD-806M x 2
Dimensions: 8 x 300 mm
Eluent: 0.01 M LiBr /DMF
Flow Rate: 1.0 mL/min
Detector: Shodex RI
Temperature: 42 °C
Sample: Polyvinylpyrrolidone 0.5 %, 50 µL



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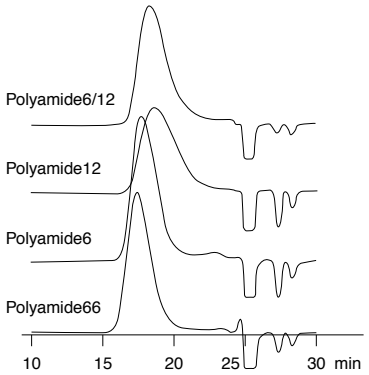
Organic GPC Columns (continued)

App ID 5523

Polyamide (Nylon)

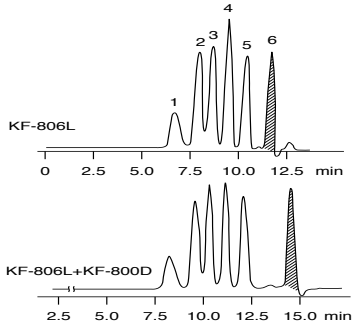
Column: Shodex GPC HFIP-806M x 2
Dimensions: 8 x 300 mm
Eluent: 5 mM TFA-Na in HFIP
Flow Rate: 1.0 mL/min
Detector: Shodex RI
Temperature: 40 °C



App ID 5524

Improved Resolution from Solvent Peak

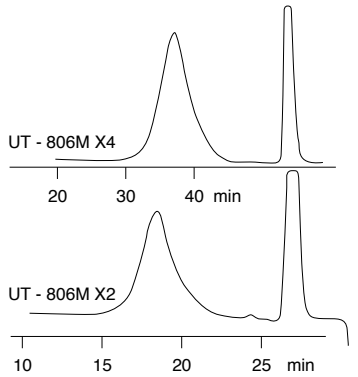
Column: Shodex GPC KF-806L + KF-800D
Dimensions: 8 x 300 mm + 8 x 100 mm
Eluent: THF
Flow Rate: 1.0 mL/min
Detector: UV @ 254 nm
Sample: Polystyrene standards
1. MW 4,480,000
2. MW 422,000
3. MW 107,000
4. MW 16,700
5. MW 2,800
6. MW 120 (Propylbenzene)



App ID 5525

Low Density Polyethylene

Column: Shodex GPC UT-806M x 4, HT-806M x 2
Dimensions: 8 x 300 mm
Eluent: 0.1 % BHT in o-Dichlorobenzene
Flow Rate: 1.0 mL/min
Detector: Shodex RI
Temperature: 140 °C
Sample: 1. LDPE



ORDERING INFORMATION

Standard Columns

Column Type / Part No.: THF	Chloroform	DMF	ID x Length (mm)	Plate Number	Exclusion Limit
GPC KF-801	GPC K-801	GPC KD-801	8 x 300	>16,000	1.5 x 10^3 (KD-801, 2.5 x 10^3)
GPC KF-802	GPC K-802	GPC KD-802	8 x 300	>16,000	5 x 10^3
GPC KF-802.5	GPC K-802.5	GPC KD-802.5	8 x 300	>16,000	2 x 10^4
GPC KF-803	—	GPC KD-803	8 x 300	>16,000	7 x 10^4
GPC KF-804	GPC K-804	GPC KD-804	8 x 300	>16,000	4 x 10^5
GPC KF-805	GPC K-805	GPC KD-805	8 x 300	>10,000	4 x 10^6
GPC KF-806	GPC K-806	GPC KD-806	8 x 300	>10,000	(2 x 10^7)
GPC KF-807	—	GPC KD-807	8 x 300	>5,000	(2 x 10^8)

NOTE: 803, 804, 805, 806 and 807 are available packed in HFIP.

Mixed bed columns are specially designed to have wide linear molecular weight ranges. These mixed bed columns are highly recommended for correcting non-linear sections of molecular weight calibration curves.

Mixed Bed Columns

Column Type / Part No.: THF	Chloroform	DMF	HFIP	ID x Length (mm)	Plate Number	Exclusion Limit
GPC KF-803L	GPC K-803L	—	—	8 x 300	>16,000	7 x 10^4
GPC KF-804L	GPC K-804L	—	—	8 x 300	>16,000	4 x 10^5
GPC KF-805L	GPC K-805L	—	—	8 x 300	>10,000	4 x 10^6
—	GPC K-806L	—	—	8 x 300	>10,000	(2 x 10^7)
GPC KF-806M	—	GPC KD-806M	GPC HFIP-806M*	8 x 300	>12,000	(2 x 10^7)
GPC KF-807L	—	—	—	8 x 300	> 5,000	(2 x 10^8)

** HFIP-806M plate number is >8,000 and the effective molecular weight range is 10^3~10^7.*

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Organic GPC Columns (continued)

ORDERING INFORMATION

High Temperature GPC Columns

Column Type Toluene	ID x Length (mm)	Exclusion Limit	Usable Temperature (°C)	Price
GPC HT-803	8 x 300	7×10^4	100-140	
GPC HT-804	8 x 300	4×10^5	100-140	
GPC HT-805	8 x 300	4×10^5	100-140	
GPC HT-806	8 x 300	(2×10^7)	100-140	

NOTE: Exclusion Limits in parentheses,( ), are estimated values.

Solvent-Peak Separation Columns*

Column Type THF	Chloroform	ID x Length (mm)	Price
GPC KF-800D	GPC K-800D	8 x 100	

**These columns make the elution of low-molecular weight components slower and can be used to separate them from a solvent peak or other troublesome peaks.*

Wide Linear Working Range

Column	ID x Length (mm)	Plate Number	Exclusion Limit	Price
GPC LF-804	8 x 300	> 17,000	7×10^4	

Downsized GPC Columns

Column Type THF	ID x Length (mm)	Particle Size (µm)	Pore Size (Å)	Plate Number	Exclusion Limit (Polystyrene)	Price
GPC KF-601	6.0 x 150	3	20	>17,000	1,500	
GPC KF-602	6.0 x 150	3	60	>17,000	5,000	
GPC KF-602.5	6.0 x 150	3	80	>17,000	20,000	
GPC KF-603	6.0 x 150	3	100	>17,000	70,000	
GPC KF-604	6.0 x 150	3	200	>16,000	400,000	
GPC KF-605	6.0 x 150	10	500	>7,000	4,000,000	
GPC KF-606	6.0 x 150	10	1,000	>7,000	(20,000,000)	
GPC KF-606M	6.0 x 150	10	—	>8,000	(20,000,000)	
GPC KF-607	6.0 x 150	18	>1,000	>5,000	(200,000,000)	
GPC KF-G	4.6 x 10	8	—	—	Guard Column	

NOTES: For all column types. Recommended flow rate: 0.4 to 0.6 mL/min; Max. usable flow rate: 0.8 mL/min; Max. usable temperature 45 °C.

3 µm Semi-micro GPC Columns

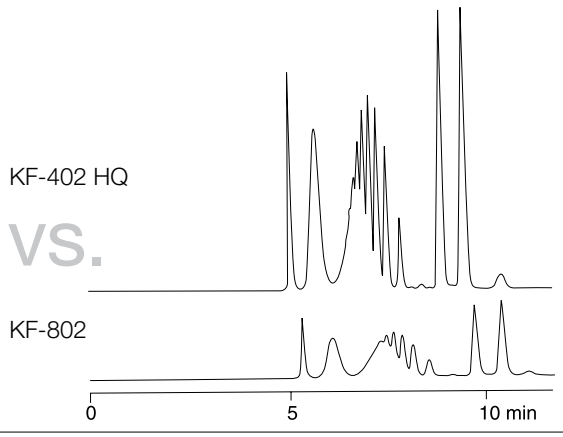
Column Type	ID x Length (mm)	Plate Number	Exclusion Limit (Polystyrene)	Price
GPC KF-401 HQ	4.6 x 250	25,000	1,500	
GPC KF-402 HQ	4.6 x 250	25,000	5,000	
GPC KF-402.5 HQ	4.6 x 250	25,000	20,000	
GPC KF-403 HQ	4.6 x 250	25,000	70,000	
GPC KF-404 HQ	4.6 x 250	25,000	400,000	
GPC KF-405L HQ	4.6 x 250	8,000	4,000,000	
GPC KF-406L HQ	4.6 x 250	8,000	(20,000,000)	
GPC KF-G	4.6 x 10	—	Guard column	

Comparison Between KF-400 HQ Series (Semi-micro GPC) and KF-800 Series (Standard Type)

1. The plate number has increased by 1.5 times or more
2. The consumption of eluent has decreased to less than one fourth

KF-400 series columns are best suited to determine molecular weight distribution and analysis of low molecular weight materials in polymer. Based on a 3 µm SDVB copolymer packing material, improvements over older GPC columns include higher resolution, less solvent usage, better detection limits, and assurance of linear calibration curves.

Column: Shodex GPC
(A) KF-402HQ (4.6 x 250 mm)
(B) KF-802 (8.0 x 300 mm)
Eluent: THF
Flow Rate: (A) 0.3 mL/min
(B) 1.0 mL/min
Detector: UV @ 254 nm
Temperature: 25 °C
Injection volume: 5 µL



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GFC (AQUEOUS GPC) COLUMNS

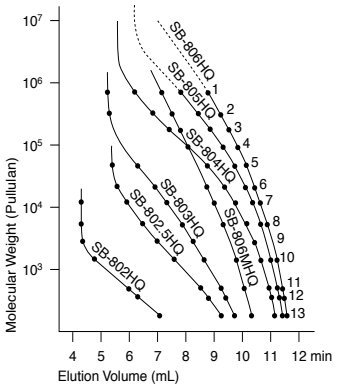
Shodex has a wide variety of columns for GFC. Three types of GFC columns packed with different gel materials are available.

Series Name	Packing Material	Applications
OHpak SB-800HQ	PHM gel	Used for general purpose GFC of water-soluble polymers, proteins and enzymes
SUGAR KS-800	Sulfonated PS gel	Mono, di, tri, oligo and polysaccharides, starches and celluloses
PROTEIN KW-800	Porous silica gel	GFC of proteins, glycoproteins and peptides

App ID 10769

Calibration Curves for OHpak SB-800HQ Series

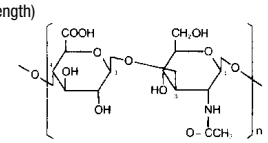
Column: Shodex OHpak SB-800HQ
Dimensions: 8 x 300 mm
Eluent: Water
Sample:
1. P-800
2. P-400
3. P-200
4. P-100
5. P-50
6. P-20
7. P-10
8. P-5
9. P-3
10. P-1
11. Maltotriose
12. Maltose
13. Glucose

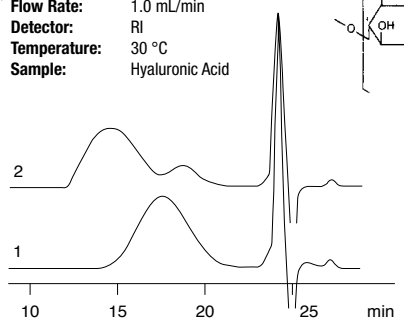


App ID 5527

Hyaluronic Acid

Column: Shodex OHpak SB-805 HQ x 2
Dimensions: 8 x 300 mm (600 mm total length)
Eluent: 0.1 M $NaNO_3$
Flow Rate: 1.0 mL/min
Detector: RI
Temperature: 30 °C
Sample: Hyaluronic Acid

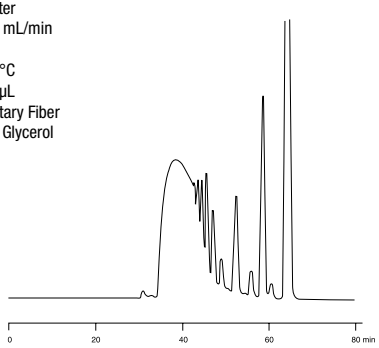




App ID 10771

Dietary Fiber

Column: Shodex SUGAR KS-802 x 2
Dimensions: 8 x 300 mm (600 mm total length)
Eluent: Water
Flow Rate: 0.3 mL/min
Detector: RI
Temperature: 80 °C
Injection Volume: 20 µL
Sample: Dietary Fiber
1. Glycerol



ORDERING INFORMATION

Aqueous GPC Columns

Column Type/Part No.	ID x Length (mm)	Plate Number	Exclusion Limit	Price
OHpak SB-802HQ	8 x 300	>10,000	4×10^3	
OHpak SB-802.5HQ	8 x 300	>15,000	1×10^4	
OHpak SB-803HQ	8 x 300	>15,000	1×10^5	
OHpak SB-804HQ	8 x 300	>15,000	1×10^6	
OHpak SB-805HQ	8 x 300	>10,000	4×10^6	
OHpak SB-806HQ	8 x 300	>10,000	(2×10^7)	
OHpak SB-806MHQ	8 x 300	>10,000	(2×10^7)	
OHpak SB-807HQ	8 x 300	>1,500	(5×10^8)	
SUGAR KS-801 (Na^+)	8 x 300	>15,000	1×10^3	
SUGAR KS-802 (Na^+)	8 x 300	>15,000	1×10^4	
SUGAR KS-803 (Na^+)	8 x 300	>15,000	5×10^4	
SUGAR KS-804 (Na^+)	8 x 300	>15,000	4×10^5	
SUGAR KS-805 (Na^+)	8 x 300	>8,000	5×10^6	
SUGAR KS-806 (Na^+)	8 x 300	>8,000	(5×10^7)	
PROTEIN KW-802.5	8 x 300	>20,000	5×10^4	
PROTEIN KW-803	8 x 300	>20,000	1.5×10^5	
PROTEIN KW-804	8 x 300	>10,000	6×10^5	

NOTE: Exclusion Limits in parentheses,( ), are estimated values.

CALIBRATION STANDARDS

ORDERING INFORMATION

Calibration Standards

Standard Type/Part No.	Material	Content	MW Range	Applications	Price
STANDARD P-82	Pullulan	0.2 g x 8 grades	5,000 - 800,000	GFC (aqueous GPC)	
STANDARD SM-105	PS	0.5 g x 10 grades	1,300 - 3,000,000	GPC with THF, chloroform, toluene, etc.	

See p. 343 for full line of Polymer Calibration Standards.

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COLUMNS FOR PROTEINS AND NUCLEIC ACIDS

Ion-Exchange Columns

IEC series columns are suited for the analysis of proteins and nucleic acids. AXpak WA-624 is suited for the analysis of nucleic acids.

ORDERING INFORMATION

IEC Series Columns

Column Type/Part No.	ID x Length (mm)	Plate Number	Packing Material	Functional Group	Price
IEC QA-825	8 x 75	>2,000	PHM gel	Quaternary ammonium (strong anion)	
IEC DEAE-825	8 x 75	>2,000	PHM gel	Diethylaminoethyl (weak anion)	
IEC SP-825	8 x 75	>2,000	PHM gel	Sulfopropyl (strong cation)	
IEC CM-825	8 x 75	>2,000	PHM gel	Carboxymethyl (weak cation)	
AXpak WA-624	6 x 150	>1,500	PHM gel	Diethylaminoethyl (weak anion)	

Affinity Columns

Column Type/Part No.	ID x Length (mm)	Ligand	Ligand Load/g	Compound Capacity/ Column	Applications	Price
AFpak AAB-894	8 x 50	Aminobenzamidine	100 µmol	—	Serine proteases	
AFpak AAF-894	8 x 50	Acriflavine	10 µmol	ATP Na 1.8 mg	RNA, DNA, vitamins	
AFpak AAM-894	8 x 50	5'AMP	10 µmol	Lactic dehydrogenase 1.5 mg	NAD, ATP enzymes	
AFpak AAV-894	8 x 50	Avidin	5 mg	Biotin 8 µg	Biotin derivatives	
AFpak ACA-894	8 x 50	Concanavalin A	15 mg	—	Glycoproteins, polysaccharides	
AFpak ACB-894	8 x 50	Cibacron Blue	40 µmol	BSA 20 mg	Albumin, NAD dependent enzymes	
AFpak AHR-894	8 x 50	Heparin	5 mg	Lysozyme 4 mg	Lipoproteins, blood coagulation factors	
AFpak ALC-894	8 x 50	LCA (Lentil lectin)	7 mg	—	Glycoproteins, polysaccharides	
AFpak APA-894	8 x 50	Protein A	8 mg	IgG human 20 mg	Human IgG, immune complexes	
AFpak APG-894	8 x 50	Protein G	5 mg	IgG human 10 mg	IgG immune complex	
AFpak ARC-894	8 x 50	RCA-I	20 mg	—	Glycoproteins, polysaccharides	
AFpak AST-894	8 x 50	Soybean trypsin inhibitor	20 mg	—	Trypsin-like proteases	
AFpak AWG-894	8 x 50	Wheat germ agglutinin	14 mg	—	Glycoproteins, polysaccharides	

Other Columns

Column Type/Part No.	ID x Length (mm)	Plate Number	Packing Material	Functional Group	Separation Mode	Applications	Price
HIC PH-814	8 x 75	>2,000	PHM gel	Phenyl	HIC	Proteins	
RSpak NN-614	6 x 150	>5,000	PHM gel	—	P&A	Cystine and cysteine	

COLUMNS FOR SUGAR ANALYSIS

Series Name	Applications
SUGAR series	Effective separation is possible for sugars and sugar alcohols using mixed modes such as SEC, IEX, LEC and P&A.
SUGAR KS-801	Suited for the separation of mono, di and oligosaccharides by mixed mode such as SEC and LEC.

ORDERING INFORMATION

Sugar Columns

Column Type/ Part No.	ID x Length (mm)	Plate Number	Exclusion Limit	Packing Material	Counter Ion	Separation Mode	Price
SUGAR SH1011	8 x 300	>15,000	1,000	S-DVB gel	H^+	SEC + IEX	
SUGAR SH1821	8 x 300	>15,000	10,000	S-DVB gel	H^+	SEC + IEX	
SUGAR SC1011	8 x 300	>12,000	1,000	S-DVB gel	Ca^{2+}	SEC + LEC	
SUGAR SC1821	8 x 300	>12,000	10,000	S-DVB gel	Ca^{2+}	SEC + LEC	
SUGAR SP0810	8 x 300	>10,000	1,000	S-DVB gel	Pb^{2+}	SEC + LEC	
SUGAR SC1211	6 x 250	>5,000		S-DVB gel	Ca^{2+}	P&A + LEC	
SUGAR SZ5532	6 x 150	>5,000		S-DVB gel	Zn^{2+}	P&A + LEC	
SUGAR KS-801	8 x 300	>15,000	1,000	S-DVB gel	Na^+	SEC + LEC	

Aside from the columns listed here, there are other columns that can be used for sugar separations. Disaccharides of similar molecular weight can be separated by NPC using RSpak DC-613.

SUGAR KS-800 series and OHpak SB-800 HQ series can also be used for sugar separations by SEC.

SHODEX®

by Showa Denko K.K.

COLUMNS FOR ORGANIC ACIDS

KC-811 enables an effective organic acids separation using a mixed mode of IEX, SEC and P&A. Organic acids also can be separated by RPC using RSpak DE-613.

ORDERING INFORMATION

RSpak

Column Type*/ Part No.	ID x Length (mm)	Plate Number	Packing Material	Counter Ion	Price
RSpak KC-811	8 x 300	>15,000	S-DVB gel	H+	

**NOTE: RSpak KC-811 was formerly known as Ionpak KC-811.*

ION CHROMATOGRAPHY COLUMNS

- **Great alternative to Dionex IonPac AS4, AS4A and AS14 columns**
- **High efficiency, general purpose IC column**
- **Improved, high-speed separation of EPA Method 300 analytes**
- **Fluoride well-resolved from water dip**
- **Patent-pending gel eliminates overlap of carbonate system peak**

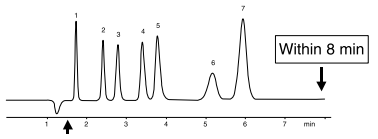
Shodex offers an innovative IC column for the suppressor method that improves both the separation speed and resolution of anions in most matrices. With high theoretical plates (>5000/m for Sulfate), the column easily and efficiently separates organic and inorganic anions such as EPA Method 300 analytes, acetate, formate, methacrylate and oxalate. High loading and exceptional resistance to loading combine with features such as improved separation of the fluoride peak from the water dip. The patent-pending PVA gel was also specifically engineered to optimize the elution behavior of the carbonate ion so as not to interfere with the quantitation of EPA Method 300 anions.

App ID 14175

Anions

Column: SI-90 4E
Dimensions: 4.0 x 250 mm
Eluent: 1.8 mM Na_2CO_3 / 1.7 mM $NaHCO_3$
Flow Rate: 2.0 mL/min
Temperature: Ambient
Sample: 20 µL

1. Fluoride 2 mg/L
2. Chloride 3 mg/L
3. Nitrite 5 mg/L
4. Bromide 10 mg/L
5. Nitrate 10 mg/L
6. Phosphate 15 mg/L
7. Sulfate 15 mg/L

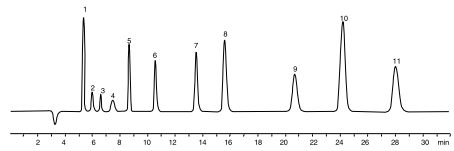


App ID 14176

Organic Acids and Inorganic Anions

Column: SI-50 4E
Dimensions: 4.0 x 250 mm
Eluent: 3.2 mM Na_2CO_3 / $NaHCO_3$
Flow Rate: 0.7 mL/min
Temperature: Ambient
Sample: 20 µL

1. Fluoride 2 mg/L
2. Acetate 10 mg/L
3. Formate 2 mg/L
4. Methacrylate 10 mg/L
5. Chloride 3 mg/L
6. Nitrite 5 mg/L
7. Bromide 10 mg/L
8. Nitrate 10 mg/L
9. Phosphate 15 mg/L
10. Sulfate 15 mg/L
11. Oxalate 15 mg/L



ORDERING INFORMATION

IC Columns

Column Type/ Part No.	ID x Length (mm)	Plate Number	Packing Material	Functional Group	Applications	Price
IC SI-90 4E	4.0 x 250	>5,000 (SO_4)	PVA	Quaternary ammonium	Inorganic anions and organic acids	
IC SI-90 G	4.6 x 10	(Guard)	—	—	(General purpose)	
IC SI-50 4E*	4.0 x 250	>14,000	PVA	Quaternary ammonium	Inorganic anions and organic acids	
IC I-524A	4.6 x 100	>2,000	PHM gel	Quaternary ammonium	Inorganic anions	
IC Y-521	4.6 x 150	>3,000	—	—	Cations (general purpose)	
IC Y-G	4.6 x 10	(Guard)	—	—	—	
IC YK-421	4.6 x 125	>2,500	Hydrophilic Polymer	Carboxyl Coated Silica	Simultaneous separation of monovalent and divalent cations	
IC YK-G	4.6 x 10	(Guard)	—	—	—	
IC YS-50	4.6 x 125	>5,500	PVA	—	Cations, Alkylamines, Transition Metal ions	
IC YS-G	4.6 x 10	(Guard)	—	—	—	
IC T-521	4.6 x 150	>3,000	S-DVB gel	Sulfo (H^+)	Transition metal ions (packed in PEEK column)	
IC T-G	4.6 x 10	(Guard)	—	—	—	

**Use IC SI-90G guard.*

SHODEX®

by Showa Denko K.K.

POLYMER-BASED REVERSED PHASE COLUMNS

RSpak	Applications
RP18	500 Å column well-suited for protein and peptide analysis.
DS	Suited for analysis of hydrophilic substances that cannot be retained by ODS columns, such as medicines and food additives.
DE	Suited for wide applications because its characteristics are similar to those of ODS columns.
DM	Suited for analysis of amino acids and polypeptides.
NN	Suited for analysis of complex samples that are composed of neutral and basic substances. Generally, neutral substances are separated by reversed phase mode, acid substances by ion-exclusion mode and basic substances by reversed phase mode and ion-exchange mode.

ORDERING INFORMATION

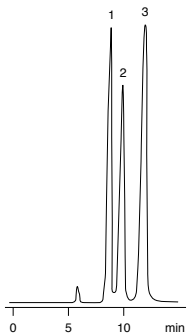
RSpak

Column Type/Part No.	Plate Number	ID x Length (mm)	Price
RSpak RP18-415	>3,000	4.6 x 150	
RSpak DS-613	>6,000	6.0 x 150	
RSpak DE-613	>7,000	6.0 x 150	
RSpak DE-413	>11,000	4.6 x 150	
RSpak DE-413L	>17,000	4.6 x 250	
RSpak DE-G (DE-613P)	(guard column)	4.6 x 10	
RSpak DM-614	>4,000	6.0 x 150	
RSpak DM-G (DM-614P)	(guard column)	4.6 x 10	
RSpak DC-613	>5,000	6.0 x 150	
RSpak NN-614	>5,000	6.0 x 150	

App ID 5533

Catecholamines

Column: Shodex RSpak DE-613
Dimensions: 6 x 150 mm
Eluent: 0.05 M KH_2PO_4 + 0.05 % H_3PO_4
Flow Rate: 0.6 mL/min
Detection: UV @ 254 nm
Temperature: Ambient
Sample: Catecholamines 5 µL
1. Norepinephrine 0.02 %
2. Epinephrine 0.02 %
3. Dopamine 0.02 %

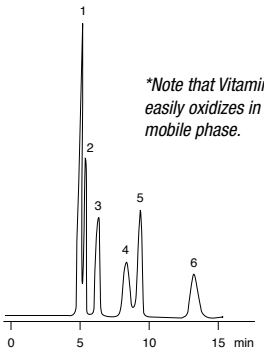


App ID 5534

Water-Soluble Vitamins

Column: Shodex RSpak DM-614
Dimensions: 6 x 150 mm
Eluent: 0.055 M Na_2HPO_4 + 0.045 M KH_2PO_4 + 7 % CH_3OH
Flow Rate: 0.6 mL/min
Detection: UV @ 254 nm
Temperature: Ambient
Sample: 0.05 % each, 4 µL
1. Vitamin C*
2. Vitamin B12
3. Vitamin B6
4. Vitamin B1
5. Vitamin B2
6. Caffeine

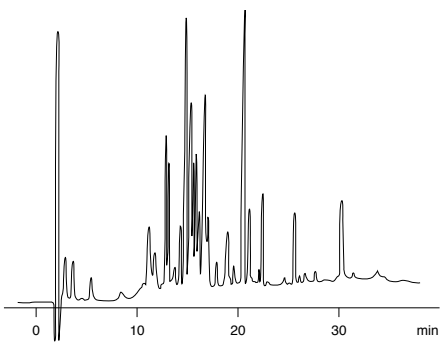
**Note that Vitamin C easily oxidizes in this mobile phase.*



App ID 5535

Tryptic Digest of Myoglobin

Column: Shodex RSpak RP18-415
Dimensions: 4.6 x 150 mm
Eluent: A: 1 % Acetonitrile in 0.1 % TFA
B: 95 % Acetonitrile in 0.1 % TFA
Gradient: Linear B 0 % to 50 %, 30 min
Flow Rate: 1.0 mL/min
Detection: UV @ 220 nm
Temperature: Ambient



SHODEX®

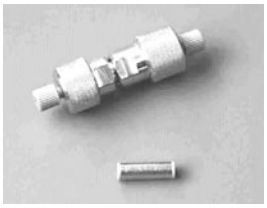
by Showa Denko K.K.

MSPAK PK-2A AND 4A

Polymer Based Cartridge Columns

Ultrafast On-Line SPE and analysis columns for LC/MS or LC/UV by column switching.

- **For direct injection and analysis of drugs from serum, plasma or other body fluids**
- **Unique polymer based cartridge system**
- **2 cartridge dimensions 10 x 2.0 mm ID and 10 x 4.0 mm ID**
- **Also for ultrafast on-line SPE for LC/MS/MS**



ORDERING INFORMATION

MSpak

Column Type/Part No.	ID x length (mm)	Unit	Price
MSpak PK-2A 2p	2 x 10	2/pk	
MSpak PK-2A 5p	2 x 10	5/pk	
MSpak PK-4A 2p	4 x 10	2/pk	
MSpak HLD	Holder	ea	

GUARD COLUMNS

Use of a guard column immediately before the analytical or preparative column is highly recommended to protect the packing materials in the analytical column from contaminants or readily adsorbable substances. The guard column should be replaced at regular intervals.

ORDERING INFORMATION

Guard Columns

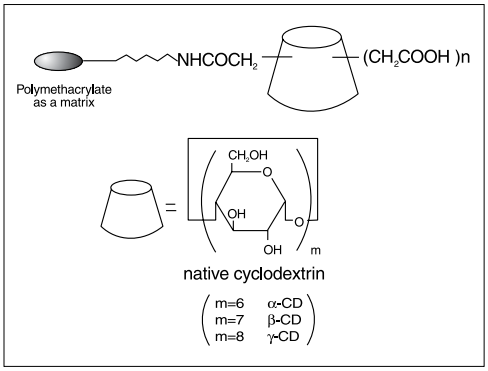
Guard Column/ Part No.	ID x Length (mm)	Associated Column	Price
GPC KF-G	4.6 x 10	KF-800	
GPC KD-G	4.6 x 10	KD-800	
GPC AT-G	8.0 x 50	AT-800S	
OHpak SB-G	6.0 x 50	SB-800 HQ	
OHpak SB-LG	8.0 x 50	SB-2000	
OHpak SB-807G	8.0 x 50	SB-807 HQ	
PROTEIN KW-G	6.0 x 50	KW-800	
SUGAR KS-G	6.0 x 50	KS-800	
SUGAR SH-G	6.0 x 50	SH1011	
SUGAR SH-G	6.0 x 50	SH1821	
SUGAR SC-LG	6.0 x 50	SC1011	
SUGAR SC-LG	6.0 x 50	SC1821	
IC SI-90G	4.6 x 10	SI-904E, SI-504E	
IC YK-G	4.6 x 10	YK-421	
IC Y-G	4.6 x 10	Y-521	
IC YS-G	4.6 x 10	YS-50	
RSpak KC-G	6.0 x 50	KC-811	
RSpak DE-G	4.6 x 10	DE-613	
RSpak DM-G	4.6 x 10	DM-614	

CHIRAL COLUMNS

- **Wide range of applications**
- **Durable polymer matrix enables wide pH stability**
- **Chemically modified cyclodextrins improve enantioselectivity**

Cyclodextrin phases for the direct separation of enantiomers have become increasingly popular due to their wide applicability. Showa Denko has taken these useful phases a few steps further by modifying the cyclodextrins with carboxymethyl (CM) functionality and bonding them to a chemically and physically stable polymer backbone. Modification of the cyclodextrins improves enantioselectivity for many compounds compared to native cyclodextrins. Utilization of durable polymethacrylate polymer as the anchor for this stationary phase enables use of highly alkaline and acidic mobile phases, not possible with silica-based CD phases. Separation of enantiomers of amino acids and their derivatives, amino alcohols, carboxylic acids, amines, alcohols and others are routinely performed with these columns.

Basic Structure of CD Bonded Phase



Comparison of Retention Behavior Between Modified and Unmodified CD Bonded Phases

Bonded Phase	Met - NA*		POPA**	
	α	Rs	α	Rs
CD	2.0	2.4	1.1	0.5
CM-CD	2.2	3.3	1.2	1.4

** Met-NA: Methionine 2-naphthylamide*
*** POPA: 2-Phenoxypropionic acid*

ORDERING INFORMATION

Shodex Chiral Columns

Column Type/Part No.	ID x Length (mm)	Ligand	Price
ORpak CDA-453 HQ	4.6 x 150	α-Cyclodextrin derivatives	
ORpak CDB-453 HQ	4.6 x 150	β-Cyclodextrin derivatives	
ORpak CDC-453 HQ	4.6 x 150	γ-Cyclodextrin derivatives	
ORpak CDBS-453	4.6 x 150	β-Cyclodextrin derivatives	

See p. 108 for additional chiral stationary phases.