

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

Chromatography Separation Modes

AFC	affinity
GPC	gel permeation (organic-soluble SEC)
GFC	gel filtration (water-soluble SEC)
HIC	hydrophobic interaction
IC	ion
IEC	ion-exchange
IEX	ion-exclusion
LEX	ligand-exchange
NPC	normal phase
P & A	partition and adsorption
RPC	reversed phase
EC	size-exclusion (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, KD-802.5-807, KF-602.5-607	257-258
		SEC	GPC KF-801-802.5, KD-801-802.5, LF-804, KF-601-602.5	257-258
	under 2000	RPC	RSpak DE-413, 413L, DM-614	261
		SEC	OHpak SB-803-806HQ, SUGAR KS-803-806, PROTEIN KW-802.5-804	259
		IEC	IEC QA-825, DEAE-825, SP-825, CM-825	261
		AXpak WA-624	261	
		HIC	HIC PH-814	261
		RPC	RSpak RP18-415	261
		AFFINITY	AFpak	261
		AFFINITY	AFpak	261
Water-soluble	under 2000	SEC	SB-802-802.5HQ, SUGAR KS-801-802	259
		LEC	SUGAR SC1011, SP0810	261
		IEX	RSpak KC-811, SUGAR SH1011, SUGAR SH1821	260, 261
		IEC	AXpak WA-624	261
		IC	IC SI-90 4E, SI-50 4E, IC I-524A, Y-521, YK-421, T-521	260
		RPC	RSpak DE-613, 413, DS-613	261
		NPC	SUGAR SZ5532, RSpak DC-613	261
		AFFINITY	AFpak	261
		AFFINITY	AFpak	261
		AFFINITY	AFpak	261

By Showa Denko K.K.

Organic GPC Columns

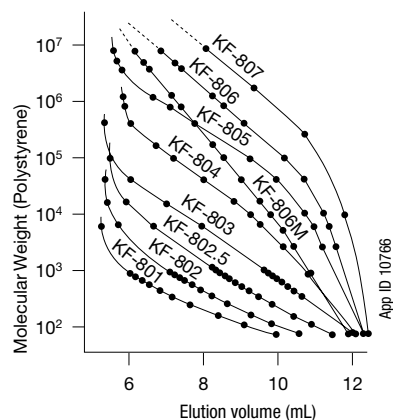
Shodex has a wide variety of columns for GPC (or SEC) using organic solvents. The columns are packed with porous S-DVB gels specially developed for GPC use. Five types of GPC columns packed in different solvents are available. Custom

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		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

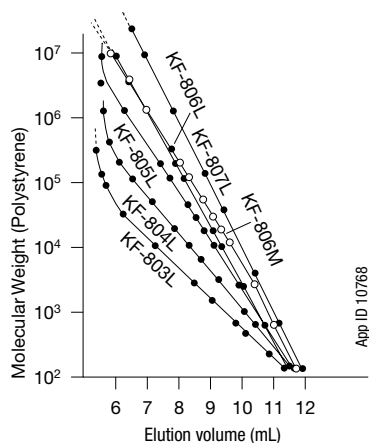
Calibration Curves for GPC KF-800 Series

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



Calibration Curves for GPC Mixed Bed Columns

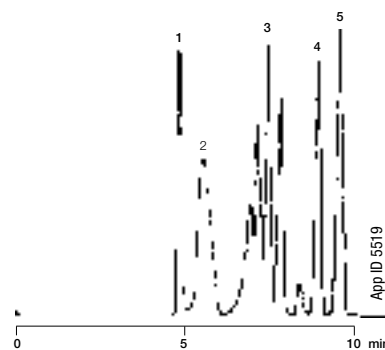
Column: Shodex GPC KF-800L series and KF-806M
Dimensions: 8 x 300 mm



Polystyrene Standards

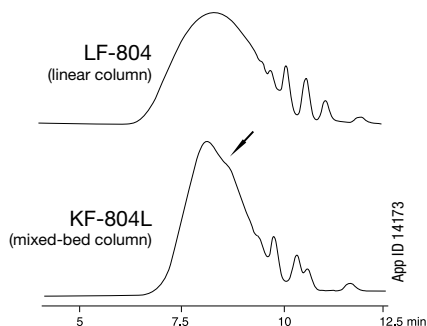
Column: Shodex GPC KF-802
Dimensions: 8 x 300 mm
Eluent: THF
Flow Rate: 1.0 mL/min
Detector: Shodex UV @ 254 nm
Temperature: Ambient
Sample:

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%



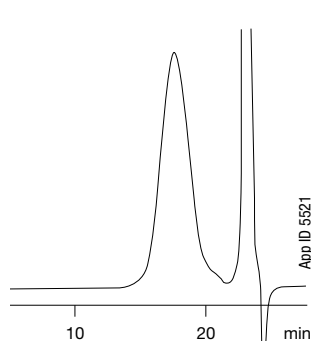
Phenol Resin

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



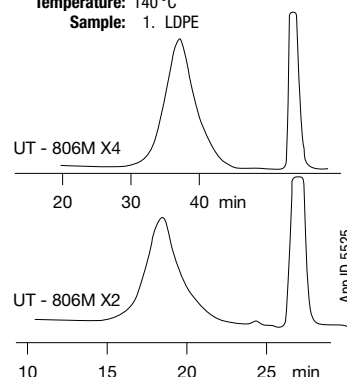
PEEK Resin

Column: Shodex GPC K-806M x 2
Dimensions: 8 x 300 mm
Eluent: CHCl₃/Cl₂CHCOOH=90/10
Flow Rate: 1.0 mL/min
Detector: Shodex RI
Temperature: Ambient
Sample: PEEK 0.2%, 50 µL



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



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Organic GPC Columns (cont'd)

Ordering Information

Standard Columns

Column Type / Part No.

THF	DMF	ID x Length (mm)	Plate Number	Exclusion Limit
GPC KF-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 KD-802	8 x 300	>16,000	5 x 10 ³
GPC KF-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 KD-804	8 x 300	>16,000	4 x 10 ⁵
GPC KF-805	GPC KD-805	8 x 300	>10,000	4 x 10 ⁵
GPC KF-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 ⁹)

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.



For organic GPC column performance test standards, see p. 259.

Mixed Bed Columns

Column Type / Part No.

THF	DMF	ID x Length (mm)	Plate Number	Exclusion Limit
GPC KF-803L	—	8 x 300	>16,000	7 x 10 ⁴
GPC KF-804L	—	8 x 300	>16,000	4 x 10 ⁵
GPC KF-805L	—	8 x 300	>10,000	4 x 10 ⁶
—	—	8 x 300	>10,000	(2 x 10 ⁷)
GPC KF-806M	GPC KD-806M	8 x 300	>12,000	(2 x 10 ⁷)
GPC KF-807L	—	8 x 300	> 5,000	(2 x 10 ⁹)

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

High Temperature GPC Columns

Column Type/Part No.	ID x Length (mm)	Exclusion Limit	Usable Temperature (°C)	Price
GPC HT-803	8 x 300	7 x 10 ⁴	100-140	
GPC HT-804	8 x 300	4 x 10 ⁵	100-140	
GPC HT-805	8 x 300	4 x 10 ⁵	100-140	
GPC HT-806	8 x 300	(2 x 10 ⁷)	100-140	

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

Wide Linear Working Range

Column Type/Part No.	ID x Length (mm)	Plate Number	Exclusion Limit	Price
GPC LF-804	8 x 300	> 17,000	7 x 10 ⁴	

Downsized GPC Columns

Column Type/Part No.	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.

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

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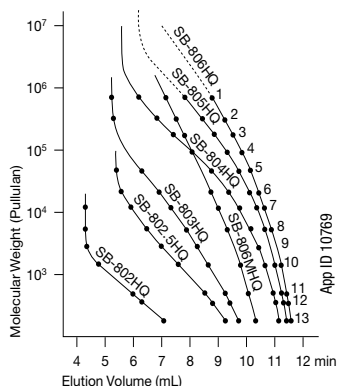
GFC (Aqueous GPC) Columns

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

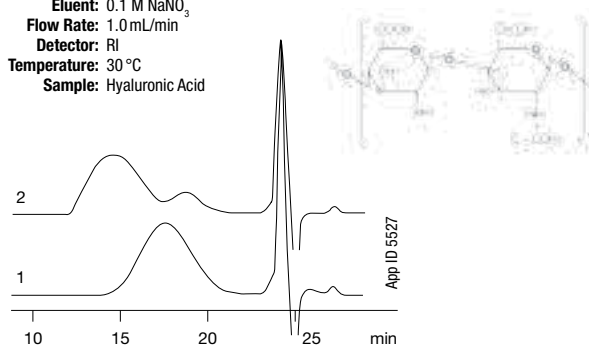
Calibration Curves for OHpak SB-800HQ Series

- 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



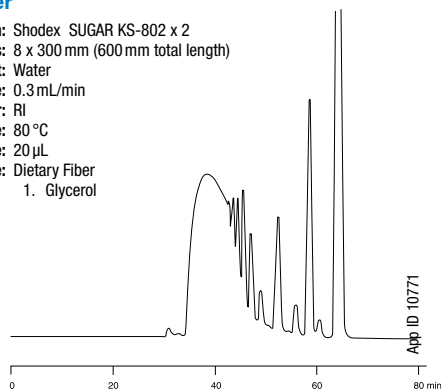
Hyaluronic Acid

- Column:** Shodex OHpak SB-805 HQ x 2
Dimensions: 8 x 300 mm (600 mm total length)
Eluent: 0.1 M NaNO₃
Flow Rate: 1.0 mL/min
Detector: RI
Temperature: 30 °C
Sample: Hyaluronic Acid



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 x 10 ³	
OHpak SB-802.5HQ	8 x 300	>15,000	1 x 10 ⁴	
OHpak SB-803HQ	8 x 300	>15,000	1 x 10 ⁵	
OHpak SB-804HQ	8 x 300	>15,000	1 x 10 ⁶	
OHpak SB-805HQ	8 x 300	>10,000	4 x 10 ⁶	
OHpak SB-806HQ	8 x 300	>10,000	(2 x 10 ⁷)	
OHpak SB-806MHQ	8 x 300	>10,000	(2 x 10 ⁷)	
SUGAR KS-801 (Na ⁺)	8 x 300	>15,000	1 x 10 ³	
SUGAR KS-802 (Na ⁺)	8 x 300	>15,000	1 x 10 ⁴	
SUGAR KS-803 (Na ⁺)	8 x 300	>15,000	5 x 10 ⁴	
SUGAR KS-804 (Na ⁺)	8 x 300	>15,000	4 x 10 ⁵	
SUGAR KS-805 (Na ⁺)	8 x 300	>8,000	5 x 10 ⁶	
SUGAR KS-806 (Na ⁺)	8 x 300	>8,000	(5 x 10 ⁷)	
PROTEIN KW-802.5	8 x 300	>20,000	5 x 10 ⁴	
PROTEIN KW-803	8 x 300	>20,000	1.5 x 10 ⁵	
PROTEIN KW-804	8 x 300	>10,000	6 x 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	GFC with THF, chloroform, toluene, etc.	

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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.

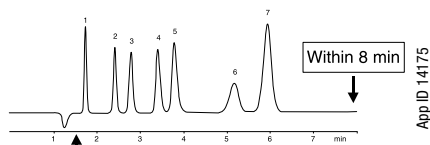
Ion Chromatography Columns

- 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

Anions

Column: SI-90 4E
 Dimensions: 4.0 x 250 mm
 Eluent: 1.8 mM Na₂CO₃,
 1.7 mM NaHCO₃
 Flow Rate: 2.0 mL/min
 Temperature: Ambient
 Sample: 20 µL

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

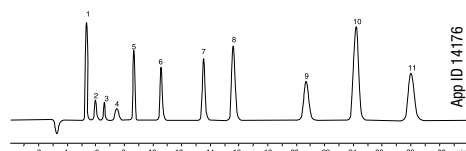


Shodex offers an innovative IC column for the suppressor method that improves both the separation speed and resolution of anions in most matrices. With high theoretical plates (>5000/m for Sulfate), the column easily and efficiently separates organic and inorganic anions such as EPA Method 300 analytes, 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.

Organic Acids and Inorganic Anions

Column: SI-50 4E
 Dimensions: 4.0 x 250 mm
 Eluent: 3.2 mM Na₂CO₃ / NaHCO₃
 Flow Rate: 0.7 mL/min
 Temperature: Ambient
 Sample: 20 µL

1. Fluoride	2 mg/L	7. Bromide	10 mg/L
2. Acetate	10 mg/L	8. Nitrate	10 mg/L
3. Formate	2 mg/L	9. Phosphate	15 mg/L
4. Methacrylate	10 mg/L	10. Sulfate	15 mg/L
5. Chloride	3 mg/L	11. Oxalate	15 mg/L
6. Nitrite	5 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 (S04)	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 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.

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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 AHR-894	8 x 50	Heparin	5 mg	Lysozyme 4 mg	Lipoproteins, blood coagulation factors	
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 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	

Columns for Sugar Analysis

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.

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 Columns

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	