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Shodex™ HPLC Columns 2013 – 2015

HPLC Columns

# Shodex™

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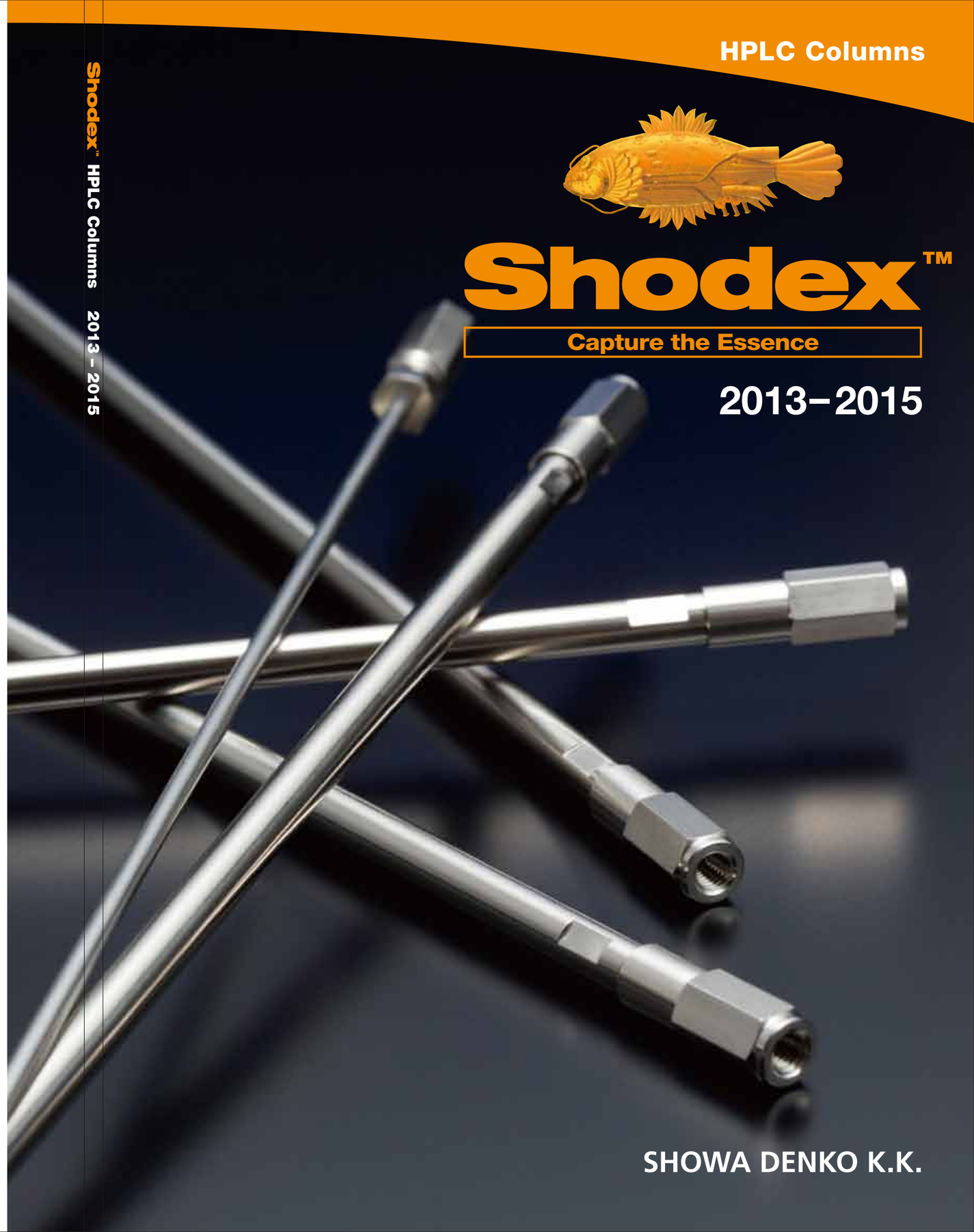
2013–2015



SHOWA DENKO K.K.

# Shodex™

We provide a wide range of products to meet your analytical needs, from pretreatment and separation columns to calibration standards for size exclusion chromatography.
Please visit the Shodex website to see application data and uses.

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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.

# Contents

# 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 | — | 6, 58 |
| | Asahipak | ODP-50, ODP-40 | Polyvinyl alcohol | Octadecyl | 8, 58 |
| | Asahipak | C8P-50 | Polyvinyl alcohol | Octyl | 8 |
| | Asahipak | C4P-50 | Polyvinyl alcohol | Butyl | 8 |
| | RSpak | RP18-415, DS | Styrene divinylbenzene copolymer | — | 10 |
| | RSpak | DE | Polymethacrylate | — | 10, 58 |
| | RSpak | DM-614 | Polyhydroxymethacrylate | — | 10 |
| | RSpak | NN | Polyhydroxymethacrylate | Sulfo | 10, 58 |
| | RSpak | JJ-50 | Polyvinyl alcohol | Quaternary ammonium | 10, 58 |
| | Asahipak | NH2P | Polyvinyl alcohol | Amino | 12, 58 |
| | | ET-RP1 | Polyvinyl alcohol | Octadecyl | 56 |
| Reversed Phase & HILIC & Normal Phase (Silica-based) | ODSpak | F | Silica | Octadecyl | 14 |
| | Silica | C18M, C18P | Silica | Octadecyl | 14 |
| | Silicapak | E-411 | Silica | — | 14 |
| | Silica | 5SIL | Silica | — | 14 |
| | Silica | 5C8 | Silica | Octyl | 14 |
| | Silica | 5C4 | Silica | Butyl | 14 |
| | Silica | 5CN | Silica | Cyanopropyl | 14 |
| | Silica | 5NPE | Silica | Nitrophenylethyl | 14 |
| | Silica | 5PYE | Silica | Pyrenylethyl | 14 |
| | Silica | 5NH | Silica | Aminopropyl | 14 |
| Ligand Exchange | SUGAR, EP | SC | Styrene divinylbenzene copolymer | Sulfo ($Ca^{2+}$) | 16 |
| | SUGAR | SP0810 | Styrene divinylbenzene copolymer | Sulfo ($Pb^{2+}$) | 16 |
| | SUGAR | KS-800 | Styrene divinylbenzene copolymer | Sulfo ($Na^{+}$) | 16 |
| | RSpak | DC-613 | Styrene divinylbenzene copolymer | Sulfo ($Na^{+}$) | 16 |
| | SUGAR | SZ5532 | Styrene divinylbenzene copolymer | Sulfo ($Zn^{2+}$) | 16 |
| | USPpak | MN-431 | Styrene divinylbenzene copolymer | Sulfo ($Ca^{2+}$) | 16 |
| Ion Exclusion | SUGAR | SH | Styrene divinylbenzene copolymer | Sulfo | 20 |
| | RSpak | KC-811 | Styrene divinylbenzene copolymer | Sulfo | 20 |
| Ion Chromatography | IC | NI-424, I-524A | Polyhydroxymethacrylate | Quaternary ammonium | 22 |
| | IC | SI | Polyvinyl alcohol | Quaternary ammonium | 22 |
| | IC | YS-50 | Polyvinyl alcohol | Carboxyl | 24 |
| | IC | YK-421 | Silica | Carboxyl | 24 |
| | IC | Y-521, T-521 | Styrene divinylbenzene copolymer | Sulfo | 24 |
| Aqueous SEC (GFC) | PROTEIN | KW-800 | Silica | Hydrophilic polymer | 28 |
| | | KW400 | Silica | Hydrophilic polymer | 28 |
| | OHpak | SB-800 HQ | Polyhydroxymethacrylate | — | 30 |
| Multimode | Asahipak | GS-HQ | Polyvinyl alcohol | — | 32 |
| | Asahipak | GS-620 7G-P | Polyvinyl alcohol | — | 32 |
| Aqueous/Organic SEC | Asahipak | GF-HQ | Polyvinyl alcohol | — | 34 |
| | MSpak | GF-310 | Polyvinyl alcohol | — | 34, 58 |
| Organic SEC (GPC) | GPC | KF-800, K-800, KD-800, KF-600, KF-400HQ, HFIP-800, HFIP-600, LF, HT-800, UT-800, AT-806MS | Styrene divinylbenzene copolymer | — | 36, 38, 40, 42, 44, 46, 48, 58 |
| Ion Exchange | IEC | QA-825 | Polyhydroxymethacrylate | Quaternary ammonium | 52 |
| | IEC | DEAE-825 | Polyhydroxymethacrylate | Diethylaminoethyl | 52 |
| | IEC | DEAE3N | Polyhydroxymethacrylate | Diethylaminoethyl | 52 |
| | PIKESS | DEAE-2B | Polyhydroxymethacrylate | Diethylaminoethyl | 52 |
| | Asahipak | ES-502N | Polyvinyl alcohol | Diethylaminoethyl | 52 |
| | AXpak | WA-624 | Polyhydroxymethacrylate | Diethylaminoethyl | 52 |
| | IEC | SP-825 | Polyhydroxymethacrylate | Sulfopropyl | 54 |
| | IEC | SP-420N | Polyhydroxymethacrylate | Sulfopropyl | 54 |
| | PIKESS | SP-2B | Polyhydroxymethacrylate | Sulfopropyl | 54 |
| | IEC | CM-825 | Polyhydroxymethacrylate | Carboxymethyl | 54 |
| | Asahipak | ES-502C | Polyvinyl alcohol | Carboxymethyl | 54 |
| | CXpak | P-421S | Styrene divinylbenzene copolymer | Sulfo ($Na^{+}$) | 54 |
| Hydrophobic Interaction | HIC | PH-814 | Polyhydroxymethacrylate | Phenyl | 56 |
| Affinity | AFpak | Various | Polyhydroxymethacrylate | Various ligand | 56 |
| Chiral Separation | ORpak | CDBS-453 | Silica | β-Cyclodextrin derivative | 56 |
| | ORpak | CRX-853 | Polyhydroxymethacrylate | L-amino acid derivative | 56 |
| GPC Clean-up | CLNpak | EV | Styrene divinylbenzene copolymer | — | 62 |
| | CLNpak | PAE | Polyvinyl alcohol | — | 62 |
| Column Switching Pretreatment | MSpak | PK | Hydrophilic copolymers containing N-vinyl acetamide | — | 64 |
| | MSpak | GF-4A | Polyvinyl alcohol | — | 64 |





# 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 that results 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 mechanism can be obtained by using particular combinations of stationary and mobile phases.

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

# Column Selection by Sample Character and Separation Mode

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

| Sample Solubility | Sample MW | Separation Mode |
|---|---|---|
| Organic soluble | ≥ 2,000 | SEC |
| | ≤ 2,000 | RPC |
| | | NPC |
| | | SEC |

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

# Column Selection (Application)

## Pharmaceuticals, Cosmetics

| | | Separation Mode | Page |
|---|---|---|---|
| Pharmaceuticals Metabolites | Hydrophobic substances | RPC | 6, 8, 10, 14, 56, 58 |
| | Hydrophilic substances | HILIC | 12, 58 |
| | | IEC+RPC | 10, 58 |
| | | LEX+SEC | 16 |
| | Substances in bio-fluid (serum·plasma·urine) | RPC | 6, 58 |
| | | SEC+RPC | 32,34,58,64 |
| Moisturizers | Polyalcohols | RPC | 10, 58 |
| | | LEX+SEC | 16 |
| | | LEX+HILIC | 16 |
| | | SEC | 30, 34, 58 |
| | Protein hydrolysates | RPC | 8, 10, 58 |
| | | SEC | 28 |
| | Mucopolysaccharides | SEC | 30 |
| Emulsifiers | Surfactants | SEC+RPC | 34, 58 |
| | | SEC | 36, 42, 58 |
| Preservatives | Paraben Dehydroacetic acid | RPC | 8, 10, 14, 58 |
| Optical active materials | | CS | 56 |

## Foods

| | | Separation Mode | Page |
|---|---|---|---|
| Nutritional ingredients | Monosaccharides Disaccharides Sugar alcohols | HILIC | 12, 58 |
| | | LEX+SEC | 16 |
| | | LEX+HILIC | 16 |
| | Oligosaccharides | HILIC | 12, 58 |
| | | LEX+HILIC | 16 |
| | | SEC | 16, 30, 32 |
| | Low molecular water-soluble dietary fiber | SEC | 32 |
| | Polysaccharides | SEC | 16, 30 |
| | Organic acids | RPC | 6, 10, 58 |
| | | IEX+RPC | 10, 20, 58 |
| | | IC | 22 |
| | Water-soluble vitamins | RPC | 6, 8, 10, 58 |
| | | IEC+RPC | 10, 58 |
| | | HILIC | 12, 58 |
| | Fat-soluble vitamins | RPC | 8, 58 |
| | | NPC | 14 |
| | | SEC | 36, 42, 58 |
| | Fatty acids | RPC | 10, 14, 58 |
| | | SEC | 34,36,38,42 |
| | Nucleic acids (umami) | IEC+SEC | 32 |
| | Amino acids | IEC+IEX+RPC | 10, 58 |
| | | IC | 24 |
| | | IEC | 54 |
| Food safety | Food additives | RPC | 8, 10, 56, 58 |
| | | HILIC | 12, 58 |
| | Pesticides | RPC | 10, 58 |
| | | IEC+RPC | 10, 58 |
| | | IC | 22 |
| | Mycotoxin | RPC | 14 |
| | Pretreatment of residual pesticides | SEC (GPC Clean-up) | 62 |

## New Materials

| | | Separation Mode | Page |
|---|---|---|---|
| Synthetic polymers | Organic solvent soluble | SEC | 34,36,38,42,44 |
| | Polar organic solvent soluble | | 30,34,40,42,44 |
| | High temperature/ Ultra high temperature | | 46 |
| | Water-soluble | | 28,30,32,34 |
| Additives Oligomers | | RPC | 8, 10, 14 |
| | Organic solvent soluble | SEC | 34,36,38,42 |
| | Polar organic solvent soluble | | 30,34,40,42 |
| | Water-soluble | | 28,30,32,34 |

**Separation Mode (p.4 and p.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



## Biotechnology

| | | Separation Mode | Page |
|---|---|---|---|
| Genomics | Nucleobases Nucleotides Nucleosides | RPC | 10, 58 |
| | | IEC+SEC | 10, 32, 58 |
| | | IEC | 52 |
| | Oligo nucleic acids | RPC | 10, 58 |
| | | IEC+SEC | 32 |
| | | IEC | 52 |
| | DNA, RNA | SEC | 30, 34 |
| Proteomics | Amino acids | RPC | 8, 58 |
| | | IEC+IEX+RPC | 10, 58 |
| | | IEC | 24, 54 |
| | | IEC+SEC | 32 |
| | Peptides Proteins | RPC | 8, 10, 58 |
| | | SEC | 28,30,32,34 |
| | | IEC | 52, 54 |
| | | HIC | 56 |
| Glycomics | Glycoproteins | RPC | 8, 10, 58 |
| | | SEC | 28,30,32,34 |
| | | IEC | 52, 54 |
| | | HIC | 56 |
| | | AFC | 56 |
| | Sugar chains | HILIC | 12, 58 |
| | | AFC | 56 |
| | Monosaccharides | HILIC | 12, 58 |
| | | LEX+SEC | 16 |
| | | LEX+HILIC | 16 |
| | Sialic acids Uronic acids Aldonic acids | IEX+SEC | 20 |
| Hormone | Amines | RPC | 6, 8, 10, 58 |
| | | IEC | 54 |
| | Steroids | RPC | 8, 58 |
| | | HILIC | 12, 58 |
| | | SEC | 30, 34, 58 |
| Lipid | Phospholipids | NPC | 14 |
| | | SEC | 34,36,42,58 |
| | Lipoproteins | SEC | 30 |
| | | AFC | 56 |

## Environment

| | | Separation Mode | Page |
|---|---|---|---|
| Water quality | Anions | IC | 22 |
| | Oxyhalides | IC | 22 |
| | | IEC | 58 |
| | Cyanide Cyanogen chloride | IEX | 20 |
| | Cations | IC | 24 |
| | Surfactants | RPC | 8, 14 |
| | | SEC+RPC | 34, 58 |
| | Perchloric acids | IC | 22 |
| | | IEC | 58 |
| | Pesticides | RPC | 10, 58 |
| | | IEC+RPC | 10, 58 |
| | | IC | 22 |
| Soil | Anions | IC | 22 |
| | Heavy metals | IC | 24 |
| | Humic substances | SEC | 30 |
| | Organic arsenic | IEX+RPC | 10, 58 |
| | Pesticides | RPC | 10 |
| | | IEC+RPC | 10, 58 |
| | | IC | 22 |
| Environmental hormones | Pretreatment of Phthalates PCBs Benzo [a] pyrene | SEC (GPC Clean-up) | 62 |
| Bioethanols | Monosaccharides Oligosaccharides | HILIC | 12, 58 |
| | | LEX+SEC | 16 |
| | Oligosaccharides Alcohols Furfural | LEX+SEC | 16 |
| | Saccharides Organic acids Alcohols Furfural | IEX+RPC+SEC | 20 |
| | Hemicelluloses Celluloses | SEC | 40, 44 |
| Biodiesels | Cations | IC | 24 |
| | Fatty acid glycerides | SEC | 34, 58 |
| | Fatty acid methyl esters | RPC | 10 |
| | Organic acids | IC | 22 |

# Columns for Polymer-based Reversed Phase Chromatography

## Features

**ODP2 HP**

- Provides nearly twice as large theoretical plate number compared with generally available polymer-based reversed phase columns
- Column offering enhanced retention of high polar substances compared with ODS column
- Suitable for reversed phase analysis of small molecules such as pharmaceutical compounds in the presence of protein matrix
- Ideal for LC/MS analysis of high polar compounds

Note book No.6 News No.30, 36

See also page 8, "Features and applications of different packing materials used for columns for reversed phase, hydrophilic interaction and normal phase chromatography".

## Standard columns

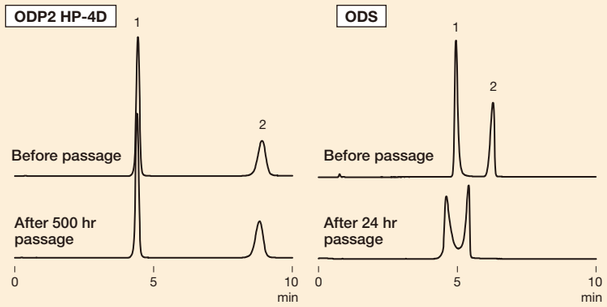
| Product Code | Product Name | Plate Number (TP/column) | Functional Group | Particle Size (µm) | Pore Size (Å) | Column Size (mm) I.D. x Length | Shipping Solvent |
|---|---|---|---|---|---|---|---|
| F7622001 | **ODP2 HP-4B** | ≥ 3,500 | – | 5 | 40 | **4.6 × 50** | $H_2O/CH_3CN$=55/45 |
| F7622002 | **ODP2 HP-4D** | ≥ 13,000 | – | 5 | 40 | **4.6 × 150** | $H_2O/CH_3CN$=55/45 |
| F7622003 | **ODP2 HP-4E** | ≥ 17,000 | – | 5 | 40 | **4.6 × 250** | $H_2O/CH_3CN$=55/45 |
| F6714010 | **ODP2 HPG-4A** | (guard column) | – | 5 | – | **4.6 × 10** | $H_2O/CH_3CN$=55/45 |
| F7622004 | **ODP2 HP-2B** | ≥ 3,000 | – | 5 | 40 | **2.0 × 50** | $H_2O/CH_3CN$=55/45 |
| F7622005 | **ODP2 HP-2D** | ≥ 7,000 | – | 5 | 40 | **2.0 × 150** | $H_2O/CH_3CN$=55/45 |
| F6714011 | **ODP2 HPG-2A** | (guard column) | – | 5 | – | **2.0 × 10** | $H_2O/CH_3CN$=55/45 |

Base Material : Polyhydroxymethacrylate

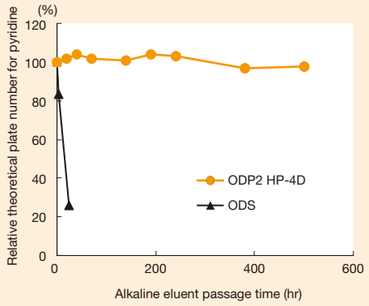
## Tolerance of ODP2 HP for alkaline condition

### Comparison of chromatograms obtained before and after passage of alkaline eluent

Sample : 5µL
1. Pyridine 200µg/mL
2. Phenol 430µg/mL




### Correlation between alkaline eluent passage time and relative theoretical plate number




**Condition**

**Column : Shodex ODP2 HP-4D**
**ODS from other manufacturer**
Eluent : $H_2O/CH_3OH$=70/30
Flow rate : 1.0mL/min
Detector : UV(254nm)
Column temp. : 40˚C

**Eluent passage conditions for alkali tolerance test**

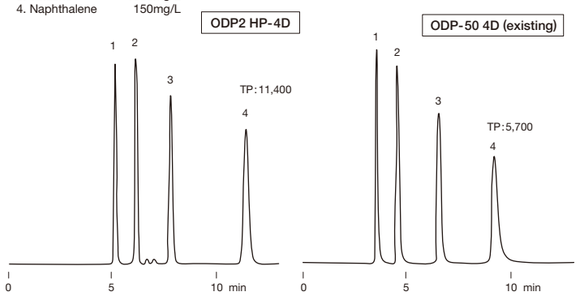
Eluent : 10mM Sodium phosphate buffer(pH12)/$CH_3CN$=45/55
Flow rate : 0.6mL/min
Column temp. : 30˚C

*Contact Shodex or our distributors near you for customized columns.



### Comparison between ODP2 HP and ODP-50 (existing)

Sample : 5µL
1. Phenol 300mg/L
2. Methyl benzoate 350mg/L
3. Toluene 1000mg/L
4. Naphthalene 150mg/L

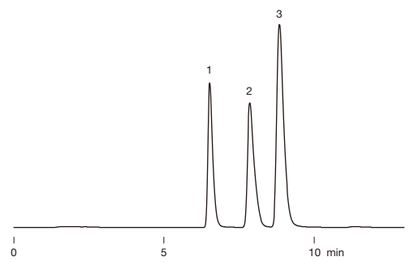



**Column : Shodex ODP2 HP-4D**
Eluent : $H_2O/CH_3CN$=55/45
Flow rate : 0.6mL/min
Detector : UV(254nm)
Column temp. : 40˚C

**Column : Shodex Asahipak ODP-50 4D**
Eluent : $H_2O/CH_3CN$=35/65
Flow rate : 0.6mL/min
Detector : UV(254nm)
Column temp. : 40˚C

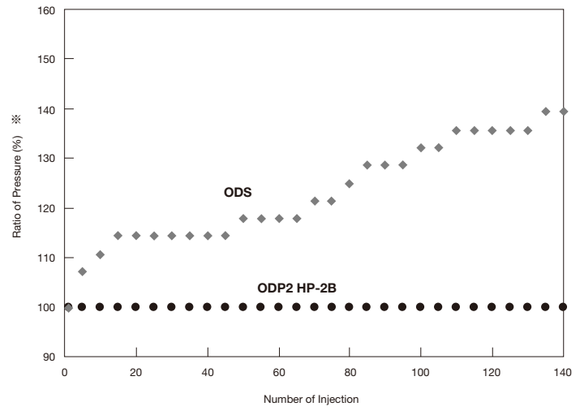
### Imidazoles

Sample : 0.1% each, 10µL
1. Imidazole
2. 2-Methylimidazole
3. 4-Methylimidazole




**Column : Shodex ODP2 HP-4E**
Eluent : 10mM $Na_2HPO_4$ aq./$CH_3CN$=90/10
Flow rate : 0.8mL/min
Detector : UV(220nm)
Column temp. : 40˚C

### Influence of repeated protein injection on column pressure




※ Taking original pressure as 100%

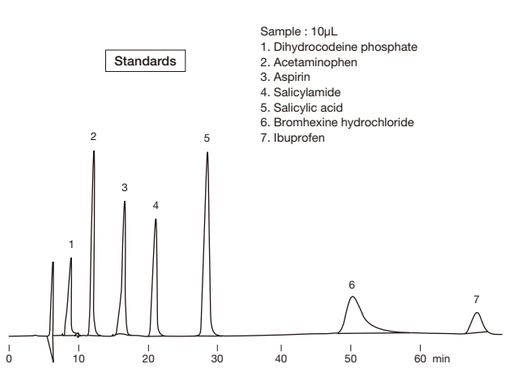
ODP2 HP series column is packed with gels having increased surface polarity and small pore size. This enables to remove and prevent adsorption of proteins. BSA was injected multiple times to an ODS and an ODP2 HP columns. A significant column pressure increase was observed with the ODS column, while no considerable change was observed with the ODP2 HP column even after 140 injections.

Sample : 7.0mg/mL BSA, 5µL

**Column : Shodex ODP2 HP-2B**
**ODS from other manufacturer**
Eluent : 1mM Ammonium acetate aq./$CH_3CN$=90/10
Flow rate : 0.2mL/min
Detector : UV(220nm)
Column temp. : 30˚C

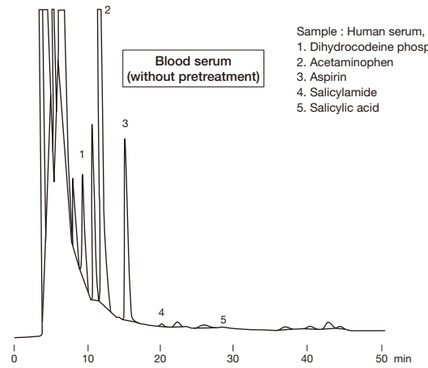
### Simultaneous analysis of multi symptom cold formula in serum

Sample : 10µL
1. Dihydrocodeine phosphate
2. Acetaminophen
3. Aspirin
4. Salicylamide
5. Salicylic acid
6. Bromhexine hydrochloride
7. Ibuprofen




**Column : Shodex ODP2 HP-4E**
Eluent : 0.1% TFA aq./$CH_3CN$=70/30
Flow rate : 0.4mL/min
Detector : UV(235nm)
Column temp. : 40˚C

Sample : Human serum, 10µL
1. Dihydrocodeine phosphate
2. Acetaminophen
3. Aspirin
4. Salicylamide
5. Salicylic acid




**Column : Shodex ODP2 HP-4E**
Eluent : 0.1% TFA aq./$CH_3CN$=70/30
Flow rate : 0.4mL/min
Detector : UV(235nm)
Column temp. : 40˚C

Data courtesy of Katsuko Hara.MT Yutaka Komiyama.Ph.D., Department of Clinical Sciences and Laboratory Medicine, Kansai Medical University.

# Columns for Polymer-based Reversed Phase Chromatography

## Features

**ODP-50, C8P-50, C4P-50**

- Relative large pore size is suitable for the analysis of amino acids, peptides, and proteins
- Usable in a wide pH range from acidic to alkaline (pH 2 to 13)
- Usable in 100% water or buffer solution
- Best used for the analysis of basic substances

News No.35 Preparative Columns p.78

**ODP-40**

- Higher performance type of ODP-50 series

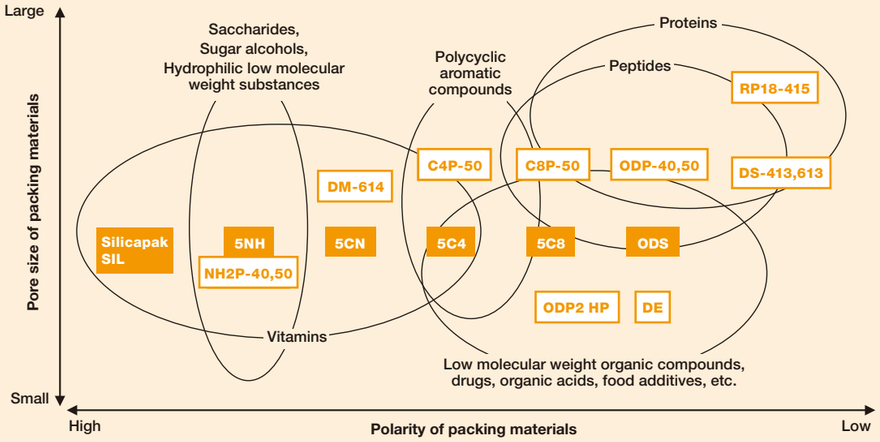
News No.1 Semi-micro Micro Columns p.72

## Standard columns

| Product Code | Product Name | Plate Number (TP/column) | Functional Group | Particle Size (μm) | Pore Size (Å) | Column Size (mm) I.D. x Length | Shipping Solvent |
|---|---|---|---|---|---|---|---|
| F7621001 | **Asahipak ODP-40 4D** | ≥ 11,000 | Octadecyl | 4 | 250 | **4.6 × 150** | $H_2O/CH_3CN$=35/65 |
| F7621002 | **Asahipak ODP-40 4E** | ≥ 17,000 | Octadecyl | 4 | 250 | **4.6 × 250** | $H_2O/CH_3CN$=35/65 |
| F7620002 | **Asahipak ODP-50 6D** | ≥ 9,000 | Octadecyl | 5 | 250 | **6.0 × 150** | $H_2O/CH_3CN$=35/65 |
| F7620001 | **Asahipak ODP-50 6E** | ≥ 14,000 | Octadecyl | 5 | 250 | **6.0 × 250** | $H_2O/CH_3CN$=35/65 |
| F6710001 | **Asahipak ODP-50G 6A** | (guard column) | Octadecyl | 5 | – | **6.0 × 10** | $H_2O/CH_3CN$=35/65 |
| F6710023 | **Asahipak ODP-50 4B** | ≥ 2,500 | Octadecyl | 5 | 250 | **4.6 × 50** | $H_2O/CH_3CN$=35/65 |
| F7620004 | **Asahipak ODP-50 4D** | ≥ 9,000 | Octadecyl | 5 | 250 | **4.6 × 150** | $H_2O/CH_3CN$=35/65 |
| F7620003 | **Asahipak ODP-50 4E** | ≥ 14,000 | Octadecyl | 5 | 250 | **4.6 × 250** | $H_2O/CH_3CN$=35/65 |
| F6710022 | **Asahipak ODP-50G 4A** | (guard column) | Octadecyl | 5 | – | **4.6 × 10** | $H_2O/CH_3CN$=35/65 |
| F7620009 | **Asahipak ODP-50 2D** | ≥ 5,000 | Octadecyl | 5 | 250 | **2.0 × 150** | $H_2O/CH_3CN$=35/65 |
| F6713001 | **Asahipak ODP-50G 2A** | (guard column) | Octadecyl | 5 | – | **2.0 × 10** | $H_2O/CH_3CN$=35/65 |
| F7620006 | **Asahipak C8P-50 4D** | ≥ 7,000 | Octyl | 5 | 250 | **4.6 × 150** | $H_2O/CH_3CN$=35/65 |
| F7620005 | **Asahipak C8P-50 4E** | ≥ 11,000 | Octyl | 5 | 250 | **4.6 × 250** | $H_2O/CH_3CN$=35/65 |
| F6710002 | **Asahipak C8P-50G 4A** | (guard column) | Octyl | 5 | – | **4.6 × 10** | $H_2O/CH_3CN$=35/65 |
| F7620008 | **Asahipak C4P-50 4D** | ≥ 6,000 | Butyl | 5 | 250 | **4.6 × 150** | $H_2O/CH_3CN$=35/65 |
| F7620007 | **Asahipak C4P-50 4E** | ≥ 9,000 | Butyl | 5 | 250 | **4.6 × 250** | $H_2O/CH_3CN$=35/65 |
| F6710003 | **Asahipak C4P-50G 4A** | (guard column) | Butyl | 5 | – | **4.6 × 10** | $H_2O/CH_3CN$=35/65 |

Base Material : Polyvinyl alcohol

## Features and applications of different packing materials used for columns for reversed phase, hydrophilic interaction and normal phase chromatography

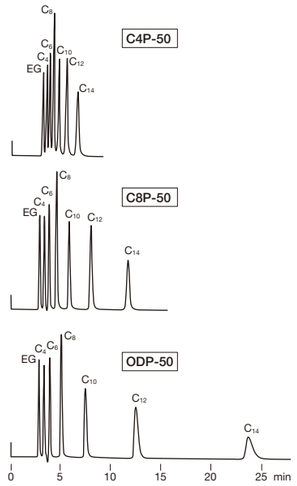


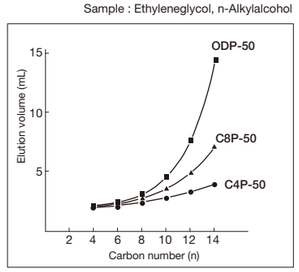

*Contact Shodex or our distributors near you for customized columns.





### Alkylalcohols

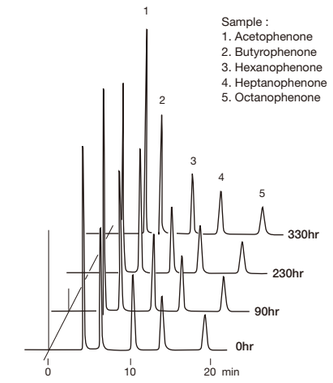



Relationship between the carbon number of alkylalcohols and elution volume

**Column** : **Shodex Asahipak ODP-50 4D**
**Asahipak C8P-50 4D**
**Asahipak C4P-50 4D**
Eluent : $H_2O/CH_3OH$=20/80
Flow rate : 0.6mL/min
Detector : RI
Column temp. : 30°C

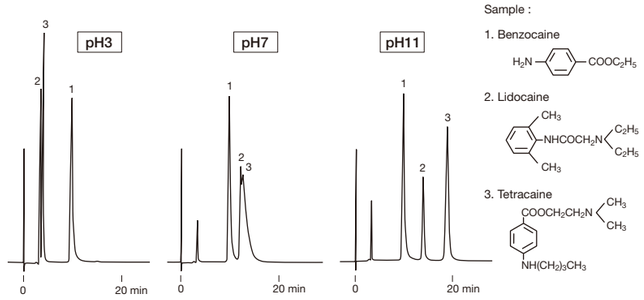
### Tolerance of ODP-50 for alkaline condition




**Column** : **Shodex Asahipak ODP-50 4D**
Eluent : 10mM NaOH aq.(pH12.0)/$CH_3CN$=35/65
Flow rate : 0.6mL/min
Detector : UV(254nm)
Column temp. : 30°C

### Local anesthetics

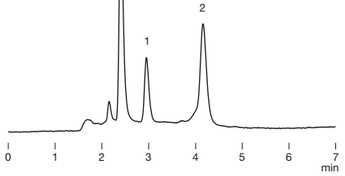
Dissociation of tertiary amino groups in basic drugs can be suppressed by making pH of the eluent higher than pKa of the amino groups. This increases the relative hydrophobicity of the basic drugs, thereby allowing the column to retain the drugs stronger and provide baseline separation of them.




**Column** : **Shodex AsahipakODP-50 4D**
Eluent : 25mM Phosphate buffer/$CH_3CN$=60/40
Flow rate : 0.6mL/min
Detector : UV(254nm)
Column temp. : 30°C

### Nonionic surfactants

Sample : 20μL
1. Heptaoxyethylenedodecylether(PAR-Co) 1μg/L
2. PAR

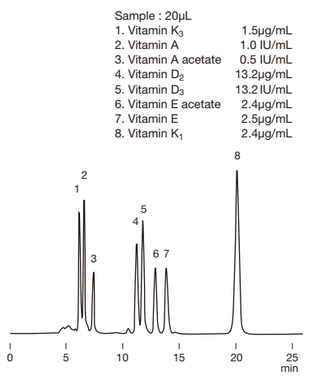



**Column** : **Shodex Asahipak ODP-40 4D**
Eluent : 10mM Sodium tetraborate aq./$CH_3OH$=62/38
Flow rate : 0.8mL/min
Detector : VIS(510nm)
Column temp. : 40°C

### Fat-soluble vitamins

Sample : 20μL

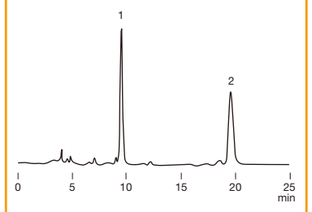
| | |
|---|---|
| 1. Vitamin $K_3$ | 1.5μg/mL |
| 2. Vitamin A | 1.0 IU/mL |
| 3. Vitamin A acetate | 0.5 IU/mL |
| 4. Vitamin $D_2$ | 13.2μg/mL |
| 5. Vitamin $D_3$ | 13.2 IU/mL |
| 6. Vitamin E acetate | 2.4μg/mL |
| 7. Vitamin E | 2.5μg/mL |
| 8. Vitamin $K_1$ | 2.4μg/mL |




**Column** : **Shodex Asahipak ODP-50 4E**
Eluent : $CH_3CN/CH_3OH$=50/50
Flow rate : 0.6mL/min
Detector : UV(280nm)
Column temp. : 30°C

### Macrolide antibiotics

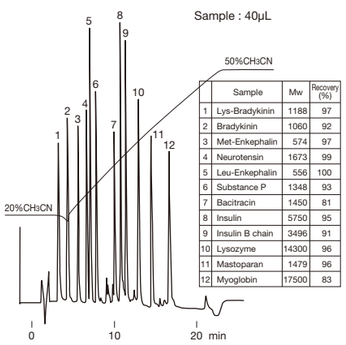
Sample : 0.1% each, 10μL
1. Erythromycin
2. Azithromycin




**Column** : **Shodex Asahipak ODP-40 4E**
Eluent : 40mM Potassium phosphate buffer(pH11.0)/$CH_3CN$=40/60
Flow rate : 0.5mL/min
Detector : UV(223nm)
Column temp. : 40°C

### Gradient analysis of proteins and peptides

Sample : 40μL




| | Sample | Mw | Recovery (%) |
|---|---|---|---|
| 1 | Lys-Bradykinin | 1188 | 97 |
| 2 | Bradykinin | 1060 | 92 |
| 3 | Met-Enkephalin | 574 | 97 |
| 4 | Neurotensin | 1673 | 99 |
| 5 | Leu-Enkephalin | 556 | 100 |
| 6 | Substance P | 1348 | 93 |
| 7 | Bacitracin | 1450 | 81 |
| 8 | Insulin | 5750 | 95 |
| 9 | Insulin B chain | 3496 | 91 |
| 10 | Lysozyme | 14300 | 96 |
| 11 | Mastoparan | 1479 | 96 |
| 12 | Myoglobin | 17500 | 83 |

**Column** : **Shodex Asahipak ODP-50 6D**
Eluent : (A); 0.05% TFA aq./$CH_3CN$=80/20
(B); 0.05% TFA aq./$CH_3CN$=50/50
Linear gradient; (A) to (B), 20min
Flow rate : 1.0mL/min
Detector : UV(220nm)
Column temp. : 30°C

# Columns for Polymer-based Reversed Phase Chromatography

## Features

**RP18-415**
- Large pore size is suitable for the analysis of proteins and peptides

**DS-613, 413**
- Suitable for reversed phase analysis of highly hydrophilic substances, which cannot be retained well by ODS columns

**DE**
- Polymer-based columns, with similar polarity to that of ODS columns, can be used in general and wide purpose
- Wide working pH range (2-12), usable in 100% water and buffer solutions

News No.14, 23, 24, 35

Semi-micro Micro Columns p.72
Preparative Columns p.78

**DM-614**
- Suitable for the analysis of amino acids and water-soluble vitamins

Preparative Columns p.78

**NN**
- The packing material contains sulfo groups, and supports multimode (reversed phase and cation exchange) analysis
- Ideal for analysis of complex samples containing neutral and ionic substances

Note book No.3 News No.7

Semi-micro Micro Columns p.72

**JJ-50**
- The packing material contains trace amounts of quaternary ammonium groups, and supports multimode (reversed phase and anion exchange) analysis
- Ideal for analysis of complex samples containing neutral and ionic substances

News No.7

See also page 8, "Features and applications of different packing materials used for columns for reversed phase, hydrophilic interaction and normal phase chromatography".

## Standard columns

| Product Code | Product Name | Plate Number (TP/column) | Functional Group | Base Material | Particle Size (μm) | Pore Size (Å) | Column Size (mm) I.D. x Length | Shipping Solvent |
|---|---|---|---|---|---|---|---|---|
| F7009000 | **RSpak RP18-415** | ≥ 5,000 | – | Styrene divinylbenzene copolymer | 6 | 450 | **4.6 × 150** | $H_2O/CH_3CN$=5/95 |
| F6709558 | **RSpak RP18-G** | (guard column) | – | Styrene divinylbenzene copolymer | 6 | – | **4.6 × 10** | $H_2O/CH_3CN/THF$=40/30/30 |
| F7001001 | **RSpak DS-613** | ≥ 6,500 | – | Styrene divinylbenzene copolymer | 6 | 200 | **6.0 × 150** | $H_2O/CH_3CN/THF$=30/40/30 |
| F7001012 | **RSpak DS-413** | ≥ 11,000 | – | Styrene divinylbenzene copolymer | 3.5 | 200 | **4.6 × 150** | $H_2O/CH_3CN/THF$=40/30/30 |
| F6700140 | **RSpak DS-G** | (guard column) | – | Styrene divinylbenzene copolymer | 10 | – | **4.6 × 10** | $H_2O/CH_3CN/THF$=30/40/30 |
| F7001004 | **RSpak DE-613** | ≥ 7,000 | – | Polymethacrylate | 6 | 25 | **6.0 × 150** | $H_2O$ |
| F7001005 | **RSpak DE-413** | ≥ 11,000 | – | Polymethacrylate | 4 | 25 | **4.6 × 150** | $H_2O/CH_3CN$=50/50 |
| F7009030 | **RSpak DE-413L** | ≥ 17,000 | – | Polymethacrylate | 4 | 25 | **4.6 × 250** | $H_2O/CH_3CN$=50/50 |
| F6700150 | **RSpak DE-G** | (guard column) | – | Polymethacrylate | 10 | – | **4.6 × 10** | $H_2O$ |
| F7001007 | **RSpak DE-213** | ≥ 8,000 | – | Polymethacrylate | 4 | 25 | **2.0 × 150** | $H_2O/CH_3CN$=50/50 |
| F6700151 | **RSpak DE-SG** | (guard column) | – | Polymethacrylate | 6 | – | **2.0 × 10** | $H_2O/CH_3CN$=50/50 |
| F7001002 | **RSpak DM-614** | ≥ 4,500 | – | Polyhydroxymethacrylate | 10 | 200 | **6.0 × 150** | 5mM $H_3PO_4$ aq. |
| F6700160 | **RSpak DM-G** | (guard column) | – | Polyhydroxymethacrylate | 12 | – | **4.6 × 10** | 5mM $H_3PO_4$ aq. |
| F7008140 | **RSpak NN-814** | ≥ 9,000 | Sulfo | Polyhydroxymethacrylate | 10 | 200 | **8.0 × 250** | 0.1M Sodium phosphate buffer (pH3.0) |
| F7008150 | **RSpak NN-614** | ≥ 4,000 | Sulfo | Polyhydroxymethacrylate | 10 | 200 | **6.0 × 150** | 0.1M Sodium phosphate buffer (pH3.0) |
| F6700510 | **RSpak NN-G** | (guard column) | Sulfo | Polyhydroxymethacrylate | 10 | – | **6.0 × 50** | 0.1M Sodium phosphate buffer (pH3.0) |
| F7008160 | **RSpak NN-414** | ≥ 6,000 | Sulfo | Polyhydroxymethacrylate | 10 | 200 | **4.6 × 150** | 0.1M Sodium phosphate buffer (pH3.0) |
| F7008240 | **RSpak JJ-50 4D** | ≥ 4,500 | Quaternary ammonium | Polyvinyl alcohol | 5 | 100 | **4.6 × 150** | $H_2O/CH_3CN$=40/60 |
| F7008220 | **RSpak JJ-50 2D** | ≥ 3,500 | Quaternary ammonium | Polyvinyl alcohol | 5 | 100 | **2.0 × 150** | $H_2O/CH_3CN$=40/60 |

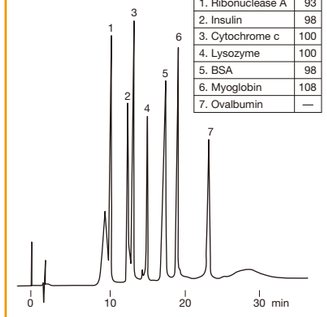
*Contact Shodex or our distributors near you for customized columns.





### Separation and recovery rate of standard proteins

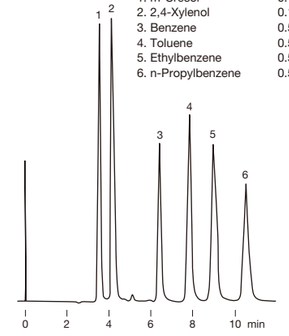
| Recovery (%) | |
|---|---|
| 1. Ribonuclease A | 93 |
| 2. Insulin | 98 |
| 3. Cytochrome c | 100 |
| 4. Lysozyme | 100 |
| 5. BSA | 98 |
| 6. Myoglobin | 108 |
| 7. Ovalbumin | — |




**Column** : **Shodex RSpak RP18-415**
Eluent : (A); 0.1% TFA aq./$CH_3CN$=99/1
(B); 0.1% TFA aq./$CH_3CN$=5/95
Linear gradient; 20%(B) to 60%(B), 20min
Flow rate : 1.0mL/min
Detector : UV(220nm)
Column temp. : Room temp.

### Alkylbenzenes

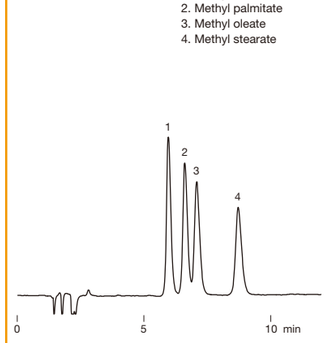
Sample : 5μL
1. m-Cresol 0.1%
2. 2,4-Xylenol 0.1%
3. Benzene 0.5%
4. Toluene 0.5%
5. Ethylbenzene 0.5%
6. n-Propylbenzene 0.5%




**Column** : **Shodex RSpak DS-613**
Eluent : $H_2O/CH_3CN/THF$=30/40/30
Flow rate : 1.0mL/min
Detector : UV(254nm)
Column temp. : 40°C

### Fatty acid methyl esters

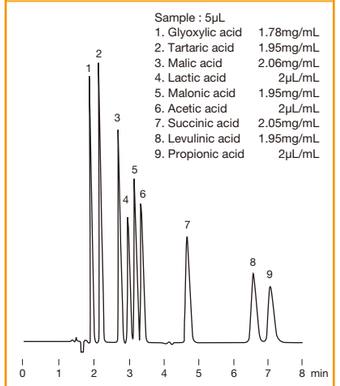
Sample : 0.2% each, 20μL
1. Methyl linoleate
2. Methyl palmitate
3. Methyl oleate
4. Methyl stearate




**Column** : **Shodex RSpak DS-413**
Eluent : $H_2O/CH_3CN/THF$=25/45/30
Flow rate : 1.0mL/min
Detetor : RI
Column temp. : 40°C

### Organic acids

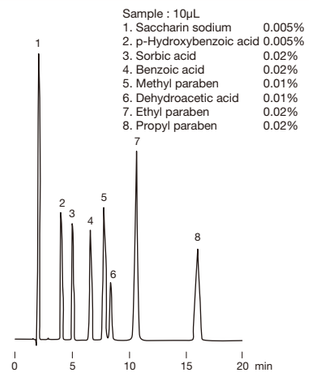
Sample : 5μL
1. Glyoxylic acid 1.78mg/mL
2. Tartaric acid 1.95mg/mL
3. Malic acid 2.06mg/mL
4. Lactic acid 2μL/mL
5. Malonic acid 1.95mg/mL
6. Acetic acid 2μL/mL
7. Succinic acid 2.05mg/mL
8. Levulinic acid 1.95mg/mL
9. Propionic acid 2μL/mL




**Column** : **Shodex RSpak DE-413**
Eluent : 10mM $H_3PO_4$ aq.
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 50°C

### Food additives (Preservatives)

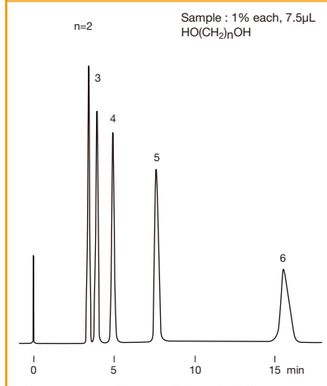
Sample : 10μL
1. Saccharin sodium 0.005%
2. p-Hydroxybenzoic acid 0.005%
3. Sorbic acid 0.02%
4. Benzoic acid 0.02%
5. Methyl paraben 0.01%
6. Dehydroacetic acid 0.01%
7. Ethyl paraben 0.02%
8. Propyl paraben 0.02%




**Column** : **Shodex RSpak DE-413**
Eluent : 50mM $KH_2PO_4$ + 0.1% $H_3PO_4$ aq. /$CH_3CN$=65/35
Flow rate : 1.0mL/min
Detector : UV(210nm)
Column temp. : 40°C

### Diols

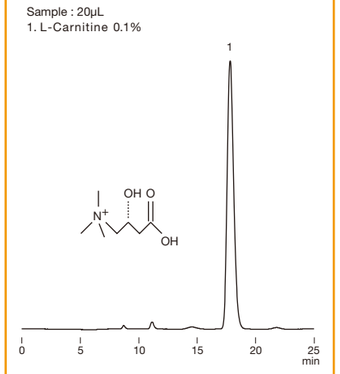
n=2
Sample : 1% each, 7.5μL
$HO(CH_2)_nOH$




**Column** : **Shodex RSpak DE-613**
Eluent : $H_2O$
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 60°C

### Carnitine

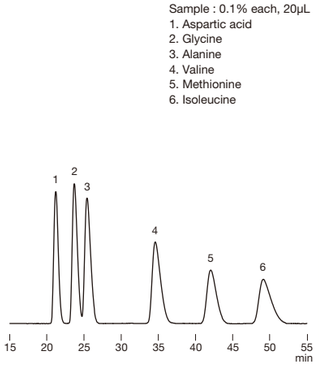
Sample : 20μL
1. L-Carnitine 0.1%




**Column** : **Shodex RSpak NN-814**
Eluent : 0.1M $H_3PO_4$ aq.
Flow rate : 1.0mL/min
Detector : UV(210nm)
Column temp. : 25°C

### Amino acids

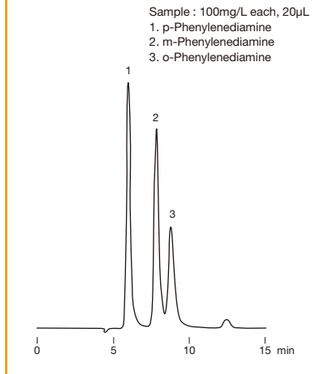
Sample : 0.1% each, 20μL
1. Aspartic acid
2. Glycine
3. Alanine
4. Valine
5. Methionine
6. Isoleucine




**Column** : **Shodex RSpak NN-814**
Eluent : 40mM $H_3PO_4$ aq.
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 40°C

### Phenylenediamine isomers

Sample : 100mg/L each, 20μL
1. p-Phenylenediamine
2. m-Phenylenediamine
3. o-Phenylenediamine




**Column** : **Shodex RSpak JJ-50 4D**
Eluent : 25mM Ammonium acetate buffer (pH9.2)/$CH_3CN$=70/30
Flow rate : 0.4mL/min
Detector : UV(254nm)
Column temp. : 30°C

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

## Features

**NH2P-50**

- Suitable for saccharides analysis by hydrophilic interaction chromatography (HILIC)
- Polymer-based packing material provides excellent chemical stability and minimum deterioration over extended time period
- Washable with alkaline solution
- Also suitable for evaporative light scattering detector, corona charged aerosol detector, and LC/MS

Note book No.2 News No.6, 14, 17, 32 Preparative Columns p.79

**NH2P-40 3E**

- Provides higher theoretical plate number compared to NH2P-50 series
- Achieves 2-3 times improved detection sensitivity even with a conventional HPLC system
- Uses less than 50% solvent compared to NH2P-50 4E

News No.44 Semi-micro Micro Columns p.72

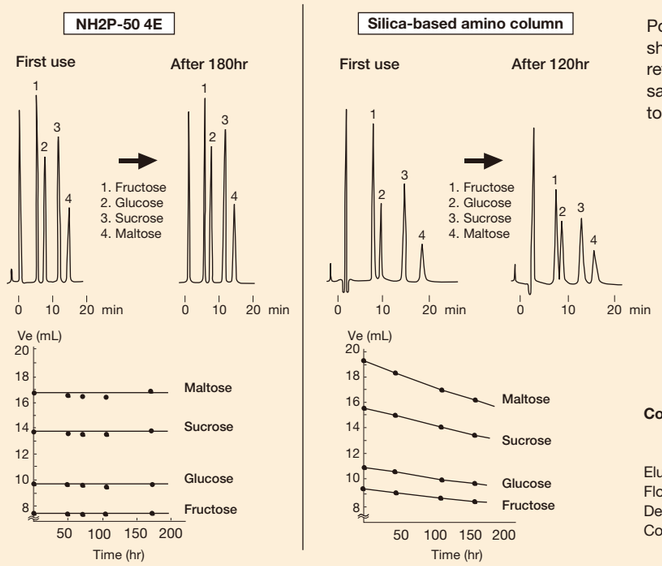
See also page 8, "Features and applications of different packing materials used for columns for reversed phase, hydrophilic interaction and normal phase chromatography".

## Standard columns

| Product Code | Product Name | Plate Number (TP/column) | Functional Group | Particle Size (μm) | Pore Size (Å) | Column Size (mm) I.D.x Length | Shipping Solvent |
|---|---|---|---|---|---|---|---|
| F7630005 | **Asahipak NH2P-50 4B** | ≥ 1,500 | Amino | 5 | 100 | **4.6 × 50** | $H_2O/CH_3CN$=25/75 |
| F7630002 | **Asahipak NH2P-50 4D** | ≥ 5,500 | Amino | 5 | 100 | **4.6 × 150** | $H_2O/CH_3CN$=25/75 |
| F7630001 | **Asahipak NH2P-50 4E** | ≥ 7,500 | Amino | 5 | 100 | **4.6 × 250** | $H_2O/CH_3CN$=25/75 |
| F6710016 | **Asahipak NH2P-50G 4A** | (guard column) | Amino | 5 | – | **4.6 × 10** | $H_2O/CH_3CN$=25/75 |
| F7630006 | **Asahipak NH2P-50 2D** | ≥ 3,500 | Amino | 5 | 100 | **2.0 × 150** | $H_2O/CH_3CN$=25/75 |
| F6713000 | **Asahipak NH2P-50G 2A** | (guard column) | Amino | 5 | – | **2.0 × 10** | $H_2O/CH_3CN$=25/75 |
| F7630007 | **Asahipak NH2P-40 3E** | ≥ 8,500 | Amino | 4 | 100 | **3.0 × 250** | $H_2O/CH_3CN$=25/75 |
| F6710030 | **Asahipak NH2P-50G 3A** | (guard column) | Amino | 5 | – | **3.0 × 10** | $H_2O/CH_3CN$=25/75 |
| F6710100 | **Asahipak NH2P-LF** | (line filter) | Amino | – | – | **8.0 × 75** | $H_2O/CH_3CN$=25/75 |

Base Material : Polyvinyl alcohol

## Comparison of polymer-based (NH2P-50) and silica-based amino columns







Polymer-based amino column, NH2P-50, showed highly repeatable result (both retention time and peak shapes) for all saccharides tested; proving its high tolerance to time degradation.

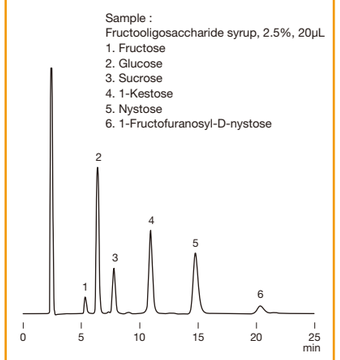
**Column : Shodex Asahipak NH2P-50 4E**
**Silica-based amino column from other manufacturer**
Eluent : $H_2O/CH_3CN$=25/75
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 30°C

*Contact Shodex or our distributors near you for customized columns.



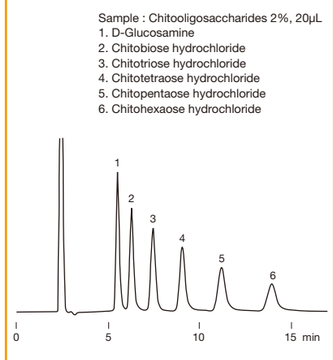


### Fructooligosaccharide syrup



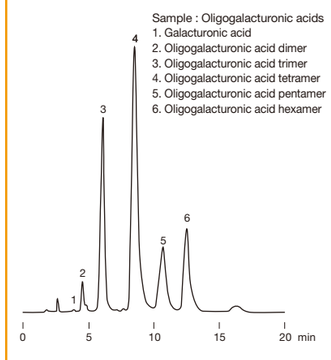

**Column : Shodex Asahipak NH2P-50 4E**
Eluent : $H_2O/CH_3CN$=30/70
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 25°C

### Chitooligosaccharides




**Column : Shodex Asahipak NH2P-50 4E**
Eluent : $H_2O/CH_3CN$=30/70
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 25°C

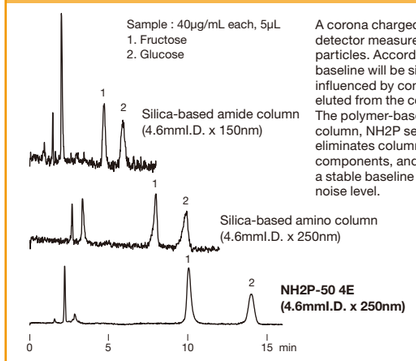
### Oligogalacturonic acids




**Column : Shodex Asahipak NH2P-50 4E**
Eluent : 0.3M Sodium phosphate buffer(pH4.4)
Flow rate : 1.0mL/min
Detector : UV(210nm)
Column temp. : 40°C

**Sample offered by Prof. Yoshino in Kyoto Women's Univ.**

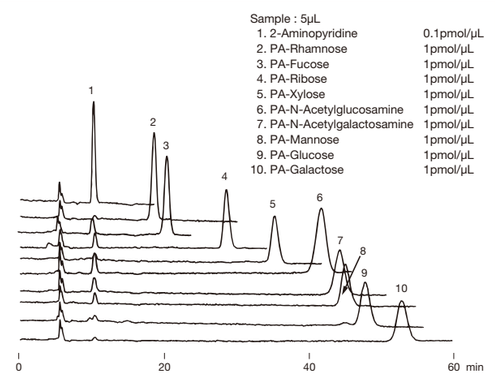
### Saccharides analysis using corona charged aerosol detector




A corona charged aerosol detector measures effluents as particles. Accordingly, the baseline will be significantly influenced by components eluted from the column. The polymer-based amino column, NH2P series eliminates column originated components, and thus enables a stable baseline with lower noise level.

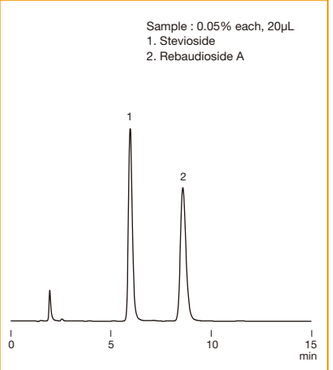
**Column : Shodex Asahipak NH2P-50 4E**
**Silica-based amino column from other manufacturer**
**Silica-based amide column from other manufacturer**
Eluent : $H_2O/CH_3CN$=20/80
Flow rate : 1.0mL/min
Detector : Corona charged aerosol
Column temp : 30°C(NH2P-50 4E, Silica-based amino column)
80°C(Silica-based amide column)

### Pyridylaminated monosaccharides



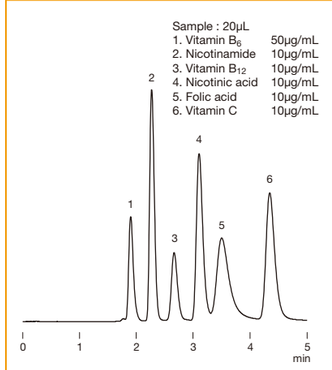

**Column : Shodex Asahipak NH2P-50 4E**
Eluent : $H_3PO_4/H_2O/CH_3CN$=1/14/85
Flow rate : 0.5mL/min
Detector : Fluorescence(Ex. : 310nm, Em. : 380nm)
Column temp. : 40°C

### Stevioside and rebaudioside A



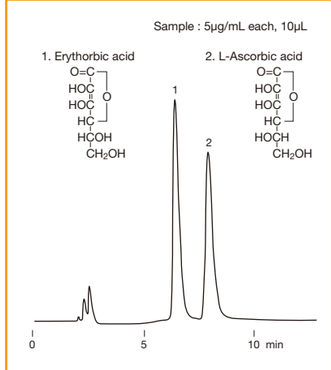

**Column : Shodex Asahipak NH2P-50 4E**
Eluent : $H_2O/CH_3CN$=25/75
Flow rate : 1.0mL/min
Detector : UV(210nm)
Column temp. : 30°C

### Simultaneous analysis of water-soluble vitamins




**Column : Shodex Asahipak NH2P-50 4E**
Eluent : 40mM $H_3PO_4$ aq./$CH_3CN$=45/55
Flow rate : 1.0mL/min
Detector : UV(254nm)
Column temp. : 40°C

### Ascorbic acid and erythorbic acid




**Column : Shodex Asahipak NH2P-50 4E**
Eluent : 20mM $NaH_2PO_4$ + 30mM $H_3PO_4$ aq. /$CH_3CN$=20/80
Flow rate : 1.0mL/min
Detector : UV(254nm)
Column temp. : 30°C

# Columns for Silica-based Reversed Phase, HILIC and Normal Phase Chromatography

## [ODS columns]

### Features

**F** ● This ODS column has been sold for over 30 years with reliable quality

**C18M** ● Monomeric type ODS column, fully end capped high purity silica (99.99% or higher) Preparative Columns p.79

**C18P** ● Polymeric type ODS column, fully end capped high purity silica (99.99% or higher)
● Excellent acid tolerance
● Advantageous for separating planar and nonplanar compounds from each other

See also page 8, "Features and applications of different packing materials used for columns for reversed phase, hydrophilic interaction and normal phase chromatography".

### ● 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 |
|---|---|---|---|---|---|---|---|---|
| F6604112 | **ODSpak F-411** | ≥ 8,000 | Octadecyl | 5 | 14 | 100 | **4.6 × 150** | $H_2O/CH_3OH$=20/80 |
| F6605110 | **ODSpak F-511** | ≥ 14,000 | Octadecyl | 5 | 14 | 100 | **4.6 × 250** | $H_2O/CH_3OH$=20/80 |
| F6604113 | **ODSpak F-411/S** | ≥ 10,000 | Octadecyl | 3 | 14 | 100 | **4.6 × 100** | $H_2O/CH_3OH$=20/80 |
| F6650040 | **Silica C18M 4D** | ≥ 10,000 | Octadecyl | 5 | 16 | 100 | **4.6 × 150** | $H_2O/CH_3OH$=30/70 |
| F6650041 | **Silica C18M 4E** | ≥ 16,000 | Octadecyl | 5 | 16 | 100 | **4.6 × 250** | $H_2O/CH_3OH$=30/70 |
| F6650042 | **Silica C18M 2D** | ≥ 9,000 | Octadecyl | 5 | 16 | 100 | **2.0 × 150** | $H_2O/CH_3OH$=40/60 |
| F6650045 | **Silica C18P 4D** | ≥ 10,000 | Octadecyl | 5 | 17 | 100 | **4.6 × 150** | $H_2O/CH_3OH$=30/70 |
| F6650046 | **Silica C18P 4E** | ≥ 16,000 | Octadecyl | 5 | 17 | 100 | **4.6 × 250** | $H_2O/CH_3OH$=30/70 |
| F6650047 | **Silica C18P 2D** | ≥ 9,000 | Octadecyl | 5 | 17 | 100 | **2.0 × 150** | $H_2O/CH_3OH$=40/60 |

Base Material : Silica

## [Other silica-based columns]

### Features

**E-411** ● Silica gel packed column without any chemical modification

**5SIL** ● Uses high purity silica (99.99% or higher)
● Like E-411, suitable for normal phase analysis using a nonpolar organic solvent Preparative Columns p.79

**5C8** ● Use when the retention capacity of C18 is too strong or that of 5C4 is too week
● Applicable to ion pair chromatography, because of its rapid mass transfer and equilibration Preparative Columns p.79

**5C4** ● Use when the retention capacity of C18 or C8 is too strong Preparative Columns p.79

**5CN** ● Utilizes reversed phase interaction and π-electron interaction to separate regioisomers, which typically cannot be separated with ODS, C8, or C4 columns

**5NPE, 5PYE** ● Utilizes several types of interactions based on π-electrons to separate structural isomers

**5NH** ● Suitable for saccharides analysis by hydrophilic interaction chromatography (HILIC) Preparative Columns p.79

See also page 8, "Features and applications of different packing materials used for columns for reversed phase, hydrophilic interaction and normal phase chromatography".

### ● 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 |
|---|---|---|---|---|---|---|---|---|
| F6604110 | **Silicapak E-411** | ≥ 8,000 | – | 5 | – | 50 | **4.6 × 150** | IPA/Dichloromethane/n-Hexane =1/50/49 |
| F6650050 | **Silica 5SIL 4D** | ≥ 9,000 | – | 5 | – | 100 | **4.6 × 150** | $C_6H_{14}/C_2H_5OH$=95/5 |
| F6650051 | **Silica 5SIL 4E** | ≥ 15,000 | – | 5 | – | 100 | **4.6 × 250** | $C_6H_{14}/C_2H_5OH$=95/5 |
| F6650052 | **Silica 5C8 4D** | ≥ 9,000 | Octyl | 5 | 10 | 100 | **4.6 × 150** | $H_2O/CH_3OH$=34/66 |
| F6650053 | **Silica 5C8 4E** | ≥ 15,000 | Octyl | 5 | 10 | 100 | **4.6 × 250** | $H_2O/CH_3OH$=34/66 |
| F6650054 | **Silica 5C4 4D** | ≥ 9,000 | Butyl | 5 | 7 | 100 | **4.6 × 150** | $H_2O/CH_3OH$=45/55 |
| F6650055 | **Silica 5C4 4E** | ≥ 15,000 | Butyl | 5 | 7 | 100 | **4.6 × 250** | $H_2O/CH_3OH$=45/55 |
| F6650058 | **Silica 5CN 4D** | ≥ 7,000 | Cyanopropyl | 5 | – | 100 | **4.6 × 150** | $H_2O/CH_3OH$=60/40 |
| F6650059 | **Silica 5CN 4E** | ≥ 12,000 | Cyanopropyl | 5 | – | 100 | **4.6 × 250** | $H_2O/CH_3OH$=60/40 |
| F6650062 | **Silica 5NPE 4D** | ≥ 8,000 | Nitrophenylethyl | 5 | – | 100 | **4.6 × 150** | $H_2O/CH_3OH$=45/55 |
| F6650063 | **Silica 5PYE 4D** | ≥ 7,000 | Pyrenylethyl | 5 | – | 100 | **4.6 × 150** | $H_2O/CH_3OH$=30/70 |
| F6650060 | **Silica 5NH 4D** | ≥ 5,000 | Aminopropyl | 5 | – | 100 | **4.6 × 150** | $H_2O/CH_3N$=5/95 |
| F6650061 | **Silica 5NH 4E** | ≥ 8,000 | Aminopropyl | 5 | – | 100 | **4.6 × 250** | $H_2O/CH_3N$=5/95 |

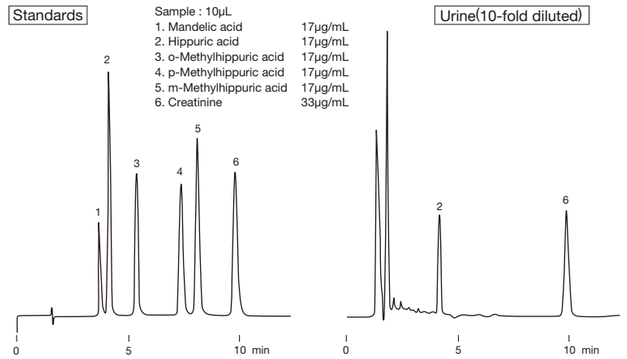
Base Material : Silica

*Contact Shodex or our distributors near you for customized columns.





### Hippuric acids in urine

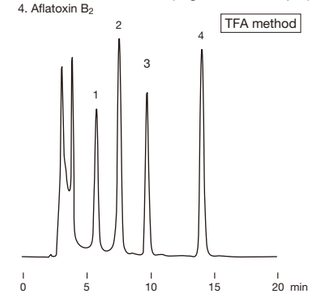



**Column** : **Shodex ODSpak F-411**
Eluent : [20mM $H_3PO_4$ + 20mM β-Cyclodextrin(pH2.5)]/$CH_3CN$=88/12 + 4.5mM Sodium dodecyl sulfate
Flow rate : 1.0mL/min
Detector : UV(225nm)
Column temp. : 50°C

### Aflatoxins

Sample :
5µg/L each, 20µL
1. Derived Aflatoxin $G_1$
2. Derived Aflatoxin $B_1$
3. Aflatoxin $G_2$
4. Aflatoxin $B_2$

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



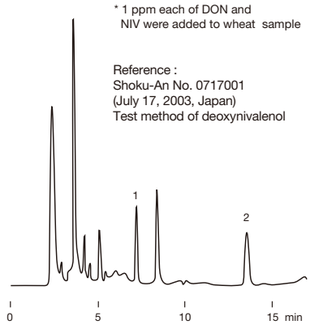

**Column** : **Shodex Silica C18M 4E**
Eluent : $H_2O/CH_3CN/CH_3OH$=60/10/30
Flow rate : 1.0mL/min
Detector : Fluorescence(Ex. : 365nm, Em. : 450nm)
Column temp. : 40°C

### Trichothecene mycotoxins

Sample : 20µL
1. Nivalenol (NIV)
2. Deoxynivalenol (DON)

* 1 ppm each of DON and NIV were added to wheat sample

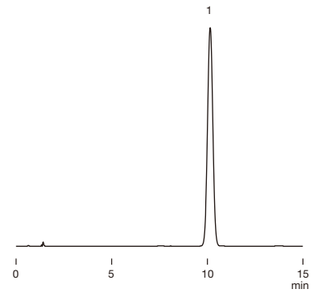
Reference :
Shoku-An No. 0717001
(July 17, 2003, Japan)
Test method of deoxynivalenol




**Column** : **Shodex Silica C18M 4E**
Eluent : $H_2O/CH_3CN/CH_3OH$=90/5/5
Flow rate : 1.0mL/min
Detector : UV(220nm)
Column temp. : 40°C

### Coenzyme Q10

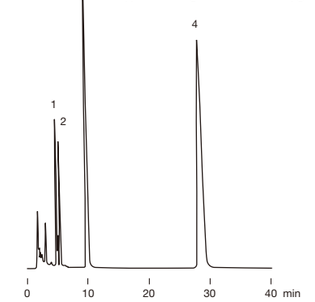
Sample : 5µL
1. Coenzyme Q10 1mg/mL




**Column** : **Shodex Silica C18P 4D**
Eluent : $CH_3OH/C_2H_5OH$=13/7
Flow rate : 1.2mL/min
Detector : UV(275nm)
Column temp. : 35°C

### Catechins in green tea

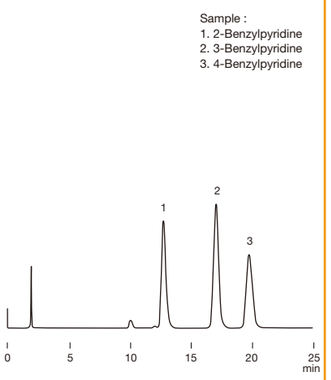
Sample :
1. (-)-Epigallocatechin 1.0µg
2. (-)-Catechin 1.0µg
3. (-)-Epigallocatechin gallate 0.5µg
4. (-)-Catechin gallate 1.0µg




**Column** : **Shodex Silica C18P 4D**
Eluent : 0.1% $H_3PO_4$ aq./$CH_3OH$=20/80
Flow rate : 1.0mL/min
Detector : UV(254nm)
Column temp. : 30°C

### Benzylpyridine isomers

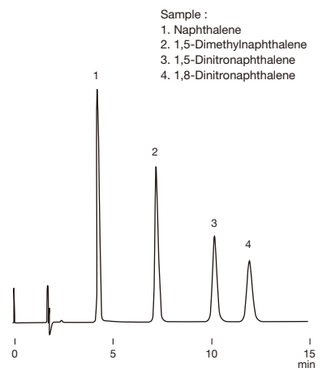
Sample :
1. 2-Benzylpyridine
2. 3-Benzylpyridine
3. 4-Benzylpyridine




**Column** : **Shodex Silica 5PYE 4D**
Eluent : 20mM $KH_2PO_4$ aq./$CH_3OH$=40/60
Flow rate : 1.0mL/min
Detector : UV(254nm)
Column temp. : 30°C

### Dinitronaphthalene isomers

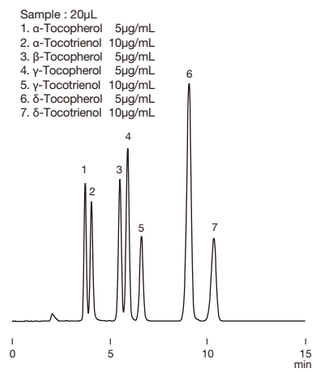
Sample :
1. Naphthalene
2. 1,5-Dimethylnaphthalene
3. 1,5-Dinitronaphthalene
4. 1,8-Dinitronaphthalene




**Column** : **Shodex Silica 5NPE 4D**
Eluent : $H_2O/CH_3OH$=30/70
Flow rate : 1.0mL/min
Detector : UV(254nm)
Column temp. : 30°C

### Simultaneous analysis of vitamin E homologs

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




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

# Columns for Ligand Exchange Chromatography

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

## Features

**SC1011, 1821, SP0810 KS-801, 802**

- Separates saccharides by combination of ligand exchange and size exclusion modes
- Three types of counter ions are available: $Ca^{2+}$, $Pb^{2+}$, and $Na^{+}$
- Only water is required for the analysis of neutral sugars

Note book No.3 News No.6, 40, 43

[KS-801, 802] Preparative Columns p.80

**KS-803~807**

- Suitable for separation of polysaccharides by size exclusion mode
- Can be used in tandem e.g., KS-802 and KS-801
- Only water is required for the analysis of neutral sugars

Note book No.3 News No.8, 13

[KS-803~806] Preparative Columns p.80

**DC-613, SZ5532, SC1211**

- Separates by combination of ligand exchange and HILIC modes
- DC-613 can analyze sugars without removing sodium salts in the sample
- SZ5532 is recommended for the separation of disaccharides or trisaccharides
- SC1211 is suitable for separation of sugar alcohols

Note book No.2

[DC-613] Preparative Columns p.80

**MN-431, SC1011-7F**

- MN-431 is for the analysis of mannitol in conformity with USP
- SC1011-7F is for the analysis of sugar alcohols and saccharides in conformity with EP
- Ca-type ligand exchange chromatography columns

## Standard columns

### Ligand exchange and size exclusion

| Product Code | Product Name | Plate Number (TP/column) | Functional Group (Counter Ion) | Exclusion Limit (Pullulan) | Particle Size (μm) | Column Size (mm) I.D. x Length | Shipping Solvent |
|---|---|---|---|---|---|---|---|
| F6378102 | **SUGAR SC1011** | ≥ 13,000 | Sulfo ($Ca^{2+}$) | 1,000 | 6 | **8.0 × 300** | $H_2O$ |
| F6378103 | **SUGAR SC1821** | ≥ 13,000 | Sulfo ($Ca^{2+}$) | 10,000 | 6 | **8.0 × 300** | $H_2O$ |
| F6700090 | **SUGAR SC-LG** | (guard column) | Sulfo ($Ca^{2+}$) | – | 10 | **6.0 × 50** | $H_2O$ |
| F6378105 | **SUGAR SP0810** | ≥ 11,000 | Sulfo ($Pb^{2+}$) | 1,000 | 7 | **8.0 × 300** | $H_2O$ |
| F6700081 | **SUGAR SP-G** | (guard column) | Sulfo ($Pb^{2+}$) | – | 10 | **6.0 × 50** | $H_2O$ |
| F6378010 | **SUGAR KS-801** | ≥ 17,000 | Sulfo ($Na^{+}$) | 1,000 | 6 | **8.0 × 300** | $H_2O$ |
| F6378020 | **SUGAR KS-802** | ≥ 17,000 | Sulfo ($Na^{+}$) | 10,000 | 6 | **8.0 × 300** | $H_2O$ |
| F6378025 | **SUGAR KS-803** | ≥ 17,000 | Sulfo ($Na^{+}$) | 50,000 | 6 | **8.0 × 300** | $H_2O$ |
| F6378035 | **SUGAR KS-804** | ≥ 17,000 | Sulfo ($Na^{+}$) | 400,000 | 7 | **8.0 × 300** | $H_2O$ |
| F6378050 | **SUGAR KS-805** | ≥ 9,000 | Sulfo ($Na^{+}$) | 5,000,000 | 17 | **8.0 × 300** | $H_2O$ |
| F6378060 | **SUGAR KS-806** | ≥ 9,000 | Sulfo ($Na^{+}$) | (50,000,000)* | 17 | **8.0 × 300** | $H_2O$ |
| F6700020 | **SUGAR KS-G** | (guard column) | Sulfo ($Na^{+}$) | – | 10 | **6.0 × 50** | $H_2O$ |
| F6378070 | **SUGAR KS-807** | ≥ 4,000 | Sulfo ($Na^{+}$) | (200,000,000)* | 30 | **8.0 × 300** | $H_2O$ |
| F6700021 | **SUGAR KS-807G** | (guard column) | Sulfo ($Na^{+}$) | – | 30 | **8.0 × 50** | $H_2O$ |

( )* Estimated value Base Material : Styrene divinylbenzene copolymer

### Ligand exchange and HILIC

| Product Code | Product Name | Plate Number (TP/column) | Functional Group (Counter Ion) | Particle Size (μm) | Pore Size (Å) | Column Size (mm) I.D. x Length | Shipping Solvent |
|---|---|---|---|---|---|---|---|
| F7001003 | **RSpak DC-613** | ≥ 5,500 | Sulfo ($Na^{+}$) | 6 | 100 | **6.0 × 150** | $H_2O/CH_3CN$=30/70 |
| F6700170 | **RSpak DC-G** | (guard column) | Sulfo ($Na^{+}$) | 10 | – | **4.6 × 10** | $H_2O/CH_3CN$=30/70 |
| F7001300 | **SUGAR SZ5532** | ≥ 5,500 | Sulfo ($Zn^{2+}$) | 6 | 100 | **6.0 × 150** | $H_2O/CH_3CN$=30/70 |
| F6700110 | **SUGAR SZ-G** | (guard column) | Sulfo ($Zn^{2+}$) | 6 | – | **4.6 × 10** | $H_2O/CH_3CN$=30/70 |
| F7001400 | **SUGAR SC1211** | ≥ 5,500 | Sulfo ($Ca^{2+}$) | 6 | 50 | **6.0 × 250** | $H_2O/CH_3CN$=75/25 |
| F6700120 | **SUGAR SC-G** | (guard column) | Sulfo ($Ca^{2+}$) | 10 | – | **4.6 × 10** | $H_2O/CH_3CN$=75/25 |

Base Material : Styrene divinylbenzene copolymer

### For the United States Pharmacopeia (USP)

| Product Code | Product Name | Functional Group (Counter Ion) | Particle Size (μm) | Column Size (mm) I.D. x Length | Shipping Solvent |
|---|---|---|---|---|---|
| F6379230 | **USPpak MN-431** | Sulfo ($Ca^{2+}$) | 8 | **4.0 × 250** | $H_2O$ |

See p.71 for USP (Ver.35) Column List. Base Material : Styrene divinylbenzene copolymer

### For the European Pharmacopeia (EP)

| Product Code | Product Name | Functional Group (Counter Ion) | Particle Size (μm) | Column Size (mm) I.D. x Length | Shipping Solvent |
|---|---|---|---|---|---|
| F6379300 | **EP SC1011-7F** | Sulfo ($Ca^{2+}$) | 8 | **7.8 × 300** | $H_2O$ |

Base Material : Styrene divinylbenzene copolymer

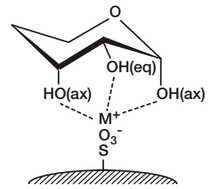
*Contact Shodex or our distributors near you for customized columns.



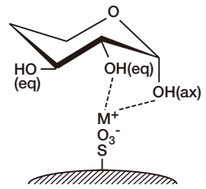


## Mechanism of saccharide separation using the ligand exchange mode

Saccharides exhibits an energy-stable chair conformation in 5-membered ring (furanose) or 6-membered ring (pyranose) forms. Since hydroxyl group on each carbon can take either equatorial or axial position, even two saccharides having the same molecular structures may have different three dimensional configurations. Ligand exchange mode separates saccharides using this configuration difference of the complex formed between saccharides' hydroxyl groups and metal ions. As shown in the left figure, saccharides having a larger number of ax-eq-ax configuration (triplet) units form stronger complexes with metal ions. Meanwhile, as right figure shows, saccharides lacking such a triplet structure form complexes with ax-eq (pair) hydroxyl group. As the unit number of this pair structure increases, saccharides become more potent forming complexes with metal ions. The complex formation capacity also differs depending on modified metal ions.



triplet



pair

$M^{+}$ : Metal ion

### Elution volume of saccharides analysis with various columns
**[Partial list only; refer to our website for complete list]**

| Substances | Elution Volume (mL) | | | | | | |
|---|---|---|---|---|---|---|---|
| | SP0810 | SC1011 | KS-801 | SZ5532 | NH2P-50 4E | SC1211 | DC-613 |
| **Arabinose** | 10.42 | 8.91 | 8.21 | 5.11 | 6.18 | 5.56 | 5.75 |
| **D-Arabitol** | 15.86 | 11.33 | 7.63 | 7.27 | 6.29 | 8.16 | 5.81 |
| **Dulcitol** | 20.18 | 12.76 | 7.40 | 9.46 | 7.45 | 11.28 | 7.33 |
| ***meso*-Erythritol** | 12.70 | 10.09 | 7.86 | 5.73 | 5.43 | 6.27 | 4.84 |
| **D(-)-Fructose** | 11.05 | 8.85 | 7.71 | 5.37 | 6.75 | 5.90 | 6.19 |
| **D(+)-Fucose** | 10.48 | 8.84 | 8.09 | 4.50 | 5.43 | 4.96 | 4.81 |
| **D(+)-Galactose** | 9.74 | 7.98 | 7.58 | 6.46 | 8.10 | 4.98 | 7.28 |
| **Gentiobiose** | 7.22 | 6.08 | 5.75 | 10.50 | 16.36 | * | 14.45 |
| **Glucose** | 8.63 | 7.30 | 7.17 | 5.87 | 8.61 | 4.76 | 6.83 |
| ***myo*-Inositol** | 12.77 | 8.86 | 7.99 | 12.63 | 9.96 | 7.87 | 15.80 |
| **Isomaltose** | 7.68 | 6.26 | 5.95 | 10.57 | 15.18 | * | 13.82 |
| **Isomaltotriose** | 7.09 | 5.75 | 5.34 | 21.17 | 27.55 | * | 32.02 |
| **1-Kestose** | 6.79 | 5.75 | 5.26 | 13.09 | 20.11 | * | — |
| **Kojibiose** | 7.56 | 6.21 | 5.88 | 9.65 | 14.82 | * | 11.47 |
| **Lactitol** | 13.27 | 8.09 | 6.13 | 16.35 | 11.82 | 6.67 | 14.04 |
| **Lactose** | 8.05 | 6.51 | 5.99 | 10.12 | 13.27 | 4.07 | 11.69 |
| **Lactulose** | 9.13 | 6.99 | 6.19 | 9.16 | 10.72 | 4.65 | 10.80 |
| **Maltitol** | 12.23 | 8.26 | 6.03 | 13.04 | 11.82 | 6.77 | 11.81 |
| **Maltose** | 7.85 | 6.34 | 5.94 | 8.67 | 14.24 | * | 10.61 |
| **Maltotriose** | 7.48 | 5.89 | 5.38 | 13.79 | 24.96 | * | 17.88 |
| **Mannitol** | 15.80 | 11.10 | 7.23 | 8.75 | 7.39 | 9.03 | 6.84 |

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

| Substances | Elution Volume (mL) | | | | | | |
|---|---|---|---|---|---|---|---|
| | SP0810 | SC1011 | KS-801 | SZ5532 | NH2P-50 4E | SC1211 | DC-613 |
| **D-Mannose** | 10.72 | 8.17 | 7.64 | 5.83 | 7.84 | 5.01 | 6.72 |
| **Melibiose** | 8.16 | 6.45 | 5.98 | 11.69 | 14.70 | 4.23 | 14.83 |
| **Nystose** | 6.38 | 5.45 | 4.93 | 20.05 | 31.90 | * | — |
| **Palatinit** | 2peaks | 2peaks | 5.90 | 2peaks | 12.73 | 2peaks | 2peaks |
| **Palatinose** | 7.84 | 6.45 | 5.89 | 8.08 | 12.12 | 3.99 | 9.81 |
| **Panose** | 7.14 | 5.78 | 5.32 | 16.87 | 25.60 | * | 23.14 |
| **D(+)-Raffinose** | 7.14 | 5.78 | 5.29 | 16.36 | 20.25 | * | 19.11 |
| **Rhamnose** | 9.77 | 8.23 | 7.37 | 3.93 | 5.52 | 4.43 | 4.09 |
| **D(-)-Ribose** | 19.35 | 13.66 | 9.04 | 4.82 | 5.45 | 8.64 | 5.30 |
| **D(-)-Sorbitol** | 21.61 | 13.31 | 7.42 | 9.79 | 7.09 | 11.88 | 7.27 |
| **Sorbose** | 9.67 | 8.03 | 7.38 | 5.12 | 7.35 | 4.92 | 5.91 |
| **Stachyose** | 6.82 | 5.57 | 4.97 | — | 36.22 | * | — |
| **Sucrose** | 7.54 | 6.29 | 5.87 | 7.91 | 11.87 | * | 8.68 |
| **α-D-Talose** | 21.33 | 12.59 | 8.76 | 5.69 | 6.47 | 8.51 | 6.32 |
| **Trehalose** | 7.62 | 6.27 | 5.78 | 10.85 | 13.25 | * | 11.49 |
| **Trehalulose** | 8.92 | 6.95 | 6.10 | 9.54 | 11.68 | 4.78 | 11.38 |
| **Xylitol** | 19.87 | 13.14 | 7.94 | 7.77 | 6.10 | 10.16 | 6.19 |
| **Xylobiose** | 8.16 | 6.68 | 6.40 | 5.65 | 9.05 | * | 6.71 |
| **D(+)-Xylose** | 9.21 | 7.90 | 7.71 | 4.55 | 6.58 | 4.48 | 5.21 |
| **D-Xylulose** | 10.64 | 9.02 | 8.04 | 4.06 | 5.41 | 5.07 | 4.56 |

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

**Column : SUGAR SP0810, SC1011, KS-801**
Eluent : $H_2O$
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 80℃

**Column : SUGAR SZ5532**
Eluent : $H_2O/CH_3CN$=25/75
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 60℃

**Column : RSpak DC-613**
Eluent : $H_2O/CH_3CN$=25/75
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 70℃

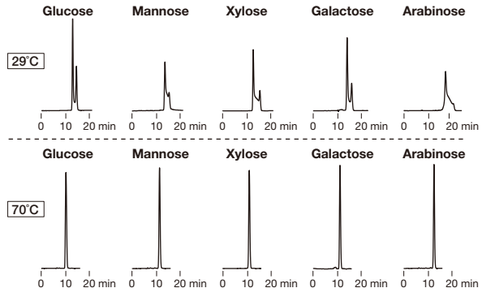
**Column : SUGAR SC1211**
Eluent : $H_2O/CH_3CN$=65/35
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 70℃

**Column : Asahipak NH2P-50 4E**
Eluent : $H_2O/CH_3CN$=25/75
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 30℃

## Anomer separation of saccharides

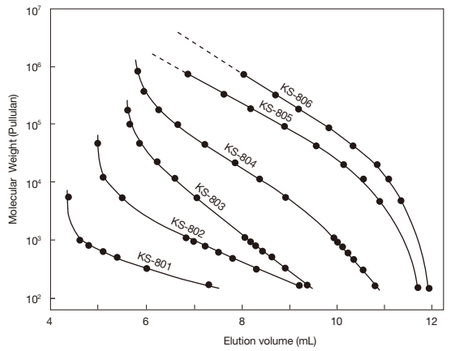
Anomer separation of saccharides affects a chromatogram. When using a SUGAR column to analyze saccharides, the analysis at high temperatures would suppress the influence of anomer separation, resulting in proper chromatograms.

Sample : 0.5% each, 10µL




**Column : Shodex SUGAR SC1011**
Eluent : $H_2O$
Flow rate : 0.7mL/min
Detector : RI
Column temp. : 29˚C, 70˚C

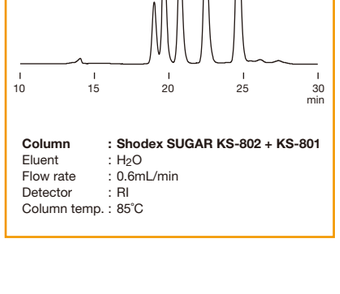
## Calibration curves for KS-800 series using pullulan




**Column : Shodex SUGAR KS-800 series**
Eluent : $H_2O$
Detector : RI
Column temp. : 80˚C

## Hydrolyzed starch

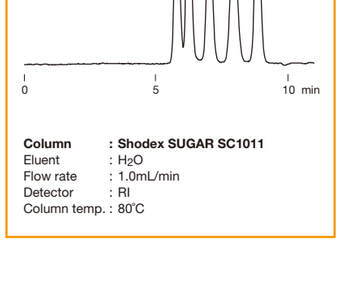
Sample : 20µL
Hydrolyzed starch 1%




**Column : Shodex SUGAR KS-802 x 2**
Eluent : $H_2O$
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 80˚C

## Saccharides in wood (model)

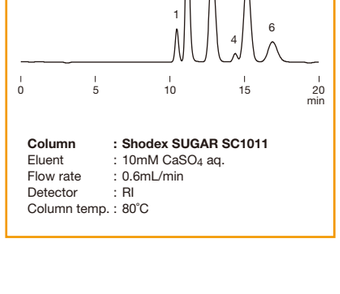
Sample : 5µL
1. Cellobiose 1.0%
2. Glucose 1.5%
3. Xylose 0.5%
4. Galactose 0.5%
5. Arabinose 0.5%
6. Mannose 1.0%




**Column : Shodex SUGAR SP0810**
Eluent : $H_2O$
Flow rate : 0.6mL/min
Detector : RI
Column temp. : 85˚C

## Ketohexoses

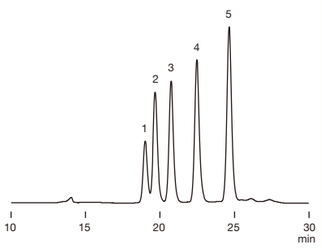
Sample : 0.025% each, 10µL
1. Sorbose
2. Fructose
3. Tagatose
4. Psicose




**Column : Shodex SUGAR SP0810**
Eluent : $H_2O$
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 80˚C

## Oligosaccharides in soybean

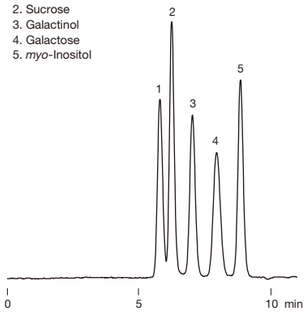
Sample : 0.1% each, 20µL
1. Verbascose
2. Stachyose
3. Raffinose
4. Sucrose
5. Pinitol




**Column : Shodex SUGAR KS-802 + KS-801**
Eluent : $H_2O$
Flow rate : 0.6mL/min
Detector : RI
Column temp. : 85˚C

## Saccharides related to raffinose biosynthesis

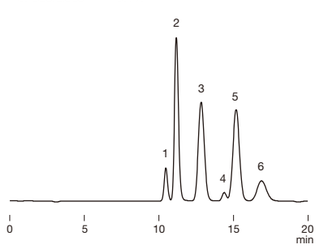
Sample : 20µL, 0.1% each
1. Raffinose
2. Sucrose
3. Galactinol
4. Galactose
5. *myo*-Inositol




**Column : Shodex SUGAR SC1011**
Eluent : $H_2O$
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 80˚C

## Acesulfame K and sucralose

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

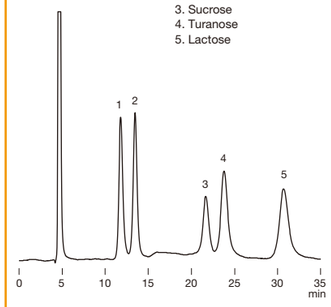



**Column : Shodex SUGAR SC1011**
Eluent : 10mM $CaSO_4$ aq.
Flow rate : 0.6mL/min
Detector : RI
Column temp. : 80˚C



## Sucrose and turanose

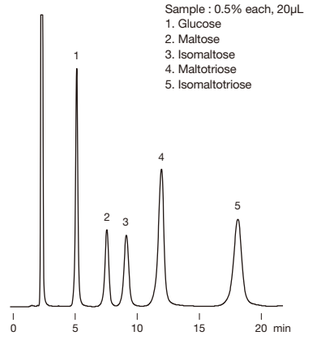
Sample : 0.5% each, 10µL
1. Fructose
2. Glucose
3. Sucrose
4. Turanose
5. Lactose




**Column : Shodex SUGAR SZ5532**
Eluent : $H_2O/CH_3CN$=20/80
Flow rate : 0.6mL/min
Detector : RI
Column temp. : 60˚C

## Maltose and isomaltose

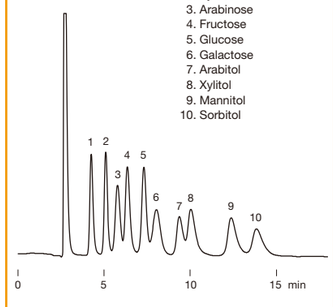
Sample : 0.5% each, 20µL
1. Glucose
2. Maltose
3. Isomaltose
4. Maltotriose
5. Isomaltotriose




**Column : Shodex SUGAR SZ5532**
Eluent : $H_2O/CH_3CN$=25/75
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 60˚C

## Saccharides and sugar alcohols

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




**Column : Shodex SUGAR SZ5532**
Eluent : $H_2O/CH_3CN$=20/80
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 65˚C

## Saccharides in presence of sodium salt

Since DC-613 uses $Na^+$ as counter ion, it enables the analysis of saccharides in sodium salt containing samples without desalting. Acid hydrolyzed sample can be analyzed after neutralizing the remaining acid, such as hydrochloric or sulfuric acid, with sodium hydroxide.

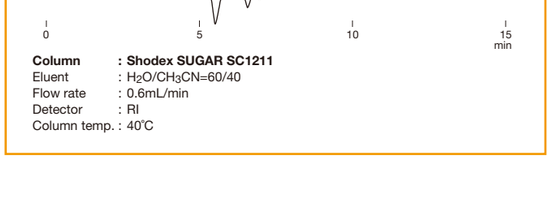
Sample : 0.1% each, 10µL
1. Xylose
2. Sucrose
3. Cellobiose
4. Lactose

**Solvent for sample preparation**

1% NaCl aq./$CH_3CN$ =50/50

1% $Na_2SO_4$ aq./$CH_3CN$ =50/50

$H_2O/CH_3CN$ =50/50

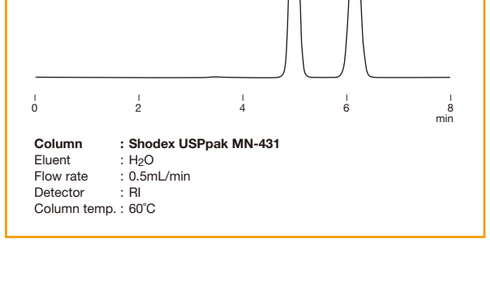



**Column : Shodex RSpak DC-613**
Eluent : $H_2O/CH_3CN$=30/70
Flow rate : 0.8mL/min
Detector : RI
Column temp. : 50˚C

* High concentration of acetonitrile is used for saccharide analysis by DC-613. Be cautions of possible salt deposition when analyzing high concentration salt containing samples.

## Pinitol

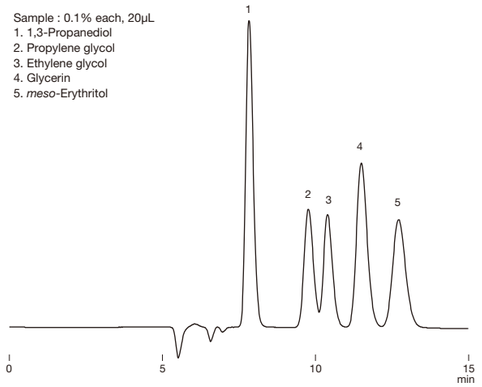
Sample : 0.1% each, 10µL
1. Pinitol
2. Fructose
3. Glucose
4. Sucrose
5. *chiro*-Inositol
6. *myo*-Inositol




**Column : Shodex RSpak DC-613**
Eluent : $H_2O/CH_3CN$=25/75
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 70˚C

## Moisturizing components

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

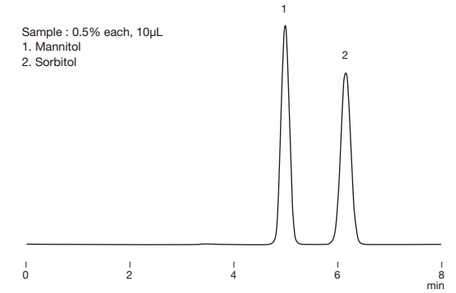



**Column : Shodex SUGAR SC1211**
Eluent : $H_2O/CH_3CN$=60/40
Flow rate : 0.6mL/min
Detector : RI
Column temp. : 40˚C

## Mannitol analysis with USP method

According to the USP (United States Pharmacopeia) method, mannitol should be analyzed using a column which can separate mannitol and sorbitol with a resolution equal to or greater than 2.0.
MN-431 is a column specially designed for mannitol analysis, which satisfies this criteria.

Sample : 0.5% each, 10µL
1. Mannitol
2. Sorbitol




**Column : Shodex USPpak MN-431**
Eluent : $H_2O$
Flow rate : 0.5mL/min
Detector : RI
Column temp. : 60˚C

# Columns for Ion Exclusion Chromatography

## Features

**SH1011, 1821**

- 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

Note book No.3 News No.25, 40, 43

**KC-811**

- Columns for the analysis of organic acids
- Ion exclusion mode (+ reversed phase mode)
- Highly selective detection with post column method
- KC-811 6E is suitable for the analysis of cyanide ions and cyanogen chloride in accordance with the Japanese Water Supply Act

Note book No.3 News No.6 Preparative Columns p.80

## Standard columns

**For simultaneous analysis of saccharides and organic acids**

| Product Code | Product Name | Plate Number (TP/column) | Functional Group | Exclusion Limit (Pullulan) | Particle Size (μm) | Column Size (mm) I.D. x Length | Shipping Solvent |
|---|---|---|---|---|---|---|---|
| F6378100 | **SUGAR SH1011** | ≥ 17,000 | Sulfo | 1,000 | 6 | **8.0 × 300** | $H_2O$ |
| F6378101 | **SUGAR SH1821** | ≥ 17,000 | Sulfo | 10,000 | 6 | **8.0 × 300** | $H_2O$ |
| F6700080 | **SUGAR SH-G** | (guard column) | Sulfo | – | 10 | **6.0 × 50** | $H_2O$ |

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 Lenngth | Shipping Solvent |
|---|---|---|---|---|---|---|
| F6378030 | **RSpak KC-811** | ≥ 17,000 | Sulfo | 6 | **8.0 × 300** | $H_2O$ |
| F6378033 | **RSpak KC-811 6E** | ≥ 13,000 | Sulfo | 6 | **6.0 × 250** | $H_2O$ |
| F6700030 | **RSpak KC-G** | (guard column) | Sulfo | 10 | **6.0 × 50** | $H_2O$ |
| F6700010 | **RSpak KC-LG** | (guard column) | Sulfo | 13 | **8.0 × 50** | $H_2O$ |

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

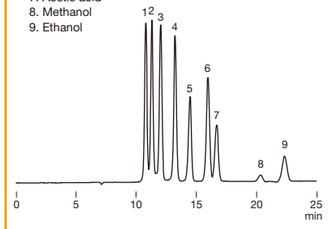
Base Material : Styrene divinylbenzene copolymer

*Contact Shodex or our distributors near you for customized columns.



### Maltooligosaccharides, organic acids and ethanol

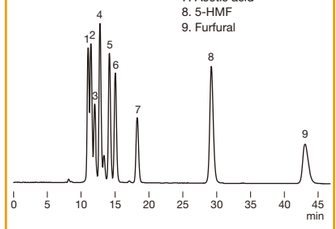
Sample : 0.05% each, 20μL
1. Maltotetraose
2. Maltotriose
3. Maltose
4. Glucose
5. Lactic acid
6. Glycerol
7. Acetic acid
8. Methanol
9. Ethanol




**Column : Shodex SUGAR SH1821**
Eluent : 0.5mM $H_2SO_4$ aq.
Flow rate : 0.6mL/min
Detector : RI
Column temp. : 75°C

### Cello-oligosaccharides and furfurals

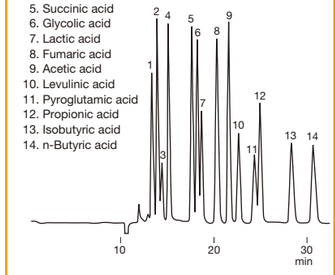
Sample : 0.1% each, 10μL
1. Cellopentaose
2. Cellotetraose
3. Cellotriose
4. Cellobiose
5. Glucose
6. Glyceric acid
7. Acetic acid
8. 5-HMF
9. Furfural




**Column : Shodex SUGAR SH1821**
Eluent : 2mM $H_2SO_4$ aq.
Flow rate : 0.6mL/min
Detector : RI
Column temp. : 60°C

### General organic acids

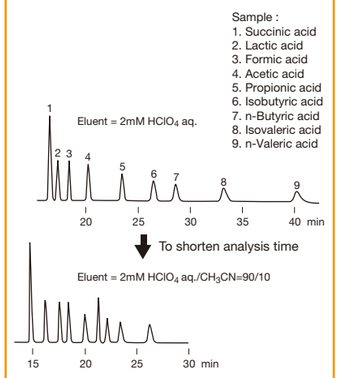
Sample :
1. Citric acid
2. Tartaric acid
3. Pyruvic acid
4. Malic acid
5. Succinic acid
6. Glycolic acid
7. Lactic acid
8. Fumaric acid
9. Acetic acid
10. Levulinic acid
11. Pyroglutamic acid
12. Propionic acid
13. Isobutyric acid
14. n-Butyric acid




**Column : Shodex RSpak KC-811 x 2**
Eluent : 6mM $HClO_4$ aq.
Flow rate : 1.0mL/min
Detector : VIS(430nm)
post column method
Column temp. : 50°C

### Hydrophobic organic acids

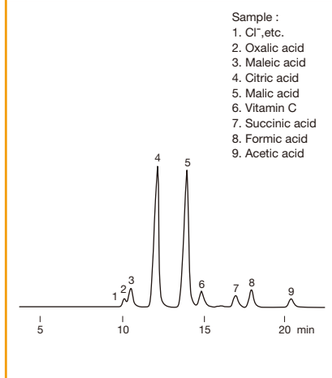
Sample :
1. Succinic acid
2. Lactic acid
3. Formic acid
4. Acetic acid
5. Propionic acid
6. Isobutyric acid
7. n-Butyric acid
8. Isovaleric acid
9. n-Valeric acid




**Column : Shodex RSpak KC-LG + KC-811 x 2**
Flow rate : 1.0mL/min
Detector : VIS(430nm)
post column method
Column temp. : 47°C

### Organic acids and vitamin C in fruit juice

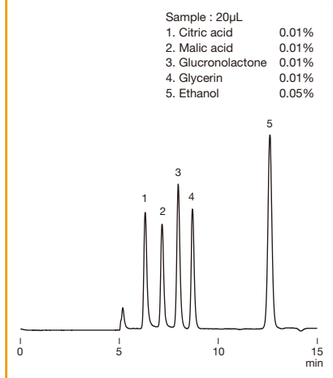
Sample :
1. $Cl^-$,etc.
2. Oxalic acid
3. Maleic acid
4. Citric acid
5. Malic acid
6. Vitamin C
7. Succinic acid
8. Formic acid
9. Acetic acid




**Column : Shodex RSpak KC-LG + KC-811 x 2**
Eluent : 1mM $HClO_4$ aq.
Flow rate : 1.0mL/min
Detector : VIS(430nm)
post column method
Column temp. : 40°C

### Glucronolactone and organic acids

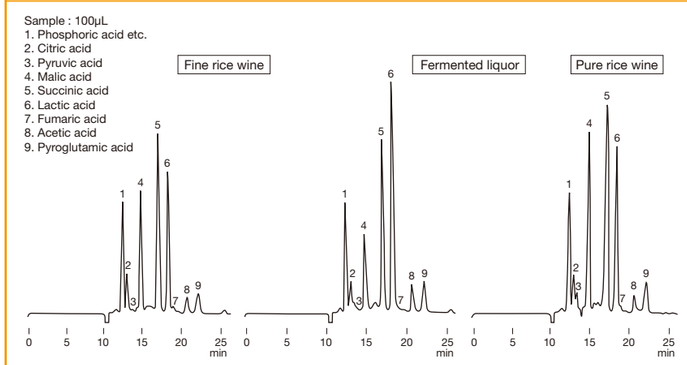
Sample : 20μL
1. Citric acid 0.01%
2. Malic acid 0.01%
3. Glucronolactone 0.01%
4. Glycerin 0.01%
5. Ethanol 0.05%




**Column : Shodex RSpak KC-811**
Eluent : 3mM $HClO_4$ aq.
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 40°C

### Organic acids in sake

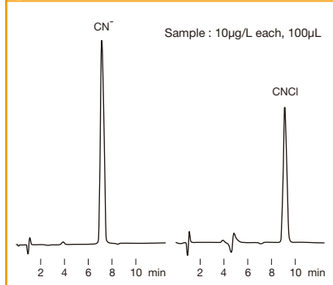
Sample : 100μL
1. Phosphoric acid etc.
2. Citric acid
3. Pyruvic acid
4. Malic acid
5. Succinic acid
6. Lactic acid
7. Fumaric acid
8. Acetic acid
9. Pyroglutamic acid




**Column : Shodex RSpak KC-LG + KC-811 x 2**
Eluent : 4.8mM $HClO_4$ aq.
Flow rate : 1.0mL/min
Detector : VIS(430nm)
post column method
Column temp. : 63°C

### Cyanide ion and cyanogen chloride with post column method

Sample : 10μg/L each, 100μL




**Column : Shodex RSpak KC-811 6E**
Eluent : 1.0mM $H_2SO_4$ aq.
Reagent A : Chloramine T solution
Reagent B : 4-Pyridinecarboxylic acid-Pyrazolone solution
Flow rate : (Eluent) 1.0mL/min
(Reagent) 0.5mL/min each
Detector : VIS(638nm)
Column temp. : 40°C
Reaction temp. : (Reagent A) 40°C
(Reagent B) 80°C

# Columns for Ion Chromatography (Anion Analysis)

## Features

**NI-424, I-524A**
- Columns for anion analysis with non-suppressor method
- NI-424 supports simultaneous analysis of fluoride and phosphate ions

**SI-90, SI-50**
- Columns for anion analysis with suppressor method
- Suitable for the quantitative analysis of fluoride ion
- SI-50 separates target inorganic anions from organic acids
- Not interfered by the system peak derived from carbonate

**NEW SI-35**
**SI-52**
- Columns for the analysis of oxyhalides
- SI-35 supports rapid analysis of oxyhalides and general inorganic ions
- SI-52 supports simultaneous analysis of oxyhalides and general inorganic ions

## Standard columns

**For anions (non-suppressor method)**

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

Base Material : Polyhydroxymethacrylate

**For anions (suppressor method)**

| Product Code | Product Name | Plate Number (TP/column) | Functional Group | Particle Size (μm) | Column Size (mm) I.D. x Length | Shipping Solvent |
|---|---|---|---|---|---|---|
| F6995244 | **IC SI-90 4E** | ≥ 5,000 | Quaternary ammonium | 9 | **4.0 × 250** | 1.8mM $Na_2CO_3$ + 1.7mM $NaHCO_3$ aq. |
| F6709620 | **IC SI-90G** | (guard column) | Quaternary ammonium | 9 | **4.6 × 10** | 1.8mM $Na_2CO_3$ + 1.7mM $NaHCO_3$ aq. |
| F6995245 | **IC SI-50 4E** | ≥ 10,000 | Quaternary ammonium | 5 | **4.0 × 250** | 3.2mM $Na_2CO_3$ + 1.0mM $NaHCO_3$ aq. |
| F6709625 | **IC SI-50G** | (guard column) | Quaternary ammonium | 5 | **4.6 × 10** | 3.2mM $Na_2CO_3$ + 1.0mM $NaHCO_3$ aq. |

Base Material : Polyvinyl alcohol
Housing Material : PEEK

**For oxyhalides (suppressor method)**

| Product Code | Product Name | Plate Number (TP/column) | Functional Group | Particle Size (μm) | Column Size (mm) I.D. x Length | Shipping Solvent |
|---|---|---|---|---|---|---|
| F6995290 | **NEW IC SI-35 4D** | ≥ 13,000 | Quaternary ammonium | 3.5 | **4.0 × 150** | 3.6mM $Na_2CO_3$ aq. |
| F6709627 | **NEW IC SI-95G** | (guard column) | Quaternary ammonium | 9 | **4.6 × 10** | 3.6mM $Na_2CO_3$ aq. |
| F6995260 | **IC SI-52 4E** | ≥ 14,000 | Quaternary ammonium | 5 | **4.0 × 250** | 3.6mM $Na_2CO_3$ aq. |
| F6709626 | **IC SI-92G** | (guard column) | Quaternary ammonium | 9 | **4.6 × 10** | 3.6mM $Na_2CO_3$ aq. |

Base Material : Polyvinyl alcohol
Housing Material : PEEK

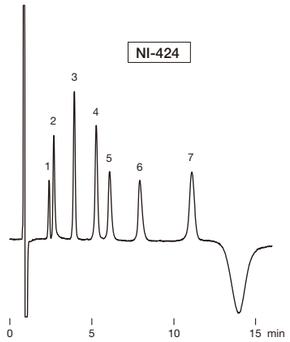
## Line filters for IC

| Product Code | Product Name | Application | Contents |
|---|---|---|---|
| F8500630 | **IC FL-1** | For general purposes | One holder and one filter |
| F8500640 | **IC FL-1 filter** | Replacement filter for IC FL-1 | 5 filters |
| F8500650 | **IC FL-2** | Non-metal type | One holder and one filter |
| F8500660 | **IC FL-2 filter** | Replacement filter for IC FL-2 | 4 filters |

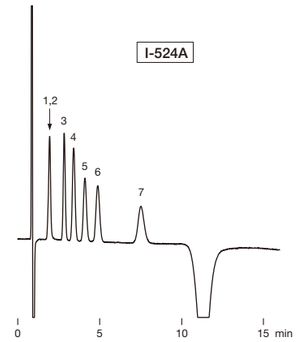
*Contact Shodex or our distributors near you for customized columns.



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




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




NI-424 is a high performance type column offers twice increased theoretical plate number than I-524A does.

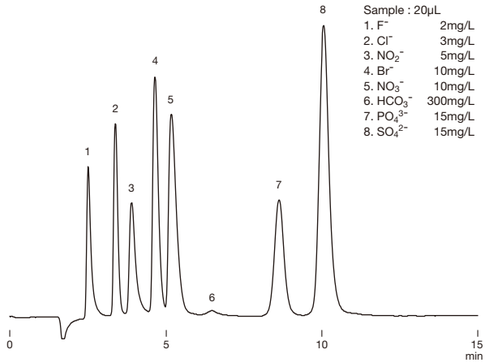
<Features of NI-424>
(1) Enables the separation of $H_2PO_4^-$ and $F^-$ ions which were difficult to separate with I-524A.
(2) The shape of each peak is sharper, and the separation balance is proper. Especially, the separation of $Cl^-$ and $NO_2^-$ is improved.

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

**Column** : **Shodex IC I-524A**
Eluent : 2.5mM Phthalic acid + 2.3mM Tris(hydroxymethyl)aminomethane aq.
Flow rate : 1.2mL/min
Detector : Non-suppressed conductivity
Column temp. : 40°C

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

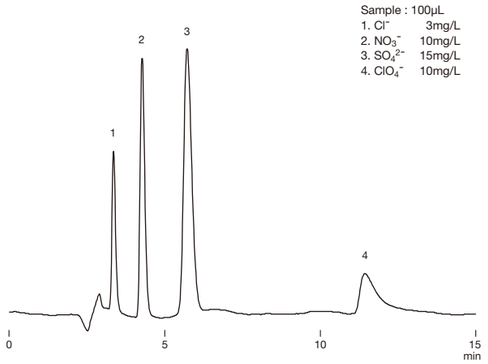
### Anions analysis using SI-90 4E (suppressor method)




Sample : 20μL
1. $F^-$ 2mg/L
2. $Cl^-$ 3mg/L
3. $NO_2^-$ 5mg/L
4. $Br^-$ 10mg/L
5. $NO_3^-$ 10mg/L
6. $HCO_3^-$ 300mg/L
7. $PO_4^{3-}$ 15mg/L
8. $SO_4^{2-}$ 15mg/L

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

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

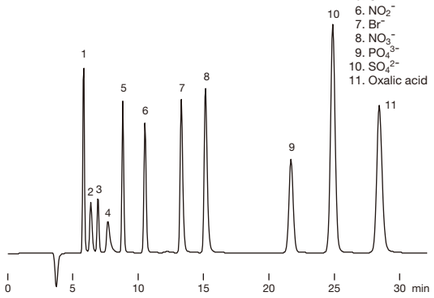



Sample : 100μL
1. $Cl^-$ 3mg/L
2. $NO_3^-$ 10mg/L
3. $SO_4^{2-}$ 15mg/L
4. $ClO_4^-$ 10mg/L

**Column** : **Shodex IC SI-90 4E**
Eluent : 6mM $Na_2CO_3$ aq. + 10% $CH_3CN$
Flow rate : 1.0mL/min
Detector : Suppressed conductivity
Column temp. : 25°C

### Anions 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.

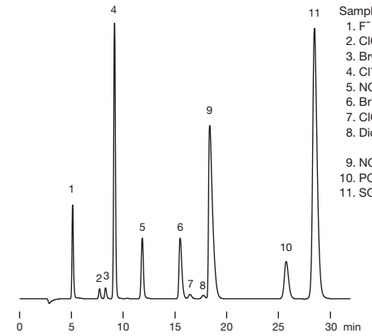



Sample : 20μL
1. $F^-$ 2mg/L
2. Acetic acid 10mg/L
3. Formic acid 2mg/L
4. Methacrylic acid 10mg/L
5. $Cl^-$ 3mg/L
6. $NO_2^-$ 5mg/L
7. $Br^-$ 10mg/L
8. $NO_3^-$ 10mg/L
9. $PO_4^{3-}$ 15mg/L
10. $SO_4^{2-}$ 15mg/L
11. Oxalic acid 15mg/L

**Column** : **Shodex IC SI-50 4E**
Eluent : 3.2mM $Na_2CO_3$ + 1.0mM $NaHCO_3$ aq.
Flow rate : 0.7mL/min
Detector : Suppressed conductivity
Column temp. : 25°C

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

SI-52 4E is a high resolution type column offers 14,000 or higher theoretical plate number. It supports simultaneous analysis of oxyhalides and inorganic anions. The recommended analysis temperature is 45°C.




Sample : 50μL
1. $F^-$ 2mg/L
2. $ClO_2^-$ 1mg/L
3. $BrO_3^-$ 1mg/L
4. $Cl^-$ 10mg/L
5. $NO_2^-$ 5mg/L
6. $Br^-$ 10mg/L
7. $ClO_3^-$ 1mg/L
8. Dichloroacetic acid 1mg/L
9. $NO_3^-$ 30mg/L
10. $PO_4^{3-}$ 15mg/L
11. $SO_4^{2-}$ 40mg/L

**Column** : **Shodex IC SI-52 4E**
Eluent : 3.6mM $Na_2CO_3$ aq.
Flow rate : 0.8mL/min
Detector : Suppressed conductivity
Column temp. : 45°C

# Columns for Ion Chromatography (Cation Analysis)

## Features

**YS-50**
- High performance type of YK-421
- Applicable to both suppressor and non-suppressor methods
- Peak shape is sharper, especially for divalent cation analysis
- Supports the analysis of alkylamines and transition metals

**YK-421**
- Column for cation analysis with non-suppressor method
- Simultaneous analysis of monovalent and divalent cations
- Suitable for separation of alkylamines

**Y-521**
- Column for cation analysis with non-suppressor method
- For the separation of monovalent or divalent cations

**T-521**
- Column for transition metal ion analysis
- High sensitivity analysis is achieved by post column color reaction method

## Standard columns

### For cations

| Product Code | Product Name | Plate Number (TP/column) | Functional Group | Base Material | Particle Size (μm) | Column Size (mm) I.D. x Length | Shipping Solvent |
|---|---|---|---|---|---|---|---|
| F7122000 | **IC YS-50** | ≥ 5,500 | Carboxyl | Polyvinyl alcohol | 5 | **4.6 × 125** | $H_2O$ |
| F6700530 | **IC YS-G** | (guard column) | Carboxyl | Polyvinyl alcohol | 5 | **4.6 × 10** | $H_2O$ |
| F7120012 | **IC YK-421** | ≥ 2,800 | Carboxyl | Silica | 5 | **4.6 × 125** | 5mM Tartaric acid + 1mM Dipicolinic acid + 1.5g/L Boric acid aq. |
| F6709608 | **IC YK-G** | (guard column) | Carboxyl | Silica | 5 | **4.6 × 10** | 5mM Tartaric acid + 1mM Dipicolinic acid + 1.5g/L Boric acid aq. |
| F6995210 | **IC Y-521** | ≥ 3,000 | Sulfo | Styrene divinylbenzene copolymer | 12 | **4.6 × 150** | 4mM $HNO_3$ aq. |
| F6700230 | **IC Y-G** | (guard column) | Sulfo | Styrene divinylbenzene copolymer | 12 | **4.6 × 10** | 4mM $HNO_3$ aq. |

### For transition metal ions

| Product Code | Product Name | Plate Number (TP/column) | Functional Group | Base Material | Particle Size (μm) | Column Size (mm) I.D. x Length | Shipping Solvent |
|---|---|---|---|---|---|---|---|
| F6995250 | **IC T-521** | ≥ 3,000 | Sulfo | Styrene divinylbenzene copolymer | 12 | **4.6 × 150** | 3mM $HNO_3$ aq. |
| F6700412 | **IC T-G** | (guard column) | Sulfo | Styrene divinylbenzene copolymer | 12 | **4.6 × 10** | 3mM $HNO_3$ aq. |

Housing Material : PEEK

## Line filters for IC

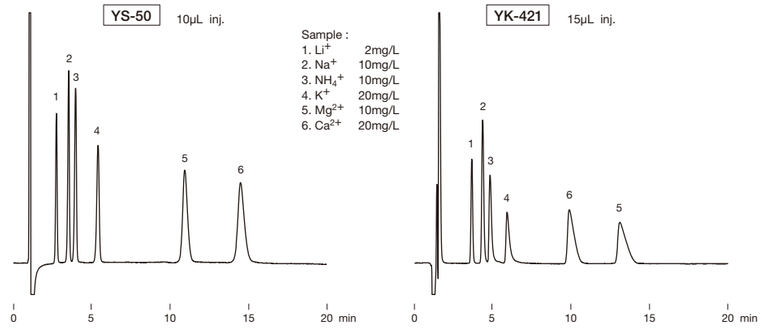
| Product Code | Product Name | Application | Contents |
|---|---|---|---|
| F8500630 | **IC FL-1** | For general purposes | One holder and one filter |
| F8500640 | **IC FL-1 filter** | Replacement filter for IC FL-1 | 5 filters |
| F8500650 | **IC FL-2** | Non-metal type | One holder and one filter |
| F8500660 | **IC FL-2 filter** | Replacement filter for IC FL-2 | 4 filters |

*Contact Shodex or our distributors near you for customized columns.





## Standard cations (YS-50 and YK-421)




YS-50 is a high performance type column offers twice increased theoretical plate number than YK-421 does. In particular, the peak shape is improved. The quantitative performance for $NH_4^+$ in a sample containing high concentration $Na^+$ is also enhanced.

| Resolution factor of $Na^+$and $NH_4^+$ | YS-50 | YK-421 |
|---|---|---|
| | 2.5 | 2.1 |

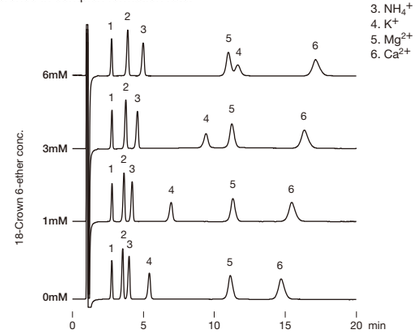
| TP | YS-50 | YK-421 |
|---|---|---|
| $Mg^{2+}$ | 6,900 | 3,000 |
| $Ca^{2+}$ | 6,600 | 3,000 |

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

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

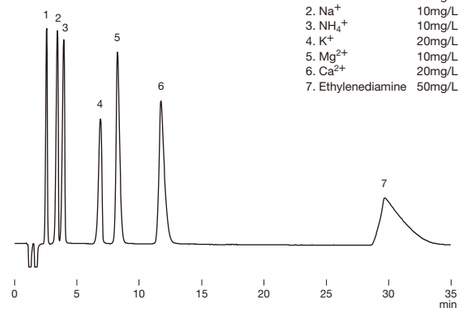
## Effects of crown ether in eluent

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



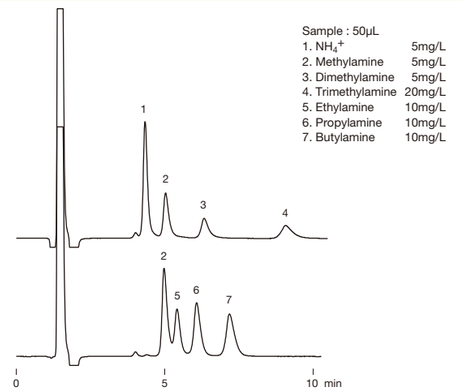

**Column** : **Shodex IC YS-50**
Eluent : 4mM Methanesulfonic acid + 18-Crown 6-ether aq.
Flow rate : 1.0mL/min
Detector : Non-suppressed conductivity
Column temp. : 40℃

## Simultaneous analysis for cations and ethylenediamine



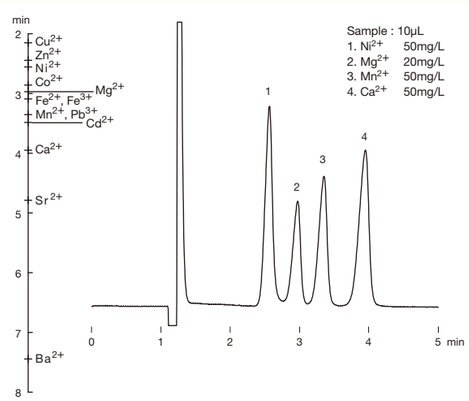

**Column** : **Shodex IC YS-50**
Eluent : 4mM Nitric acid + 1.5mM 18-Crown 6-ether aq. /$CH_3CN$=90/10
Flow rate : 1.0mL/min
Detector : Non-suppressed conductivity
Column temp. : 40℃

## Alkylamines




**Column** : **Shodex IC YK-421**
Eluent : 4mM $H_3PO_4$ aq./$CH_3CN$=90/10
Flow rate : 1.0mL/min
Detector : Non-suppressed conductivity
Column temp. : 25℃

## Alkaline earth metal ions

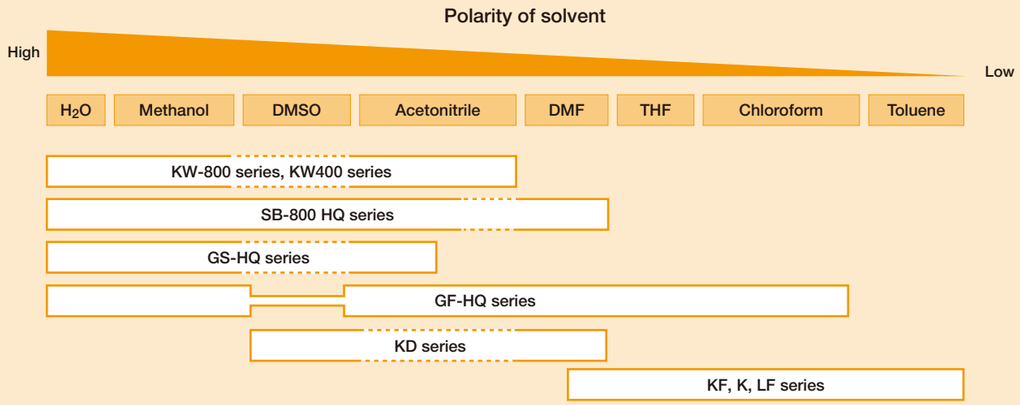



**Column** : **Shodex IC Y-521**
Eluent : 4mM Tartaric acid + 2mM Ethylenediamine aq.
Flow rate : 1.0mL/min
Detector : Non-suppressed conductivity
Column temp. : 40℃

# 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 | | 28 |
| | | Buffer etc. | KW400 series | High performance (solvent-saving) | 28 |
| | Biological macromolecules (high MW range) | Buffer etc. | SB-800 HQ series | | 30 |
| | Water-soluble polymers (polyacrylamide, polyethylenimine, etc.) Polysaccharides | $H_2O$, Buffer Aqueous solution etc. | SB-800 HQ series | | 30 |
| | Oligosaccharide, polysaccharides | $H_2O$, Aqueous solution | KS-800 series | | 16 |
| | | | GS-HQ series | | 32 |
| Organic SEC (GPC) | General polymers | THF | KF-800 series | | 36 |
| | | THF | KF-600 series | Rapid analysis (solvent-saving) | 42 |
| | | THF | KF-400HQ series | High performance (solvent-saving) | 42 |
| | | THF | LF series | High linearity of calibration curve | 44 |
| | | Chloroform | K-800 series | | 38 |
| | Polar polymers (polyimides, polyvinylpyrrolidones etc.) | DMF | KD-800 series | | 40 |
| | | DMF | SB-800 HQ series | | 30 |
| | Analysis at high temperature (polyethylene, polypropylene etc.) | ODCB etc. | HT-800 series | | 46 |
| | | ODCB etc. | UT-800 series | | 46 |
| | | ODCB etc. | AT-806MS | | 46 |
| | Engineering resin analysis at room temperature [polyamide (Nylon), polyethylene terephthalate (PET) etc.] | HFIP | HFIP-800 series | | 48 |
| | | HFIP | HFIP-600 series | Rapid analysis (solvent-saving) | 48 |
| | | HFIP | LF series | High linearity of calibration curve | 44 |
| Aqueous/Organic SEC | | | GF-HQ series | | 34 |

## Guideline for column solvent usability




* See page 50 for the solvent replaceability of organic solvent SEC (GPC) packed columns.





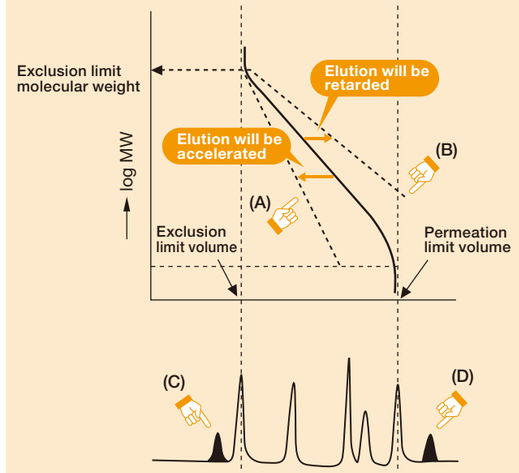
# Precautions for Polar Polymer Analysis

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

## Interfering interactions likely to be observed

### Interactions between the analyte and the packing materials

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




### Interaction within and between the analyte

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

### Interactions between the analyte and the solvent

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

## Methods to reduce interactions

### Aqueous SEC (GFC)

#### Ionic Interaction

- **Add salt**

#### Hydrophobic interaction

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

### Organic solvent SEC (GPC)

#### Ionic Interaction

- **Add salt**
  (Example) Add LiBr to DMF
  Add $CF_3COONa$ to HFIP

#### Hydrophobic interaction

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

#### Hydrophillic interaction

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

# Aqueous SEC (GFC) Columns : Silica-based

## Features

**KW-800**

- Silica-based packed columns for aqueous SEC (GFC) analysis
- Suitable for the analysis of proteins and enzymes

Note book No.7 Preparative Columns p.81

**KW400**

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

Note book No.5, 7 News No.31 Semi-micro Micro Columns p.73

## Standard columns

| Product Code | Product Name | Plate Number (TP/column) | Exclusion Limit (Pullulan) | Exclusion Limit (Protein) | Particle Size (µm) | Maximum Pore Size (Å) | Column Size (mm) I.D. x Length | Shipping Solvent |
|---|---|---|---|---|---|---|---|---|
| F6989000 | **PROTEIN KW-802.5** | ≥ 21,000 | 60,000 | 150,000 | 5 | 400 | **8.0 × 300** | $H_2O$ |
| F6989103 | **PROTEIN KW-803** | ≥ 21,000 | 170,000 | 700,000 | 5 | 1,000 | **8.0 × 300** | $H_2O$ |
| F6989104 | **PROTEIN KW-804** | ≥ 16,000 | 500,000 | (1,000,000)* | 7 | 1,500 | **8.0 × 300** | $H_2O$ |
| F6700131 | **PROTEIN KW-G** | (guard column) | – | – | 7 | – | **6.0 × 50** | $H_2O$ |

Base Material : Silica
Usable pH range : pH3.0-7.5
( )* Estimated value

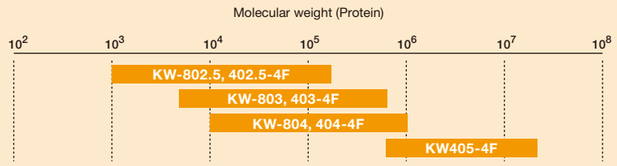
## High performance semi-micro columns

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

| Product Code | Product Name | Plate Number (TP/column) | Exclusion Limit (Pullulan) | Exclusion Limit (Protein) | Particle Size (µm) | Maximum Pore Size (Å) | Column Size (mm) I.D. x Length | Shipping Solvent |
|---|---|---|---|---|---|---|---|---|
| F6989201 | **KW402.5-4F** | ≥ 35,000 | 60,000 | 150,000 | 3 | 400 | **4.6 × 300** | $H_2O$ |
| F6989202 | **KW403-4F** | ≥ 35,000 | 150,000 | 600,000 | 3 | 800 | **4.6 × 300** | $H_2O$ |
| F6989203 | **KW404-4F** | ≥ 25,000 | 500,000 | (1,000,000)* | 5 | 1,500 | **4.6 × 300** | $H_2O$ |
| F6989204 | **KW405-4F** | ≥ 25,000 | 1,300,000 | (20,000,000)* | 5 | 2,000 | **4.6 × 300** | $H_2O$ |
| F6700132 | **KW400G-4A** | (guard column) | – | – | 5 | – | **4.6 × 10** | $H_2O$ |

Base Material : Silica
Usable pH range : pH3.0-7.5
( )* Estimated value

## Molecular weight range with protein (eluent : phosphate buffer)

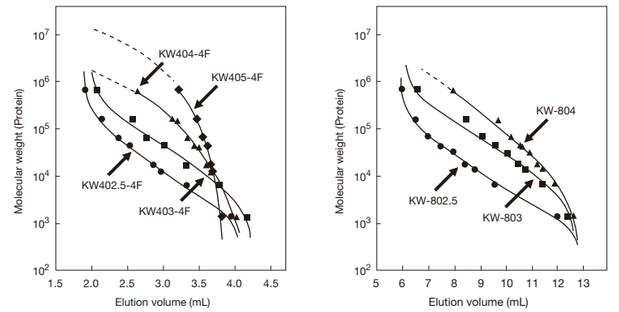



Calibration Standards See page 51 for Calibration Standards

*Contact Shodex or our distributors near you for customized columns.



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




**Column** : **Shodex KW400-4F series, PROTEIN KW-800 series**
Eluent : 50mM Sodium phosphate buffer + 0.3M NaCl(pH7.0)
Flow rate : (KW400) 0.33mL/min
(KW-800) 1.0mL/min
Detector : (KW400) UV(280nm) (small cell volume)
(KW-800) UV(280nm) (conventional type)
Column temp. : 25℃

### Recovery rate of proteins

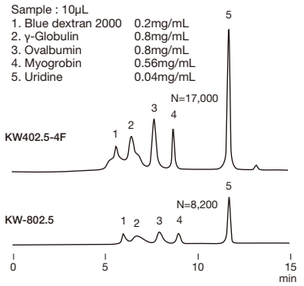
| Protein | Recovery (%) KW402.5-4F | Recovery (%) KW403-4F |
|---|---|---|
| γ - Globulin | 98 | 96 |
| Bovine serum albumin | 89 | 96 |
| Ovalbumin | 89 | 97 |
| Myoglobin | 90 | 89 |
| Cytochrome c | 92 | 92 |
| Lysozyme | 87 | 98 |
| α-Chymotrypsinogen A | 95 | 94 |

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

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

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

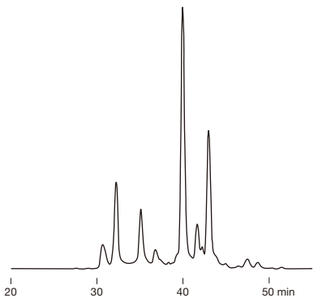
Sample : 10µL
1. Blue dextran 2000 0.2mg/mL
2. γ-Globulin 0.8mg/mL
3. Ovalbumin 0.8mg/mL
4. Myogrobin 0.56mg/mL
5. Uridine 0.04mg/mL




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

### Whey in yogurt

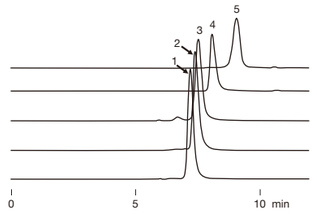
Sample : Whey, 5µL




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

### Lectins

Sample : 5µL
1. Lectin from Soybean 0.6mg/mL
2. Lectin from Arachis hypogaea 1.1mg/mL
3. Lectin from Canavalia ensiformis (Con A) 0.9mg/mL
4. Lectin from Lens culinaris (LCA) 0.7mg/mL
5. Lectin from Triticum vulgaris (WGA) 0.8mg/mL

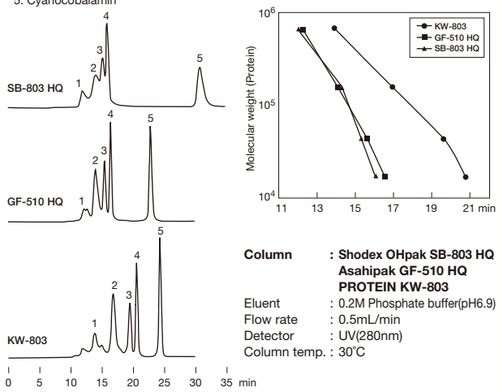



**Column** : **Shodex KW402.5-4F**
Eluent : 50mM Sodium phosphate buffer + 0.3M NaCl(pH7.0)
Flow rate : 0.33mL/min
Detector : UV(220nm) (small cell volume)
Column temp. : 30℃

### Comparison of various GFC columns for separation of standard proteins

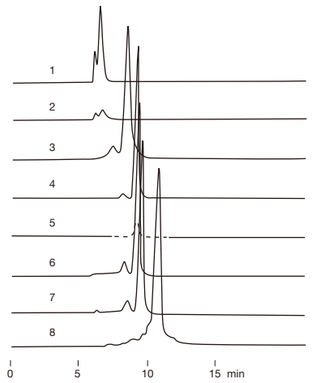
Sample :
1. Thyroglobulin (bovine)
2. γ-Globulin (bovine)
3. Ovalbumin (chicken)
4. Myoglobin (horse)
5. Cyanocobalamin

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




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

### Proteins in human blood serum



Sample : 0.1% each
1. Fibrinogen 50µL
2. $\alpha_2$ -Macroglobulin 50µL
3. IgG 50µL
4. Transferrin 50µL
5. Plasminogen 50µL
6. Albumin 100µL
7. Antitrypsin 100µL
8. Hemoglobin 100µL

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

# Aqueous SEC (GFC) Columns : Polymer-based

## Features

**SB-800 HQ**

- Polymer-based packed columns for aqueous SEC (GFC) analysis
- Supports a wide range of molecular weight sample analysis
- The eluent can be replaced with DMF (except SB-802 HQ and SB-807 HQ), enabling the analysis of polar polymers
- Method using SB-804 HQ or SB-805 HQ for gelatin's mean molecular weight determination is comparable with PAGI method (Ver. 10, Japan)

News No.29

Semi-micro Micro Columns p.74
Preparative Columns p.81

**SB-807 HQ**

- Column for the analysis of water-soluble ultra high molecular weight polymers
- Large particle size gel is packed to prevent shear degradation of polymers

## Standard columns

| Product Code | Product Name | Plate Number (TP/column) | Exclusion Limit (Pullulan) | Particle Size (µm) | Maximum Pore Size (Å) | Column Size (mm) I.D. x Length | Shipping Solvent |
|---|---|---|---|---|---|---|---|
| F6429100 | **OHpak SB-802 HQ** | ≥ 12,000 | 4,000 | 8 | 100 | **8.0 × 300** | 0.02% $NaN_3$ aq. |
| F6429101 | **OHpak SB-802.5 HQ** | ≥ 16,000 | 10,000 | 6 | 200 | **8.0 × 300** | 0.02% $NaN_3$ aq. |
| F6429102 | **OHpak SB-803 HQ** | ≥ 16,000 | 100,000 | 6 | 800 | **8.0 × 300** | 0.02% $NaN_3$ aq. |
| F6429103 | **OHpak SB-804 HQ** | ≥ 16,000 | (1,000,000) | 10 | 2,000 | **8.0 × 300** | 0.02% $NaN_3$ aq. |
| F6429104 | **OHpak SB-805 HQ** | ≥ 12,000 | (4,000,000)* | 13 | 7,000 | **8.0 × 300** | 0.02% $NaN_3$ aq. |
| F6429105 | **OHpak SB-806 HQ** | ≥ 12,000 | (20,000,000)* | 13 | 15,000 | **8.0 × 300** | 0.02% $NaN_3$ aq. |
| F6429106 | **OHpak SB-806M HQ** | ≥ 12,000 | (20,000,000)* | 13 | 15,000 | **8.0 × 300** | 0.02% $NaN_3$ aq. |
| F6709430 | **OHpak SB-G** | (guard column) | – | 10 | – | **6.0 × 50** | 0.02% $NaN_3$ aq. |

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

Base Material : Polyhydroxymethacrylate
Usable pH range : pH3-10
( )* Estimated value

### For water-soluble ultra high molecular weight polymers

| Product Code | Product Name | Plate Number (TP/column) | Exclusion Limit (Pullulan) | Particle Size (µm) | Maximum Pore Size (Å) | Column Size (mm) I.D. x Length | Shipping Solvent |
|---|---|---|---|---|---|---|---|
| F6429108 | **OHpak SB-807 HQ** | ≥ 1,500 | (500,000,000)* | 35 | 30,000 | **8.0 × 300** | $H_2O$ |
| F6709431 | **OHpak SB-807G** | (guard column) | – | 35 | – | **8.0 × 50** | $H_2O$ |

Base Material : Polyhydroxymethacrylate
Usable pH range : pH3-10
( )* Estimated value

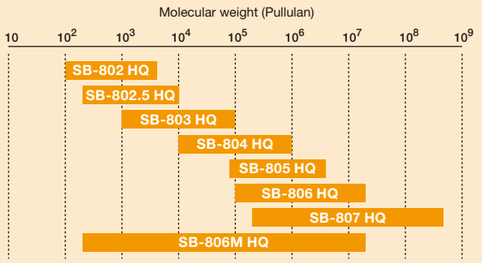
## Usable concentration of organic solvents

| Product Name | 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** | 75 | 75 | 100 |
| **SB-807 HQ, SB-807G** | 30 | 30 | 0 |

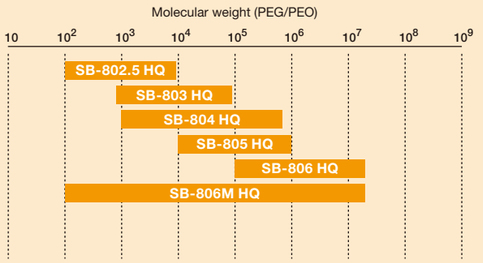
(Note)
The maximum solvent tolerance of preparative type SB-800 HQ, SB-2000 series, is 50% of methanol, acetonitrile, and DMF (SB-2002 is not tolerant of organic solvents, similar to SB-802 HQ).

Calibration Standards See page 51 for Calibration Standards

### Molecular weight range with pullulan (eluent : ultrapure water)



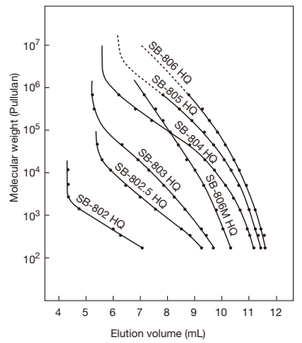

### Molecular weight range with PEG/PEO (eluent : DMF)




*Contact Shodex or our distributors near you for customized columns.

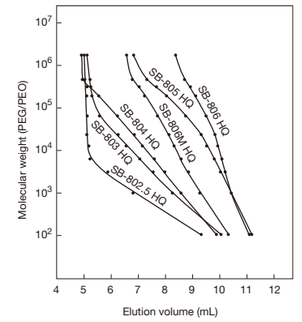


### Calibration curves for SB-800 HQ series using pullulan (eluent: $H_2O$)



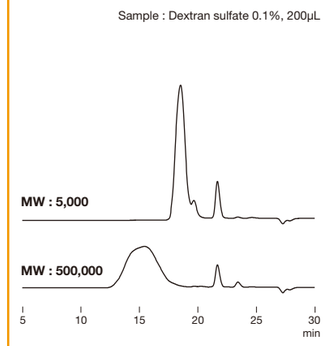

**Column** : **Shodex OHpak SB-800 HQ series**
Eluent : $H_2O$
Flow rate : 1.0mL/min
Detector : RI
Column temp. : Room temp.

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



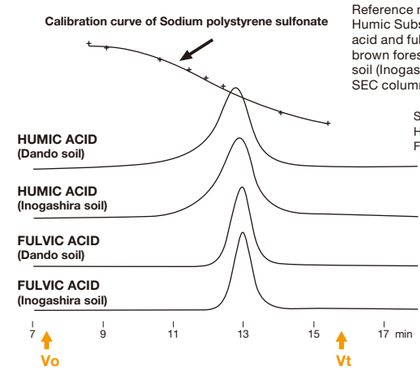

**Column** : **Shodex OHpak SB-800 HQ series**
Eluent : 20mM LiBr in DMF
Flow rate : 0.8mL/min
Detector : RI
Column temp. : 40°C

### Dextran sulfate




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

### SEC analysis of humic substance




Reference materials (from the Japanese Humic Substances Society) for humic acid and fulvic acid, prepared from brown forest soil (Dando) and kuroboku soil (Inogashira), were analyzed using SEC columns.

Sample : Humic substances, 30µL
Humic acid 0.02mg/mL
Fulvic acid 0.02mg/mL

**Column** : **Shodex OHpak SB-G + SB-805 HQ**
Eluent : 10mM $NaH_2PO_4$ + 10mM $Na_2HPO_4$(pH7.0) + 25% $CH_3CN$
Flow rate : 0.8mL/min
Detector : UV(260nm)
Column temp. : 40°C

Data courtesy of Associate Professor Nobuhide Fujitake, Student Affairs Section, Graduate School of Agricultural Science, Kobe University

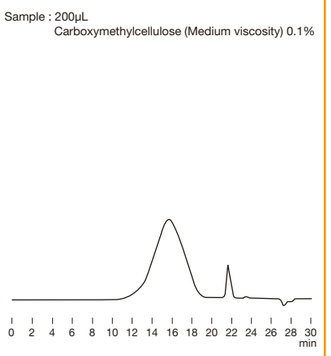
### Effects of sodium nitrate concentration in eluent on the analysis of polyallylamine

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



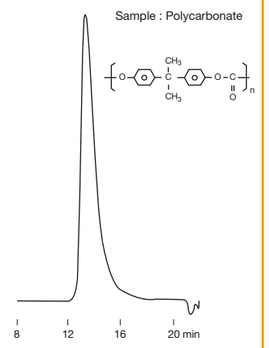

**Column** : **Shodex OHpak SB-806M HQ x 2**
Eluent : 0.5M Acetic acid + $NaNO_3$ aq.
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 40°C

### Carboxymethylcellulose



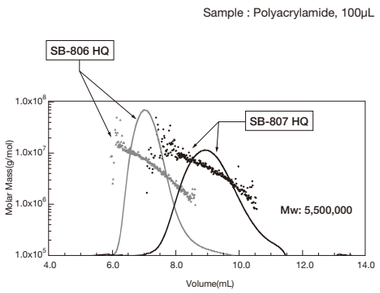

**Column** : **Shodex OHpak SB-806M HQ x 2**
Eluent : 0.1M NaCl aq.
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 40°C

### Polycarbonate




**Column** : **Shodex OHpak SB-805 HQ + SB-802.5 HQ**
Eluent : 5mM LiBr in DMF
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 40°C

### Polyacrylamide




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

# Multimode Columns

## Features

**GS-HQ**

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

Note book No.3

Semi-micro Micro Columns p.75
Preparative Columns p.82

**GS-620 7G-P**

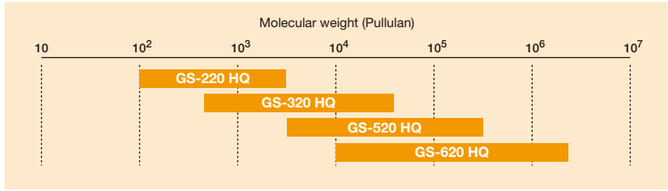
- Columns to determine molecular weight distribution of gelatin compliant with PAGI method (Ver. 10, Japan)

## Standard columns

| Product Code | Product Name | Plate Number (TP/column) | Exclusion Limit (Pullulan) | Particle Size (µm) | Maximum Pore Size (Å) | Column Size (mm) I.D. x Length | Shipping Solvent |
|---|---|---|---|---|---|---|---|
| F7600005 | **Asahipak GS-220 HQ** | ≥ 19,000 | 3,000* | 6 | 150 | **7.5 × 300** | $H_2O/CH_3OH$=70/30 |
| F7600006 | **Asahipak GS-320 HQ** | ≥ 19,000 | 40,000 | 6 | 400 | **7.5 × 300** | $H_2O/CH_3OH$=70/30 |
| F7600007 | **Asahipak GS-520 HQ** | ≥ 18,000 | 300,000 | 7 | 2,000 | **7.5 × 300** | $H_2O/CH_3OH$=70/30 |
| F7600008 | **Asahipak GS-620 HQ** | ≥ 18,000 | (2,000,000)** | 7 | 7,000 | **7.5 × 300** | $H_2O/CH_3OH$=70/30 |
| F6710019 | **Asahipak GS-2G 7B** | (guard column) | – | 9 | – | **7.5 × 50** | $H_2O/CH_3OH$=70/30 |

Base Material : Polyvinyl alcohol
Usable pH range : pH2-12
(GS-220 HQ : pH2-9)
Usable concentration of methanol is up to 100%
(GS-220 HQ : up to 30%)
Usable concentration of acetonitrile is up to 50%
* PEG equivalent
( )** Estimated value

### Molecular weight range with pullulan (eluent : ultrapure water)




### For determination of gelatin molecular weight distribution

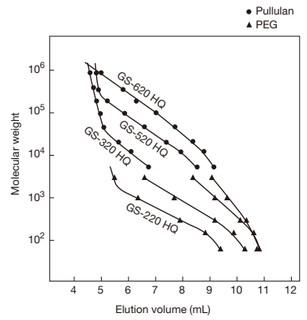
| Product Code | Product Name | Application | Column Size (mm) I.D. x Length | Shipping Solvent |
|---|---|---|---|---|
| F7600023 | **Asahipak GS-620 7G-P** | Gelatin for photo film | **7.5 × 500** | $H_2O/CH_3OH$=70/30 |
| F6710019 | **Asahipak GS-2G 7B** | (guard column) | **7.5 × 50** | $H_2O/CH_3OH$=70/30 |

Calibration Standards See page 51 for Calibration Standards

*Contact Shodex or our distributors near you for customized columns.



### Calibration curves for GS-HQ series using pullulan and PEG




**Column** : **Shodex Asahipak GS-HQ series**
Eluent : $H_2O$
Flow rate : 0.6mL/min
Detector : RI
Column temp. : 30°C

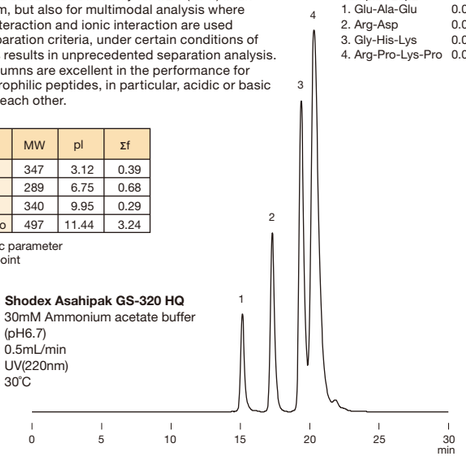
### Peptides

GS-HQ columns can be used not only for SEC (GFC) in an aqueous system, but also for multimodal analysis where hydrophobic interaction and ionic interaction are used together as separation criteria, under certain conditions of the eluent. This results in unprecedented separation analysis. GS-320 HQ columns are excellent in the performance for separating hydrophilic peptides, in particular, acidic or basic peptides, from each other.

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

| | 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 |

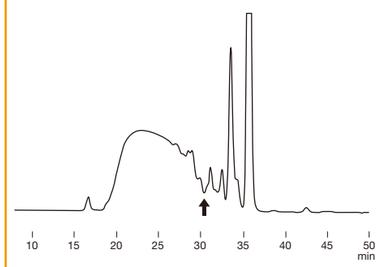
Σf : Hydrophobic parameter
pI : Isoelectric point




**Column** : **Shodex Asahipak GS-320 HQ**
Eluent : 30mM Ammonium acetate buffer (pH6.7)
Flow rate : 0.5mL/min
Detector : UV(220nm)
Column temp. : 30°C

### Low molecular weight water-soluble dietary fiber

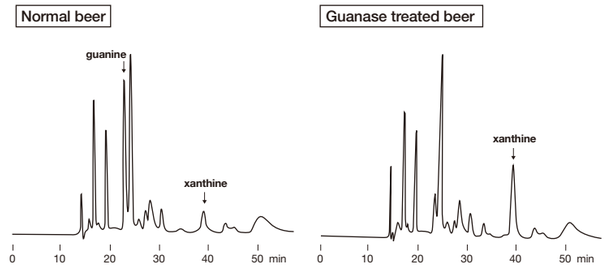
By using GS-220 HQ, monosaccharides, disaccharides, and sugar alcohols elute after indigestible component faction (indicated by an arrow on the chromatogram). This separation makes the method preferable for the quantification of low molecular weight water-soluble dietary fiber.




**Column** : **Shodex Asahipak GS-220 HQ x 2**
Eluent : $H_2O$
Flow rate : 0.5mL/min
Detector : RI
Column temp. : 60°C

### Analysis of purine bases in beer

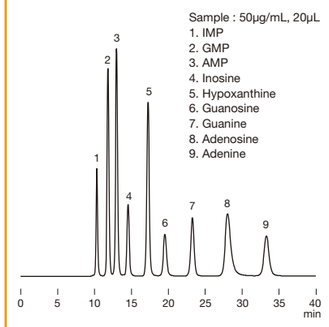
Purine in foods is analyzed as purine base after a step of sample preparation; homogenization, freeze drying, hydolyzation with 70% perchloric acid, and neutralization. Example below shows the analysis of purin in regular beer and beer treated with guanase (an enzyme that degrades guanine to xanthine). The following data indicates that guanine was decreased and xanthine was increased by guanase.




**Column** : **Shodex Asahipak GS-320 HQ**
Eluent : 150mM Sodium phosphate buffer(pH2.5)
Flow rate : 0.6mL/min
Detector : UV(260nm)
Column temp. : 35°C

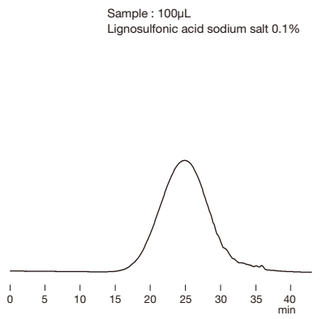
Data provided by Kiyoko Kaneko Ph.D., Faculty of Pharmaceutical Sciences, Teikyo University

### "Umami"



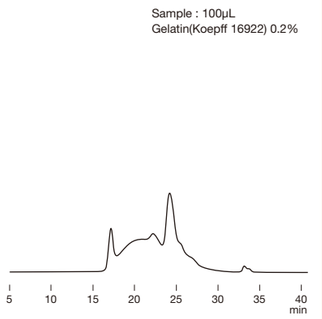

**Column** : **Shodex Asahipak GS-320 HQ**
Eluent : 10mM $NaH_2PO_4$ aq./10mM $Na_2HPO_4$ aq. =1000/31
Flow rate : 1.0mL/min
Detector : UV(260nm)
Column temp. : 40°C

### Lignosulfonic acid




**Column** : **Shodex Asahipak GS-520 HQ x 2**
Eluent : 20mM $Na_2HPO_4$ aq.
Flow rate : 0.6mL/min
Detector : UV(254nm)
Column temp. : 40°C

### Gelatin analysis with PAGI method




**Column** : **Shodex Asahipak GS-620 7G-P x 2**
Eluent : 0.1M $KH_2PO_4$ aq./0.1M $Na_2HPO_4$ aq. =50/50
Flow rate : 1.0mL/min
Detector : UV(230nm)
Column temp. : 50°C

# Aqueous/Organic SEC Columns

## Features

**GF-HQ**

- Polymer-based SEC columns exhibit high solvent durability
- Supports both aqueous and organic solvents

News No.2

Semi-micro Micro Columns p.76
Preparative Columns p.82

**NEW GF-210 HQ**

- Column for low molecular weight substance analysis with exclusion limit of 9,000 (pullulan)

**GF-310**

- Semi-micro columns for Asahipak GF-310 HQ
- Effective for drug analysis in biological samples by using column switching method to remove proteins
- Useful for LC/MS analysis
- Suitable for the analysis of surfactants

News No.2

## Standard columns

| Product Code | Product Name | Plate Number (TP/column) | Exclusion Limit (Pullulan) | Particle Size (μm) | Maximum Pore Size (Å) | Column Size (mm) I.D. x Length | Shipping Solvent |
|---|---|---|---|---|---|---|---|
| F7600000 | NEW Asahipak GF-210 HQ | ≥ 19,000 | 9,000 | 5 | 180 | 7.5 × 300 | $H_2O$ |
| F7600001 | Asahipak GF-310 HQ | ≥ 19,000 | 40,000 | 5 | 400 | 7.5 × 300 | $H_2O/CH_3OH$=70/30 |
| F7600002 | Asahipak GF-510 HQ | ≥ 19,000 | 300,000 | 5 | 2,000 | 7.5 × 300 | $H_2O/CH_3OH$=70/30 |
| F7600003 | Asahipak GF-710 HQ | ≥ 11,000 | (10,000,000)* | 9 | 10,000 | 7.5 × 300 | $H_2O/CH_3OH$=70/30 |
| F7600004 | Asahipak GF-7M HQ | ≥ 13,000 | (10,000,000)* | 9 | 10,000 | 7.5 × 300 | $H_2O/CH_3OH$=70/30 |
| F6710018 | Asahipak GF-1G 7B | (guard column) | – | 9 | – | 7.5 × 50 | $H_2O/CH_3OH$=70/30 |

GF-7M HQ is a mixed-gel column capable of analyzing samples over a wide range of molecular weight.

Base Material : Polyvinyl alcohol
Usable pH range : pH2-9
( )* Estimated value

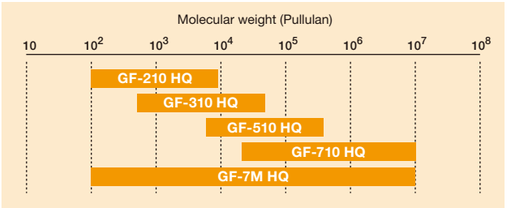
## Usable solvents

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

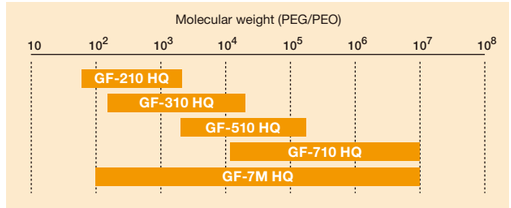
(Note)
The usable solvents for preparative columns of GF-710 HQ, GS-710 20F and 20G, are water and methanol. GSM-700 20F or 20G is recommended when other solvents are required.

* 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.

### Molecular weight range with pullulan (eluent : ultrapure water)




### Molecular weight range with PEG/PEO (eluent : DMF)




## Semi-micro columns

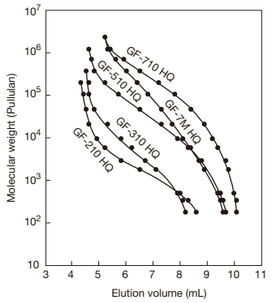
| Product Code | Product Name | Plate Number (TP/column) | Particle Size (μm) | Maximum Pore Size (Å) | Column Size (mm) I.D. x Length | Shipping Solvent |
|---|---|---|---|---|---|---|
| F7600100 | MSpak GF-310 4B | ≥ 3,000 | 5 | 400 | 4.6 × 50 | $H_2O$ |
| F7600110 | MSpak GF-310 4D | ≥ 10,000 | 5 | 400 | 4.6 × 150 | $H_2O$ |
| F7600024 | MSpak GF-310 4E | ≥ 16,000 | 5 | 400 | 4.6 × 250 | $H_2O$ |
| F7600120 | MSpak GF-310 2D | ≥ 5,500 | 5 | 400 | 2.0 × 150 | $H_2O$ |

Calibration Standards See page 51 for Calibration Standards

*Contact Shodex or our distributors near you for customized columns.

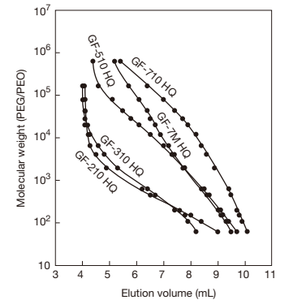


### Calibration curves for GF-HQ series using pullulan



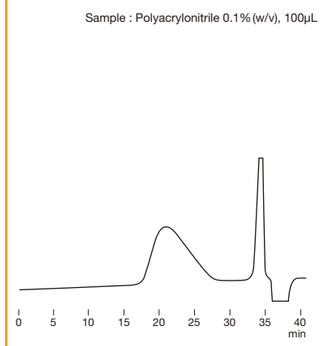

**Column** : Shodex Asahipak GF-HQ series
Eluent : $H_2O$
Flow rate : 0.6mL/min
Detector : RI
Column temp. : 30℃

### Calibration curves for GF-HQ series using PEG/PEO



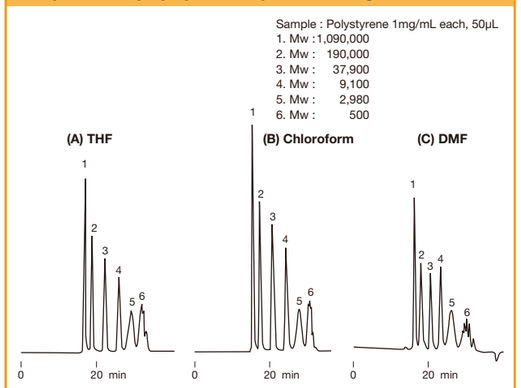

**Column** : Shodex Asahipak GF-HQ series
Eluent : DMF
Flow rate : 0.6mL/min
Detector : RI
Column temp. : 40℃

### Polyacrylonitrile



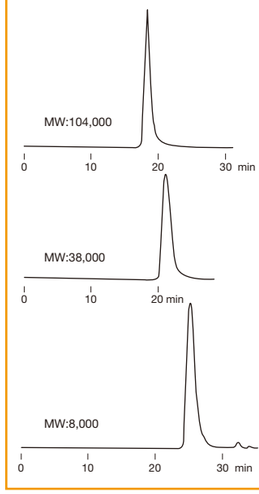

**Column** : Shodex Asahipak GF-710 HQ x 2
Eluent : 20mM LiBr in DMF
Flow rate : 0.6mL/min
Detector : RI
Column temp. : 40℃

### Comparison of polystyrenes separation using various solvents




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

### Sodium polystyrene sulfonates



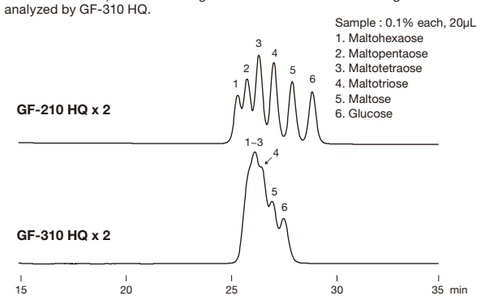

Polymers having both hydrophobic and hydrophilic functional groups may exhibit hydrophobic interactions with packing materials.
When analyzing such polymers, the hydrophobic interaction can be suppressed by adding organic solvents to the eluent.

Sample : 1mg/mL each, 50μL
Sodium polystylene sulfonate

**Column** : Shodex Asahipak GF-510 HQ
Eluent : 50mM LiCl aq./$CH_3CN$ =60/40
Flow rate : 0.6mL/min
Detector : UV(254nm)
Column temp. : 30℃

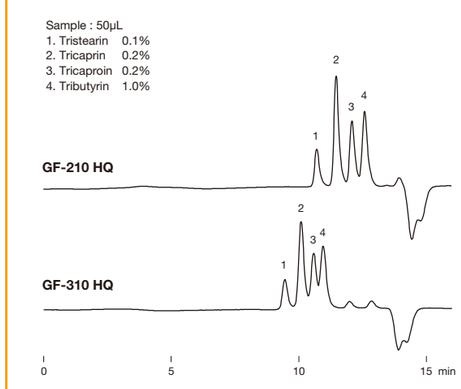
### Comparison of two GF columns for the separation performance of maltooligosaccharides

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




**Column** : Shodex Asahipak GF-210 HQ x 2, GF-310 HQ x 2
Eluent : $H_2O$
Flow rate : 0.6mL/min
Detector : RI
Column temp. : 50℃

### Comparison of two GF columns for the separation performance of triglycerides




**Column** : Shodex Asahipak GF-210 HQ, GF-310 HQ
Eluent : Chloroform
Flow rate : 0.6mL/min
Detector : RI
Column temp. : 50℃

# 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

Preparative Columns p.82, 83

## Standard columns

**KF-800 series : Shipping solvent Tetrahydrofuran (THF)**

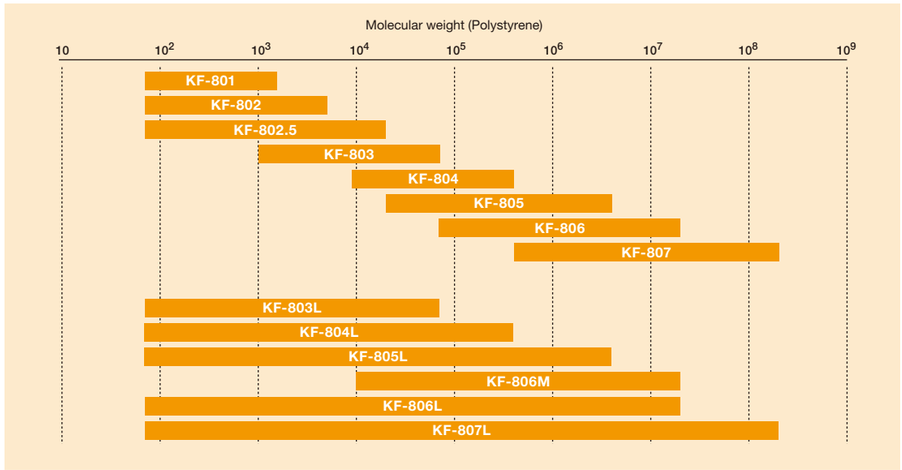
| Product Code | Product Name | Plate Number (TP/column) | Exclusion Limit (Polystyrene) | Particle Size (µm) | Maximum Pore Size (Å) | Column Size (mm) I.D. x Length |
|---|---|---|---|---|---|---|
| F6028010 | **GPC KF-801** | ≥ 18,000 | 1,500 | 6 | 50 | **8.0 × 300** |
| F6028020 | **GPC KF-802** | ≥ 18,000 | 5,000 | 6 | 150 | **8.0 × 300** |
| F6028025 | **GPC KF-802.5** | ≥ 18,000 | 20,000 | 6 | 300 | **8.0 × 300** |
| F6028030 | **GPC KF-803** | ≥ 18,000 | 70,000 | 6 | 500 | **8.0 × 300** |
| F6027030 | **GPC KF-803L** | ≥ 18,000 | 70,000 | 6 | 500 | **8.0 × 300** |
| F6028040 | **GPC KF-804** | ≥ 18,000 | 400,000 | 7 | 1,500 | **8.0 × 300** |
| F6027040 | **GPC KF-804L** | ≥ 18,000 | 400,000 | 7 | 1,500 | **8.0 × 300** |
| F6028050 | **GPC KF-805** | ≥ 11,000 | 4,000,000 | 10 | 5,000 | **8.0 × 300** |
| F6027050 | **GPC KF-805L** | ≥ 11,000 | 4,000,000 | 10 | 5,000 | **8.0 × 300** |
| F6028060 | **GPC KF-806** | ≥ 11,000 | (20,000,000)* | 10 | 10,000 | **8.0 × 300** |
| F6028090 | **GPC KF-806M** | ≥ 13,000 | (20,000,000)* | 10 | 10,000 | **8.0 × 300** |
| F6027060 | **GPC KF-806L** | ≥ 11,000 | (20,000,000)* | 10 | 10,000 | **8.0 × 300** |
| F6028070 | **GPC KF-807** | ≥ 6,000 | (200,000,000)* | 18 | 20,000 | **8.0 × 300** |
| F6027070 | **GPC KF-807L** | ≥ 6,000 | (200,000,000)* | 18 | 20,000 | **8.0 × 300** |
| F6700300 | **GPC KF-G** | (guard column) | – | 8 | – | **4.6 × 10** |
| F6709350 | **GPC KF-800D** | (solvent-peak separation column) | – | 10 | – | **8.0 × 100** |

* See page 40 for details of the solvent-peak separation columns. 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
( )* Estimated value

* See page 50 for applicability of SEC (GPC) columns to solvent replacement.

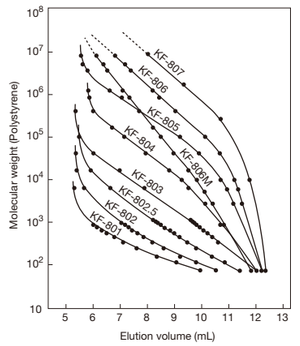
## Molecular weight range with polystyrene (eluent : THF)




Calibration Standards See page 51 for Calibration Standards

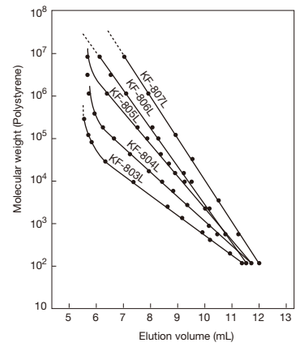
*Contact Shodex or our distributors near you for customized columns.

### Calibration curves for KF-800 series using polystyrene



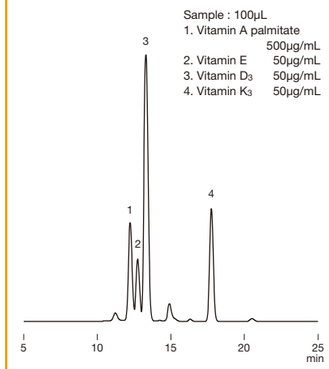

**Column : Shodex GPC KF-800 series**
Eluent : THF
Flow rate : 1.0mL/min
Detector : RI
Column temp. : Room temp.

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



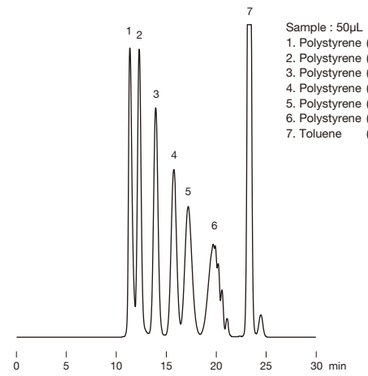

**Column : Shodex GPC KF-800L series**
Eluent : THF
Flow rate : 1.0mL/min
Detector : RI
Column temp. : Room temp.

### Fat-soluble vitamins

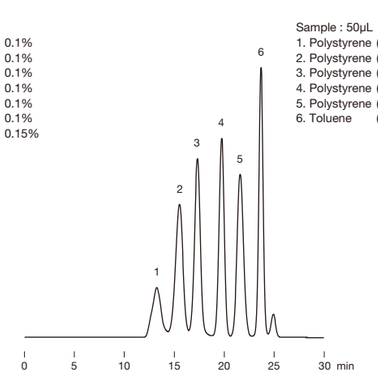



**Column : Shodex GPC KF-801 x 2**
Eluent : THF
Flow rate : 1.0mL/min
Detector : UV(280nm)
Column temp. : 40°C

### Standard polystyrenes

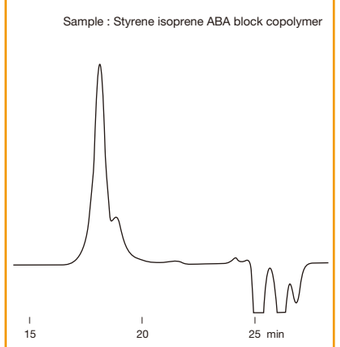



**Column : Shodex GPC KF-803L x 2**
Eluent : THF
Flow rate : 1.0mL/min
Detector : UV(254nm)
Column temp. : 40°C



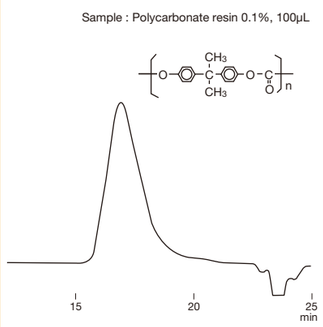

**Column : Shodex GPC KF-807L x 2**
Eluent : THF
Flow rate : 1.0mL/min
Detector : UV(254nm)
Column temp. : 40°C

### Styrene isoprene ABA block copolymer



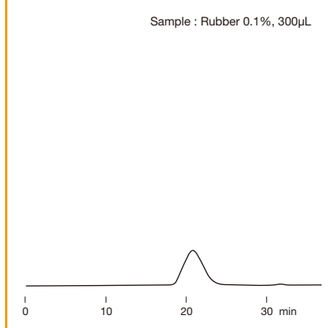

**Column : Shodex GPC KF-806M x 2**
Eluent : THF
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 30°C

### Polycarbonate resin




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

### Raw rubber




**Column : Shodex GPC KF-806M x 2 + KF-802**
Eluent : Toluene
Flow rate : 1.0mL/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

Preparative Columns p.83

## Standard columns

**K-800 series : Shipping solvent Chloroform**

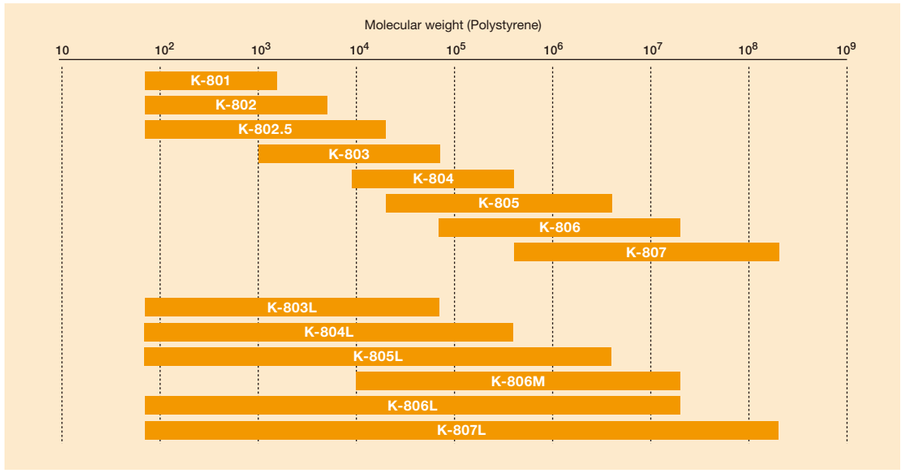
| Product Code | Product Name | Plate Number (TP/column) | Exclusion Limit (Polystyrene) | Particle Size (µm) | Maximum Pore Size (Å) | Column Size (mm) I.D. x Length |
|---|---|---|---|---|---|---|
| F6028110 | **GPC K-801** | ≥ 18,000 | 1,500 | 6 | 50 | **8.0 × 300** |
| F6028120 | **GPC K-802** | ≥ 18,000 | 5,000 | 6 | 150 | **8.0 × 300** |
| F6028125 | **GPC K-802.5** | ≥ 18,000 | 20,000 | 6 | 300 | **8.0 × 300** |
| F6028130 | **GPC K-803** | ≥ 18,000 | 70,000 | 6 | 500 | **8.0 × 300** |
| F6028194 | **GPC K-803L** | ≥ 18,000 | 70,000 | 6 | 500 | **8.0 × 300** |
| F6028140 | **GPC K-804** | ≥ 18,000 | 400,000 | 7 | 1,500 | **8.0 × 300** |
| F6028195 | **GPC K-804L** | ≥ 18,000 | 400,000 | 7 | 1,500 | **8.0 × 300** |
| F6028150 | **GPC K-805** | ≥ 11,000 | 4,000,000 | 10 | 5,000 | **8.0 × 300** |
| F6028196 | **GPC K-805L** | ≥ 11,000 | 4,000,000 | 10 | 5,000 | **8.0 × 300** |
| F6028160 | **GPC K-806** | ≥ 11,000 | (20,000,000)* | 10 | 10,000 | **8.0 × 300** |
| F6028190 | **GPC K-806M** | ≥ 13,000 | (20,000,000)* | 10 | 10,000 | **8.0 × 300** |
| F6028197 | **GPC K-806L** | ≥ 11,000 | (20,000,000)* | 10 | 10,000 | **8.0 × 300** |
| F6028170 | **GPC K-807** | ≥ 6,000 | (200,000,000)* | 18 | 20,000 | **8.0 × 300** |
| F6028198 | **GPC K-807L** | ≥ 6,000 | (200,000,000)* | 18 | 20,000 | **8.0 × 300** |
| F6700401 | **GPC K-G** | (guard column) | – | 8 | – | **4.6 × 10** |
| F6709450 | **GPC K-800D** | (solvent-peak separation column) | – | 10 | – | **8.0 × 100** |

* See page 40 for details of the solvent-peak separation columns. 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
( )* Estimated value

* See page 50 for applicability of SEC (GPC) columns to solvent replacement.

## Molecular weight range with polystyrene (eluent : chloroform)

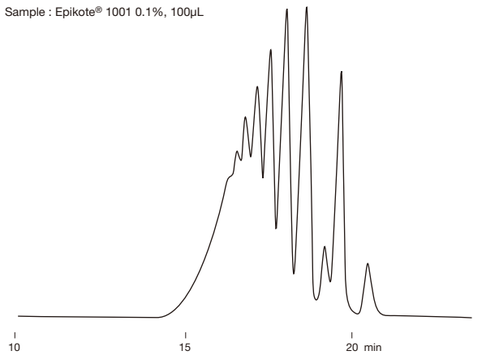



Calibration Standards See page 51 for Calibration Standards

*Contact Shodex or our distributors near you for customized columns.

### Epoxy resin

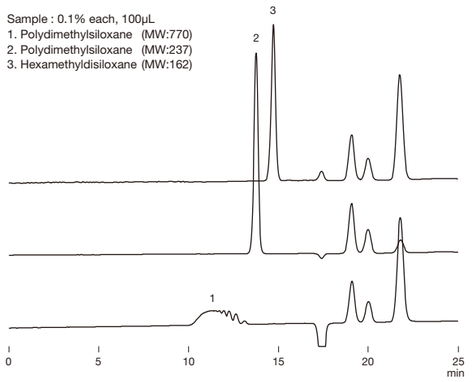
Sample : Epikote® 1001 0.1%, 100µL




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

### Low molecular polydimethylsiloxanes

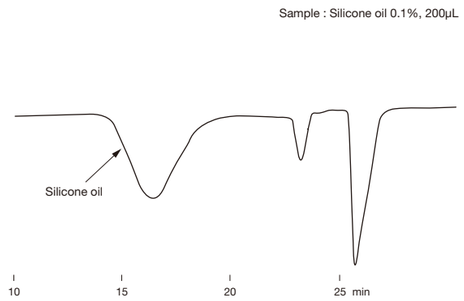
Sample : 0.1% each, 100µL
1. Polydimethylsiloxane (MW:770)
2. Polydimethylsiloxane (MW:237)
3. Hexamethyldisiloxane (MW:162)




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

### Silicon oil

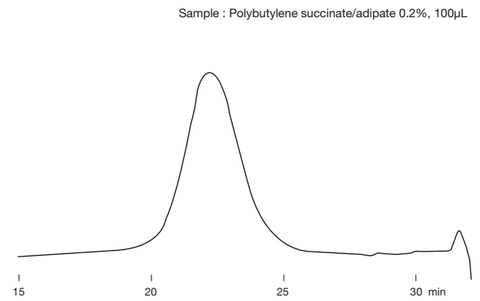
Sample : Silicone oil 0.1%, 200µL




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

### Bionolle™ (Polybutylene succinate/adipate)

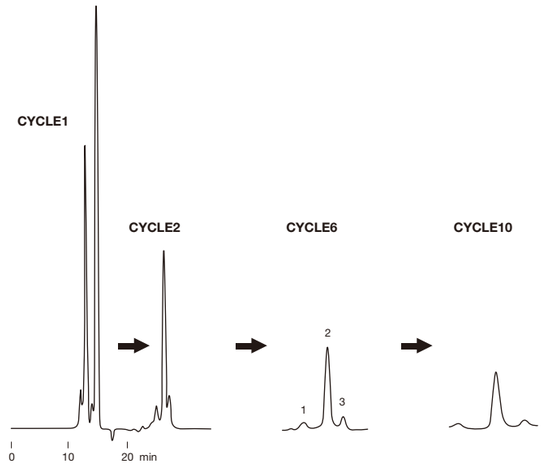
Sample : Polybutylene succinate/adipate 0.2%, 100µL




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

### Recycling fractionation of lauryl stearyl thiodipropionate

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




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

* See page 83 for K-2001

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

## Features

**KD-800**

- Standard organic solvent SEC (GPC) column
- Supports a wide range of applications from low to high molecular weight compounds

### Standard columns

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

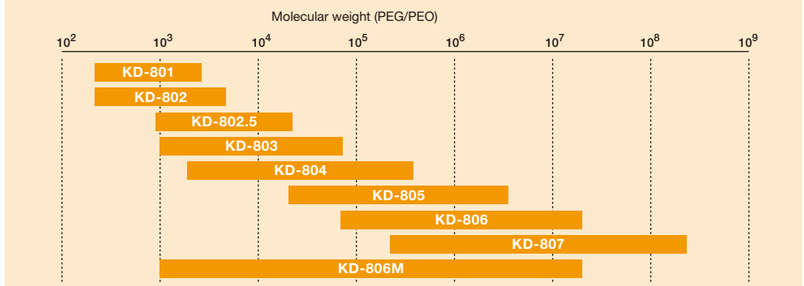
| Product Code | Product Name | Plate Number (TP/column) | Exclusion Limit (PEG/PEO)* | Particle Size (μm) | Maximum Pore Size (Å) | Column Size (mm) I.D. x Length |
|---|---|---|---|---|---|---|
| F6028210 | **GPC KD-801** | ≥ 17,000 | 2,500 | 6 | 50 | **8.0 × 300** |
| F6028220 | **GPC KD-802** | ≥ 17,000 | 5,000 | 6 | 150 | **8.0 × 300** |
| F6028225 | **GPC KD-802.5** | ≥ 17,000 | 20,000 | 6 | 300 | **8.0 × 300** |
| F6028230 | **GPC KD-803** | ≥ 17,000 | 70,000 | 6 | 500 | **8.0 × 300** |
| F6028240 | **GPC KD-804** | ≥ 17,000 | 400,000 | 7 | 1,500 | **8.0 × 300** |
| F6028250 | **GPC KD-805** | ≥ 11,000 | 4,000,000 | 10 | 5,000 | **8.0 × 300** |
| F6028260 | **GPC KD-806** | ≥ 11,000 | (20,000,000)** | 10 | 10,000 | **8.0 × 300** |
| F6028290 | **GPC KD-806M** | ≥ 13,000 | (20,000,000)** | 10 | 10,000 | **8.0 × 300** |
| F6028270 | **GPC KD-807** | ≥ 6,000 | (200,000,000)** | 18 | 20,000 | **8.0 × 300** |
| F6700411 | **GPC KD-G** | (guard column) | – | 8 | – | **4.6 × 10** |

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

* See page 50 for applicability of SEC (GPC) columns to solvent replacement.

Base Material : Styrene divinylbenzene copolymer
*PEG : polyethylene glycol
*PEO : polyethylene oxide
( )** Estimated value

### Molecular weight range with PEG/PEO (eluent : DMF)




# Solvent-peak Separation Columns for Organic SEC (GPC)

## Features

**KF-800D, K-800D**

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

### Solvent-peak separation columns

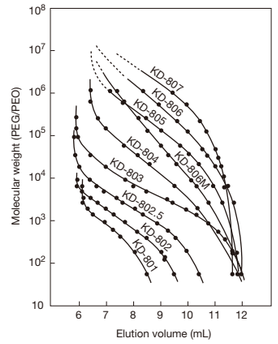
| Product Code | Product Name | Column Combination | Particle Size (μm) | Column Size (mm) I.D. x Length | Shipping Solvent |
|---|---|---|---|---|---|
| F6709350 | **GPC KF-800D** | KF-805L, 806L, 806M, 807L | 10 | **8.0 × 100** | THF |
| F6709450 | **GPC K-800D** | K-805L, 806L, 806M, 807L | 10 | **8.0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

Base Material : Styrene divinylbenzene copolymer

*Contact Shodex or our distributors near you for customized columns.

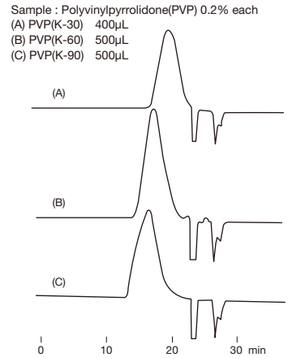


### Calibration curves for KD-800 series using PEG/PEO



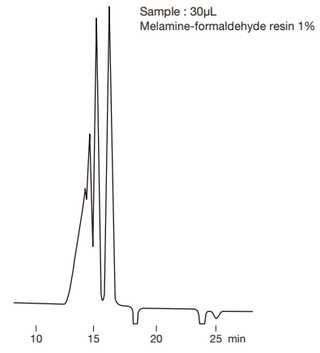

**Column : Shodex GPC KD-800 series**
Eluent : DMF
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 50℃

### Polyvinylpyrrolidones



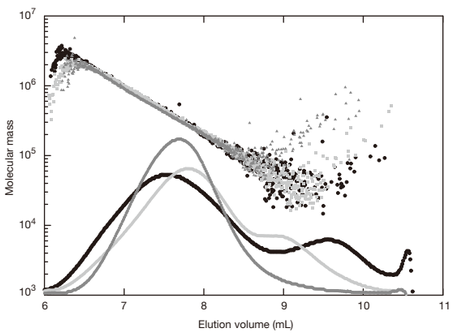

**Column : Shodex GPC KD-806M x 2**
Eluent : 10mM LiBr in DMF
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 50℃

### Melamine formaldehyde resin




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

### Celluloses




Sample : Cellulose ca. 0.05% each 100μL

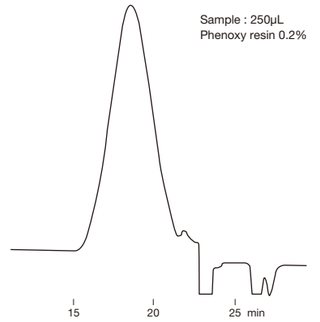
Cellulose is known to be difficult to dissolve. A cellulose solution is prepared by repeating solvent replacement. It is reported that the long time required for dissolution (1 to 60 days), depends on solvent type, the crystallinity and molecular weight of the sample.

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

* DMI 1,3-dimethyl-2-imidazolidinone

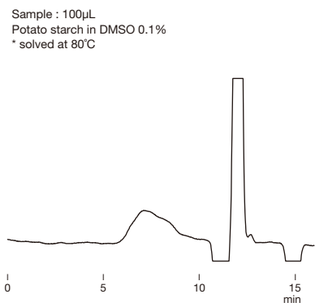
Data provided by Dr. Masahiko Yanagisawa,
Isogai group,
Graduate School of Agricultural and Life Sciences,
The University of Tokyo

### Phenoxy resin



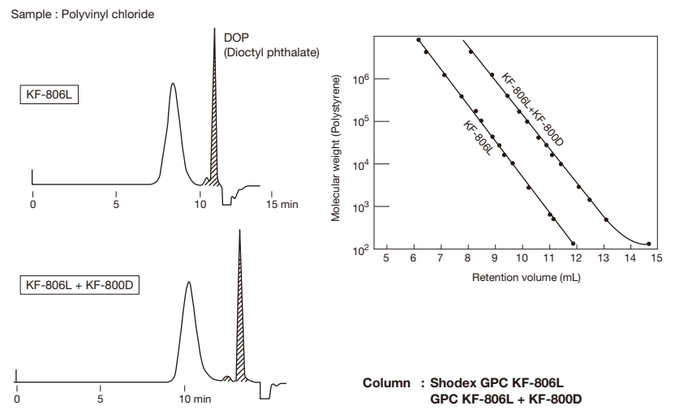

**Column : Shodex GPC KD-806M x 2**
Eluent : 10mM LiBr in DMF
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 50℃

### Potato starch




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

### Effects of solvent-peak separation column




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

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

## Features

**KF-600**

- Approximately half of the analysis time compared with standard columns
- The amount of solvent used is reduced to about a third
- Improved applicability of solvent replacement

**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

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## Rapid analysis downsized columns

**KF-600 series**

◎ Use of the KF-600 series with semi-micro type devices is recommended.

| Product Code | Product Name | Plate Number (TP/column) | Exclusion Limit (Polystyrene) | Particle Size (μm) | Maximum Pore Size (Å) | Column Size (mm) I.D. x Length |
|---|---|---|---|---|---|---|
| F6028091 | GPC KF-601 | ≥ 17,000 | 1,500 | 3 | 50 | 6.0 × 150 |
| F6028092 | GPC KF-602 | ≥ 17,000 | 5,000 | 3 | 150 | 6.0 × 150 |
| F6028093 | GPC KF-602.5 | ≥ 17,000 | 20,000 | 3 | 300 | 6.0 × 150 |
| F6028094 | GPC KF-603 | ≥ 17,000 | 70,000 | 3 | 500 | 6.0 × 150 |
| F6028095 | GPC KF-604 | ≥ 16,000 | 400,000 | 3 | 1,500 | 6.0 × 150 |
| F6028096 | GPC KF-605 | ≥ 7,000 | 4,000,000 | 10 | 5,000 | 6.0 × 150 |
| F6028097 | GPC KF-606 | ≥ 7,000 | (20,000,000)* | 10 | 10,000 | 6.0 × 150 |
| F6028098 | GPC KF-606M | ≥ 8,000 | (20,000,000)* | 10 | 10,000 | 6.0 × 150 |
| F6028099 | GPC KF-607 | ≥ 5,000 | (200,000,000)* | 18 | 20,000 | 6.0 × 150 |
| F6700300 | GPC KF-G | (guard column) | – | 8 | – | 4.6 × 10 |

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

* See page 50 for applicability of SEC (GPC) columns to solvent replacement.

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

## High performance semi-micro columns

**KF-400HQ series**

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

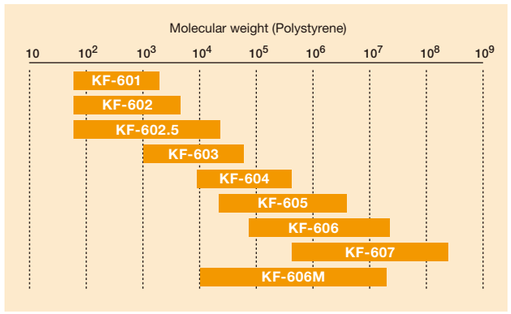
| Product Code | Product Name | Plate Number (TP/column) | Exclusion Limit (Polystyrene) | Particle Size (μm) | Maximum Pore Size (Å) | Column Size (mm) I.D. x Length |
|---|---|---|---|---|---|---|
| F6028111 | GPC KF-401HQ | ≥ 25,000 | 1,500 | 3 | 50 | 4.6 × 250 |
| F6028112 | GPC KF-402HQ | ≥ 25,000 | 5,000 | 3 | 150 | 4.6 × 250 |
| F6028114 | GPC KF-402.5HQ | ≥ 25,000 | 20,000 | 3 | 300 | 4.6 × 250 |
| F6028116 | GPC KF-403HQ | ≥ 25,000 | 70,000 | 3 | 500 | 4.6 × 250 |
| F6028118 | GPC KF-404HQ | ≥ 25,000 | 400,000 | 3 | 1,500 | 4.6 × 250 |
| F6028119 | GPC KF-405LHQ | ≥ 10,000 | 4,000,000 | 10 | 5,000 | 4.6 × 250 |
| F6028122 | GPC KF-406LHQ | ≥ 10,000 | (20,000,000)* | 10 | 10,000 | 4.6 × 250 |
| F6700300 | GPC KF-G | (guard column) | – | 8 | – | 4.6 × 10 |

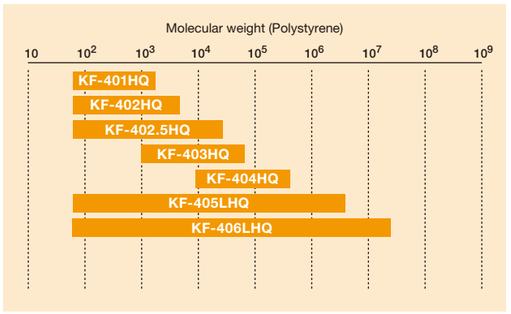
* The columns with 'L' at the end of column names are mixed-gel column capable of analyzing samples over a wide range of molecular weight distribution.

* See page 50 for applicability of SEC (GPC) columns to solvent replacement.

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

## Molecular weight range with polystyrene (eluent : THF)

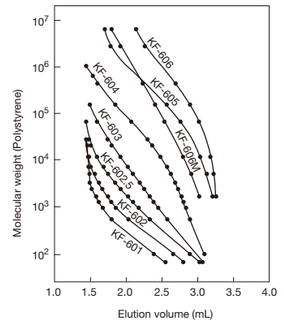



See page 51 for Calibration Standards

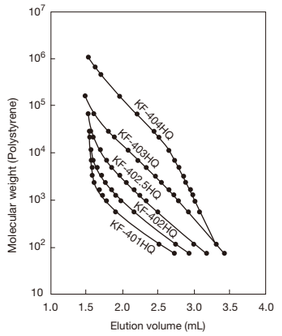
*Contact Shodex or our distributors near you for customized columns.

## Calibration curves for KF-600 series using polystyrene



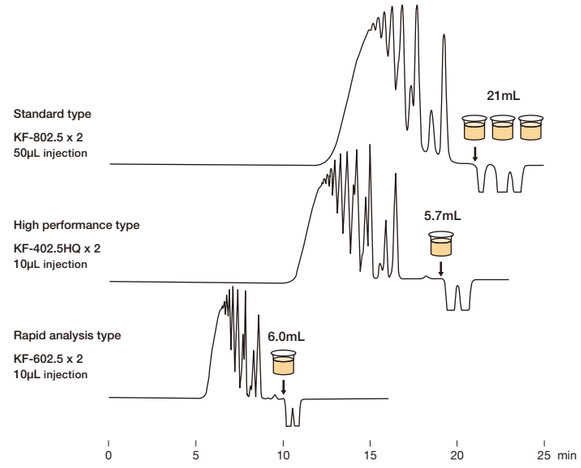

**Column : Shodex GPC KF-600 series**
Eluent : THF
Flow rate : 0.5mL/min
Detector : UV(254nm)
Column temp. : Room temp.

## Calibration curves for KF-400HQ series using polystyrene




**Column : Shodex GPC KF-400HQ series**
Eluent : THF
Flow rate : 0.3mL/min
Detector : UV(254nm)
Column temp. : Room temp.

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



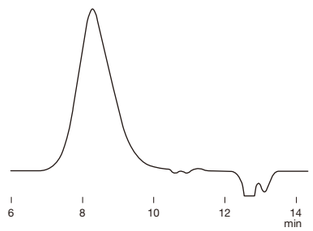

Sample : EPON1001 0.2%

By using KF-602.5, the analysis time is reduced to less than half of that of KF-802.5. Thus KF-600 series enables rapid analysis. On the other hand, KF-402.5HQ has a theoretical plate number 1.5 times larger than that of the standard column, thereby improving resolution especially in the analysis of molecules that have a small to medium molecular weight. 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**
**GPC KF-402.5HQ x 2**
**GPC KF-602.5 x 2**
Eluent : THF
Flow rate : (KF-802.5) 1.0mL/min
(KF-402.5HQ) 0.3mL/min
(KF-602.5) 0.6mL/min
Detector : (KF-802.5) RI(conventional type)
(KF-402.5HQ, KF-602.5) RI(small cell volume)
Column temp. : 40℃

## Styrene acrylonitrile copolymer

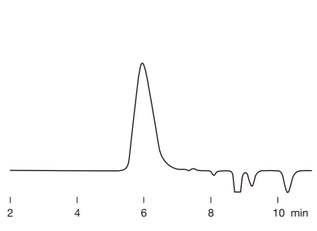
Sample : Styrene-acrylonitrile (30:70) copolymer




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

## Liquid paraffin

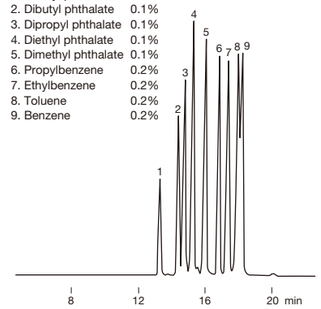
Sample : Liquid paraffin 1%, 5μL




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

## Phthalates

Sample : 10μL
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 : 0.3mL/min
Detector : UV(254nm) (small cell volume)
Column temp. : 40℃

# Organic SEC (GPC) Columns : Linear Calibration Type

## Features

**LF**

- Employs a special packing material with a wide pore size distribution (multi pore type)
- Highly linear calibration curve without inflection points
- Molecular weight distribution can be determined with high precision
- Enables analysis over a broad range of molecular weights (100 to 2,000,000)
- Column for rapid analysis (LF-604) and column for high performance analysis (LF-404) enabling reduction in solvent use are also available

Note book No.1 News No.4, 40

## Standard column

| Product Code | Product Name | Plate Number (TP/column) | Exclusion Limit (Polystyrene) | Particle Size (μm) | Maximum Pore Size (Å) | Column Size (mm) I.D.x Length |
|---|---|---|---|---|---|---|
| F6021041 | **GPC LF-804** | ≥ 17,000 | 2,000,000 | 6 | 3,000 | **8.0 × 300** |
| F6709621 | **GPC LF-G** | (guard column) | – | 6 | – | **4.6 × 10** |

* See page 50 for applicability of SEC (GPC) columns to solvent replacement.

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

## Rapid analysis downsized column

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

| Product Code | Product Name | Plate Number (TP/column) | Exclusion Limit (Polystyrene) | Particle Size (μm) | Maximum Pore Size (Å) | Column Size (mm) I.D.x Length |
|---|---|---|---|---|---|---|
| F6021042 | **GPC LF-604** | ≥ 9,000 | 2,000,000 | 6 | 3,000 | **6.0 × 150** |
| F6709621 | **GPC LF-G** | (guard column) | – | 6 | – | **4.6 × 10** |

* See page 50 for applicability of SEC (GPC) columns to solvent replacement.

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

## High performance semi-micro column

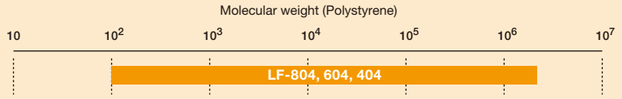
◎ Use of the LF-404 with semi-micro type devices is recommended.

| Product Code | Product Name | Plate Number (TP/column) | Exclusion Limit (Polystyrene) | Particle Size (μm) | Maximum Pore Size (Å) | Column Size (mm) I.D.x Length |
|---|---|---|---|---|---|---|
| F6021043 | **GPC LF-404** | ≥ 14,000 | 2,000,000 | 6 | 3,000 | **4.6 × 250** |
| F6709621 | **GPC LF-G** | (guard column) | – | 6 | – | **4.6 × 10** |

* See page 50 for applicability of SEC (GPC) columns to solvent replacement.

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

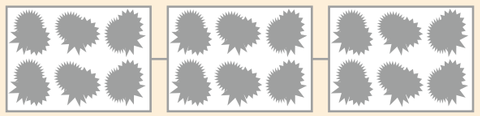
## Molecular weight range with polystyrene (eluent : THF)




Calibration Standards See page 51 for Calibration Standards

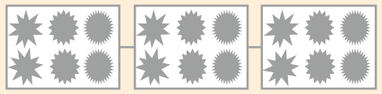
## Schematic diagram of linear calibration type packing

**Connecting linear calibration type columns (LF series)**

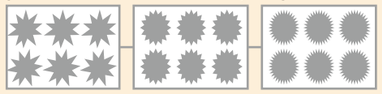


The linear calibration type column covers a broad range of molecular weights with only one kind of packing (column).

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

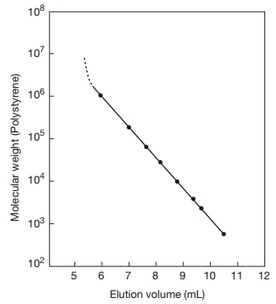


**Connecting different grades columns (KF-804 + KF-803 + KF-802, etc.)**



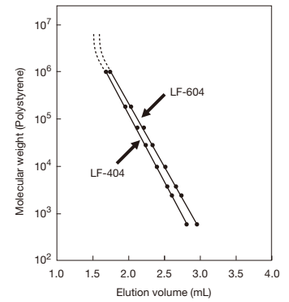
*Contact Shodex or our distributors near you for customized columns.

### Calibration curve for LF-804 using polystyrene




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

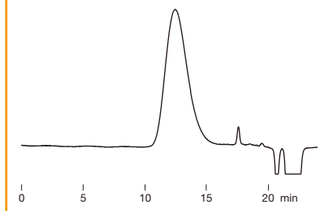
### Calibration curves for LF-604 and LF-404 using polystyrene




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

### Polyurethane

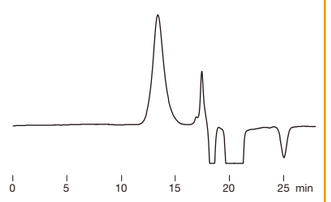
Sample : Polyurethane 0.1%, 20μL




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

### Xylan

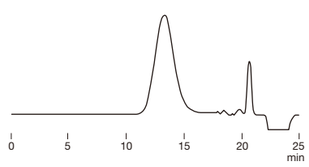
Sample : Xylan 0.1%, 100μL




**Column : Shodex GPC LF-804**
Eluent : 20mM $H_3PO_4$ + 20mM LiBr in (DMSO/DMF=80/20)
Flow rate : 0.6mL/min
Detector : RI
Column temp. : 50℃

### Polyamide (Nylon6/6)

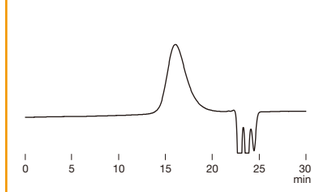
Sample : Nylon® 6/6 0.1%, 20μL




**Column : Shodex GPC LF-404**
Eluent : 5mM $CF_3COONa$ in HFIP
Flow rate : 0.15mL/min
Detector : RI(small cell volume)
Column temp. : 40℃

### Polymethyl methacrylate

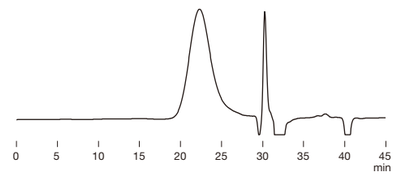
Sample : 100μL
Polymethyl methacrylate




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

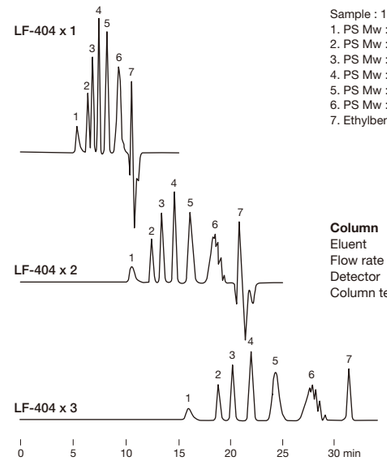
### Polyamic acid

Sample : Poly(pyromellitic dianhydride-co-4,4'-oxydianiline), 100μL




**Column : Shodex GPC LF-804 x 2**
Eluent : 30mM LiBr + 30mM $H_3PO_4$ in NMP
Flow rate : 0.7mL/min
Detector : RI
Column temp. : 50℃

### Comparison of polystyrenes separation with different numbers of LF-404




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

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

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

## Features

**HT-800**
- Varied product lineup to support a wide range of molecular weights

**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

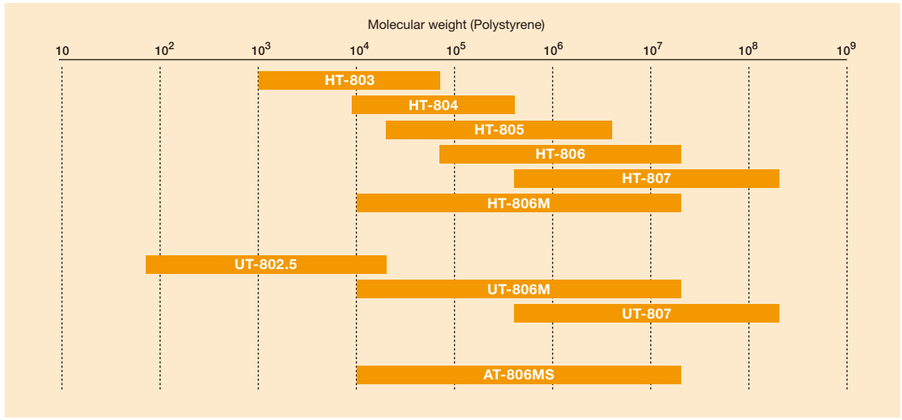
## Standard columns

| Product Code | Product Name | Plate Number (TP/column) | Exclusion Limit * (Polystyrene) | Usable Temperature (˚C) | Particle Size (µm) | Maximum Pore Size (Å) | Column Size (mm) I.D.x Length |
|---|---|---|---|---|---|---|---|
| F6208700 | **GPC HT-803** | ≥ 7,000 | 70,000 | 100–150 | 13 | 500 | **8.0 × 300** |
| F6208710 | **GPC HT-804** | ≥ 7,000 | 400,000 | 100–150 | 13 | 1,500 | **8.0 × 300** |
| F6208720 | **GPC HT-805** | ≥ 7,000 | 4,000,000 | 100–150 | 13 | 5,000 | **8.0 × 300** |
| F6208730 | **GPC HT-806** | ≥ 7,000 | (20,000,000)** | 100–150 | 13 | 10,000 | **8.0 × 300** |
| F6208740 | **GPC HT-806M** | ≥ 7,000 | (20,000,000)** | 100–150 | 13 | 10,000 | **8.0 × 300** |
| F6208770 | **GPC HT-807** | ≥ 4,000 | (200,000,000)** | 100–150 | 18 | 20,000 | **8.0 × 300** |
| F6709410 | **GPC HT-G** | (guard column) | – | 100–150 | 13 | – | **8.0 × 50** |
| F6208600 | **GPC UT-802.5** | ≥ 4,400 | 20,000 | 100–210 | 30 | 300 | **8.0 × 300** |
| F6208610 | **GPC UT-806M** | ≥ 4,400 | (20,000,000)** | 100–210 | 30 | 10,000 | **8.0 × 300** |
| F6208620 | **GPC UT-807** | ≥ 3,300 | (200,000,000)** | 100–210 | 30 | 20,000 | **8.0 × 300** |
| F6709400 | **GPC UT-G** | (guard column) | – | 100–210 | 30 | – | **8.0 × 50** |
| F6208390 | **GPC AT-806MS** | ≥ 6,000 | (20,000,000)** | Ta*** –150 | 12 | 10,000 | **8.0 × 250** |
| F6700280 | **GPC AT-G** | (guard column) | – | Ta*** –150 | 15 | – | **8.0 × 50** |

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

Base Material : Styrene divinylbenzene copolymer
Shipping Solvent : Toluene
*Exclusion limit was measured with THF
( )** Estimated value
Ta*** : Ambient temperature

## Molecular weight range with polystyrene (eluent : THF)

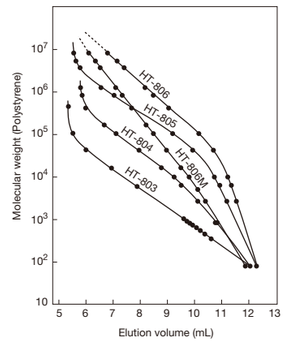



See page 51 for Calibration Standards

*Contact Shodex or our distributors near you for customized columns.



### Calibration curves for HT-800 series using polystyrene

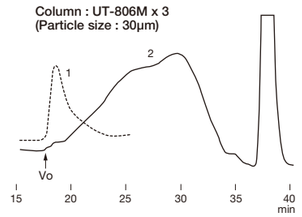



**Column** : **Shodex GPC HT-800 series**
Eluent : THF
Flow rate : 1.0mL/min
Detector : RI
Column temp. : Room temp.

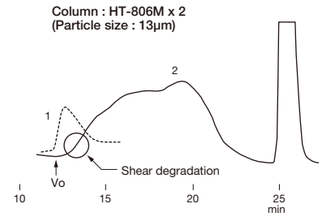
### Effects of gel particle size in high temperature GPC columns

High temperature SEC 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. GPC UT-800 series, which are packed with large particle size (30 um) gel, are recommended for the analysis of macromolecules. The large particle size prevents potential molecular shear degradation of the sample.

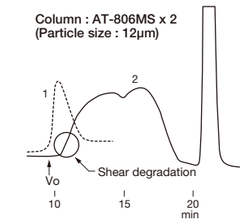
**Column : UT-806M x 3 (Particle size : 30µm)**




**Column : HT-806M x 2 (Particle size : 13µm)**




**Column : AT-806MS x 2 (Particle size : 12µm)**

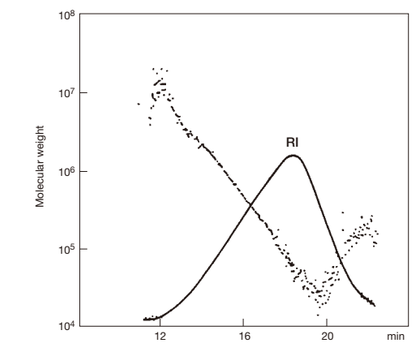



Sample :
1. Polystyrene (MW : 20,000,000)
2. High density polyethylene (HDPE-A)

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

### High density polyethylene

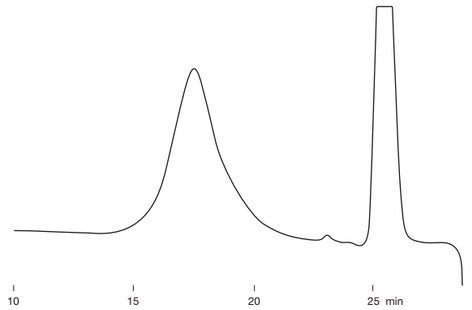
Sample : High density polyethylene (HDPE-B)




**Column** : **Shodex GPC UT-806M x 2**
Eluent : 0.1% BHT in o-Dichlorobenzene
Flow rate : 1.0mL/min
Detector : RI, MALS(Multi angle laser 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 o-Dichlorobenzene
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 140˚C

# Organic SEC (GPC) Columns : HFIP

## Features

**HFIP-800** ● Columns exclusively for use with hexafluoroisopropanol (HFIP)

**HFIP-600** ● Rapid analysis, solvent saving type

## ● Standard columns

### HFIP-800 series

| Product Code | Product Name | Plate Number (TP/column) | Exclusion Limit (PMMA)* | Particle Size (μm) | Maximum Pore Size (Å) | Column Size (mm) I.D. x Length |
|---|---|---|---|---|---|---|
| F6028530 | **GPC HFIP-803** | ≥ 12,000 | 30,000 | 10 | 500 | **8.0 × 300** |
| F6028540 | **GPC HFIP-804** | ≥ 12,000 | 100,000 | 7 | 1,500 | **8.0 × 300** |
| F6028550 | **GPC HFIP-805** | ≥ 10,000 | 1,000,000 | 10 | 5,000 | **8.0 × 300** |
| F6028560 | **GPC HFIP-806** | ≥ 10,000 | (10,000,000)** | 10 | 10,000 | **8.0 × 300** |
| F6028590 | **GPC HFIP-806M** | ≥ 10,000 | (10,000,000)** | 10 | 10,000 | **8.0 × 300** |
| F6028570 | **GPC HFIP-807** | ≥ 4,000 | (100,000,000)** | 18 | 20,000 | **8.0 × 300** |
| F6700500 | **GPC HFIP-LG** | (guard column) | – | 15 | – | **8.0 × 50** |

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

Base Material : Styrene divinylbenzene copolymer
Shipping Solvent : Hexafluoroisopropanol (HFIP)
*PMMA : Polymethylmethacrylate
( )** Estimated value

## ● Rapid analysis downsized columns

### HFIP-600 series

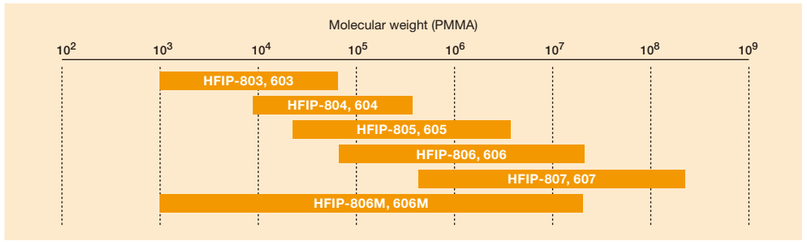
◎Use of the HFIP-600 series with semi-micro type devices is recommended.

| Product Code | Product Name | Plate Number (TP/column) | Exclusion Limit (PMMA)* | Particle Size (μm) | Maximum Pore Size (Å) | Column Size (mm) I.D. x Length |
|---|---|---|---|---|---|---|
| F6021030 | **GPC HFIP-603** | ≥ 12,000 | 30,000 | 3 | 500 | **6.0 × 150** |
| F6021040 | **GPC HFIP-604** | ≥ 12,000 | 100,000 | 3 | 1,500 | **6.0 × 150** |
| F6021050 | **GPC HFIP-605** | ≥ 5,000 | 1,000,000 | 10 | 5,000 | **6.0 × 150** |
| F6021060 | **GPC HFIP-606** | ≥ 5,000 | (10,000,000)** | 10 | 10,000 | **6.0 × 150** |
| F6021080 | **GPC HFIP-606M** | ≥ 6,000 | (10,000,000)** | 10 | 10,000 | **6.0 × 150** |
| F6021070 | **GPC HFIP-607** | ≥ 3,000 | (100,000,000)** | 18 | 20,000 | **6.0 × 150** |
| F6700511 | **GPC HFIP-G** | (guard column) | – | 8 | – | **4.6 × 10** |

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

Base Material : Styrene divinylbenzene copolymer
Shipping Solvent : Hexafluoroisopropanol (HFIP)
*PMMA : Polymethylmethacrylate
( )** Estimated value

## Molecular weight range with PMMA (eluent : HFIP)

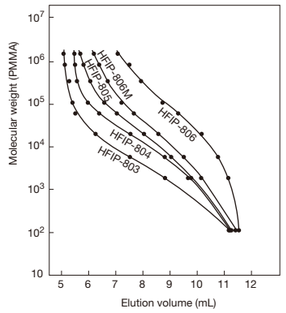



Calibration Standards See page 51 for Calibration Standards

*Contact Shodex or our distributors near you for customized columns.

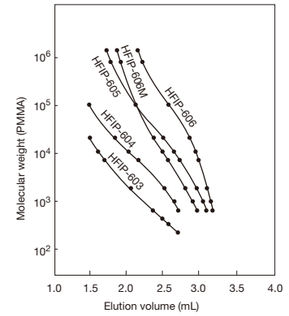


### Calibration curves for HFIP-800 series using PMMA




**Column : Shodex GPC HFIP-800 series**
Eluent : HFIP
Flow rate : 1.0mL/min
Detector : RI
Column temp. : Room temp.

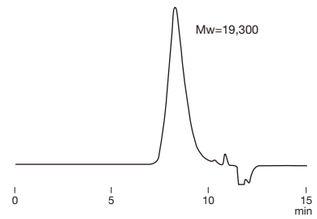
### Calibration curves for HFIP-600 series using PMMA




**Column : Shodex GPC HFIP-600 series**
Eluent : 5mM $CF_3COONa$ in HFIP
Detector : RI(small cell volume)
Column temp. : 40℃

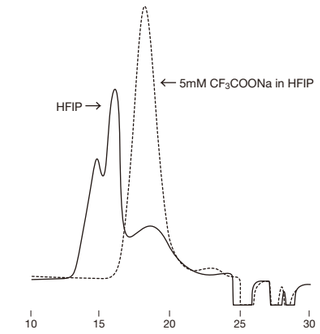
### Polyethylene terephthalate (PET)

Sample : PET 0.2%, 20μL




**Column : Shodex GPC HFIP-606M x 2**
Eluent : 5mM $CF_3COONa$ in HFIP
Flow rate : 0.6mL/min
Detector : RI(small cell volume)
Column temp. : 40℃

### Polyamide (effects of salt addition)



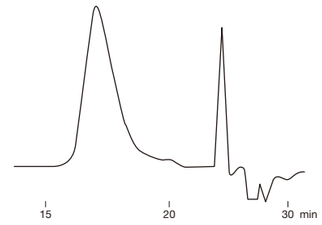

Sample : Polycaprolactum (Nylon® 6)

In SEC analysis using HFIP, some samples may yield abnormal peaks as a result of ionic interaction. In this case, ionic interaction can be suppressed by adding sodium trifluoroacetate to HFIP.

**Column : Shodex GPC HFIP-806M x 2**
Eluent : HFIP(solid line), 5mM $CF_3COONa$ in HFIP(broken line)
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 40℃

### Polybutylene terephthalate (PBT)

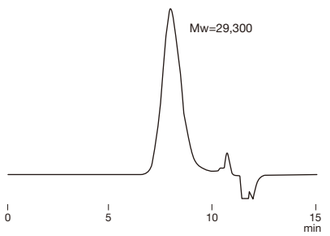
Sample : PBT 0.05%, 500μL



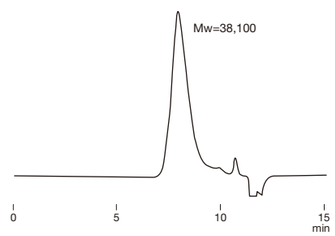

**Column : Shodex GPC HFIP-805 + HFIP-803**
Eluent : 5mM $CF_3COONa$ in HFIP
Flow rate : 1.0mL/min
Detector : RI
Column temp. : 40℃

### Polyamides (Nylon 6/10 and Nylon 6)

Sample : Nylon® 6/10 0.2%, 20μL



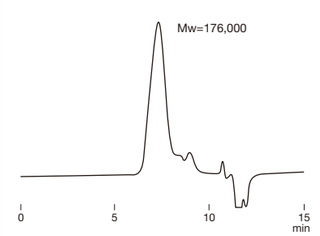

Sample : Nylon® 6 0.2%, 20μL




**Column : Shodex GPC HFIP-606M x 2**
Eluent : 5mM $CF_3COONa$ in HFIP
Flow rate : 0.6mL/min
Detector : RI(small cell volume)
Column temp. : 40℃

### Polyacetal

Sample : Polyacetal 0.2%, 20μL




**Column : Shodex GPC HFIP-606M x 2**
Eluent : 5mM $CF_3COONa$ in HFIP
Flow rate : 0.6mL/min
Detector : RI(small cell volume)
Column temp. : 40℃

# Applicability of SEC (GPC) Columns to Solvent Replacement

| Solvent | Product Name | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Shipping Solvent : THF | | | | | | | Shipping Solvent : DMF | | |
| | KF-801 | KF-802<br>KF-802.5<br>KF-803L<br>KF-804L | KF-803 | KF-804<br>KF-805<br>KF-806<br>KF-807<br>KF-806M<br>KF-805L<br>KF-806L<br>KF-807L | KF-601<br>KF-602<br>KF-602.5 | KF-603<br>KF-604<br>KF-605<br>KF-606<br>KF-607<br>KF-606M | LF-804<br>LF-604<br>LF-404 | KD-801<br>KD-802<br>KD-802.5 | KD-803 | KD-804<br>KD-805<br>KD-806<br>KD-807<br>KD-806M |
| | Shipping Solvent : Chloroform | | | | Shipping Solvent : THF | | | | | |
| | K-801 | K-802<br>K-802.5<br>K-803L<br>K-804L | K-803 | K-804<br>K-805<br>K-806<br>K-807<br>K-806M<br>K-805L<br>K-806L<br>K-807L | KF-401HQ<br>KF-402HQ<br>KF-402.5HQ | KF-403HQ<br>KF-404HQ<br>KF-405LHQ<br>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) | × | × | ○ | ○ | ○ *1 | ○ *1 | ○ *1 | ○ | ○ | ○ |
| Dimethylacetamide(DMAc) | × | × | ○ | ○ | ○ *1 | ○ *1 | ○ *1 | × | ○ | ○ |
| Hexafluoroisopropanol(HFIP) | × | × | × | ○ | × | △ *1 | ○ *1 | × | ○ | ○ |
| m-Cresol | × | × | ○ | ○ | | | | × | ○ | ○ |
| o-Chlorophenol | × | × | ○ | ○ | | | | × | ○ | ○ |
| Quinolin | × | × | ○ | ○ | | | | × | ○ | ○ |
| N-Methylpyrrolidone(NMP) | × | × | ○ | ○ | ○ *1 | ○ *1 | ○ *1 | × | ○ | ○ |
| Dimethylsulfoxide(DMSO) | × | × | × | △ | △ *1 | ○ *1 | ○ *1 | × | ○ | ○ |
| 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
*1 : Usable at 40℃ or higher
× : Solvent replacement not possible





# Calibration Standards for SEC

## [Polystyrene (PS)]

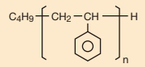
### Features

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

**Kit type**

| Product Code | Product Name | Contents | MW Range |
|---|---|---|---|
| F8601105 | **STANDARD SL-105** | 0.5g x 10 kinds | 580 - 21,800 |
| F8602105 | **STANDARD SM-105** | 0.5g x 10 kinds | 1,270 - 2,700,000 |
| F8603075 | **STANDARD SH-75** | 0.5g x 7 kinds | 591,000 - 6,870,000 |

Structural formula of S series



■ **SL-105**

| Std. No. | Mp | Mw/Mn |
|---|---|---|
| S-22 | 21,800 | 1.02 |
| S-13 | 13,000 | 1.02 |
| S-10 | 10,400 | 1.03 |
| S-6.9 | 6,940 | 1.03 |
| S-4.9 | 4,910 | 1.03 |
| S-2.9 | 2,940 | 1.04 |
| S-2.2 | 2,170 | 1.04 |
| S-1.3 | 1,280 | 1.07 |
| S-0.7 | 770 | 1.08 |
| S-0.5 | 580 | 1.12 |

■ **SM-105**

| Std. No. | Mp | Mw/Mn |
|---|---|---|
| S-2704 | 2,700,000 | 1.04 |
| S-1345 | 1,350,000 | 1.03 |
| S-609 | 609,000 | 1.02 |
| S-333 | 333,000 | 1.03 |
| S-139 | 139,000 | 1.03 |
| S-53 | 52,500 | 1.03 |
| S-22 | 21,800 | 1.02 |
| S-6.9 | 6,940 | 1.03 |
| S-3.2 | 3,180 | 1.04 |
| S-1.3 | 1,270 | 1.06 |

■ **SH-75**

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

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

## [Polymethylmethacrylate (PMMA)]

### Features

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

**Kit type**

| Product Code | Product Name | Contents | MW Range |
|---|---|---|---|
| F8604075 | **STANDARD M-75** | 0.5g x 7 kinds | 2,890 - 955,000 |

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

| Std. No. | Mp | Mw/Mn |
|---|---|---|
| M-955 | 955,000 | 1.05 |
| M-509 | 509,000 | 1.03 |
| M-202 | 202,000 | 1.02 |
| M-63 | 63,000 | 1.02 |
| M-20 | 20,300 | 1.03 |
| M-6.8 | 6,830 | 1.10 |
| M-2.9 | 2,890 | 1.10 |

## [Pullulan]

### Features

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

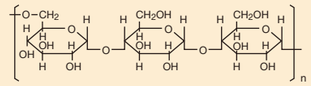
**Kit type**

| Product Code | Product Name | Contents | MW Range |
|---|---|---|---|
| F8400000 | **STANDARD P-82** | 0.2g x 8 kinds | 5,900 - 708,000 |

**Single type**

| Product Code | Product Name | Contents | Mp | Mw/Mn |
|---|---|---|---|---|
| F8402500 | **STD P-2500** | 0.2g | 2,350,000 | 1.49 |
| F8401300 | **STD P-1300** | 0.2g | 1,220,000 | 1.37 |
| F8400800 | **STD P-800** | 0.5g | 708,000 | 1.27 |
| F8400400 | **STD P-400** | 0.5g | 344,000 | 1.15 |
| F8400200 | **STD P-200** | 0.5g | 200,000 | 1.11 |
| F8400100 | **STD P-100** | 0.5g | 107,000 | 1.13 |
| F8400050 | **STD P-50** | 0.5g | 47,100 | 1.07 |
| F8400020 | **STD P-20** | 0.5g | 21,100 | 1.09 |
| F8400010 | **STD P-10** | 0.5g | 9,600 | 1.09 |
| F8400005 | **STD P-5** | 0.5g | 5,900 | 1.09 |
| F8400003 | **STD P-3** | 0.2g | 2,890 | 1.12 |
| F8400002 | **STD P-2** | 0.2g | 2,150 | 1.11 |
| F8400001 | **STD P-1** | 0.2g | 1,420 | 1.18 |

Structural formula of P series



| Std. No. | Mp | Mw/Mn |
|---|---|---|
| P-800 | 708,000 | 1.27 |
| P-400 | 344,000 | 1.15 |
| P-200 | 200,000 | 1.11 |
| P-100 | 107,000 | 1.13 |
| P-50 | 47,100 | 1.07 |
| P-20 | 21,100 | 1.09 |
| P-10 | 9,600 | 1.09 |
| P-5 | 5,900 | 1.09 |

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

# Columns for Anion Exchange Chromatography

## Features

**QA-825, DEAE-825**
- Suitable for the analysis of relatively high molecular weight compounds, such as proteins, peptides, DNA, and RNA
- Usable under wide pH range between 2 and 12

Note book No.7 Semi-micro Micro Columns p.77 Preparative Columns p.80

**DEAE3N-4T**
- Non-porous base material
- For rapid analysis

Note book No.6 News No.33

**DEAE-2B**
- Non-porous base material
- Supports UHPLC (available under hyperbaric conditions up to 30 MPa)

News No.42

**ES-502N 7C**
- Compared to IEC series columns, polyvinyl alcohol is used as base material and this offers different separation pattern
- Low hydrophobic interaction of proteins allows analysis under mild conditions

Semi-micro Micro Columns p.77 Preparative Columns p.80

**WA-624**
- Suitable for anion exchange analysis of low molecular weight compounds such as nucleotides

## Standard columns

**Strong anion exchange resin (Functional Group : Quaternary ammonium)**

| Product Code | Product Name | Ion Exchange Capacity (meq/g) | Base Material | Particle Size (μm) | Pore Size (Å) | Column Size (mm) I.D. x Length | Shipping Solvent |
|---|---|---|---|---|---|---|---|
| F6110011 | **IEC QA-825** | 0.45 | Polyhydroxymethacrylate | 12 | 5,000 | **8.0 × 75** | 50mM $Na_2SO_4$ aq. |

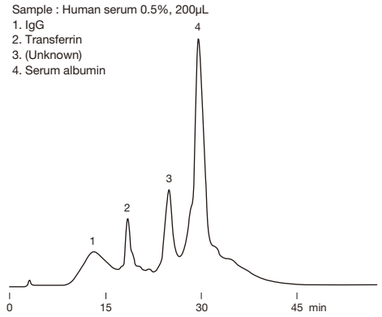
**Weak anion exchange resin (Functional Group : Diethylaminoethyl)**

| Product Code | Product Name | Ion Exchange Capacity (meq/g) | Base Material | Particle Size (μm) | Pore Size (Å) | Column Size (mm) I.D. x Length | Shipping Solvent |
|---|---|---|---|---|---|---|---|
| F6118255 | **IEC DEAE-825** | 0.6 | Polyhydroxymethacrylate | 8 | 5,000 | **8.0 × 75** | 50mM $Na_2SO_4$ aq. |
| F6112100 | **IEC DEAE3N-4T** | 0.4 | Polyhydroxymethacrylate | 2.5 | – | **4.6 × 35** | $H_2O$ |
| F6112110 | **PIKESS DEAE-2B** | 0.4 | Polyhydroxymethacrylate | 2.5 | – | **2.0 × 50** | $H_2O$ |
| F7640002 | **Asahipak ES-502N 7C** | 0.55 | Polyvinyl alcohol | 9 | 2,000 | **7.5 × 100** | 50mM 1,3-Diaminopropane + 50mM NaCl(pH10.0) |
| F6356240 | **AXpak WA-624** | 1.2 | Polyhydroxymethacrylate | 10 | 2,000 | **6.0 × 150** | 0.1M Sodium phosphate buffer (pH3.0)/$CH_3CN$=80/20 |
| F6700245 | **AXpak WA-G** | (guard column) | Polyhydroxymethacrylate | 10 | – | **4.6 × 10** | 0.1M Sodium phosphate buffer (pH3.0)/$CH_3CN$=80/20 |

*Contact Shodex or our distributors near you for customized columns.

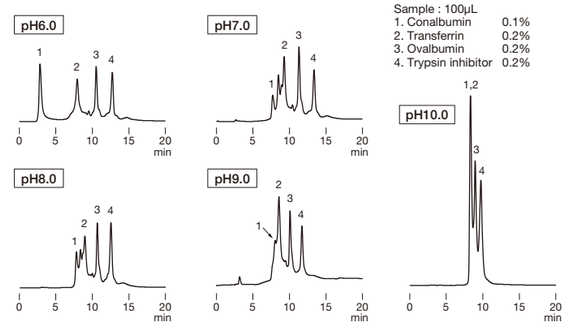


### Proteins in human serum




**Column** : **Shodex IEC QA-825**
Eluent : (A); 20mM Tris-HCl buffer(pH8.6)
(B); (A) + 0.5M NaCl
Linear gradient; 100% (A) to 50% (B), 60min
Flow rate : 1.0mL/min
Detector : UV(280nm)
Column temp. : Room temp.

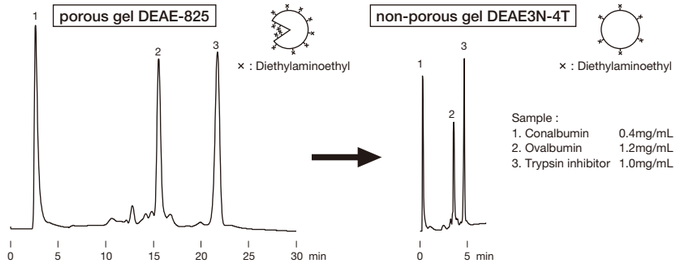
### Effects of eluent pH for DEAE-825




**Column** : **Shodex IEC DEAE-825**
Eluent : (A); 20mM Piperazine-HCl buffer(pH6.0), 20mM Bis-Tris-HCl buffer(pH7.0)
20mM Tris-HCl buffer(pH8.0), 20mM Ethanolamine-HCl buffer(pH9.0)
20mM 1,3-Diaminopropane-HCl buffer(pH10.0)
(B); (A) + 0.5M NaCl
Linear gradient; (A) to (B), 20min
Flow rate : 1.0mL/min
Detector : UV(280nm)
Column temp. : 25°C

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

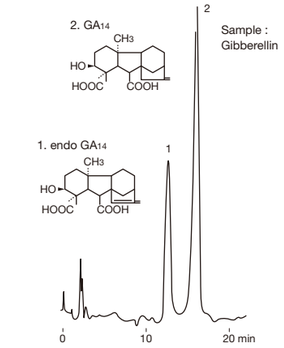
IEC DEAE3N-4T is a weak anion exchange column, having diethylaminoethyl functional group modified on non-porous gel. The non-porous gel enables rapid analysis of proteins and peptides. DEAE3N-4T is also suitable for the analysis of small-volume samples, as it provides sharp peaks even with small injection volume.




**Column** : **Shodex IEC DEAE-825**
Eluent : (A); 20mM Piperazine-HCl buffer(pH6.0)
(B); (A) + 0.5M NaCl
Linear gradient; (A) to (B), 60min
Flow rate : 1.0mL/min
Detector : UV(280nm)
Column temp. : Room temp.
Injection vol. : 100μL

**Column** : **Shodex IEC DEAE3N-4T**
Eluent : (A); 25mM Piperazine-HCl buffer(pH6.0)
(B); A + 0.5M NaCl
Linear gradient; (A) to (B), 10min
Flow rate : 1.5mL/min
Detector : UV(280nm)
Column temp. : Room temp.
Injection vol. : 20μL

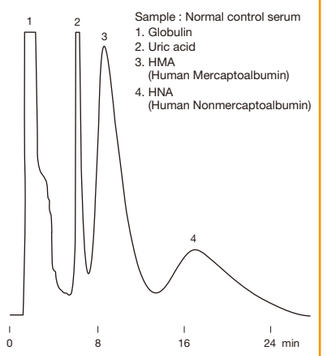
### Gibberellin Isomers




**Column** : **Shodex Asahipak ES-502N 7C**
Eluent : Acetic acid/$H_2O$/$CH_3OH$
=0.1/0.4/99.5
Flow rate : 1.5mL/min
Detector : UV(210nm)
Column temp. : 50°C

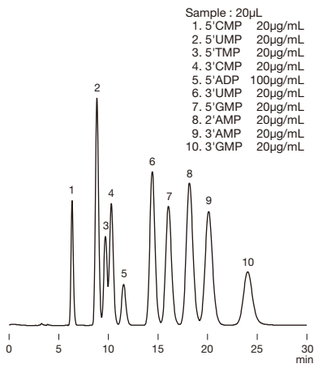
Data was provided by Prof. Yamaguch, Faculty of Agliculture, University of Tokyo.

### Mercaptoalbumin and non-mercaptoalbumin



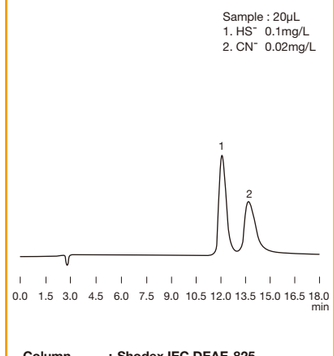

**Column** : **Shodex Asahipak ES-502N 7C**
Eluent : 50mM N-methylpiperazine-HCl buffer(pH4.8) + 400mM $Na_2SO_4$ aq. + 0.3% $C_2H_5OH$
Flow rate : 1.0mL/min
Detector : UV(280nm)
Column temp. : 35°C

### Nucleotides




**Column** : **Shodex AXpak WA-624**
Eluent : 0.35M $CH_3COOH$ aq.
/0.35M $CH_3COONH_4$ aq.=240/100
Flow rate : 1.0mL/min
Detector : UV(260nm)
Column temp. : 60°C

### Sulfide ion and cyanide ion




**Column** : **Shodex IEC DEAE-825**
Eluent : 10mM $Na_2CO_3$
+ 1mM Ethylenediamine aq.
+ 10% $CH_3OH$
Flow rate : 1.0mL/min
Detector : Electrochemical
(Electrode; Silver, 0mV SCE)
Column temp. : 25°C

# Columns for Cation Exchange Chromatography

## Features

**SP-825, CM-825**
- Suitable for the analysis of relatively high molecular weight compounds, such as proteins, peptides, DNA, and RNA
- Usable under wide pH range between 2 and 12

Note book No.7 Semi-micro Micro Columns p.77 Preparative Columns p.81

**SP-420N**
- Non-porous base material
- For rapid analysis

**SP-2B**
- Non-porous base material
- Supports UHPLC (available under hyperbaric conditions for up to 30 MPa)

Note book No.6 News No.42

**ES-502C 7C**
- Compared to IEC series columns, polyvinyl alcohol is used as base material and this offers different separation pattern
- Low hydrophobic interaction with proteins allows analysis under mild conditions

Note book No.7 Semi-micro Micro Columns p.77 Preparative Columns p.81

**P-421S**
- Column for amino acids analysis by cation exchange mode
- Supports simultaneous analysis of different amino acids

Note book No.3

## Standard columns

**Strong cation exchange resin (Functional Group : Sulfopropyl)**

| Product Code | Product Name | Ion Exchange Capacity (meq/g) | Base Material | Particle Size (µm) | Pore Size (Å) | Column Size (mm) I.D. x Length | Shipping Solvent |
|---|---|---|---|---|---|---|---|
| F6118250 | **IEC SP-825** | 0.4 | Polyhydroxymethacrylate | 8 | 5,000 | **8.0 × 75** | 50mM $Na_2SO_4$ aq. |
| F6113000 | **IEC SP-420N** | 0.3 | Polyhydroxymethacrylate | 2.5 | – | **4.6 × 35** | 20mM Sodium acetate buffer + 0.5M $Na_2SO_4$(pH5.0) |
| F6113110 | **PIKESS SP-2B** | 0.3 | Polyhydroxymethacrylate | 2.5 | – | **2.0 × 50** | 20mM Sodium acetate buffer + 0.5M $Na_2SO_4$(pH5.0) |

**Weak cation exchange resin (Functional Group : Carboxymethyl)**

| Product Code | Product Name | Ion Exchange Capacity (meq/g) | Base Material | Particle Size (µm) | Pore Size (Å) | Column Size (mm) I.D. x Length | Shipping Solvent |
|---|---|---|---|---|---|---|---|
| F6110002 | **IEC CM-825** | 0.4 | Polyhydroxymethacrylate | 8 | 5,000 | **8.0 × 75** | 50mM $Na_2SO_4$ aq. |
| F7640001 | **Asahipak ES-502C 7C** | 0.55 | Polyvinyl alcohol | 9 | 2,000 | **7.5 × 100** | 0.1M Sodium phosphate buffer (pH4.4) |

**For amino acids (Functional Group : Sulfo ($Na^+$))**

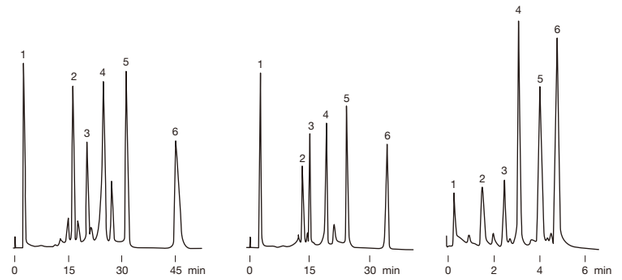
| Product Code | Product Name | Plate Number (TP/column) | Base Material | Particle Size (µm) | Column Size (mm) I.D. x Length | Shipping Solvent |
|---|---|---|---|---|---|---|
| F6354211 | **CXpak P-421S** | ≥ 3,500 | Styrene divinylbenzene copolymer | 6 | **4.6 × 150** | $H_2O$ |
| F6700210 | **CXpak P-G** | (guard column) | Styrene divinylbenzene copolymer | 6 | **4.6 × 10** | $H_2O$ |

*Contact Shodex or our distributors near you for customized columns.



### Protein separation using cation exchange columns

( I ) CM-825 (Weak cation exchange) 90µL injected
( II ) SP-825 (Strong cation exchange) 30µL injected
( III ) SP-420N (Strong cation exchange) non-porous type gel

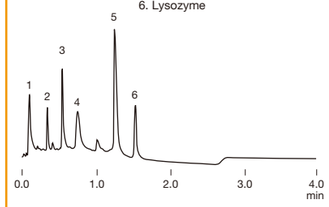



**Column** : **( I ) Shodex IEC CM-825, ( II ) IEC SP-825, ( III ) IEC SP-420N**
Eluent : (A); 20mM Sodium phosphate buffer(pH7.0) (B); (A) + 0.5M NaCl
( I , II ) Linear gradient; (A) to (B), 60min ( III ) Linear gradient; (A) to (B), 10min
Flow rate : ( I , II )1.0mL/min ( III )1.5mL/min
Detector : UV(280nm)
Column temp. : Room temp.

Sample :
1. Myoglobin
2. Trypsinogen
3. Ribonuclease A
4. α-Chymotrypsinogen A
5. Cytochrome c
6. Lysozyme

### Rapid analysis of proteins using UHPLC

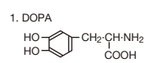
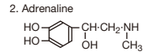
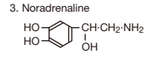
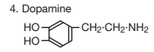
Sample : 5µL (13mg total protein )
1. Myoglobin
2. Trypsinogen
3. Ribonuclease A
4. α-Chymotrypsinogen A
5. Cytochrome c
6. Lysozyme




**Column** : **Shodex PIKESS SP-2B**
Eluent : (A); 20mM Sodium phosphate buffer(pH 7.0)
(B); (A) + 0.5 M NaCl
Linear gradient; 100%(A) to 50%(B), 2.5min
Flow rate : 1.2mL/min
Detector : UV(280nm)
Column temp. : 25°C

### Catecholamines

Sample : 300µg/mL each, 10µL

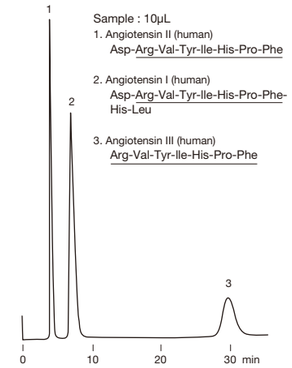
1. DOPA

2. Adrenaline

3. Noradrenaline

4. Dopamine





**Column** : **Shodex Asahipak ES-502C 7C**
Eluent : 20mM Sodium malonate buffer + 0.5M NaCl(pH6.0)
Flow rate : 1.0mL/min
Detector : UV(280nm)
Column temp. : 30°C

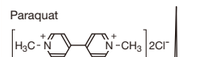
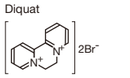
### Angiotensins

Sample : 10µL
1. Angiotensin II (human)
Asp-Arg-Val-Tyr-Ile-His-Pro-Phe
2. Angiotensin I (human)
Asp-Arg-Val-Tyr-Ile-His-Pro-Phe-His-Leu
3. Angiotensin III (human)
Arg-Val-Tyr-Ile-His-Pro-Phe




**Column** : **Shodex Asahipak ES-502C 7C**
Eluent : 50mM Sodium malonate buffer(pH6.0) /$CH_3CN$=80/20
Flow rate : 1.0mL/min
Detector : UV(280nm)
Column temp. : 30°C

### Paraquat and diquat

Paraquat

Diquat


Sample : 20µL

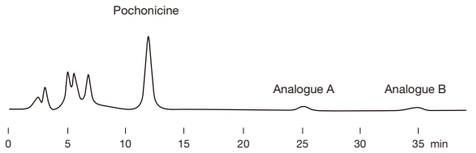



**Column** : **Shodex Asahipak ES-502C 7C**
Eluent : 50mM Sodium phosphate buffer + 150mM NaCl(pH7.0)
Flow rate : 1.0mL/min
Detector : UV(288nm)
Column temp. : 30°C

### Analysis of pochonicine and their analogues in filamentous fungi culture extract

Sample : 5µL
Fraction purified from the culture extract of *Pochonia suchlasporia var. suchlasporia* TAMA 87

(Fungi culture provided by Dr. Toru Okuda, Tamagawa University Research Institute)

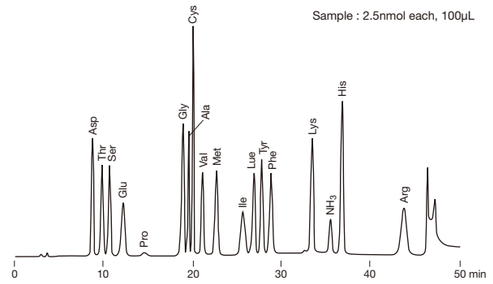



**Column** : **Shodex Asahipak ES-502C 7C**
Eluent : 10mM Ammonium bicarbonate aq.
Flow rate : 0.6mL/min
Detector : UV(210nm)
Column temp. : 40°C

Data provided by Dr. Teruhiko Nitoda, Faculty of Agriculture, Okayama University.

### Standard amino acids

Sample : 2.5nmol each, 100µL




**Column** : **Shodex CXpak P-421S**
Eluent : No.1 0.12M Sodium citrate buffer(pH3.3)
No.2 0.13M Sodium citrate buffer(pH3.2)
No.3 0.11M Sodium citrate buffer(pH4.0)
No.4 1.02M Sodium citrate buffer(pH4.9)
No.5 0.2M NaOH aq./Ethanol=90/10 (Rinse solution)
Low pressure gradient;
No.1 (0min), No.2 (1.2min), No.3 (10.0min), No.4 (21.2min), No.5 (40min)
Flow rate : 0.5mL/min
Detector : VIS(570nm)
Post column method (Ninhydrin reaction 0.35mL/min, 120°C)
Column temp. : 63°C

# Columns for Special Separation Modes

## Column for Hydrophobic Interaction Chromatography

### Features

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

### Standard 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 × 75** | $H_2O$ |

Base Material : Polyhydroxymethacrylate

## Columns for Affinity Chromatography

### Features

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

### Standard columns

| Product Code | Product Name | Ligand | Ligand Load/Gel (g) | Particle Size (µm) | Column Size (mm) I.D. x Length | Shipping Solvent |
|---|---|---|---|---|---|---|
| F7118954 | **AFpak ADS-894** | Dextran sulfate | 30mg | 18 | **8.0 × 50** | 50mM Sodium phosphate buffer + 0.02% $NaN_3$(pH7.4) |
| F7118945 | **AFpak AHR-894** | Heparin | 5mg | 18 | **8.0 × 50** | 10mM Tris-HCl buffer + 10mM NaCl + 0.02% $NaN_3$(pH7.4) |
| F7118946 | **AFpak APA-894** | Protein A | 4mg | 18 | **8.0 × 50** | 0.1M Sodium phosphate buffer + 0.5M NaCl + 0.02% $NaN_3$(pH7.0) |
| F7113050 | **AFpak APG-894** | Protein G | 4–5mg | 18 | **8.0 × 50** | 10mM Sodium phosphate buffer + 0.15M NaCl + 0.02% $NaN_3$(pH7.4) |
| F7118959 | **AFpak AWG-894** | Wheat germ agglutinin (WGA) | 14mg | 18 | **8.0 × 50** | 0.1M Tris-HCl buffer + 0.15M NaCl + 0.2M N-Acetylglucosamine + 0.02% $NaN_3$(pH7.4) |
| F7118964 | **AFpak ACH-494** | Choline oxydase, Acetylcholine esterase | – | 18 | **4.6 × 10** | 10mM Phosphate buffer + 1.0M NaCl(pH7.4) |

Base Material : Polyhydroxymethacrylate

## Columns for Chiral Separation

### Features

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

**CRX-853**
- Separates optical isomers by using the differences in metal complex formation capacities of functional group and metal ion in eluent and optical isomers
- Suitable for amino acids, hydroxyl acids, and their derivatives

### Standard columns

| Product Code | Product Name | Functional Group | Base Material | Particle Size (µm) | Column Size (mm) I.D. x Length | Shipping Solvent |
|---|---|---|---|---|---|---|
| F7146003 | **ORpak CDBS-453** | β-Cyclodextrin derivative | Silica | 3 | **4.6 × 150** | 1.0% Acetic acid + 0.2M NaCl aq. /$CH_3CN$=70/30 |
| F7140040 | **ORpak CRX-853** | L-amino acid derivative | Polyhydroxymethacrylate | 6 | **8.0 × 50** | 0.25mM $CuSO_4$ aq. |
| F6709300 | **ORpak CRX-G** (guard column) | L-amino acid derivative | Polyhydroxymethacrylate | 6 | **4.6 × 10** | 0.25mM $CuSO_4$ aq. |

## Columns for High Temperature Reversed Phase Chromatography

### Features

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

News No.41

### Standard columns

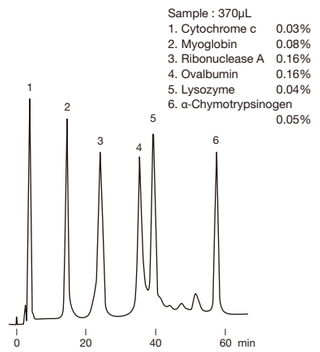
| Product Code | Product Name | Plate Number (TP/column) | Functional Group | Particle Size (µm) | Pore Size (Å) | Column Size (mm) I.D. x Length | Shipping Solvent |
|---|---|---|---|---|---|---|---|
| F7623001 | **ET-RP1 4D** | ≥ 11,000 | Octadecyl | 4 | 250 | **4.6 × 150** | $H_2O$/$CH_3CN$=35/65 |
| F7623003 | **ET-RP1 3D** | ≥ 9,000 | Octadecyl | 4 | 250 | **3.0 × 150** | $H_2O$/$CH_3CN$=35/65 |

Base Material : Polyvinyl alcohol

*Contact Shodex or our distributors near you for customized columns.

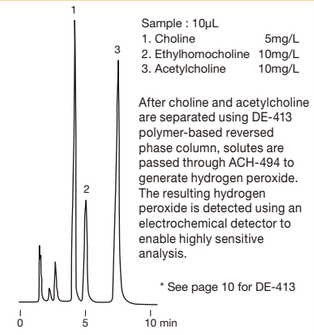


### Protein separation by hydrophobic interaction chromatography




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

### Choline and acetylcholine

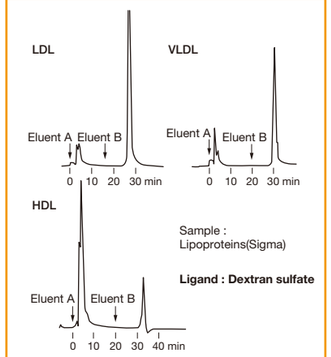



After choline and acetylcholine are separated using DE-413 polymer-based reversed phase column, solutes are passed through ACH-494 to generate hydrogen peroxide. The resulting hydrogen peroxide is detected using an electrochemical detector to enable highly sensitive analysis.

* See page 10 for DE-413

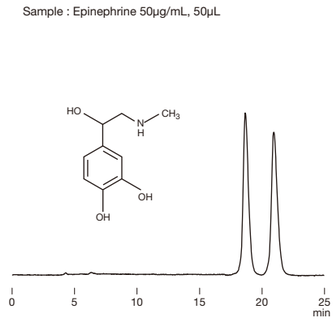
**Column** : **Shodex RSpak DE-413**
**Post column** : **Shodex AFpak ACH-494**
Eluent : 0.1M $H_3PO_4$ + 300mg/L Sodium 1-decansulfonate + 65mg/L Tetramethylammonium chloride (pH8.0 adjusted by 1.0M NaOH)
Flow rate : 1.0mL/min
Detector : Electrochemical(Electrode : Pt, 350mV SCE)
Column temp. : 37°C

### Lipoproteins in plasma



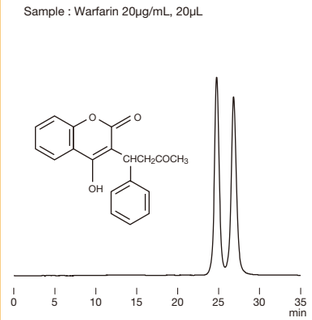

**Column** : **Shodex AFpak ADS-894**
Eluent : (A); 50mM Sodium phosphate buffer (pH7.4) (B); (A) + 1.0M NaCl Step gradient; (A) to (B)
Flow rate : 1.0mL/min
Detector : UV(280nm)
Column temp. : Room temp.

### Epinephrines



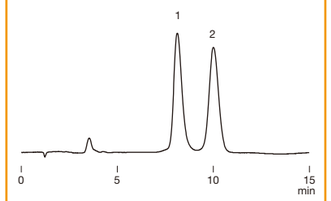

**Column** : **Shodex ORpak CDBS-453**
Eluent : 0.05% Acetic acid + 0.2M NaCl aq. /$CH_3CN$=95/5
Flow rate : 0.5mL/min
Detector : UV(254nm)
Column temp. : 10°C

### Warfarin



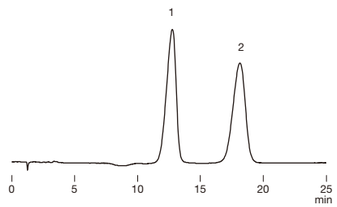

**Column** : **Shodex ORpak CDBS-453**
Eluent : 1.0% Acetic acid + 0.2M NaCl aq. /$CH_3CN$=80/20
Flow rate : 0.6mL/min
Detector : UV(310nm)
Column temp. : 16°C

### Lactic acids



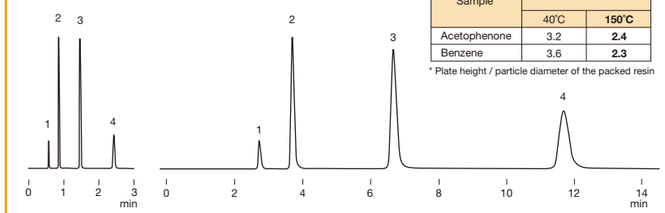

**Column** : **Shodex ORpak CRX-853**
Eluent : 0.5mM $CuSO_4$ aq.
Flow rate : 1.0mL/min
Detector : UV(230nm)
Column temp. : 50°C

### Mandelic acids




**Column** : **Shodex ORpak CRX-853**
Eluent : 0.25mM $CuSO_4$ aq.
Flow rate : 1.0mL/min
Detector : UV(230nm)
Column temp. : 50°C

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




| Sample | Reduced plate height * | |
|---|---|---|
| | 40°C | **150°C** |
| Acetophenone | 3.2 | **2.4** |
| Benzene | 3.6 | **2.3** |

* Plate height / particle diameter of the packed resin

**Column** : **Shodex ET-RP1 4D**
Eluent : (Left) $H_2O$/$CH_3CN$=50/50 (Right) $H_2O$/$CH_3CN$=75/25
Detector : Photodiode array(210nm)
Column Oven : Polaratherm 9000 Series (SandraSelerity Technonogies, Inc)

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

Data provided by Research Institute for Chromatography bvba

# Columns for LC/MS Analysis

## Columns for Polymer-based Reversed Phase Chromatography

| 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 |
|---|---|---|---|---|---|---|---|---|
| F7622004 | **ODP2 HP-2B** | ≥ 3,000 | – | Polyhydroxymethacrylate | 5 | 40 | **2.0 × 50** | $H_2O/CH_3CN$=55/45 |
| F7622005 | **ODP2 HP-2D** | ≥ 7,000 | – | Polyhydroxymethacrylate | 5 | 40 | **2.0 × 150** | $H_2O/CH_3CN$=55/45 |
| F6714011 | **ODP2 HPG-2A** | (guard column) | – | Polyhydroxymethacrylate | 5 | – | **2.0 × 10** | $H_2O/CH_3CN$=55/45 |
| F7620009 | **Asahipak ODP-50 2D** | ≥ 5,000 | Octadecyl | Polyvinyl alcohol | 5 | 250 | **2.0 × 150** | $H_2O/CH_3CN$=35/65 |
| F6713001 | **Asahipak ODP-50G 2A** | (guard column) | Octadecyl | Polyvinyl alcohol | 5 | – | **2.0 × 10** | $H_2O/CH_3CN$=35/65 |
| F7001007 | **RSpak DE-213** | ≥ 8,000 | – | Polymethacrylate | 4 | 25 | **2.0 × 150** | $H_2O/CH_3CN$=50/50 |
| F6700151 | **RSpak DE-SG** | (guard column) | – | Polymethacrylate | 6 | – | **2.0 × 10** | $H_2O/CH_3CN$=50/50 |
| F7008160 | **RSpak NN-414** | ≥ 6,000 | Sulfo | Polyhydroxymethacrylate | 10 | 200 | **4.6 × 150** | 0.1M Sodium phosphate buffer(pH3.0) |
| F7008220 | **RSpak JJ-50 2D** | ≥ 3,500 | Quaternary ammonium | Polyvinyl alcohol | 5 | 100 | **2.0 × 150** | $H_2O/CH_3CN$=40/60 |

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

| 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 |
|---|---|---|---|---|---|---|---|---|
| F7630008 | **Asahipak NH2P-40 2B** | ≥ 2,000 | Amino | Polyvinyl alcohol | 4 | 100 | **2.0 × 50** | $CH_3CN$ |
| F7630009 | **Asahipak NH2P-40 2D** | ≥ 5,500 | Amino | Polyvinyl alcohol | 4 | 100 | **2.0 × 150** | $CH_3CN$ |
| F7630010 | **Asahipak NH2P-40 2E** | ≥ 7,000 | Amino | Polyvinyl alcohol | 4 | 100 | **2.0 × 250** | $CH_3CN$ |
| F7630006 | **Asahipak NH2P-50 2D** | ≥ 3,500 | Amino | Polyvinyl alcohol | 5 | 100 | **2.0 × 150** | $H_2O/CH_3CN$=25/75 |
| F6713000 | **Asahipak NH2P-50G 2A** | (guard column) | Amino | Polyvinyl alcohol | 5 | – | **2.0 × 10** | $H_2O/CH_3CN$=25/75 |

* Asahipak NH2P-40 2B, Asahipak NH2P-40 2D, and Asahipak NH2P-40 2E are the new names for the NH2P40-2B, NH2P40-2D, and NH2P40-2E, respectively.

## Aqueous/Organic SEC Columns

| Product Code | Product Name | Plate Number (TP/column) | Exclusion Limit (Pullulan) | Base Material | Particle Size (μm) | Maximum Pore Size (Å) | Column Size (mm) I.D. x Length | Shipping Solvent |
|---|---|---|---|---|---|---|---|---|
| F7600100 | **MSpak GF-310 4B** | ≥ 3,000 | 40,000 | Polyvinyl alcohol | 5 | 400 | **4.6 × 50** | $H_2O$ |
| F7600110 | **MSpak GF-310 4D** | ≥ 10,000 | 40,000 | Polyvinyl alcohol | 5 | 400 | **4.6 × 150** | $H_2O$ |
| F7600024 | **MSpak GF-310 4E** | ≥ 16,000 | 40,000 | Polyvinyl alcohol | 5 | 400 | **4.6 × 250** | $H_2O$ |
| F7600120 | **MSpak GF-310 2D** | ≥ 5,500 | 40,000 | Polyvinyl alcohol | 5 | 400 | **2.0 × 150** | $H_2O$ |

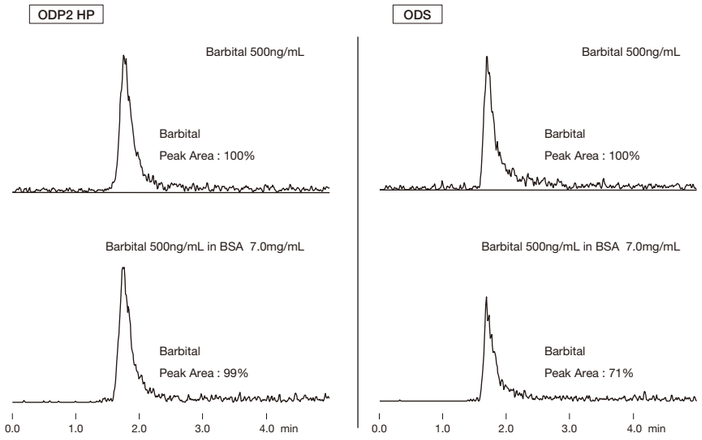
## Organic SEC (GPC) Columns

| Product Code | Product Name | Plate Number (TP/column) | Exclusion Limit (Polystyrene) | Base Material | Particle Size (μm) | Maximum Pore Size (Å) | Column Size (mm) I.D. x Length | Shipping Solvent |
|---|---|---|---|---|---|---|---|---|
| F6028111 | **GPC KF-401HQ** | ≥ 25,000 | 1,500 | Styrene divinylbenzene copolymer | 3 | 50 | **4.6 × 250** | THF |
| F6028112 | **GPC KF-402HQ** | ≥ 25,000 | 5,000 | Styrene divinylbenzene copolymer | 3 | 150 | **4.6 × 250** | THF |
| F6028114 | **GPC KF-402.5HQ** | ≥ 25,000 | 20,000 | Styrene divinylbenzene copolymer | 3 | 300 | **4.6 × 250** | THF |
| F6700300 | **GPC KF-G** | (guard column) | – | Styrene divinylbenzene copolymer | 8 | – | **4.6 × 10** | THF |

*Contact Shodex or our distributors near you for customized columns.



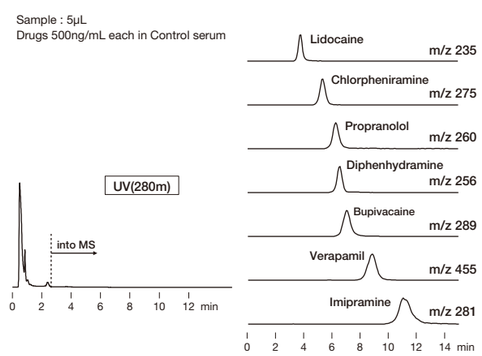
### Barbital recovery rate comparison of ODP2 HP-2B and ODS in the presence of BSA




For the LC/MS analysis of drug samples containing protein as a matrix, using ODS columns generally exhibit ion suppression of the target drugs. Since proteins are not retained by ODP2 HP column, they elute separate (as a void) from the target components. Thus, using ODP2 HP column exhibits less ion suppression influence.

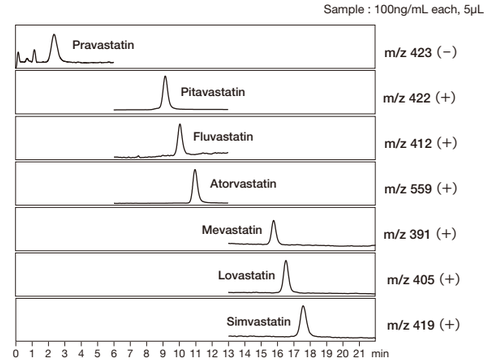
**Column : Shodex ODP2 HP-2B**
**ODS from other manufacturer**
Eluent : 10mM Ammonium acetate aq. /$CH_3CN$=70/30
Flow rate : 0.2mL/min
Detector : ESI-MS(SIM Negative : m/z 183)
Column temp. : 30°C
Injection vol. : 10μL

### LC/MS analysis of drugs in control serum




**Column : Shodex ODP2 HP-2B**
Eluent : 10mM Ammonium acetate aq./$CH_3CN$=70/30
Flow rate : 0.2mL/min
Detector : UV(280nm), ESI-MS(SIM Positive)
Column temp. : 40°C

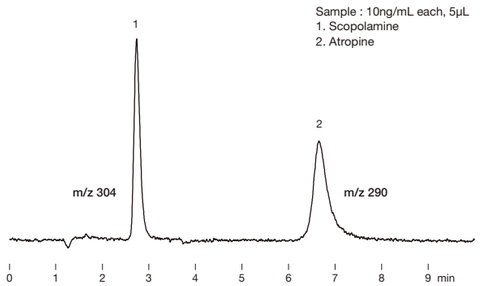
### LC/MS analysis of statins




**Column : Shodex ODP2 HP-2B**
Eluent : (A); 10mM Ammonium formate aq. (B); $CH_3CN$
Linear gradient;
B%; 10%(0min)→10%(3min)→35%(13min)→35%(20min)
Flow rate : 0.2mL/min
Detector : ESI-MS(SIM)
Column temp. : 40°C

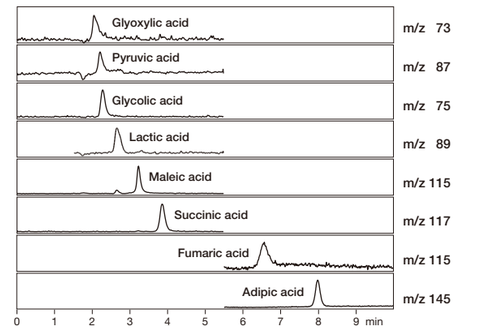
### LC/MS analysis of basic drugs

ODP-50 2D, a polymer-based reversed phase column, is capable of analyzing basic drugs at low concentration or without salt. This is preferred for ESI-MS analysis, since the presence of salt causes ion suppression, and thus influences the analysis performance.



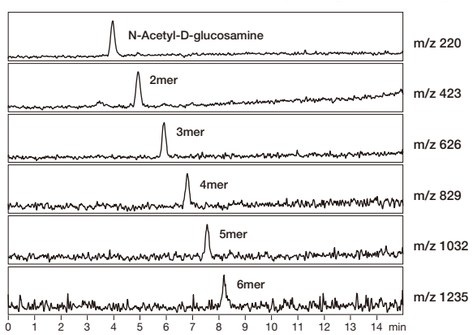

**Column : Shodex Asahipak ODP-50 2D**
Eluent : $H_2O/CH_3CN$=40/60
Flow rate : 0.2mL/min
Detector : ESI-MS(SIM Positive)
Column temp. : 30°C

### LC/MS analysis of organic acids



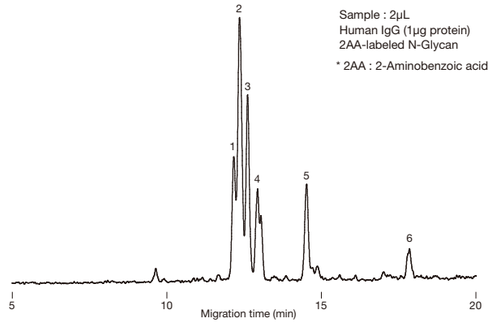

**Column : Shodex RSpak DE-213**
Eluent : (A); 0.1%(v/v) Formic acid aq. (B); $CH_3CN$
Linear gradient;
B%; 5%(0min)→5%(2min)→15%(2.5min)→15%(10min)
Flow rate : 0.2mL/min
Detector : ESI-MS(SIM Negative)
Column temp. : 30°C

## LC/MS analysis of N-acetyl-chitooligosaccharides




**Column** : **Shodex Asahipak NH2P-40 2D**
Eluent : (A); 0.05% Ammonia aq. (B); $CH_3CN$
Linear gradient; (B%) 75%(0min)→50%(10min)→50%(15min)
Flow rate : 0.2mL/min
Detector : ESI-MS(SIM Negative)
Column temp. : 30℃

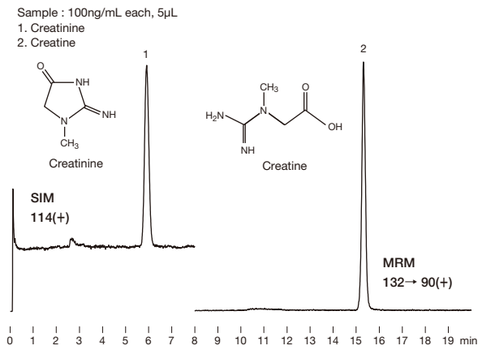
## LC/TOF-MS analysis of 2-amino benzoic acid derivatized sugar chains




**Column** : **Shodex Asahipak NH2P-40 2D**
Eluent : (A); 95% $CH_3CN$/0.1% Formic acid aq.
(B); 5% $CH_3CN$/0.1% Formic acid aq.
Linear gradient; (B%) 30%(0-2.5min), 30-95%(2.5-20min)
Flow rate : 0.2mL/min
Detector : ESI-TOF MS(Polarity : Negative, Full MS range : 2000 )
Column temp. : 45℃

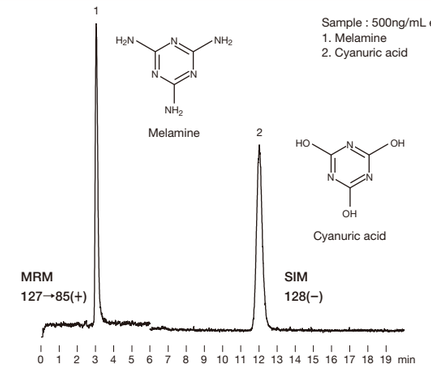
Data provided by Michihiro Kinoshita Ph.D., Faculty of Pharmacy, Kinki University

## LC/MS analysis of creatinine and creatine



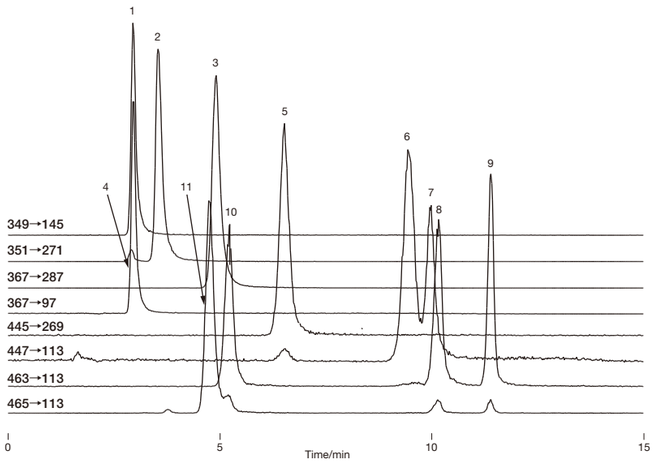

**Column** : **Shodex Asahipak NH2P-40 2D**
Eluent : (A); 50mM Ammonium formate aq. (B); $CH_3CN$
Linear gradient;
B%, 90%(0min)→90%(6min)→75%(7min)→75%(20min)
Flow rate : 0.2mL/min
Detector : Creatinine : ESI-MS, Creatine : ESI-MS/MS
Column temp. : 30℃

## LC/MS analysis of melamine and cyanuric acid




**Column** : **Shodex Asahipak NH2P-40 2D**
Eluent : 50mM Ammonium formate aq./$CH_3CN$=25/75
Flow rate : 0.2mL/min
Detector : Melamine : ESI-MS/MS
Cyanuric acid : ESI-MS
Column temp. : 30℃

## LC/MS/MS analysis of estradiol metabolites

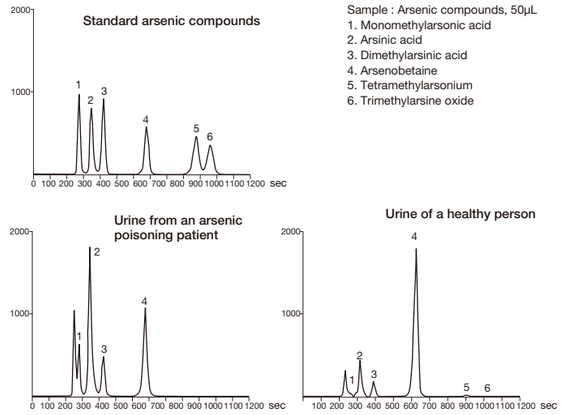



Sample : 0.1ppm each, 5μL
1. Estrone-3-sulfate
2. β-Estradiol-3-sulfate
3. Estriol-3-sulfate
4. Dehydroepiandrosterone-3-sulfate
5. Estrone-3-glucuronide
6. β-Estradiol-17-glucuronide
7. β-Estradiol-3-glucuronide
8. Estriol-3-glucuronide
9. Estriol-16-glucuronide
10. Dehydroepiandrosterone-3-glucuronide
11. Androsterone-3-glucuronide

**Column** : **Shodex Asahipak NH2P-40 2D**
Eluent : (A); 10mM $NH_4OH$ $CH_3CN$
(B); 10mM $NH_4OH$ $H_2O$
Linear gradient;
B%, 22%(0-5min), 22-70%(5-10min),
70%(10-15min)
Flow rate : 0.2mL/min
Detector : ESI-MS/MS(Polarity : Negative)
Column temp. : 40℃

Data provided by Mr. Atsushi Yamamoto,
Osaka City Institute of Public Health and Environmental Sciences

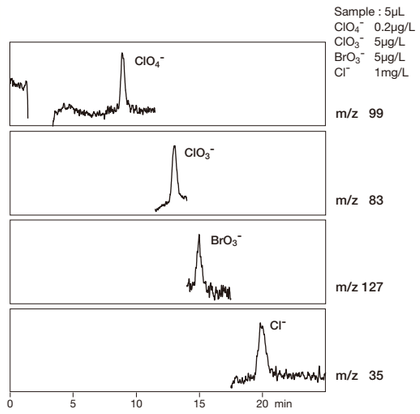
## Speciation of arsenic




**Column** : **Shodex RSpak NN-614**
Eluent : 5mM $HNO_3$/8mM $NH_4NO_3$ aq.
Flow rate : 0.8mL/min
Detector : IC-ICP-MS(SIM m/z 75)

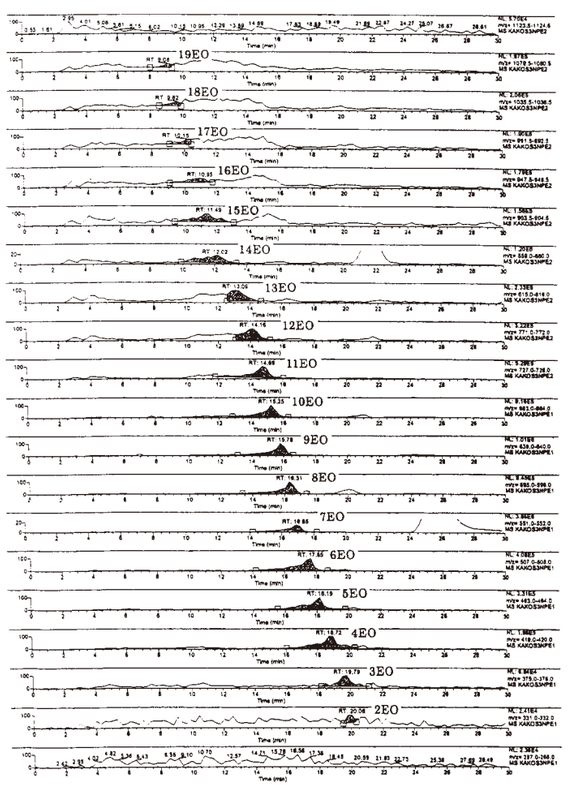
Source:
Noriko Tsunoda,
Pharmacia. 1998, vol.34, No.12, p.1237-1241

## LC/MS analysis of perchloric acid and oxyhalides




**Column** : **Shodex RSpak JJ-50 2D**
Eluent : 50mM Ammonium formate aq./$CH_3CN$=25/75
Flow rate : 0.2mL/min
Detector : ESI-MS(SIM Negative)
Column temp. : 30℃

## LC/MS analysis of nonylphenol ethoxylates



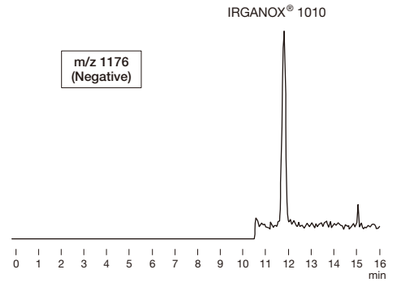

**Column** : **Shodex MSpak GF-310 4D**
Eluent : (A) $CH_3CN$, (B): $H_2O$
A/B=30/70(7min) → (23min)→ A/B=90/10
Flow rate : 0.5mL/min
Detector : ESI-MS(SIM Positive)

Source:
Mr. Yoshinari Kobuke (Environmental Science Institute of Hyogo Prefecture),
Basic Study of Chemical Substances in LC/MS,
10th Symposium on Environmental Chemistry Program and Abstracts, 542-543, 2001.

## LC/MS analysis of additives

For the analysis of additives that are present in polymers usually require sample pretreatment steps. However, by using size exclusion chromatography columns, easy and high sensitive analysis of additives was achieved without any pretreatment steps. The target additives are separated from the polymer and this allows introducing only the low molecular fraction (which contains the additives) into MS.

Sample : Cup of instant noodles (styrene foam) 1000mg/L, 5μL




**Column** : **Shodex GPC KF-402HQ x 2**
Eluent : THF
Flow rate : 0.3mL/min
Detector : UV(210nm), APCI-MS(SIM)
Column temp. : 40℃

# Columns for GPC Clean-up

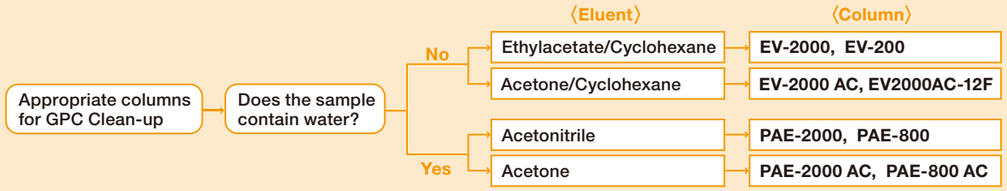
## Features

**EV**

- Suitable for fractionation of residual pesticides in foods
- Used in the purification process of test solution preparation method in Shoku-An No. 1003001 (October 3rd, 2006. Japan) of the Pharmaceutical and Food Safety Bureau, MHLW, Section 2 "Simultaneous GC/MS (LC/MS) Analyses of Agricultural Chemicals in Livestock and Marine Products"

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

Base Material : Styrene divinylbenzene copolymer

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

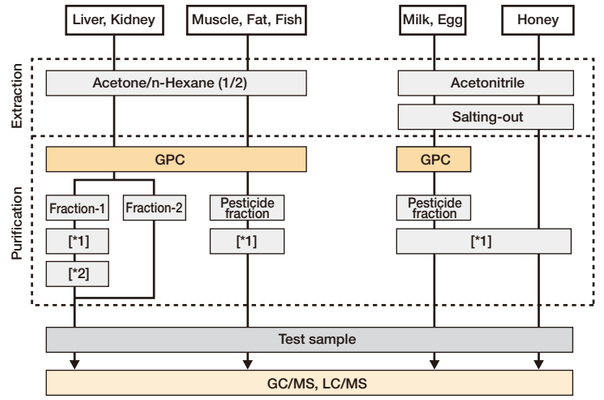
| Product Code | Product Name | Particle Size (μm) | Maximum Pore Size (Å) | Column Size (mm) I.D. x Length | Shipping Solvent |
|---|---|---|---|---|---|
| F7600025 | **CLNpak PAE-800** | 5 | 400 | **8.0 × 300** | Acetonitrile |
| F6810022 | **CLNpak PAE-2000** | 5 | 400 | **20.0 × 300** | Acetonitrile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

Base Material : Polyvinyl alcohol

*Contact Shodex or our distributors near you for customized columns.

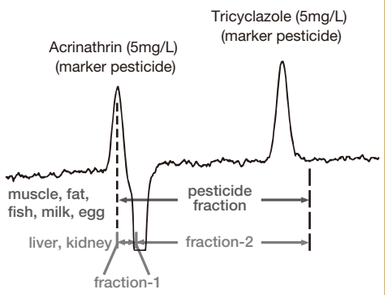


### Sample preparation outline for simultaneous GC/MS and LC/MS analysis of agricultural chemicals in livestock and marine products



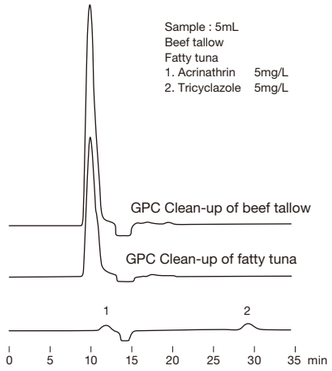

*1 Purification with ethylenediamine-N-propylsilyled silica gel mini-column
*2 Purification with silica gel mini-column

### GPC Clean-up of residual pesticides using EV-2000 AC




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

### GPC Clean-up of fatty tuna and beef tallow

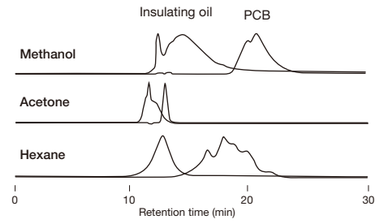



[Extraction]
1) Weigh 20.0g of the sample (5.0g for fat).
2) Add 20mL of water and homogenize.
3) Add 100mL of acetone/n-hexane (1/2) and homogenize.
4) Centrifuge (2,500rpm, 5min.) and collect the organic layer (1).
5) Add 50mL of n-hexane to the residue and homogenize.
6) Centrifuge (2,500rpm, 5min.) and collect the organic layer (2).
7) Combine (1) and (2) and add anhydrous sodium sulfate for dehydration.
8) Remove anhydrous sodium sulfate by filtering and concentrate the filtrate at 40°C or lower.
9) Remove the solvent.
10) Weigh the residue (extracted fat).
11) Dissolve in acetone/cyclohexane (1/4).

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

### PCB and insulating oil using PAE-800

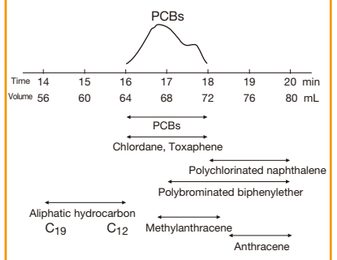
Sample : 30μL
PCB std. KC-mixture 400mg/L
Insulating oil dissolved by hexane 5,000mg/L




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

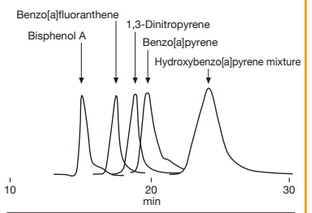
### Pretreatment of PCBs in waste oil




**Column** : **Shodex CLNpak PAE-G AC + PAE-2000 AC**
Eluent : Acetone
Flow rate : 4.0mL/min
Detector : UV(213nm)

Data provided by Mr. Koichi Sasaki et al., Analytical Center, Kokan Keisoku Corporation.

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

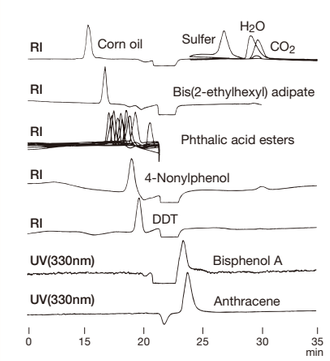



| Compound | Rt(min) | Compound | Rt(min) |
|---|---|---|---|
| Anthracene | 16.6 | Benzo[a]pyrene | 19.9 |
| Chrysene | 18.0 | Hydroxybenzo[a]pyrene compound | 23.0 |
| Fluoranthene | 17.1 | | |
| Benzo[a]fluoranthene | 17.7 | Bisphenol A | 16.1 |
| Benzo[b]fluoranthene | 18.6 | 1,3-Dinitronaphthalene | 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 : 0.8mL/min
Detector : UV(210nm)
Column temp. : Room temp.

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

### Elution positions of phthalic acid esters using PAE-800 AC




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

# Pretreatment Columns for Column Switching Method

## Features

**PK**

- Effective for both hydrophilic and hydrophobic substances
- The high protein removal rate enables efficient pretreatment

News No.9, 11, 22

**GF-4A**

- Higher protein removal rate than PK columns

* GF-4A column removes proteins well but is not suitable for trapping hydrophilic substances. Use PK columns for this purpose.

News No.9, 11, 22

## Cartridge columns and holder for column switching method

| Product Code | Product Name | Particle Size (µm) | Pore Size (Å) | Column Size (mm) I.D. x Length | Shipping Solvent | Pcs/box |
|---|---|---|---|---|---|---|
| F8700000 | **MSpak PK-2A 2p** | 30 | 30 | **2.0 x 10** | $H_2O$ | 2 |
| F8700012 | **MSpak PK-4A 2p** | 30 | 30 | **4.0 x 10** | $H_2O$ | 2 |
| F8700001 | **MSpak HLD** | – | – | **(Holder for PK)** | – | 1 |

Base Material : Hydrophilic copolymers containing N-vinyl acetoamide

* PK series are cartridge columns and thus should be installed in a column holder "MSpak HLD" before use.

## Column for column switching method

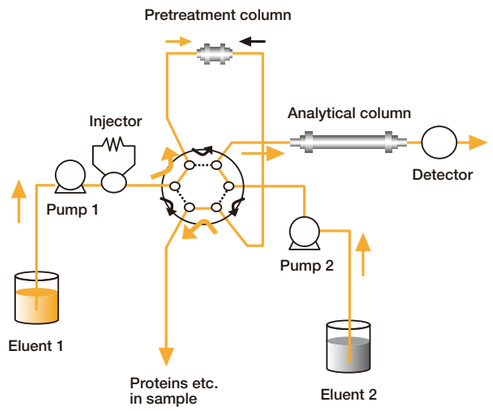
| Product Code | Product Name | Particle Size (µm) | Pore Size (Å) | Column Size (mm) I.D. x Length | Shipping Solvent |
|---|---|---|---|---|---|
| F8700015 | **MSpak GF-4A** | 9 | 400 | **4.6 × 10** | $H_2O$ |

Base Material : Polyvinyl alcohol

*Contact Shodex or our distributors near you for customized columns.

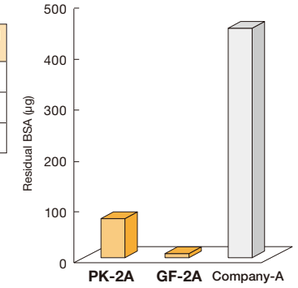


## System diagram for column switching




## Protein removal rate using pretreatment columns

| Column | Protein removal rate |
|---|---|
| PK-2A | 99.62% |
| GF-2A* | 99.80% |
| Company-A | 97.68% |




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

(Analysis)
**Column : Shodex PROTEIN KW-604S****
Eluent : 0.1% TFA in ($H_2O$/$CH_3CN$=50/50)
Flow rate : 0.5mL/min
Detector : UV(280nm)
Column temp. : Room temp.
Switching time: 5min

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

## Recovery rate of medical compounds using PK-2A

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

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

(Elution)
Eluent : 10mM Ammonium acetate buffer(pH7.0)/$CH_3CN$
Flow rate : 0.5mL/min
Detector : UV(220nm)
Switching time: 5min

# Column List for Pharmaceuticals and Cosmetics Analysis

## Pharmaceuticals, Metabolites

| Product Name | Separation Mode | Page |
|---|---|---|
| ODP2 HP | RPC | 6, 58 |
| Asahipak ODP-40 | RPC | 8 |
| Asahipak ODP-50 | RPC | 8, 58 |
| Asahipak C8P-50 | RPC | 8 |
| Asahipak C4P-50 | RPC | 8 |
| RSpak DS series | RPC | 10 |
| RSpak DE series | RPC | 10, 58 |
| RSpak NN series | IEC+RPC | 10, 58 |
| Asahipak NH2P series | HILIC | 12, 58 |
| ODSpak F-411 | RPC | 14 |
| Silica C18M | RPC | 14 |
| Silica C18P | RPC | 14 |
| USPpak MN-431 | LEX+SEC | 16 |
| ET-RP1 | RPC | 56 |

### [Substances in bio-fluid]

| Product Name | Separation Mode | Page |
|---|---|---|
| ODP2 HP | RPC | 6, 58 |
| Asahipak GS-320 HQ | SEC+RPC | 32 |
| Asahipak GF-310 HQ | SEC+RPC | 34 |
| MSpak GF-310 | SEC+RPC | 34, 58 |
| MSpak PK | SEC+RPC | 64 |

## Moisturizers

### [Polyalcohols]

| Product Name | Separation Mode | Page |
|---|---|---|
| RSpak DE series | RPC | 10, 58 |
| SUGAR SC1011 | LEX+SEC | 16 |
| SUGAR SC1211 | LEX+HILIC | 16 |
| OHpak SB-802.5 HQ | SEC | 30 |
| Asahipak GF-310 HQ | SEC | 34 |
| MSpak GF-310 | SEC | 34, 58 |

### [Protein hydrolysates]

| Product Name | Separation Mode | Page |
|---|---|---|
| Asahipak ODP-40 | RPC | 8 |
| Asahipak ODP-50 | RPC | 8, 58 |
| RSpak RP18-415 | RPC | 10 |
| PROTEIN KW-802.5 | SEC | 28 |
| KW402.5 | SEC | 28 |

### [Mucopolysaccharides]

| Product Name | Separation Mode | Page |
|---|---|---|
| OHpak SB-800 HQ series | SEC | 30 |

## Emulsifiers

| Product Name | Separation Mode | Page |
|---|---|---|
| Asahipak GF-310 HQ | SEC+RPC | 34 |
| MSpak GF-310 | SEC+RPC | 34, 58 |
| GPC KF-802 | SEC | 36 |
| GPC KF-402HQ | SEC | 42, 58 |

## Preservatives

| Product Name | Separation Mode | Page |
|---|---|---|
| Asahipak ODP-40 | RPC | 8 |
| Asahipak ODP-50 | RPC | 8, 58 |
| RSpak DS series | RPC | 10 |
| RSpak DE series | RPC | 10, 58 |
| ODSpak F-411 | RPC | 14 |
| Silica C18M | RPC | 14 |
| Silica C18P | RPC | 14 |

## Optical active materials

| Product Name | Separation Mode | Page |
|---|---|---|
| ORpak CDBS-453 | CS | 56 |
| ORpak CRX-853 | CS | 56 |

**Separation Mode**

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 List for Foods Analysis

## Nutritional ingredients

### [Monosaccharides, Disaccharides, Sugar alcohols]

| Product Name | Separation Mode | Page |
|---|---|---|
| Asahipak NH2P series | HILIC | 12, 58 |
| SUGAR SC1011 | LEX+SEC | 16 |
| SUGAR SC1821 | LEX+SEC | 16 |
| SUGAR SP0810 | LEX+SEC | 16 |
| SUGAR KS-801 | LEX+SEC | 16 |
| SUGAR KS-802 | LEX+SEC | 16 |
| SUGAR SC1211 | LEX+HILIC | 16 |
| SUGAR SZ5532 | LEX+HILIC | 16 |
| RSpak DC-613 | LEX+HILIC | 16 |

### [Oligosaccharides]

| Product Name | Separation Mode | Page |
|---|---|---|
| Asahipak NH2P series | HILIC | 12, 58 |
| SUGAR KS-802 | SEC | 16 |
| RSpak DC-613 | LEX+HILIC | 16 |
| OHpak SB-802 HQ | SEC | 30 |
| OHpak SB-802.5 HQ | SEC | 30 |
| Asahipak GS-220 HQ | SEC | 32 |

### [Low molecular weight water-soluble fiber]

| Product Name | Separation Mode | Page |
|---|---|---|
| Asahipak GS-220 HQ | SEC | 32 |

### [Polysaccharides]

| Product Name | Separation Mode | Page |
|---|---|---|
| SUGAR KS-800 series | SEC | 16 |
| OHpak SB-800 HQ series | SEC | 30 |

### [Organic acids]

| Product Name | Separation Mode | Page |
|---|---|---|
| ODP2 HP | RPC | 6, 58 |
| RSpak DE series | RPC | 10, 58 |
| RSpak NN series | IEX+RPC | 10, 58 |
| RSpak KC-811 | IEX+RPC | 20 |
| SUGAR SH1011 | IEX+RPC | 20 |
| SUGAR SH1821 | IEX+RPC | 20 |
| IC SI-90 4E | IC | 22 |
| IC SI-50 4E | IC | 22 |
| IC SI-35 4D | IC | 22 |
| IC SI-52 4E | IC | 22 |

### [Water-soluble vitamins]

| Product Name | Separation Mode | Page |
|---|---|---|
| ODP2 HP | RPC | 6, 58 |
| Asahipak ODP-40 | RPC | 8 |
| Asahipak ODP-50 | RPC | 8, 58 |
| RSpak DE series | RPC | 10, 58 |
| RSpak NN series | IEC+RPC | 10, 58 |
| Asahipak NH2P series | HILIC | 12, 58 |

### [Fat-soluble vitamins]

| Product Name | Separation Mode | Page |
|---|---|---|
| Asahipak ODP-40 | RPC | 8 |
| Asahipak ODP-50 | RPC | 8, 58 |
| Silica 5SIL | NPC | 14 |
| GPC KF-801 | SEC | 36 |
| GPC KF-401HQ | SEC | 42, 58 |

### [Fatty acids]

| Product Name | Separation Mode | Page |
|---|---|---|
| RSpak RP18 series | RPC | 10 |
| RSpak DE series | RPC | 10, 58 |
| Silica C18M | RPC | 14 |
| Silica C18P | RPC | 14 |
| Silica 5SIL | RPC | 14 |
| Asaipak GF-310 HQ | SEC | 34 |
| MSpak GF-310 | SEC | 34, 58 |
| GPC KF-802 | SEC | 36 |
| GPC KF-402 HQ | SEC | 42, 58 |

### [“Umami”, Nucleic acids]

| Product Name | Separation Mode | Page |
|---|---|---|
| Asahipak GS-320 HQ | IEC+SEC | 32 |

### [Amino acids]

| Product Name | Separation Mode | Page |
|---|---|---|
| RSpak NN series | IEC+IEX+RPC | 10, 58 |
| IC YS-50 | IC | 24 |
| CXpak P-421S | IEC | 54 |

## Food safety

### [Food additives]

| Product Name | Separation Mode | Page |
|---|---|---|
| Asahipak ODP-40 | RPC | 8 |
| Asahipak ODP-50 | RPC | 8, 58 |
| RSpak DS series | RPC | 10 |
| RSpak DE series | RPC | 10, 58 |
| Asahipak NH2P series | HILIC | 12, 58 |
| ET-RP1 | RPC | 56 |

### [Pesticides]

| Product Name | Separation Mode | Page |
|---|---|---|
| RSpak DE series | RPC | 10, 58 |
| RSpak NN series | IEC+RPC | 10, 58 |
| IC SI-90 4E | IC | 22 |

### [Mycotoxins]

| Product Name | Separation Mode | Page |
|---|---|---|
| Silica C18M 4E | RPC | 14 |

### [Pretreatment of residual pesticides]

| Product Name | Separation Mode | Page |
|---|---|---|
| CLNpak EV series | SEC (GPC Clean-up) | 62 |

**Separation Mode**

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 List for Biotechnology Analysis

## Genomics

### [Nucleobases, Nucleotides, Nucleosides]

| Product Name | Separation Mode | Page |
|---|---|---|
| RSpak DE series | RPC | 10, 58 |
| RSpak NN series | IEC+RPC | 10, 58 |
| Asahipak GS-320 HQ | IEC+SEC | 32 |
| AXpak WA-624 | IEC | 52 |

### [Oligo nucleic acids]

| Product Name | Separation Mode | Page |
|---|---|---|
| RSpak DE series | RPC | 10, 58 |
| Asahipak GS-320 HQ | IEC+SEC | 32 |
| IEC DEAE3N-4T | IEC | 52 |
| Asahipak ES-502N 7C | IEC | 52 |

### [DNA, RNA]

| Product Name | Separation Mode | Page |
|---|---|---|
| OHpak SB-800 HQ series | SEC | 30 |
| Asahipak GF-HQ series | SEC | 34 |

## Hormones

### [Amines]

| Product Name | Separation Mode | Page |
|---|---|---|
| ODP2 HP | RPC | 6, 58 |
| Asahipak ODP-40 | RPC | 8 |
| Asahipak ODP-50 | RPC | 8, 58 |
| Asahipak C8P-50 | RPC | 8 |
| Asahipak C4P-50 | RPC | 8 |
| RSpak DS series | RPC | 10 |
| RSpak DE series | RPC | 10, 58 |
| Asahipak ES-502C 7C | IEC | 54 |

### [Steroids]

| Product Name | Separation Mode | Page |
|---|---|---|
| Asahipak ODP-40 | RPC | 8 |
| Asahipak ODP-50 | RPC | 8, 58 |
| Asahipak NH2P series | HILIC | 12, 58 |
| OHpak SB-802.5 HQ | SEC | 30 |
| Asahipak GF-310 HQ | SEC | 34 |
| MSpak GF-310 | SEC | 34, 58 |

## Proteomics

### [Amino acids]

| Product Name | Separation Mode | Page |
|---|---|---|
| Asahipak ODP-50 | RPC | 8, 58 |
| RSpak NN series | IEC+IEX+RPC | 10, 58 |
| IC YS-50 | IEC | 24 |
| CXpak P-421S | IEC | 54 |
| Asahipak GS-320 HQ | IEC+SEC | 32 |

### [Peptides, Proteins]

| Product Name | Separation Mode | Page |
|---|---|---|
| Asahipak ODP-40 | RPC | 8 |
| Asahipak ODP-50 | RPC | 8, 58 |
| Asahipak C8P-50 | RPC | 8 |
| Asahipak C4P-50 | RPC | 8 |
| RSpak RP18-415 | RPC | 10 |
| PROTEIN KW-800 series | SEC | 28 |
| KW400 series | SEC | 28 |
| OHpak SB-800 HQ series | SEC | 30 |
| Asahipak GS-HQ series | SEC | 32 |
| Asahipak GF-HQ series | SEC | 34 |
| IEC QA-825 | IEC | 52 |
| IEC DEAE-825 | IEC | 52 |
| IEC DEAE3N-4T | IEC | 52 |
| PIKESS DEAE-2B | IEC | 52 |
| Asahipak ES-502N 7C | IEC | 52 |
| IEC SP-825 | IEC | 54 |
| IEC SP-420N | IEC | 54 |
| PIKESS SP-2B | IEC | 54 |
| IEC CM-825 | IEC | 54 |
| Asahipak ES-502C 7C | IEC | 54 |
| HIC PH-814 | HIC | 56 |

**Separation Mode**

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 List for Biotechnology Analysis

## Glycomics

### [Glycoproteins]

| Product Name | Separation Mode | Page |
|---|---|---|
| Asahipak ODP-40 | RPC | 8 |
| Asahipak ODP-50 | RPC | 8, 58 |
| Asahipak C8P-50 | RPC | 8 |
| Asahipak C4P-50 | RPC | 8 |
| RSpak RP18-415 | RPC | 10 |
| PROTEIN KW-800 series | SEC | 28 |
| KW400 series | SEC | 28 |
| OHpak SB-800 HQ series | SEC | 30 |
| Asahipak GS-HQ series | SEC | 32 |
| Asahipak GF-HQ series | SEC | 34 |
| IEC QA-825 | IEC | 52 |
| IEC DEAE-825 | IEC | 52 |
| IEC DEAE3N-4T | IEC | 52 |
| PIKESS DEAE-2B | IEC | 52 |
| Asahipak ES-502N 7C | IEC | 52 |
| IEC SP-825 | IEC | 54 |
| IEC SP-420N | IEC | 54 |
| PIKESS SP-2B | IEC | 54 |
| IEC CM-825 | IEC | 54 |
| Asahipak ES-502C 7C | IEC | 54 |
| HIC PH-814 | HIC | 56 |
| AFpak AWG-894 | AFC | 56 |

### [Sugar chains]

| Product Name | Separation Mode | Page |
|---|---|---|
| Asahipak NH2P series | HILIC | 12, 58 |
| AFpak AWG-894 | AFC | 56 |

### [Monosaccharides, Disaccharides, Sugar alcohols]

| Product Name | Separation Mode | Page |
|---|---|---|
| Asahipak NH2P series | HILIC | 12, 58 |
| SUGAR SC1011 | LEX+SEC | 16 |
| SUGAR SC1821 | LEX+SEC | 16 |
| SUGAR SP0810 | LEX+SEC | 16 |
| SUGAR KS-801 | LEX+SEC | 16 |
| SUGAR KS-802 | LEX+SEC | 16 |
| SUGAR SC1211 | LEX+HILIC | 16 |
| SUGAR SZ5532 | LEX+HILIC | 16 |
| RSpak DC-613 | LEX+HILIC | 16 |

### [Sialic acids, Uronic acids, Aldonic acids]

| Product Name | Separation Mode | Page |
|---|---|---|
| SUGAR SH1011 | IEX+SEC | 20 |
| SUGAR SH1821 | IEX+SEC | 20 |

## Lipids

### [Phospholipids]

| Product Name | Separation Mode | Page |
|---|---|---|
| Silica 5SIL | NPC | 14 |
| Asahipak GF-310 HQ | SEC | 34 |
| MSpak GF-310 | SEC | 34, 58 |
| GPC KF-802 | SEC | 36 |
| GPC KF-402HQ | SEC | 42 |

### [Lipoproteins]

| Product Name | Separation Mode | Page |
|---|---|---|
| OHpak SB-805 HQ | SEC | 30 |
| AFpak ADS-894 | AFC | 56 |
| AFpak AHR-894 | AFC | 56 |

**Separation Mode**

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 List for Environmental Analysis

## Water quality

### [Anions]

| Product Name | Separation Mode | Page |
|---|---|---|
| IC NI-424 | IC | 22 |
| IC I-524A | IC | 22 |
| IC SI series | IC | 22 |

### [Oxyhalides]

| Product Name | Separation Mode | Page |
|---|---|---|
| IC SI-35 4D | IC | 22 |
| IC SI-52 4E | IC | 22 |
| RSpak JJ-50 2D | IEC | 58 |

### [Cyanide, Cyanogen chloride]

| Product Name | Separation Mode | Page |
|---|---|---|
| RSpak KC-811 6E | IEX | 20 |

### [Cations]

| Product Name | Separation Mode | Page |
|---|---|---|
| IC YS-50 | IC | 24 |
| IC YK-421 | IC | 24 |
| IC Y-521 | IC | 24 |

### [Surfactants]

| Product Name | Separation Mode | Page |
|---|---|---|
| Asahipak ODP-50 4D | RPC | 8 |
| Silica C18M | RPC | 14 |
| Asahipak GF-310 HQ | SEC+RPC | 34 |
| MSpak GF-310 | SEC+RPC | 34, 58 |

### [Perchloric acids]

| Product Name | Separation Mode | Page |
|---|---|---|
| SI-90 4E | IC | 22 |
| RSpak JJ-50 2D | IEC | 58 |

### [Pesticides]

| Product Name | Separation Mode | Page |
|---|---|---|
| RSpak DE series | RPC | 10, 58 |
| RSpak NN series | IEC+RPC | 10, 58 |
| IC SI-90 4E | IC | 22 |

## Soil

### [Anions]

| Product Name | Separation Mode | Page |
|---|---|---|
| IC NI-424 | IC | 22 |
| IC I-524A | IC | 22 |
| IC SI series | IC | 22 |

### [Heavy metals]

| Product Name | Separation Mode | Page |
|---|---|---|
| IC T-521 | IC | 24 |

### [Humic substances]

| Product Name | Separation Mode | Page |
|---|---|---|
| OHpak SB-805 HQ | SEC | 30 |

### [Organic arsenics]

| Product Name | Separation Mode | Page |
|---|---|---|
| RSpak NN series | IEC+RPC | 10, 58 |

### [Pesticides]

| Product Name | Separation Mode | Page |
|---|---|---|
| RSpak DE series | RPC | 10, 58 |
| RSpak NN series | IEC+RPC | 10, 58 |
| IC SI-90 4E | IC | 22 |

## Environmental hormones

### [Pretreatment of Phthalates, PCBs, Benzo [a] pyrene]

| Product Name | Separation Mode | Page |
|---|---|---|
| CLNpak PAE series | SEC (GPC Clean-up) | 62 |

## Bioethanol

### [Monosaccharides, Oligosaccharides]

| Product Name | Separation Mode | Page |
|---|---|---|
| Asahipak NH2P series | HILIC | 12, 58 |
| SUGAR SP0810 | LEX+SEC | 16 |

### [Oligosaccharides, Alcohols, Furfural]

| Product Name | Separation Mode | Page |
|---|---|---|
| SUGAR KS-802 | LEX+SEC | 16 |
| SUGAR SC1821 | LEX+SEC | 16 |

### [Saccharides, Organic acids, Alcohols, Furfural]

| Product Name | Separation Mode | Page |
|---|---|---|
| SUGAR SH1011 | IEX+RPC+SEC | 20 |
| SUGAR SH1821 | IEX+RPC+SEC | 20 |

### [Hemicellulose, Cellulose]

| Product Name | Separation Mode | Page |
|---|---|---|
| GPC KD-800 series | SEC | 40 |
| GPC LF-804 | SEC | 44 |

## Biodiesel

### [Cations]

| Product Name | Separation Mode | Page |
|---|---|---|
| IC YS-50 | IC | 24 |

### [Fatty acid glycerides]

| Product Name | Separation Mode | Page |
|---|---|---|
| Asahipak GF-210 HQ | SEC | 34 |
| Asahipak GF-310 HQ | SEC | 34 |
| MSpak GF-310 | SEC | 34, 58 |

### [Fatty acid methyl esters]

| Product Name | Separation Mode | Page |
|---|---|---|
| RSpak DS series | RPC | 10 |

### [Organic acids]

| Product Name | Separation Mode | Page |
|---|---|---|
| IC SI-35 4D | IC | 22 |
| IC SI-52 4E | IC | 22 |

**Separation Mode**

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



# USP (Ver.35) Column List

| No. | Packing Material | Recommended Column | Page |
|---|---|---|---|
| L1 | Octadecyl silane chemically bonded to porous or non-porous silica or ceramic micro-particles, 1.5 to 10μm in diameter, or a monolithic rod | Silica C18M | 14 |
| | | Silica C18P | 14 |
| | | ODSpak F-411 | 14 |
| L3 | Porous silica particles, 1.5 to 10μm in diameter, or a monolithic silica rod. | Silica 5SIL | 14 |
| L7 | Octylsilane chemically bonded to totally or superficially porous silica particles, 1.5 to 10μm in diameter, or a monolithic silica rod. | Silica 5C8 | 14 |
| L8 | An essentially monomolecular layer of aminopropylsilane chemically bonded to totally porous silica gel support, 1.5 to 10μm in diameter | Silica 5NH | 14 |
| L10 | Nitrile groups chemically bonded to porous silica particles, 1.5 to 10μm in diameter | Silica 5CN | 14 |
| L11 | Phenyl groups chemically bonded to porous silica particles, 1.5 to 10μm in diameter | Silica 5NPE | 14 |
| L17 | Strong cation-exchange resin consisting of sulfonated cross-linked styrene-divinylbenzene copolymer in the hydrogen form, 6 to 12μm in diameter | SUGAR SH1011 | 20 |
| | | SUGAR SH1821 | 20 |
| | | RSpak KC-811 | 20 |
| | | IC Y-521 | 24 |
| L19 | Strong cation-exchange resin consisting of sulfonated cross-linked styrene-divinylbenzene copolymer in the calcium form, about 9μm in diameter | SUGAR SC1011 | 16 |
| | | SUGAR SC1821 | 16 |
| | | SUGAR SC1211 | 16 |
| | | USPpak MN-431 | 16 |
| L20 | Dihydroxypropane groups chemically bonded to porous silica or hybrid particles, 1.5 to 10μm in diameter | PROTEIN KW-800 series | 28 |
| | | KW400 series | 28 |
| L21 | A rigid, spherical styrene-divinylbenzene copolymer, 3 to 30μm in diameter | GPC KF,K,KD,HFIP,LF,AT,UT series | 36, 38, 40, 42, 44, 46, 48 |
| | | RSpak DS-613 | 10 |
| | | RSpak DS-413 | 10 |
| | | RSpak RP18-415 | 10 |
| L22 | A cation-exchange resin made of porous polystyrene gel with sulfonic acid groups, about 10μm in size | CXpak P-421S | 54 |
| | | SUGAR SP0810 | 16 |
| | | SUGAR SC1011 | 16 |
| | | SUGAR SC1821 | 16 |
| | | SUGAR KS-800 series | 16 |
| | | SUGAR SC1211 | 16 |
| | | SUGAR SZ5532 | 16 |
| | | USPpak MN-431 | 16 |
| | | RSpak DC-613 | 16 |
| | | SUGAR SH1011 | 20 |
| | | SUGAR SH1821 | 20 |
| | | RSpak KC-811 | 20 |
| | | IC Y-521 | 24 |
| L23 | An anion-exchange resin made of porous polymethacrylate or polyacrylate gel with quartenary ammonium groups, 7-12μm in size | IEC QA-825 | 52 |
| L25 | Packing having the capacity to separate compounds with a molecular weight range from 100-5000 (as determined by polyethylene oxide), applied to neutral, anionic, and cationic water-soluble polymers. A polymethacrylate resin base, cross-linked with polyhydroxylated ether (surface contained some residual carboxyl functional groups) was found suitable | OHpak SB-802 HQ | 30 |
| | | OHpak SB-802.5 HQ | 30 |
| L26 | Butyl silane chemically bonded to totally porous silica particles, 1.5 to 10μm in diameter | Silica 5C4 | 14 |
| L33 | Packing having the capacity to separate dextrans by molecular size over a range of 4,000 to 500,000Da. It is spherical, silica-based, and processed to provide pH stability | PROTEIN KW-800 series | 28 |
| | | KW400 series | 28 |
| L34 | Strong cation-exchange resin consisting of sulfonated cross-linked styrene-divinylbenzene copolymer in the lead form, about 7 to 9μm in diameter | SUGAR SP0810 | 16 |
| L37 | Packing having the capacity to separate proteins by molecular size over a range of 2,000 to 40,000 Da. It is a polymethacrylate gel | OHpak SB-803 HQ | 30 |
| L38 | A methacrylate-based size-exclusion packing for water-soluble samples | OHpak SB-800 HQ series | 30 |
| L39 | A hydrophilic polyhydroxymethacrylate gel of totally porous spherical resin | OHpak SB-800 HQ series | 30 |
| | | ODP2 HP | 6, 58 |
| | | RSpak DM-614 | 10 |
| L45 | Beta cyclodextrin, R,S-hydroxypropyl ether derivative, bonded to porous silica particles, 5 to 10μm in diameter | ORpak CDBS-453 | 56 |
| L58 | Strong cation-exchange resin consisting of sulfonated cross-linked styrene-divinylbenzene copolymer in the sodium form, about 6 to 30μm diameter | CXpak P-421S | 54 |
| | | SUGAR KS-800 series | 16 |
| | | RSpak DC-613 | 16 |
| L59 | Packing for the size-exclusion separations of proteins (separation by molecular weight) over the range of 5 to 7000kDa. It is spherical (1.5 - 10μm), silica or hybrid packing with a hydrophilic coating. | PROTEIN KW-800 series | 28 |
| | | KW400 series | 28 |
| L67 | Porous vinyl alcohol copolymer with a C18 alkyl group attached to the hydroxyl group of the polymer, 2 to 10μm in diameter | Asahipak ODP-40 | 8 |
| | | Asahipak ODP-50 | 8, 58 |
| | | ET-RP1 | 56 |
| L71 | A rigid, spherical polymetacrylate, 4 to 6μm in diameter | RSpak DE-613 | 10 |
| | | RSpak DE-413 | 10 |
| | | RSpak DE-213 | 10, 58 |

# Semi-micro and Micro Columns

## Polymer-based Packed Columns for Reversed Phase and Hydrophilic Interaction Chromatography (HILIC)

### Asahipak ODP-40 semi-micro and micro type

Base Material : Polyvinyl alcohol
Functional Group : Octadecyl

| I.D. | Length (mm) | Product Name | Product Code |
|---|---|---|---|
| 2.0mm | 250 | ODP40-2E | F7838021 |
| | 150 | ODP40-2D | F7838022 |
| | 50 | ODP40-2B | F7838023 |
| | 35 | ODP40-2T | F7838024 |
| 1.0mm | 250 | ODP40-1E | F7838031 |
| | 150 | ODP40-1D | F7838032 |
| | 50 | ODP40-1B | F7838033 |
| | 35 | ODP40-1T | F7838034 |
| 0.5mm | 250 | ODP40-M5E | F7838051 |
| | 150 | ODP40-M5D | F7838052 |
| | 50 | ODP40-M5B | F7838053 |
| | 35 | ODP40-M5T | F7838054 |

* See page 8 for Asahipak ODP-40.
* See page 78 for preparative columns.

### RSpak DE-413 semi-micro and micro type

Base Material : Polymethacrylate

| I.D. | Length (mm) | Product Name | Product Code |
|---|---|---|---|
| 2.0mm | 250 | DE413-2E | F7840121 |
| | 150 | DE413-2D | F7840122 |
| | 50 | DE413-2B | F7840123 |
| | 35 | DE413-2T | F7840124 |
| 1.0mm | 250 | DE413-1E | F7840131 |
| | 150 | DE413-1D | F7840132 |
| | 50 | DE413-1B | F7840133 |
| | 35 | DE413-1T | F7840134 |
| 0.5mm | 150 | DE413-M5D | F7840152 |
| | 50 | DE413-M5B | F7840153 |
| | 35 | DE413-M5T | F7840154 |

* See page 10 for RSpak DE-413 series.
* See page 78 for preparative columns.

### RSpak NN-414 semi-micro and micro type

Base Material : Polyhydroxymethacrylate
Functional Group : Sulfo

| I.D. | Length (mm) | Product Name | Product Code |
|---|---|---|---|
| 2.0mm | 150 | NN414-2D | F7860122 |
| | 50 | NN414-2B | F7860123 |
| | 35 | NN414-2T | F7860124 |
| 1.0mm | 150 | NN414-1D | F7860132 |
| | 50 | NN414-1B | F7860133 |
| | 35 | NN414-1T | F7860134 |
| 0.5mm | 150 | NN414-M5D | F7860152 |
| | 50 | NN414-M5B | F7860153 |
| | 35 | NN414-M5T | F7860154 |

* See page 10 for RSpak NN-414.

### Asahipak NH2P-40 semi-micro and micro type

Base Material : Polyvinyl alcohol
Functional Group : Amino

| I.D. | Length (mm) | Product Name | Product Code |
|---|---|---|---|
| 2.0mm | 250 | NH2P40-2E | Name Chenge Refer to p.58 |
| | 150 | NH2P40-2D | |
| | 50 | NH2P40-2B | |
| | 35 | NH2P40-2T | F7858024 |
| 1.0mm | 250 | NH2P40-1E | F7858031 |
| | 150 | NH2P40-1D | F7858032 |
| | 50 | NH2P40-1B | F7858033 |
| | 35 | NH2P40-1T | F7858034 |
| 0.5mm | 250 | NH2P40-M5E | F7858051 |
| | 150 | NH2P40-M5D | F7858052 |
| | 50 | NH2P40-M5B | F7858053 |
| | 35 | NH2P40-M5T | F7858054 |

* See page 12 for Asahipak NH2P-40 series.
* See page 79 for preparative columns.



*Contact Shodex or our distributors near you for customized columns.



## Aqueous SEC (GFC) Column : Silica-based

### KW402.5 semi-micro and micro type

Base Material : Silica

| I.D. | Length (mm) | Product Name | Product Code |
|---|---|---|---|
| 4.6mm | 150 | KW402.5-4D | F7781212 |
| | 50 | KW402.5-4B | F7781213 |
| 2.0mm | 250 | KW402.5-2E | F7781221 |
| | 150 | KW402.5-2D | F7781222 |
| | 50 | KW402.5-2B | F7781223 |
| 1.0mm | 250 | KW402.5-1E | F7781231 |
| | 150 | KW402.5-1D | F7781232 |
| | 50 | KW402.5-1B | F7781233 |
| 0.5mm | 250 | KW402.5-M5E | F7781251 |
| | 150 | KW402.5-M5D | F7781252 |
| | 50 | KW402.5-M5B | F7781253 |

* See page 28 for KW402.5-4F.
* See page 81 for preparative columns.

### KW403 semi-micro and micro type

Base Material : Silica

| I.D. | Length (mm) | Product Name | Product Code |
|---|---|---|---|
| 4.6mm | 150 | KW403-4D | F7781312 |
| | 50 | KW403-4B | F7781313 |
| 2.0mm | 250 | KW403-2E | F7781321 |
| | 150 | KW403-2D | F7781322 |
| | 50 | KW403-2B | F7781323 |
| 1.0mm | 250 | KW403-1E | F7781331 |
| | 150 | KW403-1D | F7781332 |
| | 50 | KW403-1B | F7781333 |
| 0.5mm | 250 | KW403-M5E | F7781351 |
| | 150 | KW403-M5D | F7781352 |
| | 50 | KW403-M5B | F7781353 |

* See page 28 for KW403-4F.
* See page 81 for preparative columns.

### KW404 semi-micro and micro type

Base Material : Silica

| I.D. | Length (mm) | Product Name | Product Code |
|---|---|---|---|
| 4.6mm | 150 | KW404-4D | F7781412 |
| | 50 | KW404-4B | F7781413 |
| 2.0mm | 250 | KW404-2E | F7781421 |
| | 150 | KW404-2D | F7781422 |
| | 50 | KW404-2B | F7781423 |
| 1.0mm | 250 | KW404-1E | F7781431 |
| | 150 | KW404-1D | F7781432 |
| | 50 | KW404-1B | F7781433 |
| 0.5mm | 250 | KW404-M5E | F7781451 |
| | 150 | KW404-M5D | F7781452 |
| | 50 | KW404-M5B | F7781453 |

* See page 28 for KW404-4F.
* See page 81 for preparative columns.

### KW405 semi-micro and micro type

Base Material : Silica

| I.D. | Length (mm) | Product Name | Product Code |
|---|---|---|---|
| 4.6mm | 150 | KW405-4D | F7781512 |
| | 50 | KW405-4B | F7781513 |
| 2.0mm | 250 | KW405-2E | F7781521 |
| | 150 | KW405-2D | F7781522 |
| | 50 | KW405-2B | F7781523 |
| 1.0mm | 250 | KW405-1E | F7781531 |
| | 150 | KW405-1D | F7781532 |
| | 50 | KW405-1B | F7781533 |
| 0.5mm | 250 | KW405-M5E | F7781551 |
| | 150 | KW405-M5D | F7781552 |
| | 50 | KW405-M5B | F7781553 |

* See page 28 for KW405-4F.
* See page 81 for preparative columns.



*Contact Shodex or our distributors near you for customized columns.

# Semi-micro and Micro Columns

## Aqueous SEC (GFC) Columns : Polymer-based

### OHpak SB-802 HQ semi-micro and micro type

Base Material : Polyhydroxymethacrylate

| I.D. | Length (mm) | Product Name | Product Code |
|---|---|---|---|
| 4.6mm | 250 | SB802-4E | F7770111 |
| | 150 | SB802-4D | F7770112 |
| | 50 | SB802-4B | F7770113 |
| 2.0mm | 250 | SB802-2E | F7770121 |
| | 150 | SB802-2D | F7770122 |
| | 50 | SB802-2B | F7770123 |
| 1.0mm | 250 | SB802-1E | F7770131 |
| | 150 | SB802-1D | F7770132 |
| | 50 | SB802-1B | F7770133 |
| 0.5mm | 250 | SB802-M5E | F7770151 |
| | 150 | SB802-M5D | F7770152 |
| | 50 | SB802-M5B | F7770153 |

* See page 30 for OHpak SB-802 HQ.
* See page 81 for preparative columns.

### OHpak SB-802.5 HQ semi-micro and micro type

Base Material : Polyhydroxymethacrylate

| I.D. | Length (mm) | Product Name | Product Code |
|---|---|---|---|
| 4.6mm | 250 | SB802.5-4E | F7770211 |
| | 150 | SB802.5-4D | F7770212 |
| | 50 | SB802.5-4B | F7770213 |
| 2.0mm | 250 | SB802.5-2E | F7770221 |
| | 150 | SB802.5-2D | F7770222 |
| | 50 | SB802.5-2B | F7770223 |
| 1.0mm | 250 | SB802.5-1E | F7770231 |
| | 150 | SB802.5-1D | F7770232 |
| | 50 | SB802.5-1B | F7770233 |
| 0.5mm | 250 | SB802.5-M5E | F7770251 |
| | 150 | SB802.5-M5D | F7770252 |
| | 50 | SB802.5-M5B | F7770253 |

* See page 30 for OHpak SB-802.5 HQ.
* See page 81 for preparative columns.

### OHpak SB-803 HQ semi-micro and micro type

Base Material : Polyhydroxymethacrylate

| I.D. | Length (mm) | Product Name | Product Code |
|---|---|---|---|
| 4.6mm | 250 | SB803-4E | F7770311 |
| | 150 | SB803-4D | F7770312 |
| | 50 | SB803-4B | F7770313 |
| 2.0mm | 250 | SB803-2E | F7770321 |
| | 150 | SB803-2D | F7770322 |
| | 50 | SB803-2B | F7770323 |
| 1.0mm | 250 | SB803-1E | F7770331 |
| | 150 | SB803-1D | F7770332 |
| | 50 | SB803-1B | F7770333 |
| 0.5mm | 250 | SB803-M5E | F7770351 |
| | 150 | SB803-M5D | F7770352 |
| | 50 | SB803-M5B | F7770353 |

* See page 30 for OHpak SB-803 HQ.
* See page 81 for preparative columns.

### OHpak SB-804 HQ semi-micro and micro type

Base Material : Polyhydroxymethacrylate

| I.D. | Length (mm) | Product Name | Product Code |
|---|---|---|---|
| 4.6mm | 250 | SB804-4E | F7770411 |
| | 150 | SB804-4D | F7770412 |
| | 50 | SB804-4B | F7770413 |
| 2.0mm | 250 | SB804-2E | F7770421 |
| | 150 | SB804-2D | F7770422 |
| | 50 | SB804-2B | F7770423 |
| 1.0mm | 250 | SB804-1E | F7770431 |
| | 150 | SB804-1D | F7770432 |
| | 50 | SB804-1B | F7770433 |
| 0.5mm | 250 | SB804-M5E | F7770451 |
| | 150 | SB804-M5D | F7770452 |
| | 50 | SB804-M5B | F7770453 |

* See page 30 for OHpak SB-804 HQ.
* See page 81 for preparative columns.

### OHpak SB-805 HQ semi-micro and micro type

Base Material : Polyhydroxymethacrylate

| I.D. | Length (mm) | Product Name | Product Code |
|---|---|---|---|
| 4.6mm | 250 | SB805-4E | F7770511 |
| | 150 | SB805-4D | F7770512 |
| | 50 | SB805-4B | F7770513 |
| 2.0mm | 250 | SB805-2E | F7770521 |
| | 150 | SB805-2D | F7770522 |
| | 50 | SB805-2B | F7770523 |
| 1.0mm | 250 | SB805-1E | F7770531 |
| | 150 | SB805-1D | F7770532 |
| | 50 | SB805-1B | F7770533 |
| 0.5mm | 250 | SB805-M5E | F7770551 |
| | 150 | SB805-M5D | F7770552 |
| | 50 | SB805-M5B | F7770553 |

* See page 30 for OHpak SB-805 HQ.
* See page 81 for preparative columns.

### OHpak SB-806 HQ semi-micro and micro type

Base Material : Polyhydroxymethacrylate

| I.D. | Length (mm) | Product Name | Product Code |
|---|---|---|---|
| 4.6mm | 250 | SB806-4E | F7770611 |
| | 150 | SB806-4D | F7770612 |
| | 50 | SB806-4B | F7770613 |
| 2.0mm | 250 | SB806-2E | F7770621 |
| | 150 | SB806-2D | F7770622 |
| | 50 | SB806-2B | F7770623 |
| 1.0mm | 250 | SB806-1E | F7770631 |
| | 150 | SB806-1D | F7770632 |
| | 50 | SB806-1B | F7770633 |
| 0.5mm | 250 | SB806-M5E | F7770651 |
| | 150 | SB806-M5D | F7770652 |
| | 50 | SB806-M5B | F7770653 |

* See page 30 for OHpak SB-806 HQ.
* See page 81 for preparative columns.

*Contact Shodex or our distributors near you for customized columns.





Semi-micro and Micro Columns

## Multimode Columns

### Asahipak GS-220 HQ semi-micro and micro type

Base Material : Polyvinyl alcohol

| I.D. | Length (mm) | Product Name | Product Code |
|---|---|---|---|
| 4.6mm | 250 | GS220A-4E | F7750211 |
| | 150 | GS220A-4D | F7750212 |
| | 50 | GS220A-4B | F7750213 |
| 2.0mm | 250 | GS220A-2E | F7750221 |
| | 150 | GS220A-2D | F7750222 |
| | 50 | GS220A-2B | F7750223 |
| 1.0mm | 250 | GS220A-1E | F7750231 |
| | 150 | GS220A-1D | F7750232 |
| | 50 | GS220A-1B | F7750233 |
| 0.5mm | 250 | GS220A-M5E | F7750251 |
| | 150 | GS220A-M5D | F7750252 |
| | 50 | GS220A-M5B | F7750253 |

* See page 32 for Asahipak GS-220 HQ.
* See page 82 for preparative columns.

### Asahipak GS-320 HQ semi-micro and micro type

Base Material : Polyvinyl alcohol

| I.D. | Length (mm) | Product Name | Product Code |
|---|---|---|---|
| 4.6mm | 250 | GS320A-4E | F7750311 |
| | 150 | GS320A-4D | F7750312 |
| | 50 | GS320A-4B | F7750313 |
| 2.0mm | 250 | GS320A-2E | F7750321 |
| | 150 | GS320A-2D | F7750322 |
| | 50 | GS320A-2B | F7750323 |
| 1.0mm | 250 | GS320A-1E | F7750331 |
| | 150 | GS320A-1D | F7750332 |
| | 50 | GS320A-1B | F7750333 |
| 0.5mm | 250 | GS320A-M5E | F7750351 |
| | 150 | GS320A-M5D | F7750352 |
| | 50 | GS320A-M5B | F7750353 |

* See page 32 for Asahipak GS-320 HQ.
* See page 82 for preparative columns.

### Asahipak GS-520 HQ semi-micro and micro type

Base Material : Polyvinyl alcohol

| I.D. | Length (mm) | Product Name | Product Code |
|---|---|---|---|
| 4.6mm | 250 | GS520A-4E | F7750511 |
| | 150 | GS520A-4D | F7750512 |
| | 50 | GS520A-4B | F7750513 |
| 2.0mm | 250 | GS520A-2E | F7750521 |
| | 150 | GS520A-2D | F7750522 |
| | 50 | GS520A-2B | F7750523 |
| 1.0mm | 250 | GS520A-1E | F7750531 |
| | 150 | GS520A-1D | F7750532 |
| | 50 | GS520A-1B | F7750533 |
| 0.5mm | 250 | GS520A-M5E | F7750551 |
| | 150 | GS520A-M5D | F7750552 |
| | 50 | GS520A-M5B | F7750553 |

* See page 32 for Asahipak GS-520 HQ.
* See page 82 for preparative columns.

### Asahipak GS-620 HQ semi-micro and micro type

Base Material : Polyvinyl alcohol

| I.D. | Length (mm) | Product Name | Product Code |
|---|---|---|---|
| 4.6mm | 250 | GS620A-4E | F7750611 |
| | 150 | GS620A-4D | F7750612 |
| | 50 | GS620A-4B | F7750613 |
| 2.0mm | 250 | GS620A-2E | F7750621 |
| | 150 | GS620A-2D | F7750622 |
| | 50 | GS620A-2B | F7750623 |
| 1.0mm | 250 | GS620A-1E | F7750631 |
| | 150 | GS620A-1D | F7750632 |
| | 50 | GS620A-1B | F7750633 |
| 0.5mm | 250 | GS620A-M5E | F7750651 |
| | 150 | GS620A-M5D | F7750652 |
| | 50 | GS620A-M5B | F7750653 |

* See page 32 for Asahipak GS-620 HQ.
* See page 82 for preparative columns.

*Contact Shodex or our distributors near you for customized columns.

# Semi-micro and Micro Columns

## Aqueous/Organic SEC Columns

### Asahipak GF-310 HQ semi-micro and micro type

Base Material : Polyvinyl alcohol

| I.D. | Length (mm) | Product Name | Product Code |
|---|---|---|---|
| 4.6mm | 250 | GF310A-4E | F7760311 |
| | 150 | GF310A-4D | F7760312 |
| | 50 | GF310A-4B | F7760313 |
| 2.0mm | 250 | GF310A-2E | F7760321 |
| | 150 | GF310A-2D | F7760322 |
| | 50 | GF310A-2B | F7760323 |
| 1.0mm | 250 | GF310A-1E | F7760331 |
| | 150 | GF310A-1D | F7760332 |
| | 50 | GF310A-1B | F7760333 |
| 0.5mm | 250 | GF310A-M5E | F7760351 |
| | 150 | GF310A-M5D | F7760352 |
| | 50 | GF310A-M5B | F7760353 |

* See page 34 for Asahipak GF-310 HQ.
* See page 82 for preparative columns.

### Asahipak GF-510 HQ semi-micro and micro type

Base Material : Polyvinyl alcohol

| I.D. | Length (mm) | Product Name | Product Code |
|---|---|---|---|
| 4.6mm | 250 | GF510A-4E | F7760511 |
| | 150 | GF510A-4D | F7760512 |
| | 50 | GF510A-4B | F7760513 |
| 2.0mm | 250 | GF510A-2E | F7760521 |
| | 150 | GF510A-2D | F7760522 |
| | 50 | GF510A-2B | F7760523 |
| 1.0mm | 250 | GF510A-1E | F7760531 |
| | 150 | GF510A-1D | F7760532 |
| | 50 | GF510A-1B | F7760533 |
| 0.5mm | 250 | GF510A-M5E | F7760551 |
| | 150 | GF510A-M5D | F7760552 |
| | 50 | GF510A-M5B | F7760553 |

* See page 34 for Asahipak GF-510 HQ.
* See page 82 for preparative columns.

### Asahipak GF-710 HQ semi-micro and micro type

Base Material : Polyvinyl alcohol

| I.D. | Length (mm) | Product Name | Product Code |
|---|---|---|---|
| 4.6mm | 250 | GF710A-4E | F7760711 |
| | 150 | GF710A-4D | F7760712 |
| | 50 | GF710A-4B | F7760713 |
| 2.0mm | 250 | GF710A-2E | F7760721 |
| | 150 | GF710A-2D | F7760722 |
| | 50 | GF710A-2B | F7760723 |
| 1.0mm | 250 | GF710A-1E | F7760731 |
| | 150 | GF710A-1D | F7760732 |
| | 50 | GF710A-1B | F7760733 |
| 0.5mm | 250 | GF710A-M5E | F7760751 |
| | 150 | GF710A-M5D | F7760752 |
| | 50 | GF710A-M5B | F7760753 |

* See page 34 for Asahipak GF-710 HQ.
* See page 82 for preparative columns.



*Contact Shodex or our distributors near you for customized columns.



# Semi-micro and Micro Columns

## Columns for Anion Exchange Chromatography

### IEC QA-825 semi-micro and micro type

Base Material : Polyhydroxymethacrylate
Functional Group : Quaternary ammonium

| I.D. | Length (mm) | Product Name | Product Code |
|---|---|---|---|
| 2.0mm | 150 | QA8-2D | F7940322 |
| | 50 | QA8-2B | F7940323 |
| | 35 | QA8-2T | F7940324 |
| 1.0mm | 150 | QA8-1D | F7940332 |
| | 50 | QA8-1B | F7940333 |
| | 35 | QA8-1T | F7940334 |
| 0.5mm | 150 | QA8-M5D | F7940352 |
| | 50 | QA8-M5B | F7940353 |
| | 35 | QA8-M5T | F7940354 |

* See page 52 for IEC QA-825.
* See page 80 for preparative columns.

### IEC DEAE-825 semi-micro and micro type

Base Material : Polyhydroxymethacrylate
Functional Group : Diethylaminoethyl

| I.D. | Length (mm) | Product Name | Product Code |
|---|---|---|---|
| 2.0mm | 150 | DEAE8-2D | F7940422 |
| | 50 | DEAE8-2B | F7940423 |
| | 35 | DEAE8-2T | F7940424 |
| 1.0mm | 150 | DEAE8-1D | F7940432 |
| | 50 | DEAE8-1B | F7940433 |
| | 35 | DEAE8-1T | F7940434 |
| 0.5mm | 150 | DEAE8-M5D | F7940452 |
| | 50 | DEAE8-M5B | F7940453 |
| | 35 | DEAE8-M5T | F7940454 |

* See page 52 for IEC DEAE-825.
* See page 80 for preparative columns.

### Asahipak ES-502N semi-micro and micro type

Base Material : Polyvinyl alcohol
Functional Group : Diethylaminoethyl

| I.D. | Length (mm) | Product Name | Product Code |
|---|---|---|---|
| 2.0mm | 150 | DEAE9A-2D | F7960122 |
| | 50 | DEAE9A-2B | F7960123 |
| | 35 | DEAE9A-2T | F7960124 |
| 1.0mm | 150 | DEAE9A-1D | F7960132 |
| | 50 | DEAE9A-1B | F7960133 |
| | 35 | DEAE9A-1T | F7960134 |
| 0.5mm | 150 | DEAE9A-M5D | F7960152 |
| | 50 | DEAE9A-M5B | F7960153 |
| | 35 | DEAE9A-M5T | F7960154 |

* See page 52 for Asahipak ES-502N 7C.
* See page 80 for preparative columns.

## Columns for Cation Exchange Chromatography

### IEC SP-825 semi-micro and micro type

Base Material : Polyhydroxymethacrylate
Functional Group : Sulfopropyl

| I.D. | Length (mm) | Product Name | Product Code |
|---|---|---|---|
| 2.0mm | 150 | SP8-2D | F7940122 |
| | 50 | SP8-2B | F7940123 |
| | 35 | SP8-2T | F7940124 |
| 1.0mm | 150 | SP8-1D | F7940132 |
| | 50 | SP8-1B | F7940133 |
| | 35 | SP8-1T | F7940134 |
| 0.5mm | 150 | SP8-M5D | F7940152 |
| | 50 | SP8-M5B | F7940153 |
| | 35 | SP8-M5T | F7940154 |

* See page 54 for IEC SP-825.
* See page 81 for preparative columns.

### IEC CM-825 semi-micro and micro type

Base Material : Polyhydroxymethacrylate
Functional Group : Carboxymethyl

| I.D. | Length (mm) | Product Name | Product Code |
|---|---|---|---|
| 2.0mm | 150 | CM8-2D | F7940222 |
| | 50 | CM8-2B | F7940223 |
| | 35 | CM8-2T | F7940224 |
| 1.0mm | 150 | CM8-1D | F7940232 |
| | 50 | CM8-1B | F7940233 |
| | 35 | CM8-1T | F7940234 |
| 0.5mm | 150 | CM8-M5D | F7940252 |
| | 50 | CM8-M5B | F7940253 |
| | 35 | CM8-M5T | F7940254 |

* See page 54 for IEC CM-825.
* See page 81 for preparative columns.

### Asahipak ES-502C semi-micro and micro type

Base Material : Polyvinyl alcohol
Functional Group : Carboxymethyl

| I.D. | Length (mm) | Product Name | Product Code |
|---|---|---|---|
| 2.0mm | 150 | CM9A-2D | F7960222 |
| | 50 | CM9A-2B | F7960223 |
| | 35 | CM9A-2T | F7960224 |
| 1.0mm | 150 | CM9A-1D | F7960232 |
| | 50 | CM9A-1B | F7960233 |
| | 35 | CM9A-1T | F7960234 |
| 0.5mm | 150 | CM9A-M5D | F7960252 |
| | 50 | CM9A-M5B | F7960253 |
| | 35 | CM9A-M5T | F7960254 |

* See page 54 for Asahipak ES-502C 7C.
* See page 81 for preparative columns.



*Contact Shodex or our distributors near you for customized columns.

# Preparative Columns (I.D. 10mm~50mm)

## Columns for Polymer-based Reversed Phase Chromatography

### Asahipak ODP-50 preparative type

| Product Code | Product Name | Plate Number (TP/column) | Functional Group | Particle Size (µm) | Column Size (mm) I.D. x Length |
|---|---|---|---|---|---|
| F6820001 | **Asahipak ODP-50 10E** | ≥ 10,000 | Octadecyl | 5 | **10.0 × 250** |
| F6820035 | **Asahipak ODP-90 20F** | ≥ 9,000 | Octadecyl | 9 | **20.0 × 300** |
| F6820019 | **Asahipak ODP-130 28F** | ≥ 9,000 | Octadecyl | 13 | **28.0 × 300** |
| F6710004 | **Asahipak ODP-130G 7B** | (guard column) | Octadecyl | 13 | **7.5 × 50** |
| F6714029 | **Asahipak ODP-130G 20C** | (guard column) | Octadecyl | 13 | **20.0 × 100** |

* See page 8 for Asahipak ODP-50.
Base Material : Polyvinyl alcohol
* See page 72 for semi-micro columns and micro columns.

### Asahipak C8P-50 preparative type

| Product Code | Product Name | Plate Number (TP/column) | Functional Group | Particle Size (µm) | Column Size (mm) I.D. x Length |
|---|---|---|---|---|---|
| F6820003 | **Asahipak C8P-50 10E** | ≥ 8,000 | Octyl | 5 | **10.0 × 250** |
| F6714004 | **Asahipak C8P-50G 7B** | (guard column) | Octyl | 5 | **7.5 × 50** |

* See page 8 for Asahipak C8P-50.
Base Material : Polyvinyl alcohol

### Asahipak C4P-50 preparative type

| Product Code | Product Name | Plate Number (TP/column) | Functional Group | Particle Size (µm) | Column Size (mm) I.D. x Length |
|---|---|---|---|---|---|
| F6820005 | **Asahipak C4P-50 10E** | ≥ 7,000 | Butyl | 5 | **10.0 × 250** |
| F6714005 | **Asahipak C4P-50G 7B** | (guard column) | Butyl | 5 | **7.5 × 50** |

* See page 8 for Asahipak C4P-50.
Base Material : Polyvinyl alcohol

### RSpak DE-613 preparative type

| Product Code | Product Name | Plate Number (TP/column) | Functional Group | Particle Size (µm) | Column Size (mm) I.D. x Length |
|---|---|---|---|---|---|
| F6513013 | **RSpak DE-2013** | ≥ 10,000 | – | 12 | **20.0 × 300** |
| F6700190 | **RSpak DE-LG** | (guard column) | – | 12 | **8.0 × 50** |
| F6513015 | **RSpak DE-5013** | – | – | 12 | **50.0 × 300** |
| F6700191 | **RSpak DE-LLG** | (guard column) | – | 12 | **20.0 × 100** |

* See page 10 for RSpak DE-613.
Base Material : Polymethacrylate
* See page 72 for semi-micro columns and micro columns.

### RSpak DM-614 preparative type

| Product Code | Product Name | Plate Number (TP/column) | Functional Group | Particle Size (µm) | Column Size (mm) I.D. x Length |
|---|---|---|---|---|---|
| F6514014 | **RSpak DM-2014** | ≥ 5,000 | – | 12 | **20.0 × 300** |
| F6700404 | **RSpak DM-LG** | (guard column) | – | 12 | **8.0 × 50** |
| F6514022 | **RSpak DM-5014** | – | – | 12 | **50.0 × 300** |
| F6700162 | **RSpak DM-LLG** | (guard column) | – | 12 | **20.0 × 100** |

* See page 10 for RSpak DM-614.
Base Material : Polyhydroxymethacrylate



*Contact Shodex or our distributors near you for customized columns.



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

### Asahipak NH2P-50 preparative type

| Product Code | Product Name | Plate Number (TP/column) | Functional Group | Particle Size (µm) | Column Size (mm) I.D. x Length |
|---|---|---|---|---|---|
| F6830001 | **Asahipak NH2P-50 10E** | ≥ 10,000 | Amino | 5 | **10.0 × 250** |
| F6830031 | **Asahipak NH2P-90 20F** | ≥ 10,000 | Amino | 9 | **20.0 × 300** |
| F6830007 | **Asahipak NH2P-130 28F** | ≥ 1,000 | Amino | 13 | **28.0 × 300** |
| F6710017 | **Asahipak NH2P-130G 7B** | (guard column) | Amino | 13 | **7.5 × 50** |

* See page 12 for Asahipak NH2P-50.
Base Material : Polyvinyl alcohol
* See page 72 for semi-micro columns and micro columns.

## Columns for Silica-based Reversed Phase Chromatography

### Silica C18M preparative type

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

* See page 14 for Silica C18M.
Base Material : Silica

### Silica 5C8 preparative type

| Product Code | Product Name | Plate Number (TP/column) | Functional Group | Particle Size (µm) | Column Size (mm) I.D. x Length |
|---|---|---|---|---|---|
| F7560062 | **Silica 5C8 10E** | ≥ 15,000 | Octyl | 5 | **10.0 × 250** |
| F7560063 | **Silica 5C8 20E** | ≥ 15,000 | Octyl | 5 | **20.0 × 250** |

* See page 14 for Silica 5C8.
Base Material : Silica

### Silica 5C4 preparative type

| Product Code | Product Name | Plate Number (TP/column) | Functional Group | Particle Size (µm) | Column Size (mm) I.D. x Length |
|---|---|---|---|---|---|
| F7560054 | **Silica 5C4 10E** | ≥ 15,000 | Butyl | 5 | **10.0 × 250** |
| F7560055 | **Silica 5C4 20E** | ≥ 15,000 | Butyl | 5 | **20.0 × 250** |

* See page 14 for Silica 5C4.
Base Material : Silica

## Columns for Silica-based Normal Phase and Hydrophilic Interaction Chromatography (HILIC)

### Silica 5SIL preparative type [For normal phase chromatography]

| Product Code | Product Name | Plate Number (TP/column) | Functional Group | Particle Size (µm) | Column Size (mm) I.D. x Length |
|---|---|---|---|---|---|
| F7560050 | **Silica 5SIL 10E** | ≥ 15,000 | – | 5 | **10.0 × 250** |
| F7560051 | **Silica 5SIL 20E** | ≥ 15,000 | – | 5 | **20.0 × 250** |

* See page 14 for Silica 5SIL.
Base Material : Silica

### Silica 5NH preparative type [For normal phase and hydrophilic interaction chromatography (HILIC)]

| Product Code | Product Name | Plate Number (TP/column) | Functional Group | Particle Size (µm) | Column Size (mm) I.D. x Length |
|---|---|---|---|---|---|
| F7560060 | **Silica 5NH 10E** | ≥ 8,000 | Aminopropyl | 5 | **10.0 × 250** |
| F7560061 | **Silica 5NH 20E** | ≥ 8,000 | Aminopropyl | 5 | **20.0 × 250** |

* See page 14 for Silica 5NH.
Base Material : Silica



*Contact Shodex or our distributors near you for customized columns.

# Preparative Columns

## Columns for Ligand Exchange Chromatography

### SUGAR KS-800 series preparative type

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

* See page 16 for SUGAR KS-800 series.

Base Material : Styrene divinylbenzene copolymer

### RSpak DC-613 preparative type

| Product Code | Product Name | Plate Number (TP/column) | Functional Group (Counter Ion) | Particle Size (µm) | Column Size (mm) I.D. x Length |
|---|---|---|---|---|---|
| F6514013 | **RSpak DC-2013** | ≥ 6,000 | Sulfo ($Na^+$) | 10 | **20.0 × 300** |
| F6700402 | **RSpak DC-LG** | (guard column) | Sulfo ($Na^+$) | 10 | **8.0 × 50** |
| F6514021 | **RSpak DC-5013** | – | Sulfo ($Na^+$) | 10 | **50.0 × 300** |
| F6700172 | **RSpak DC-LLG** | (guard column) | Sulfo ($Na^+$) | 10 | **20.0 × 100** |

* See page 16 for RSpak DC-613.

Base Material : Styrene divinylbenzene copolymer

## Columns for Ion Exclusion Chromatography

### RSpak KC-811 preparative type

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

* See page 20 for RSpak KC-811.

Base Material : Styrene divinylbenzene copolymer

## Columns for Anion Exchange Chromatography

### IEC QA-825 preparative type

| Product Code | Product Name | Functional Group | Particle Size (µm) | Column Size (mm) I.D. x Length |
|---|---|---|---|---|
| F6548000 | **IEC QA-2025** | Quaternary ammonium | 20 | **20.0 × 150** |
| F6548050 | **IEC QA-5025** | Quaternary ammonium | 37 | **50.0 × 300** |
| F6709602 | **IEC QA-LG** (guard column) | Quaternary ammonium | 20 | **8.0 × 50** |

* See page 52 for IEC QA-825.
* See page 77 for semi-micro columns and micro columns.

Base Material : Polyhydroxymethacrylate

### IEC DEAE-825 preparative type

| Product Code | Product Name | Functional Group | Particle Size (µm) | Column Size (mm) I.D. x Length |
|---|---|---|---|---|
| F6548001 | **IEC DEAE-2025** | Diethylaminoethyl | 20 | **20.0 × 150** |
| F6598051 | **IEC DEAE-5025** | Diethylaminoethyl | 37 | **50.0 × 300** |
| F6709603 | **IEC DEAE-LG** (guard column) | Diethylaminoethyl | 20 | **8.0 × 50** |

* See page 52 for IEC DEAE-825.
* See page 77 for semi-micro columns and micro columns.

Base Material : Polyhydroxymethacrylate

### Asahipak ES-502N preparative type

| Product Code | Product Name | Functional Group | Particle Size (µm) | Column Size (mm) I.D. x Length |
|---|---|---|---|---|
| F6840004 | **Asahipak ES-502N 20C** | Diethylaminoethyl | 13 | **20.0 × 100** |
| F6710021 | **Asahipak GS-20G 7B** (guard column) | – | 20 | **7.5 × 50** |

* See page 52 for Asahipak ES-502N 7C.
* See page 77 for semi-micro columns and micro columns.

Base Material : Polyvinyl alcohol

*Contact Shodex or our distributors near you for customized columns.





## Columns for Cation Exchange Chromatography

### IEC SP-825 preparative type

| Product Code | Product Name | Functional Group | Particle Size (µm) | Column Size (mm) I.D. x Length |
|---|---|---|---|---|
| F6548002 | **IEC SP-2025** | Sulfopropyl | 20 | **20.0 × 150** |
| F6548052 | **IEC SP-5025** | Sulfopropyl | 37 | **50.0 × 300** |
| F6709604 | **IEC SP-LG** (guard column) | Sulfopropyl | 20 | **8.0 × 50** |

* See page 54 for IEC SP-825.
* See page 77 for semi-micro columns and micro columns.

Base Material : Polyhydroxymethacrylate

### IEC CM-825 preparative type

| Product Code | Product Name | Functional Group | Particle Size (µm) | Column Size (mm) I.D. x Length |
|---|---|---|---|---|
| F6548003 | **IEC CM-2025** | Carboxymethyl | 20 | **20.0 × 150** |
| F6548053 | **IEC CM-5025** | Carboxymethyl | 37 | **50.0 × 300** |
| F6709605 | **IEC CM-LG** (guard column) | Carboxymethyl | 20 | **8.0 × 50** |

* See page 54 for IEC CM-825.
* See page 77 for semi-micro columns and micro columns.

Base Material : Polyhydroxymethacrylate

### Asahipak ES-502C preparative type

| Product Code | Product Name | Functional Group | Particle Size (µm) | Column Size (mm) I.D. x Length |
|---|---|---|---|---|
| F6840003 | **Asahipak ES-502C 20C** | Carboxymethyl | 13 | **20.0 × 100** |
| F6710021 | **Asahipak GS-20G 7B** (guard column) | – | 20 | **7.5 × 50** |

* See page 54 for Asahipak ES-502C 7C.
* See page 77 for semi-micro columns and micro columns.

Base Material : Polyvinyl alcohol

## Aqueous SEC (GFC) Columns : Silica-based

### PROTEIN KW-800 series preparative type

| 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** | ≥ 17,000 | 5 | **20.0 × 300** | KW-802.5 |
| F6505021 | **PROTEIN KW-2003** | ≥ 17,000 | 5 | **20.0 × 300** | KW-803 |
| F6505022 | **PROTEIN KW-2004** | ≥ 14,000 | 7 | **20.0 × 300** | KW-804 |
| F6709556 | **PROTEIN KW-LG** | (guard column) | 7 | **8.0 × 50** | (guard column) |

* See page 28 for PROTEIN KW-800 series.
* See page 73 for semi-micro columns and micro columns.

Base Material : Silica

## Aqueous SEC (GFC) Columns : Polymer-based

### OHpak SB-800 HQ series preparative type

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

* See page 30 for OHpak SB-800 HQ series.
* See page 74 for semi-micro columns and micro columns.

Base Material : Polyhydroxymethacrylate

(Note) The maximum solvent tolerance of the SB-2000 series for methanol, acetonitrile, and DMF is 50%. Solvent tolerance differs from that of the standard SB-800 HQ columns.

*Contact Shodex or our distributors near you for customized columns.

# Preparative Columns

## Multimode Columns

### Asahipak GS-HQ series preparative type

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

* See page 32 for Asahipak GS-HQ series.
Base Material : Polyvinyl alcohol
* See page 75 for semi-micro columns and micro columns.

## Aqueous/Organic SEC Columns

### Asahipak GF-HQ series preparative type

| 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 × 300** | GF-310 HQ |
| F6810031 | **Asahipak GS-510 20F** | ≥ 8,000 | 13 | **20.0 × 300** | GF-510 HQ |
| F6810032 | **Asahipak GS-710 20F** | ≥ 8,000 | 13 | **20.0 × 300** | GF-710 HQ |
| F6810033 | **Asahipak GSM-700 20F** | ≥ 8,000 | 13 | **20.0 × 300** | GF-7M HQ |
| F6810038 | **Asahipak GS-310 20G** | ≥ 14,000 | 13 | **20.0 × 500** | GF-310 HQ |
| F6810039 | **Asahipak GS-510 20G** | ≥ 14,000 | 13 | **20.0 × 500** | GF-510 HQ |
| F6810040 | **Asahipak GS-710 20G** | ≥ 14,000 | 13 | **20.0 × 500** | GF-710 HQ |
| F6810041 | **Asahipak GSM-700 20G** | ≥ 14,000 | 13 | **20.0 × 500** | GF-7M HQ |
| F6710020 | **Asahipak GS-10G 7B** | (guard column) | 20 | **7.5 × 50** | (guard column) |

* See page 34 for Asahipak GF-HQ series.
Base Material : Polyvinyl alcohol
* See page 76 for semi-micro columns and micro columns.

(Note) Usable solvents for GS-710 20F and 20G are water and methanol.
Solvent tolerance differs from the standard GF-710 HQ.
Selection of GSM-700 20F or 20G is recommended in case of use of other solvents for scale up testing with GF-710 HQ.

## Organic SEC (GPC) Columns

### GPC KF-800 series preparative type

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

* See page 36 for GPC KF-800 series.
Base Material : Styrene divinylbenzene copolymer

*Contact Shodex or our distributors near you for customized columns.





## Organic SEC (GPC) Columns

### GPC K-800 series preparative type

| 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 × 300** | K-801 |
| F6102312 | **GPC K-2002** | ≥ 18,000 | 6 | **20.0 × 300** | K-802 |
| F6102315 | **GPC K-2002.5** | ≥ 18,000 | 6 | **20.0 × 300** | K-802.5 |
| F6102303 | **GPC K-2003** | ≥ 18,000 | 6 | **20.0 × 300** | K-803 |
| F6102304 | **GPC K-2004** | ≥ 14,000 | 7 | **20.0 × 300** | K-804 |
| F6102305 | **GPC K-2005** | ≥ 10,000 | 10 | **20.0 × 300** | K-805 |
| F6102306 | **GPC K-2006** | ≥ 10,000 | 10 | **20.0 × 300** | K-806 |
| F6102309 | **GPC K-2006M** | ≥ 10,000 | 10 | **20.0 × 300** | K-806M |
| F6700407 | **GPC K-LG** | (guard column) | 15 | **8.0 × 50** | (guard column) |

* See page 38 for GPC K-800 series.
Base Material : Styrene divinylbenzene copolymer

# Preparative Columns [Custom-made]

## Organic SEC (GPC) Columns

### GPC K-800 series preparative type

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

* See page 38 for GPC K-800 series.
Base Material : Styrene divinylbenzene copolymer

### GPC KF-800 series preparative type

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

* See page 36 for GPC KF-800 series.
Base Material : Styrene divinylbenzene copolymer

### GPC K-800 series preparative type

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

* See page 38 for GPC K-800 series.
Base Material : Styrene divinylbenzene copolymer

*Contact Shodex or our distributors near you for customized columns.

# Phase-out Products

Phase-out products remain available to customers in need of them for the purpose of quality control, etc.
For more information, please contact Shodex or our distributors near you.
Please note that phase-out products may go out of production in the future.

## Polymer-based Packed Columns for Reversed Phase Chromatography

| Product Name | Column Size (mm) I.D. x Length |
|---|---|
| RSpak RP18-613 | 6.0 × 150 |
| RSpak RP18-413 | 4.6 × 150 |
| RSpak DE-413S | 4.6 × 50 |
| RSpak GOLF-413 | 4.6 × 150 |

## Column for Oxyhalides

| Product Name | Column Size (mm) I.D. x Length |
|---|---|
| IC SI-91 4C | 4.0 × 100 |

## Columns for Anions in Wine

| Product Name | Column Size (mm) I.D. x Length |
|---|---|
| WINE VH-anion 4D | 4.6 × 150 |
| WINE VH-anionG 4A | 4.6 × 10 |

## Columns for Rare Earth Metal Ions

| Product Name | Column Size (mm) I.D. x Length |
|---|---|
| IC R-621 | 6.0 × 50 |
| IC R-G | 4.6 × 10 |

## Aqueous SEC Semi-micro Columns

| Product Name | Column Size (mm) I.D. x Length |
|---|---|
| SB401-4E | 4.6 × 250 |
| SB402.5-4E | 4.6 × 250 |
| SB403-4E | 4.6 × 250 |
| SB404-4E | 4.6 × 250 |
| SB400G-4A | 4.6 × 10 |

## Multimode Columns

| Product Name | Column Size (mm) I.D. x Length |
|---|---|
| MSpak GS-320 4B | 4.6 × 50 |
| MSpak GS-320 4D | 4.6 × 150 |
| MSpak GS-320 2D | 2.0 × 150 |





## Columns for Affinity Chromatography

| Product Name | Column Size (mm) I.D. x Length |
|---|---|
| AFpak AAB-894 | 8.0 × 50 |
| AFpak AAF-894 | 8.0 × 50 |
| AFpak AAM-894 | 8.0 × 50 |
| AFpak AAP-894 | 8.0 × 50 |
| AFpak AAV-894 | 8.0 × 50 |
| AFpak ABA-894 | 8.0 × 50 |
| AFpak ABT-894 | 8.0 × 50 |
| AFpak ACA-894 | 8.0 × 50 |
| AFpak ACB-894 | 8.0 × 50 |
| AFpak AED-894 | 8.0 × 50 |
| AFpak AGA-894 | 8.0 × 50 |
| AFpak AGE-894 | 8.0 × 50 |
| AFpak AGT-894 | 8.0 × 50 |
| AFpak AIA-894 | 8.0 × 50 |
| AFpak ALC-894 | 8.0 × 50 |
| AFpak ALS-894 | 8.0 × 50 |
| AFpak ANA-894 | 8.0 × 50 |
| AFpak AOV-894 | 8.0 × 50 |
| AFpak APB-894 | 8.0 × 50 |
| AFpak APD-894 | 8.0 × 50 |
| AFpak APE-894 | 8.0 × 50 |
| AFpak APH-894 | 8.0 × 50 |
| AFpak APR-894 | 8.0 × 50 |
| AFpak AST-894 | 8.0 × 50 |
| AFpak AGO-494 | 4.6 × 10 |

## Columns for Chiral Separation

| Product Name | Column Size (mm) I.D. x Length |
|---|---|
| ORpak CDA-453 HQ | 4.6 × 150 |
| ORpak CDB-453 HQ | 4.6 × 150 |
| ORpak CDC-453 HQ | 4.6 × 150 |
| ORpak CD-G | 4.6 × 10 |

## Column for Column Switching Method

| Product Name | Column Size (mm) I.D. x Length |
|---|---|
| PROTEIN KW-604S | 6.0 × 50 |

# Column Cleaning Procedures

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

## Typical indicators of column deterioration possibility

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

## Selection guide to the cleaning solvent

Solvents capable of dissolving the adsorbed substances.

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

*Use the solvent specified in the operation manual.

## Standard cleaning procedures

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

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

*The volume of the cleaning solvent required is 5-10 times the column volume.
*Avoid pressure elevation during the cleaning.
*The cleaning is limited and does not guarantee the full regeneration of the column to its original condition.

## For your information

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



*Use the solvent specified in the operation manual.



# General Precautions for Column Handling

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

## Column mounting

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

## Column dismounting

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

## Column storage

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

## Other

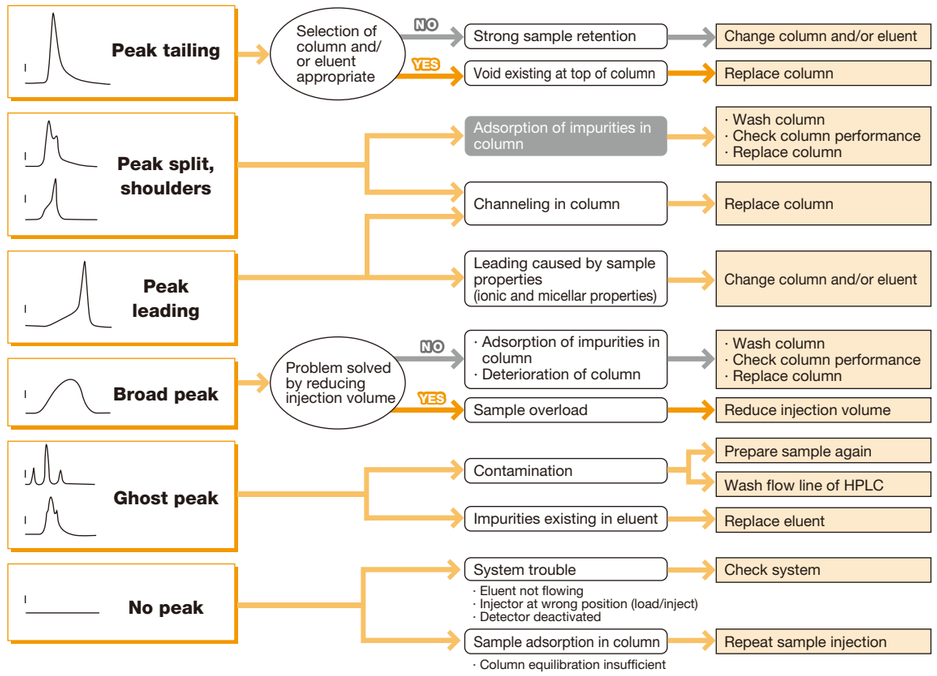
- Avoid physical shock on the column. Be cautious not to drop the column from a high position.
- Do not bend the column.
- Avoid opening the column's end-fitting, it can cause alteration of column's performance.

* Read the operation manual before using the column.

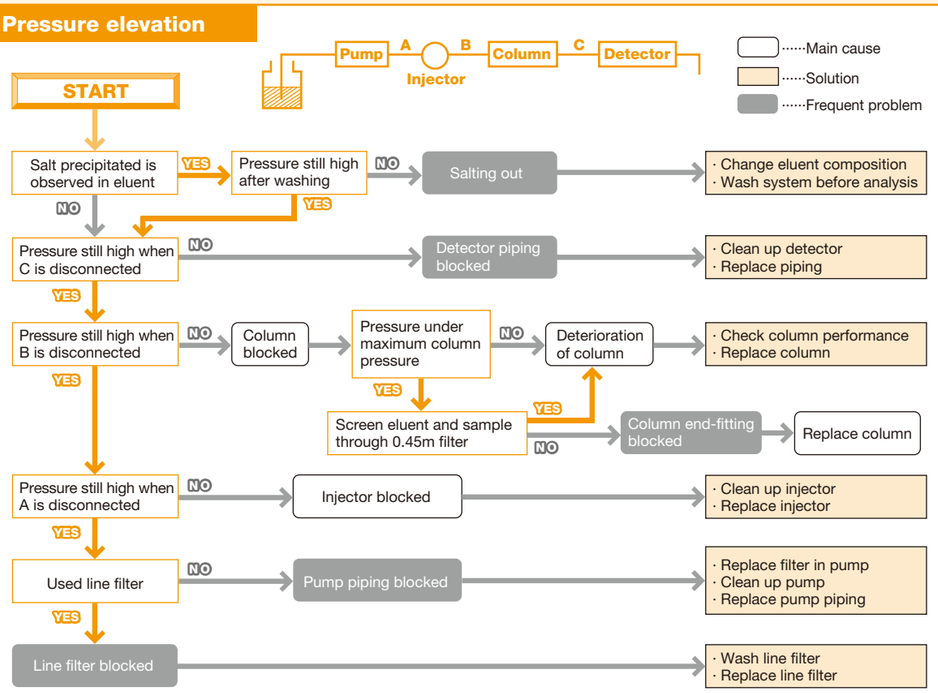
# Column Trouble Shooting

Common causes for abnormal chromatograms

## Unstable baseline values




## Pressure elevation



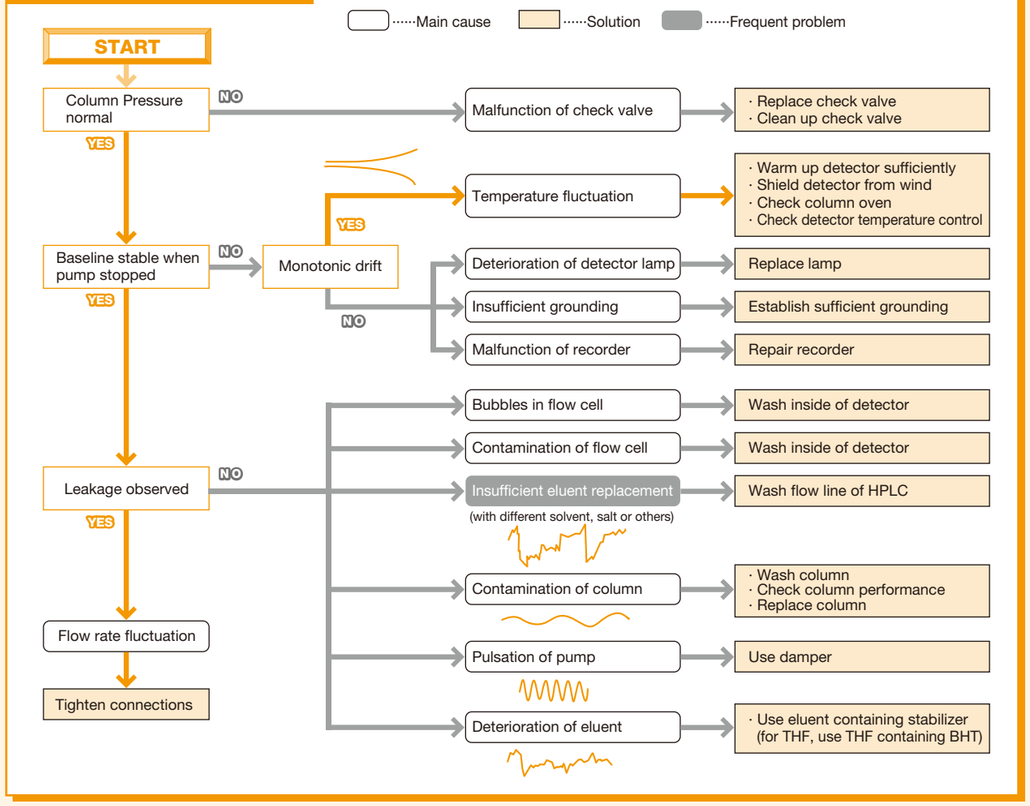




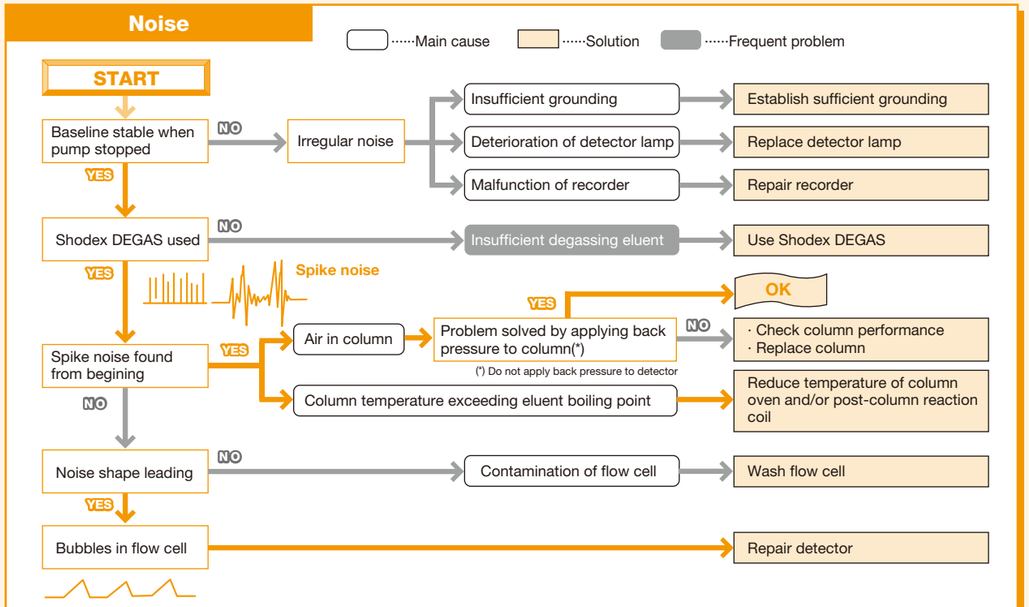

# HPLC System Trouble Shooting

Common causes for abnormal chromatograms

## Unstable baseline values




## Noise



# Index by Product Name

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

[Series name]

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| AFpak | Asahipak | AXpak | CLNpak | CXpak | EP | GPC | HIC |
| IC | IEC | MSpak | ODSpak | OHpak | ORpak | PIKESS | PROTEIN |
| RSpak | Silicapak | STANDARD | STD | SUGAR | USPpak | WINE | Silica |



* Semi-micro and micro columns and preparative columns are not included.

# Technical Notebook, Chromato News

## Technical Notebook

| No. | Title |
|---|---|
| 1 | Shodex GPC LF series columns<br>Linear calibration curves over a wide molecular weight range |
| 2 | Shodex NH2P-50 series columns<br>Analysis of saccharides in food industry |
| 3 | Food Analysis with Shodex columns<br>Saccharides, organic acids, vitamins, fatty acids and amino acids |
| 5 | Shodex KW400 series columns<br>High performance and downsized column for protein analysis |
| 6 | Shodex ODP2 HP series columns<br>Better retention of highly polar substances |
| 7 | Protein & peptide with Shodex columns |

## Chromato News

| No. | Title | Column |
|---|---|---|
| 1 | High performance reversed phase column; polymer-based column Asahipak ODP-40 | ODP-40 series |
| 2 | Direct analysis of medical compounds in serum without sample pretreatment | GF-310 series, GS-320 series |
| 3 | Semi-micro GPC columns with high resolution | KF-400HQ series |
| 4 | Linear calibration curves by GPC LF-804 | LF-804 |
| 6 | Food additives | SP0810, SC1011, NH2P-50 4E, KC-811 |
| 7 | Polymer-based column with multimode of reversed phase and ionic interaction | NN series, JJ-50 |
| 8 | Ultra high molecular weight and water-soluble polymer with SUGAR KS-807 | KS-807, KS-800 series |
| 9 | Direct analysis of proteins and peptides in surfactants using surfactant removal column MSpak PK series | PK series, GF-4A |
| 10 | Direct analysis of additives in polymer with SEC/MS | KF-400HQ series |
| 11 | Concentration of the hydrophilic medical compounds existing with proteins | PK series |
| 12 | Column selection for proteins and peptides analysis | SEC, Reversed phase, Ion exchange, Affinity columns |
| 13 | Analysis of hyaluronic acid with ultra high molecular weight in serum | KS-807, GS-620HQ |
| 14 | Water-soluble vitamins | NH2P-50 4E, DE-413 |
| 17 | Saccharides and sugar alcohols with Asahipak NH2P-50 column | NH2P-50 series |
| 22 | Online removal of surfactants in protein analysis | PK-2A, KW-604S |
| 23 | Various application with RSpak DE series; high pH, 0% organic eluent | DE series |
| 24 | Analysis of amines and amides with RSpak DE series | DE-613, DE-413, ACH-494 |
| 25 | Simultaneous analysis of monosaccharide and organic acid with SUGAR SH1011 | SH1011 |
| 29 | Water-soluble ultra high molecular compounds with OHpak SB-807HQ | SB-807HQ, SB-806HQ |
| 30 | New reversed phase column ODP2 HP | ODP2 HP series |
| 31 | New protein analysis column KW400 | KW400 series |
| 32 | High sensitive analysis of pyridylaminated saccharides | NH2P-50 |
| 33 | New rapid cation exchange column; DEAE3N-4T with non-porous gel | DEAE3N-4T |
| 35 | Shellfish poisoning and pesticides | DE413-2B, ODP-50 4E |
| 36 | Suitable column for LC/MS application; ODP2 HP | ODP2 HP |
| 40 | Analysis of sugars in bioethanol production | SH1821, KS-802, LF-804 |
| 41 | High temperature reversed phase column in high temperature for rapid analysis | ET-RP1 4D |
| 42 | Ion exchange columns for UHPLC | PIKESS series |
| 43 | Saccharides analysis with $H_2O$ eluent | SP0810, SC1011, KS-801, SH1011 |
| 44 | High resolution separation by NH2P-40 3E | NH2P-40 3E |



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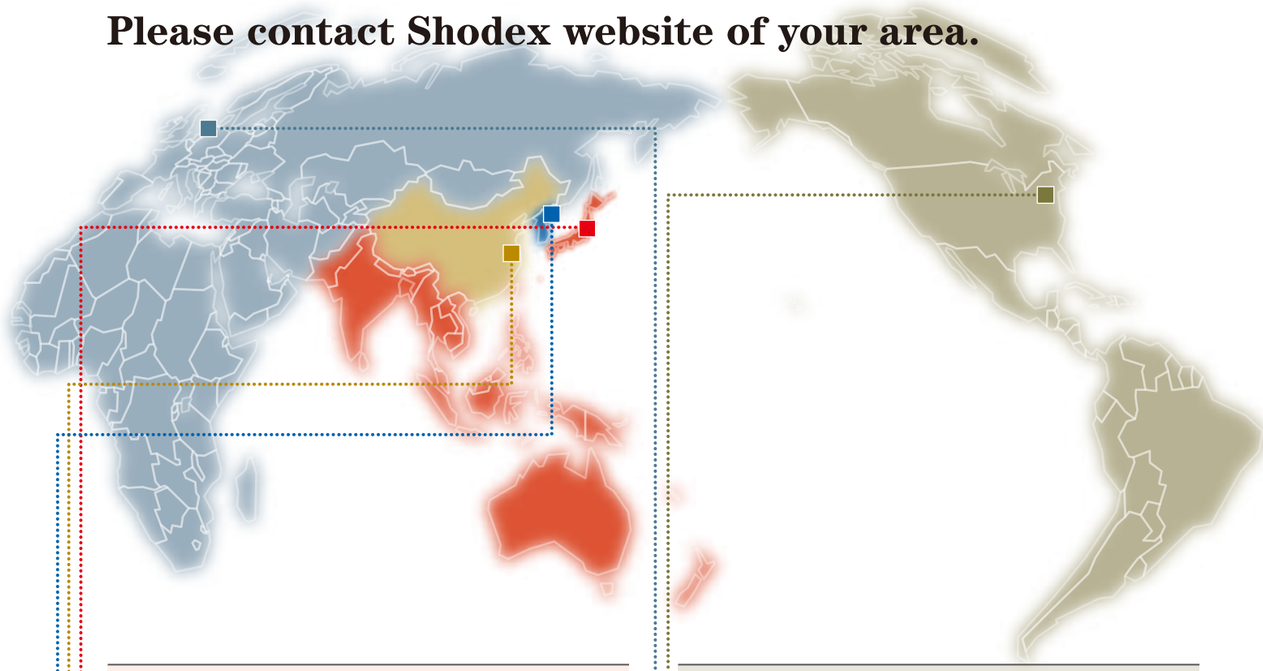

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