

# Ligand Exchange Chromatography Columns

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

## Features

- SC1011** • Separates saccharides by combination of ligand exchange and size exclusion modes  
**SC1821** • Three types of counter ions are available: Ca<sup>2+</sup>, Pb<sup>2+</sup> and Na<sup>+</sup>  
**SP0810** • Only water is required for the analysis of neutral sugars  
**KS-801** • SC1011 and SC1821 fulfill USP L19 and L22 requirements  
**KS-802** • SP0810 fulfills USP L22 and L34 requirements  
 • KS-801 and KS-802 fulfill USP L22 and L58 requirements

- KS-803 to 806** • Suitable for separation of polysaccharides by size exclusion mode  
 • Can be used in combination with other columns e.g., KS-802 and KS-801  
 • Only water is required for the analysis of neutral sugars  
 • Fulfill USP L22 and L58 requirements

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

- SC1011-7F** • Fulfills mannitol analysis requirements of JP, USP, and EP methods  
 • Ca<sup>2+</sup> modified ligand exchange chromatography column  
 • Only water is required for the analysis of neutral sugars  
 • Fulfills USP L19 and L22 requirements

## ● Standard columns

### [ Ligand exchange and size exclusion ]

Product Code	Product Name	Plate Number (TP/column)	Functional Group (Counter Ion)	Exclusion Limit (Pullulan)	Particle Size (µm)	Column Size (mm) I.D. x Length	Shipping Solvent
F6378102	<b>SUGAR SC1011</b>	≥ 13,000	Sulfo (Ca <sup>2+</sup> )	1,000	6	<b>8.0 x 300</b>	H <sub>2</sub> O
F6378103	<b>SUGAR SC1821</b>	≥ 13,000	Sulfo (Ca <sup>2+</sup> )	10,000	6	<b>8.0 x 300</b>	H <sub>2</sub> O
F6700090	<b>SUGAR SC-G 6B</b>	(guard column)	Sulfo (Ca <sup>2+</sup> )	–	10	<b>6.0 x 50</b>	H <sub>2</sub> O
F6378105	<b>SUGAR SP0810</b>	≥ 11,000	Sulfo (Pb <sup>2+</sup> )	1,000	7	<b>8.0 x 300</b>	H <sub>2</sub> O
F6700081	<b>SUGAR SP-G 6B</b>	(guard column)	Sulfo (Pb <sup>2+</sup> )	–	10	<b>6.0 x 50</b>	H <sub>2</sub> O
F6378106	<b>SUGAR SP0810 8C</b>	≥ 3,000	Sulfo (Pb <sup>2+</sup> )	1,000	7	<b>8.0 x 100</b>	H <sub>2</sub> O
F6378010	<b>SUGAR KS-801</b>	≥ 17,000	Sulfo (Na <sup>+</sup> )	1,000	6	<b>8.0 x 300</b>	H <sub>2</sub> O
F6378020	<b>SUGAR KS-802</b>	≥ 17,000	Sulfo (Na <sup>+</sup> )	10,000	6	<b>8.0 x 300</b>	H <sub>2</sub> O
F6378025	<b>SUGAR KS-803</b>	≥ 17,000	Sulfo (Na <sup>+</sup> )	50,000	6	<b>8.0 x 300</b>	H <sub>2</sub> O
F6378035	<b>SUGAR KS-804</b>	≥ 17,000	Sulfo (Na <sup>+</sup> )	400,000	7	<b>8.0 x 300</b>	H <sub>2</sub> O
F6378050	<b>SUGAR KS-805</b>	≥ 9,000	Sulfo (Na <sup>+</sup> )	5,000,000	17	<b>8.0 x 300</b>	H <sub>2</sub> O
F6378060	<b>SUGAR KS-806</b>	≥ 9,000	Sulfo (Na <sup>+</sup> )	(50,000,000)*	17	<b>8.0 x 300</b>	H <sub>2</sub> O
F6700020	<b>SUGAR KS-G 6B</b>	(guard column)	Sulfo (Na <sup>+</sup> )	–	10	<b>6.0 x 50</b>	H <sub>2</sub> O

( \*) Estimated value  
 Base Material: Styrene divinylbenzene copolymer

### [ Ligand exchange and HILIC ]

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

Base Material: Styrene divinylbenzene copolymer

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

Product Code	Product Name	Functional Group (Counter Ion)	Particle Size (μm)	Column Size (mm) I.D. x Length	Shipping Solvent
F6379300	<b>EP SC1011-7F</b>	Sulfo (Ca <sup>2+</sup> )	8	<b>7.8 x 300</b>	H <sub>2</sub> O
F6700090	<b>SUGAR SC-G 6B</b> (guard column)	Sulfo (Ca <sup>2+</sup> )	10	<b>6.0 x 50</b>	H <sub>2</sub> O
F6379230	<b>USPpak MN-431</b>	Sulfo (Ca <sup>2+</sup> )	8	<b>4.0 x 250</b>	H <sub>2</sub> O

See page 82 for USP42-NF37 Column List.

Base Material: Styrene divinylbenzene copolymer

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

[ Ligand exchange and size exclusion ]

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

### Elution volumes of saccharides analyzed by Shodex columns

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

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

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

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

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

Column : SUGAR SP0810,  
SC1011, KS-801  
Eluent : H<sub>2</sub>O  
Flow rate : 1.0 mL/min  
Detector : RI  
Column temp. : 80 °C

Column : SUGAR SC1211  
Eluent : H<sub>2</sub>O/CH<sub>3</sub>CN=65/35  
Flow rate : 1.0 mL/min  
Detector : RI  
Column temp. : 70 °C

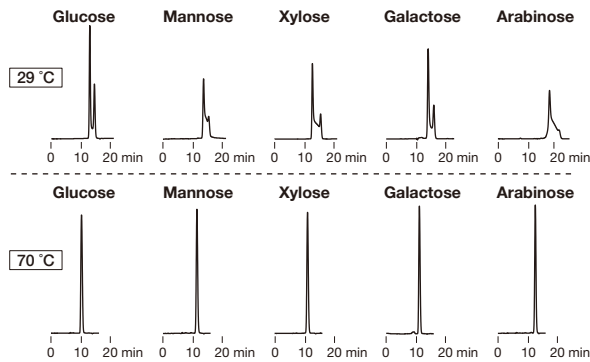
Column : SUGAR SZ5532  
Eluent : H<sub>2</sub>O/CH<sub>3</sub>CN=25/75  
Flow rate : 1.0 mL/min  
Detector : RI  
Column temp. : 60 °C

Column : Asahipak NH2P-50 4E  
Eluent : H<sub>2</sub>O/CH<sub>3</sub>CN=25/75  
Flow rate : 1.0 mL/min  
Detector : RI  
Column temp. : 30 °C

## Saccharides anomer separation

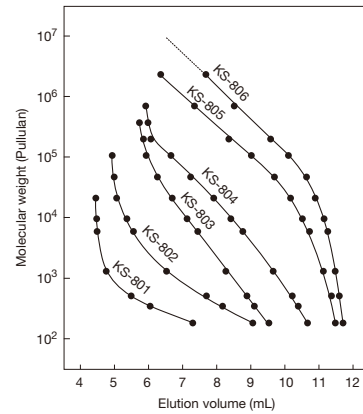
Saccharides may present their anomers at lower temperatures. By using the SUGAR series columns at higher temperatures will prevent the anomer separation and this results in providing better chromatograms of each saccharide.

Sample : 0.5 % each, 10  $\mu$ L



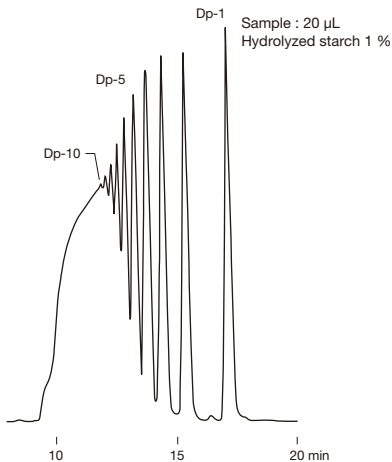
Column : Shodex SUGAR SC1011  
 Eluent : H<sub>2</sub>O  
 Flow rate : 0.7 mL/min  
 Detector : RI  
 Column temp. : 29 °C, 70 °C

## Calibration curves for KS-800 series using pullulan



Column : Shodex SUGAR KS-800 series  
 Eluent : H<sub>2</sub>O  
 Detector : RI  
 Column temp. : 80 °C

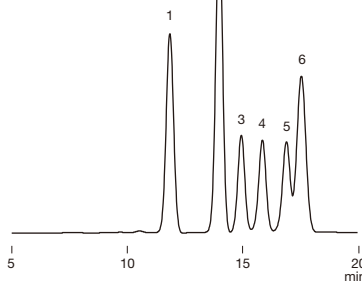
## Hydrolyzed starch



Column : Shodex SUGAR KS-802 x 2  
 Eluent : H<sub>2</sub>O  
 Flow rate : 1.0 mL/min  
 Detector : RI  
 Column temp. : 80 °C

## Biomass sugars

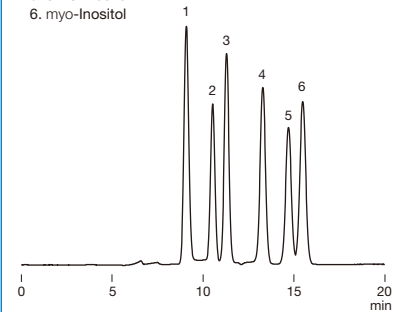
Sample : 5  $\mu$ L  
 1. Cellobiose 1.0 %  
 2. Glucose 1.5 %  
 3. Xylose 0.5 %  
 4. Galactose 0.5 %  
 5. Arabinose 0.5 %  
 6. Mannose 1.0 %



Column : Shodex SUGAR SP0810  
 Eluent : H<sub>2</sub>O  
 Flow rate : 0.6 mL/min  
 Detector : RI  
 Column temp. : 85 °C

## Pinitol

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

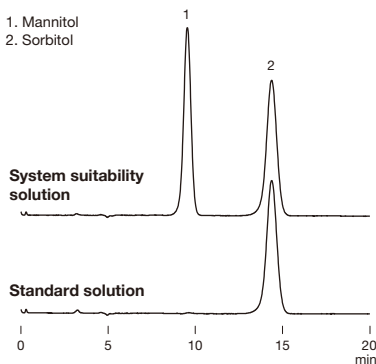


Column : Shodex SUGAR SP0810  
 Eluent : H<sub>2</sub>O  
 Flow rate : 0.8 mL/min  
 Detector : RI  
 Column temp. : 85 °C

## Analysis of sorbitol following USP method

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

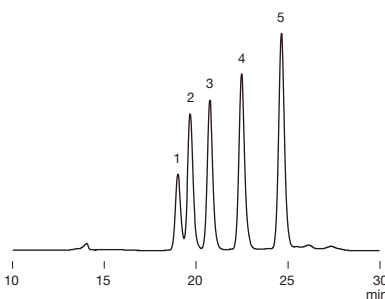
1. Mannitol  
 2. Sorbitol



Column : Shodex SUGAR SP0810 8C  
 Eluent : H<sub>2</sub>O  
 Flow rate : 0.7 mL/min  
 Detector : RI (35 °C)  
 Column temp. : 50 °C

## Oligosaccharides in soybean

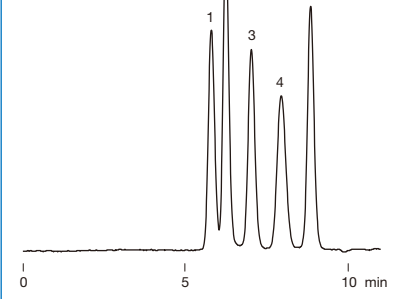
Sample : 0.1 % each, 20  $\mu$ L  
 1. Verbascose  
 2. Stachyose  
 3. Raffinose  
 4. Sucrose  
 5. Pinitol



Column : Shodex SUGAR KS-802 + KS-801  
 Eluent : H<sub>2</sub>O  
 Flow rate : 0.6 mL/min  
 Detector : RI  
 Column temp. : 85 °C

## Saccharides related to raffinose biosynthesis

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



Column : Shodex SUGAR SC1011  
 Eluent : H<sub>2</sub>O  
 Flow rate : 1.0 mL/min  
 Detector : RI  
 Column temp. : 80 °C

