

# Ligand Exchange Chromatography Columns

\* Please check our website for elution-volume summary lists of various saccharides using Shodex columns.

<https://www.shodex.de/sugar-columns-ligand-exchange>

## Features

**SC1011**  
**SP0810**  
**KS-801**  
**KS-802**

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

**KS-803**  
**KS-804**

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

**DC-613**  
**SZ5532**  
**SC1211**

- Separates elements 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 separating sugar alcohols
- DC-613 fulfills USP-NF L22 and L58 requirements
- SZ5532 fulfills USP-NF L22 requirements
- SC1211 fulfills USP-NF L19 and L22 requirements

**EP SC1011-7F**  
**MN-431**

- Pharmacopoeia method relevant columns
- Ca<sup>2+</sup> modified ligand exchange chromatography column
- Only water is required for the analysis of neutral sugars
- Fulfill USP-NF L19 and L22 requirements

## Ligand exchange and size exclusion

### • Standard columns

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
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
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

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

## ● Standard columns

Product Code	Product Name	Plate Number (TP/column)	Functional Group (Counter Ion)	Particle Size (µm)	Column Size (mm) I.D. x Length	Shipping Solvent
F6379300	<b>SUGAR EP SC1011-7F</b>	≥ 11,000	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>	≥ 4,000	Sulfo (Ca <sup>2+</sup> )	8	<b>4.0 x 250</b>	H <sub>2</sub> O

See page 72 for USP-NF Column List.

Base Material: Styrene divinylbenzene copolymer

## 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
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	2 peaks	2 peaks	5.90	2 peaks	12.73	2 peaks
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-Xylulose	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

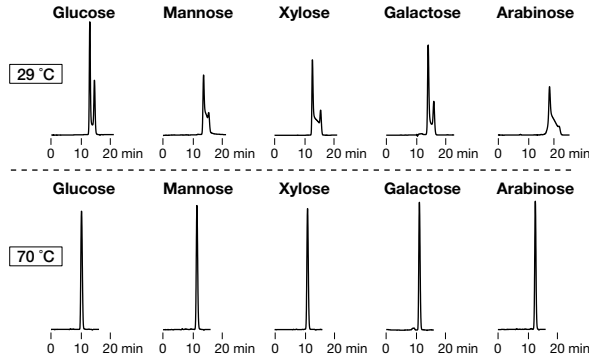
**Column** : SUGAR SC1211  
**Eluent** : H<sub>2</sub>O/CH<sub>3</sub>CN = 65/35  
**Flow rate** : 1.0 mL/min  
**Detector** : RI  
**Column temp.** : 70 °C

**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

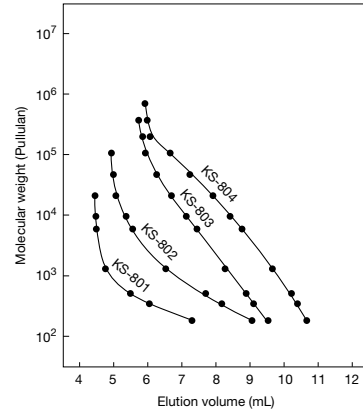
**Saccharides anomer separation**

Saccharides may present their anomers at lower temperatures. By setting 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



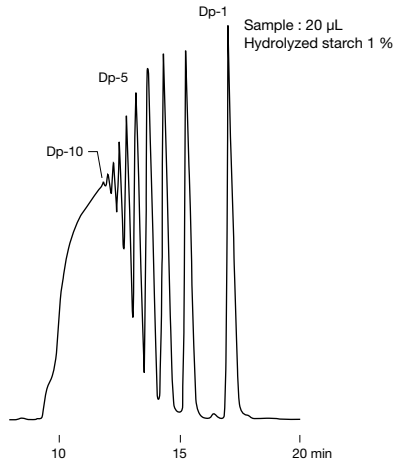
**Column** : Shodex SUGAR SC1011  
 Eluent : H<sub>2</sub>O  
 Flow rate : 0.7 mL/min  
 Detector : RI  
 Column temp. : 29 °C, 70 °C

**Calibration curves for KS-800 series using pullulan**



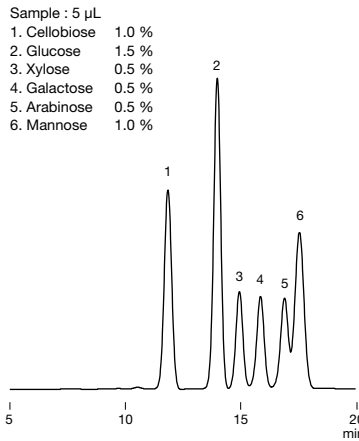
**Column** : Shodex SUGAR KS-800 series  
 Eluent : H<sub>2</sub>O  
 Detector : RI  
 Column temp. : 80 °C

**Hydrolyzed starch**



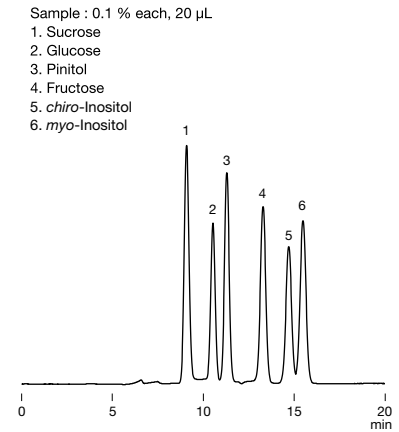
**Column** : Shodex SUGAR KS-802 x 2  
 Eluent : H<sub>2</sub>O  
 Flow rate : 1.0 mL/min  
 Detector : RI  
 Column temp. : 80 °C

**Biomass sugars**



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

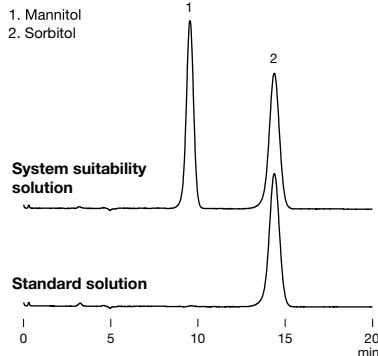
**Pinitol**



**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 according to USP-NF method**

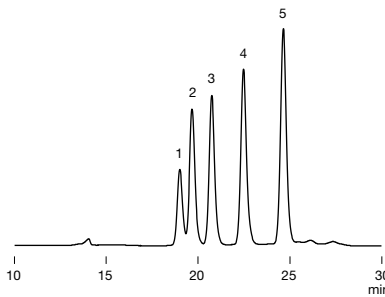
Sample : 10  $\mu$ L (System suitability solution) Mannitol, Sorbitol 4.8 mg/g each (Standard solution) Sorbitol 4.8 mg/g



**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**

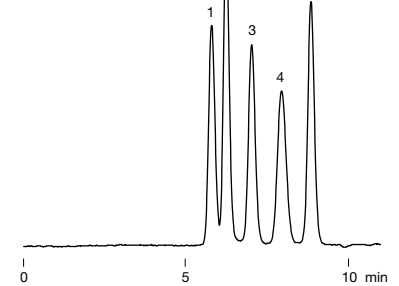
Sample : 0.1 % each, 20  $\mu$ L  
 1. Verbascose  
 2. Stachyose  
 3. Raffinose  
 4. Sucrose  
 5. Pinitol



**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

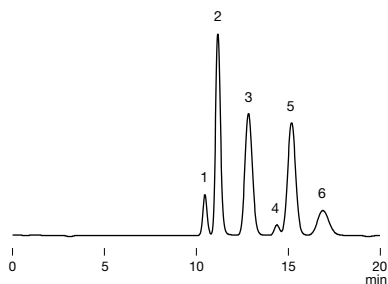


**Column** : Shodex SUGAR SC1011  
 Eluent : H<sub>2</sub>O  
 Flow rate : 1.0 mL/min  
 Detector : RI  
 Column temp. : 80 °C

## Acesulfame K and sucralose

Sample : 20  $\mu$ L

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 %

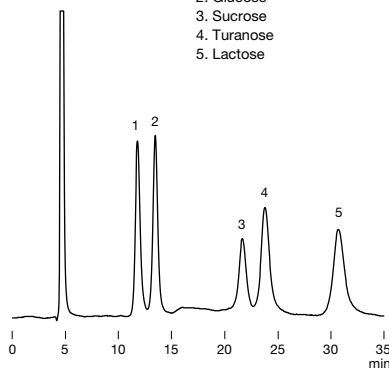


**Column** : Shodex SUGAR SC1011  
**Eluent** : 10 mM CaSO<sub>4</sub> aq.  
**Flow rate** : 0.6 mL/min  
**Detector** : RI  
**Column temp.** : 80 °C

## Sucrose and turanose

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

1. Fructose
2. Glucose
3. Sucrose
4. Turanose
5. Lactose

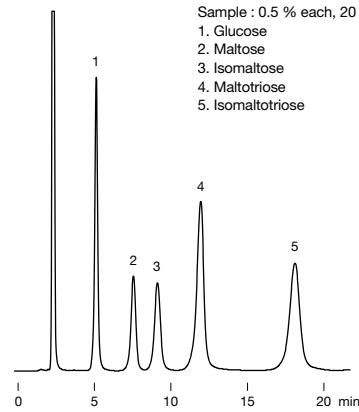


**Column** : Shodex SUGAR SZ5532  
**Eluent** : H<sub>2</sub>O/CH<sub>3</sub>CN = 20/80  
**Flow rate** : 0.6 mL/min  
**Detector** : RI  
**Column temp.** : 60 °C

## Maltose and isomaltose

Sample : 0.5 % each, 20  $\mu$ L

1. Glucose
2. Maltose
3. Isomaltose
4. Maltotriose
5. Isomaltotriose

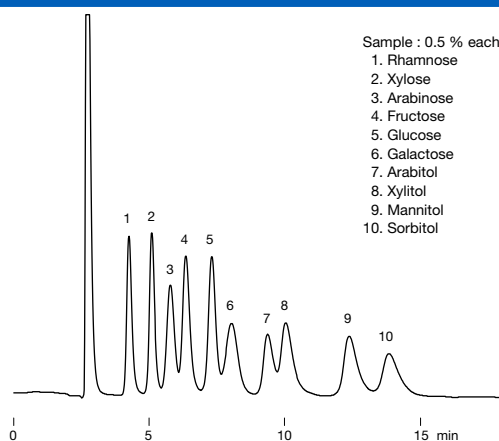


**Column** : Shodex SUGAR SZ5532  
**Eluent** : H<sub>2</sub>O/CH<sub>3</sub>CN = 25/75  
**Flow rate** : 1.0 mL/min  
**Detector** : RI  
**Column temp.** : 60 °C

## Saccharides and sugar alcohols

Sample : 0.5 % each, 20  $\mu$ L

1. Rhamnose
2. Xylose
3. Arabinose
4. Fructose
5. Glucose
6. Galactose
7. Arabitol
8. Xylitol
9. Mannitol
10. Sorbitol

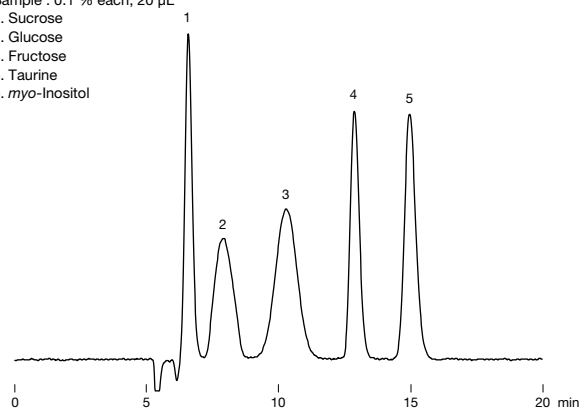


**Column** : Shodex SUGAR SZ5532  
**Eluent** : H<sub>2</sub>O/CH<sub>3</sub>CN = 20/80  
**Flow rate** : 1.0 mL/min  
**Detector** : RI  
**Column temp.** : 65 °C

## Saccharides and taurine

Sample : 0.1 % each, 20  $\mu$ L

1. Sucrose
2. Glucose
3. Fructose
4. Taurine
5. *myo*-Inositol

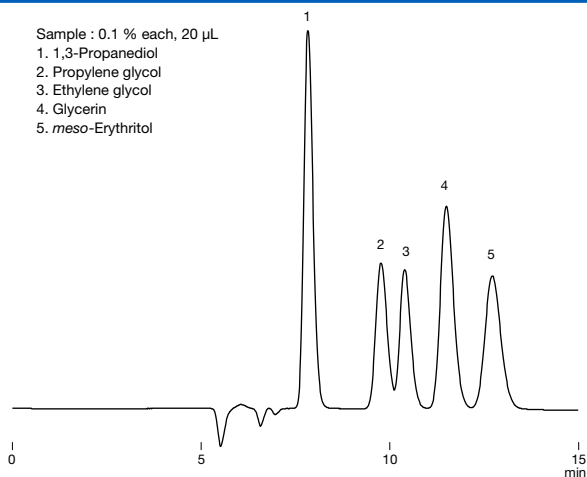


**Column** : Shodex SUGAR SC1211  
**Eluent** : H<sub>2</sub>O/CH<sub>3</sub>CN = 60/40  
**Flow rate** : 0.6 mL/min  
**Detector** : RI  
**Column temp.** : 70 °C

## Moisturizing components

Sample : 0.1 % each, 20  $\mu$ L

1. 1,3-Propanediol
2. Propylene glycol
3. Ethylene glycol
4. Glycerin
5. *meso*-Erythritol

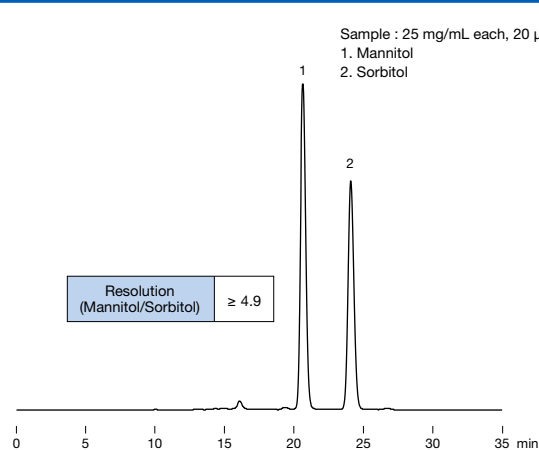


**Column** : Shodex SUGAR SC1211  
**Eluent** : H<sub>2</sub>O/CH<sub>3</sub>CN = 60/40  
**Flow rate** : 0.6 mL/min  
**Detector** : RI  
**Column temp.** : 40 °C

## Analysis of mannitol according to Pharmacopeias (JP, USP and EP)

Sample : 25 mg/mL each, 20  $\mu$ L

1. Mannitol
2. Sorbitol



**Column** : Shodex EP SC1011-7F  
**Eluent** : H<sub>2</sub>O  
**Flow rate** : 0.5 mL/min  
**Detector** : RI  
**Column temp.** : 85 °C