

# Cation Exchange HPLC Columns

Hamilton offers seven polymeric packing materials for cation exchange separations.

Type	Recommended Application(s)
<b>PRP-X200</b>	Inorganic and organic cations using conductivity or UV detection, alkali and alkaline earth metals. Separate mono or divalent cations depending on mobile phase conditions from 20 ppb to 200 ppm.
<b>PRP-X400</b>	Glyphosate and its metabolite in drinking water Organic and inorganic cations using conductivity or UV detection
<b>PRP-X800</b>	Transition metals or mono and divalent cations in the same run
<b>HC-40</b>	Oligo saccharides up to DP8
<b>HC-75 Ca<sup>2+</sup></b>	Mono and disaccharides
<b>HC-75 H<sup>+</sup></b>	Organic acids, sugars and alcohols
<b>HC-75 Pb<sup>2+</sup></b>	Sugar alcohols and plant cell wall hydrolysates

In cation exchange chromatography, the stationary bed has an ionically negative (-) charged surface while the sample ions are of positive (+) charge. This technique is used almost exclusively with ionic or ionizable samples. The stronger the positive (+) charge on the sample, the stronger it will be attracted to the negative charge on the stationary phase, and thus the longer it will take to elute. The mobile phase is an aqueous buffer, where both pH and ionic strength are used to control elution time. Ion chromatography can employ harsh conditions requiring mobile phases that are at very high pH limits (> 11). Temperatures well above the normal operating conditions where silica materials fail can also be used.



## PRP-X200 Columns

### High resolution separation of alkali and alkaline earth metals

**Pore Size:** 100 Å

**Material:** PS-DVB/Sulfonic acid exchanger

**Exchange Capacity:** 35 µeq/gm

Hamilton PRP-X200 cation exchange HPLC columns are designed for rapid, high resolution separation of alkali and alkaline earth metals. The alkali metals and ammonium are completely resolved in less than five minutes, and the alkaline earth cations separate in under four minutes. Since the mobile phase conditions are different and unique for each of the groups of cations, interferences between these groups are eliminated.

The resolution between any two ions in the alkali metal series can be increased or decreased by changing the concentration of methanol in the mobile phase. This unique feature of the PRP-X200 mobile phase/stationary phase interaction allows the chromatographer to focus on the particular ion of interest and reduce possible interference from other ions in the sample.

The stationary phase is a sulfonated poly (styrene-divinylbenzene), so it is stable to all concentrations of organic modifiers as well as strong acids and bases. The rigid spherical polymer phase allows operation up to 5,000 psi.

The PRP-X200 columns are designed for use in all of today's ion chromatographic equipment. Since exchange capacity is low, background signal is low. This allows low detection limits at the highest conductivity detector settings.

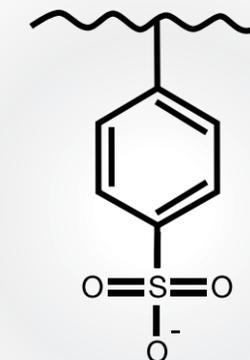
### PRP-X200 stationary phase structure and applications

#### Applications:

Inorganic and organic cations using conductivity or UV detection, alkali and alkaline earth metals. Separate mono or divalent cations depending on mobile phase conditions from 20 ppb to 200 ppm.

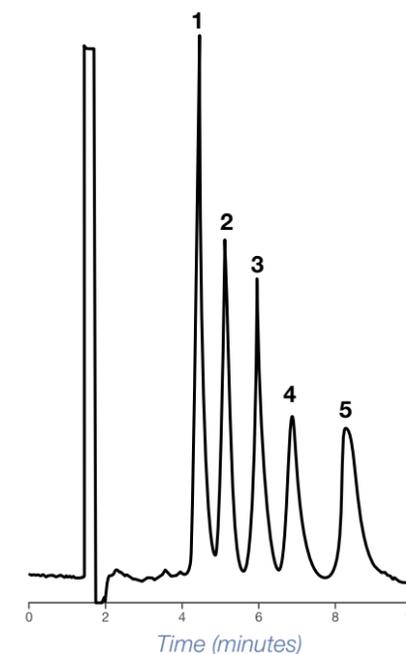
#### Examples of analytes that can be separated on PRP-X200 columns:

- ▶ Calcium
- ▶ Potassium
- ▶ Cesium
- ▶ Sodium



### PRP-X200 application chromatograms

*Monovalent Cations on PRP-X200*



**Column:** PRP-X200, 5 µm, 4.1 mm x 150 mm  
**Part number:** 79441  
**Mobile phase:** (2.3:1) 4 mM Nitric acid:Methanol  
**Flow rate:** 2 mL/min  
**Gradient:** Isocratic  
**Temperature:** Ambient  
**Injection volume:** 100 µL  
**Detection:** Conductivity

**Compounds:**  
 1. Lithium  
 2. Sodium  
 3. Ammonium  
 4. Potassium  
 5. Cesium



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The 150 mm column is ideal for rapid analysis, while the 250 mm column is recommended for higher resolution or for analysis of minor components in the presence of major interferences.

#### PRP-X200 Column Ordering Information

Dimensions	Particle Size	
	10 µm	12-20 µm
2.1 x 150 mm	79394	
4.1 x 100 mm	79363	
4.1 x 150 mm	79441	
4.1 x 250 mm	79442	
4.6 x 150 mm PEEK	79384	
4.6 x 250 mm PEEK	79357	
Bulk Resin (1 Gram)	79587	79588

## PRP-X400 Columns

### Excellent separation of glyphosate and its metabolite in drinking water

**Pore Size:** 100 Å

**Material:** PS-DVB/Sulfonic acid exchanger

**Exchange Capacity:** 2.5 meq/gm

The PRP-X400 column provides a fast separation for glyphosate and its metabolites. The exchange capacity of the PRP-X400 is greater than that of the PRP-X200, leading to characteristics better suited for the separation of glyphosate. It also performs well in other separations, such as inositol and sugar alcohols. The column does not have to be heated to 65°C and operates well at room temperature, so a column heater is not necessary for this method. PRP-X400 columns do not require the use of methanol in the mobile phase, and they cost much less than other glyphosate columns.

The PRP-X400 is a 7 µm poly(styrene-divinylbenzene) sulfonated cation exchange support (2.5 meq/gm) column. It separates glyphosate and aminomethylphosphonic acid according to charge in less than 10 minutes. This separation requires post-column oxidation and derivatization.

Post column reaction (oxidation) with calcium hypochlorite followed by derivatization with o-phthalaldehyde solution provides sensitive (6 ppb or lower) and selective (primary and secondary) amine detection.

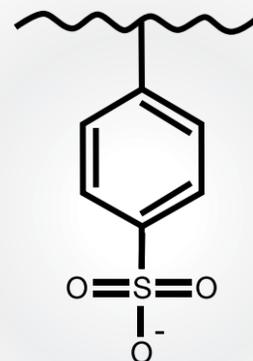
### PRP-X400 stationary phase structure and applications

#### Applications:

Glyphosate and its metabolite in drinking water. The PRP-X400 provides unique hydrophilic interaction separations. Cations, inorganic and organic using conductivity or UV detection.

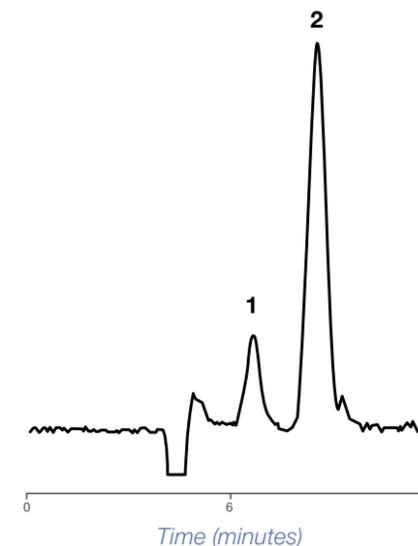
#### Examples of analytes that can be separated on PRP-X400 columns:

- ▶ Glyphosate
- ▶ Xylitol
- ▶ Maltose
- ▶ Mannitol



### PRP-X400 application chromatograms

Glyphosate on PRP-X400



**Column:** PRP-X400, 5 µm, 4.1 mm x 250 mm  
**Part number:** 79473  
**Mobile phase:** 0.005 M Monobasic potassium phosphate  
**Flow rate:** 0.5 mL/min  
**Gradient:** Isocratic  
**Temperature:** Ambient  
**Injection volume:** 200 µL  
**Detection:** Excitation wavelength—338 nm, Emission wavelength—455 nm

**Compounds:**  
 1. Glyphosate  
 2. Aminomethylphosphonic acid

### PRP-X400 Column Ordering Information

Dimensions	Particle Size		
	7 µm	12–20 µm	30–50 µm
2.1 x 250 mm	79398		
4.1 x 150 mm	79717		
4.1 x 250 mm	79473		
4.6 x 250 mm PEEK	79387		
Bulk Resin (1 Gram)	79591	79592	79593

For full details on how to use the PRP-X400 for glyphosate analysis, please visit our website at [www.hamiltoncompany.com/HPLC](http://www.hamiltoncompany.com/HPLC).



## PRP-X800 Columns

Separates transition metals or mono and divalent cations in the same run

**Pore Size:** 100 Å

**Material:** PS-DVB/Itaconate exchanger (WCX)

**Exchange Capacity:** 1.6 meq/gm

The PRP-X800 is a polymeric cation exchange column functionalized with itaconic acid that performs the isocratic separation of mono and divalent cations such as lithium, sodium, ammonium, potassium, magnesium and calcium. The column offers excellent durability, is stable to any concentration organic solvent, and enables dynamic control of exchange capacity. Detection is via conductivity or indirect UV, depending on the mobile phase.

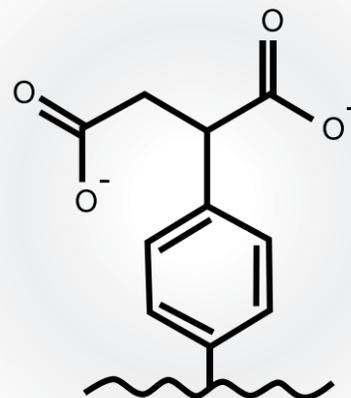
### PRP-X800 stationary phase structure and applications

#### Applications:

Mono and divalent transition metals in the same run. Transition metals (e.g., manganese, zinc, cobalt and cadmium) are also resolved on the column using an ethylenediamine/tartaric acid mobile phase and conductivity detection.

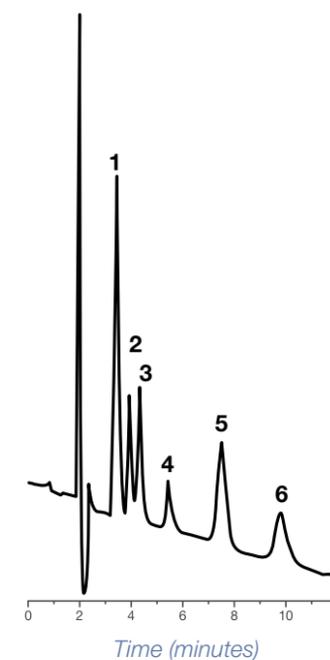
#### Examples of analytes that can be separated on PRP-X800 columns:

- ▶ Mono and divalent metal cations (e.g., sodium, potassium, calcium)
- ▶ Transitions metals (e.g., iron, manganese, nickel, copper, zinc)



### PRP-X800 application chromatograms

Mono and Divalent Cations on PRP-X800



**Column:** PRP-X800, 5 µm, 4.1 mm x 250 mm  
**Part number:** 79828  
**Mobile phase:** 2 mM Cupric Sulfate  
**Flow rate:** 0.8 mL/min  
**Gradient:** Isocratic  
**Temperature:** Ambient  
**Injection volume:** 10 µL  
**Sample concentration:** All compounds are 5 ppm  
**Detection:** Indirect UV at 220 nM

#### Compounds:

1. Lithium
2. Sodium
3. Ammonium
4. Potassium
5. Magnesium
6. Calcium

The PRP-X800 is available in PEEK hardware as a custom order. Please see page 48 for more information.

### PRP-X800 Column Ordering Information

Dimensions	Particle Size: 7 µm
4.1 x 150 mm	79855
4.1 x 250 mm	79828

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## HC-40 $\text{Ca}^{2+}$ and HC-75 ( $\text{H}^+$ , $\text{Ca}^{2+}$ , $\text{Pb}^{2+}$ ) Columns

### Separate compounds through size exclusion and ligand exchange

**Pore Size:** 100 Å

**Material:** PS-DVB/ Sulfonic acid exchanger

**Exchange Capacity:** 5 meq/gm

The HC-40 and HC-75 group of columns consist of four different packing types, each with a different retention characteristic and application. They are:

- ▶ HC-40—Oligo saccharides up to DP8 (e.g., corn syrup, high conversion corn syrup, beer)
- ▶ HC-75 Lead Form—Sugar alcohols and plant cell wall hydrolysates
- ▶ HC-75 Calcium Form—Separates mono and disaccharides (e.g., corn syrup, chewing gum sweeteners, milk product sugars, glycols and polyols, high fructose corn syrup, juices, oligosaccharides)
- ▶ HC-75 Hydrogen Form—Organic acids, sugars and alcohols

HC-40 and HC-75 columns separate compounds through size exclusion and ligand exchange. The 4% cross-linked HC-40 uses size exclusion as the primary mechanism of separation, while ligand exchange dominates in the more highly cross-linked HC-75. The different forms of the HC-75 (Hydrogen, Calcium and Lead) each provide a unique selectivity for separating varying types of charged analytes based on electronegativity toward the counterion. The higher carbohydrate oligomers elute first while the smaller di- and monosaccharides elute later.

The HC-75 column provides a slightly faster 14-minute separation up to DP 5, and the HC-40 column provides a much better separation of the oligomers up to DP 8 in 16 minutes. Because carbohydrates do not contain a chromophore, UV detection cannot be used without derivatization. The recommended detection method is refractive index. The control of carbohydrate retention lies in the selection of the correct column.

The HC-40 and HC-75 columns use water as a mobile phase (gradients and salts are not required), which simplifies eluent preparation and minimizes cost. This mobile phase characteristic also lends these columns to detection techniques such as evaporative light scattering detection and mass spectrometry. A very versatile column family, the HC-75 group can be used with up to 40% acetonitrile and can be regenerated to help restore performance.

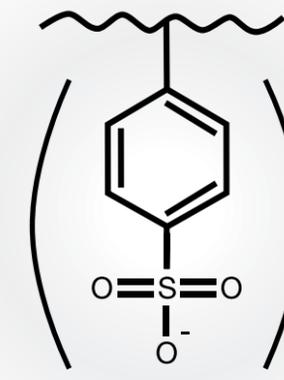
### HC-40 and HC-75 stationary phase structure and applications

#### Applications:

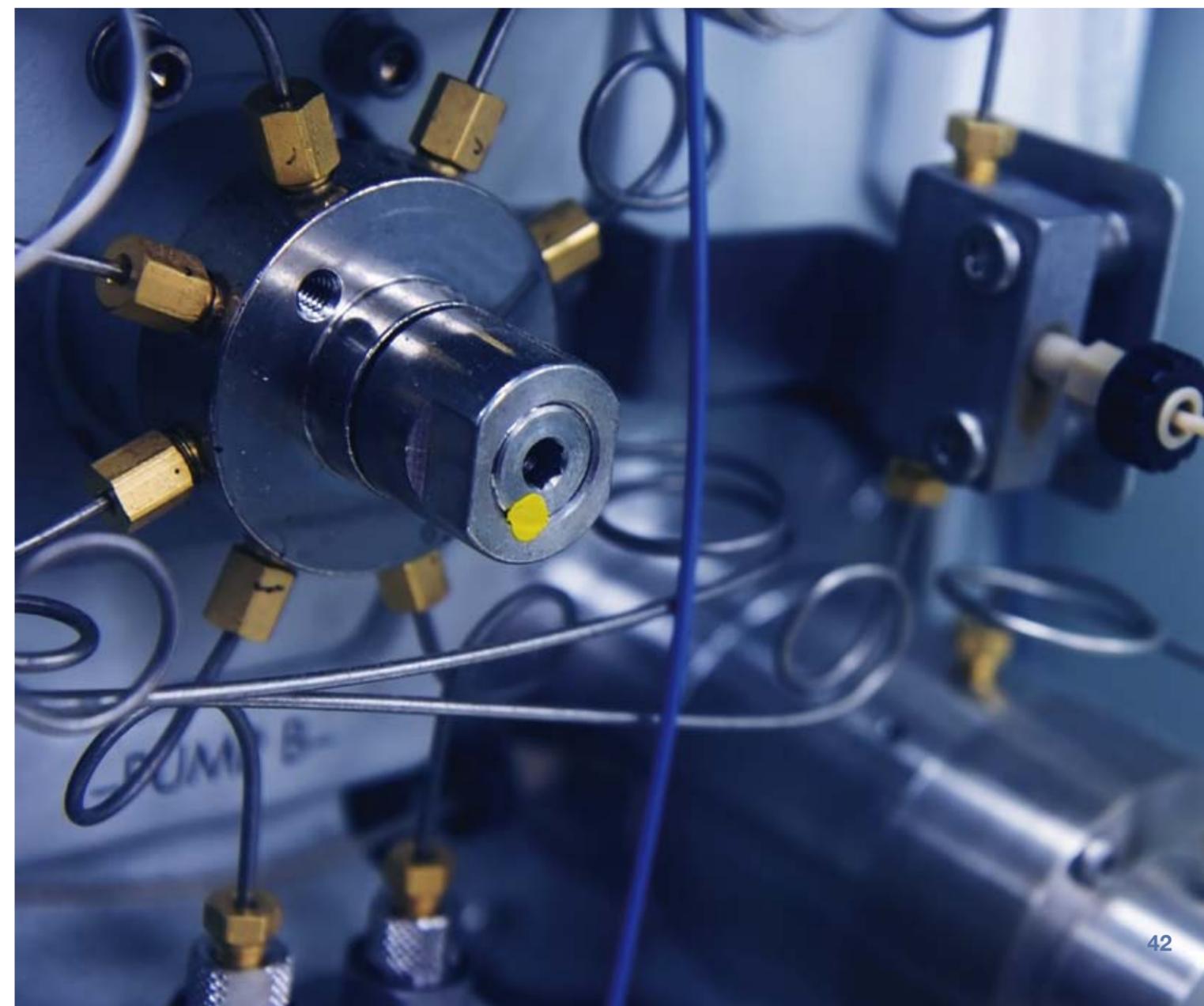
Carbohydrates, sugar oligomers up to DP8. Mono and disaccharides, organic acids, sugars, and sugar alcohols.

#### Examples of analytes that can be separated on HC-40 and HC-75 columns:

- ▶ Ethanol
- ▶ Maltotriose
- ▶ Glucose
- ▶ Fructose
- ▶ Arabinose
- ▶ Sorbitol
- ▶ Acetic acid

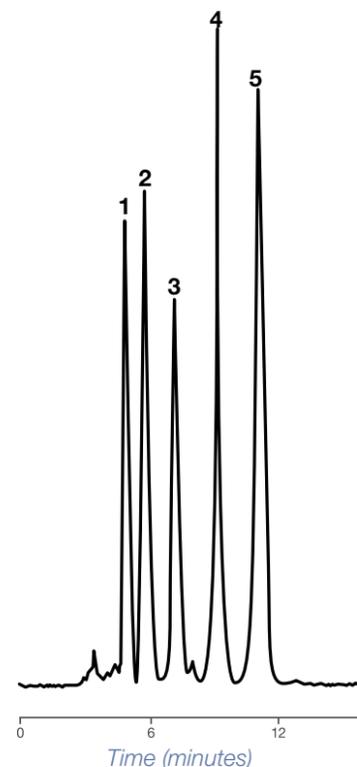


$\text{Pb}^{2+}$ ,  $2\text{H}^+$  or  $\text{Ca}^{2+}$



HC-75 application chromatograms

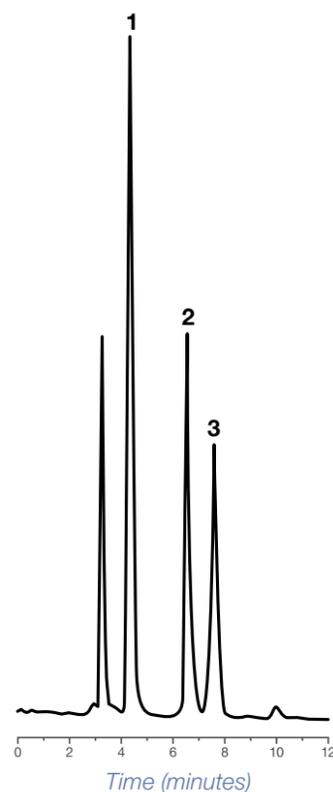
Chewing Gum Sugars on HC-75 Ca<sup>2+</sup>



**Column:** HC-75 Calcium Form, 5 μm, 7.8 mm x 305 mm  
**Part number:** 79436  
**Mobile phase:** Deionized water.  
**Flow rate:** 1.2 mL/min  
**Gradient:** Isocratic  
**Temperature:** 90°C  
**Injection volume:** 2 μL  
**Detection:** Refractive index

**Compounds:**  
 1. Sucrose  
 2. Glucose  
 3. Fructose  
 4. Mannitol  
 5. Sorbitol

Organic Acids by USP L17 on HC-75 H<sup>+</sup>

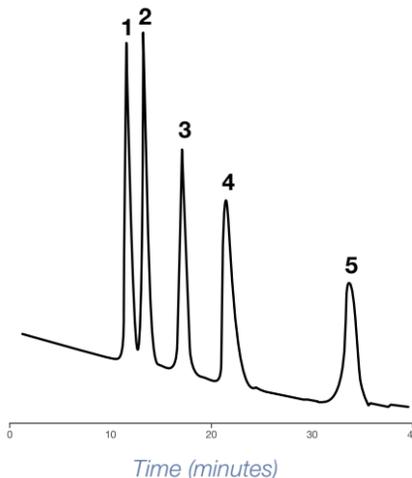


**Column:** HC-75 Hydrogen Form, 5 μm, 4.1 mm x 250 mm  
**Part number:** 79476  
**Mobile phase:** 0.01 N sulfuric  
**Flow rate:** 0.35 mL/min  
**Gradient:** Isocratic  
**Temperature:** 60°C  
**Injection volume:** 10 μL

**Sample concentration:** All compounds are 250 ppm  
**Detection:** UV at 210 nm

**Compounds:**  
 1. Citric acid  
 2. Lactic acid  
 3. Acetic acid

Sugar Standards on HC-75 Pb<sup>2+</sup>



**Column:** HC-75 Lead Form, 5 μm, 7.8 mm x 305 mm  
**Part number:** 79438  
**Mobile phase:** Deionized water  
**Flow rate:** 0.6 mL/min  
**Gradient:** Isocratic  
**Temperature:** 80°C  
**Injection volume:** 200 μL  
**Sample concentration:** All compounds are 2.5 mg/mL  
**Detection:** Refractive index

**Compounds:**  
 1. Sucrose  
 2. Glucose  
 3. Fructose  
 4. Inositol  
 5. Sorbitol

HC-75 and HC-40 Column Ordering Information

	HC-75	HC-40
<b>Dimensions</b>	<b>Particle Size</b>	
	9 μm	9 μm
(H <sup>+</sup> ) 4.1 x 250 mm	79476	
(H <sup>+</sup> ) 7.8 x 100 mm	79547	
(H <sup>+</sup> ) 7.8 x 305 mm	79544	
(H <sup>+</sup> ) Bulk Resin (1 Gram)	79711	
(Ca <sup>2+</sup> ) 4.1 x 250 mm	79431	
(Ca <sup>2+</sup> ) 7.8 x 305 mm	79436	
(Ca <sup>2+</sup> ) Bulk Resin (1 Gram)	79709	79707
(Pb <sup>2+</sup> ) 7.8 x 100 mm	79240	
(Pb <sup>2+</sup> ) 7.8 x 305 mm	79438	
(Pb <sup>2+</sup> ) Bulk Resin (1 Gram)	79712	

