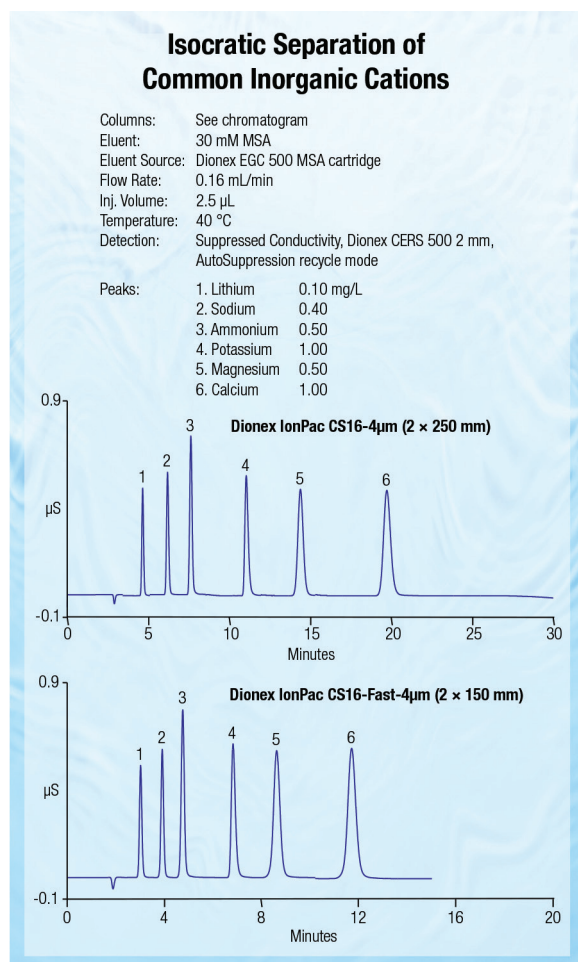


Thermo Scientific Dionex IonPac CS16-4 μ m and CS16-Fast-4 μ m Cation-Exchange Columns

The Thermo Scientific™ Dionex™ IonPac™ CS16-4 μ m and CS16-Fast-4 μ m cation-exchange columns are designed for the determination of disparate concentration ratios of sodium and ammonium (up to 10,000:1) in diverse sample matrices using an isocratic acid eluent and elevated temperature. Other important applications include the determination of short-chained alkylamines and alkanolamines in the presence of common cations in complex sample matrices. The Dionex IonPac CS16-4 μ m column is recommended for most Dionex IonPac CS15 applications. Solvent compatibility permits changing the selectivity of hydrophobic amines and easy column clean-up after the analysis of complex matrices. Formats available include 0.4 mm, 2 mm, and 4 mm, allowing use of capillary to analytical flow rates and supporting advanced IC \times IC applications.

Superior Chromatographic Performance

- Universal column for disparate concentration ratios of ammonium and sodium in complex sample matrices
- Reduced eluent consumption and reduced operating costs
- Determine trace-level ammonium in high concentrations of sodium; trace-level sodium in high concentrations of ammonium or amines
- Determine amines, including alkylamines and alkanolamines in diverse sample matrices
- Designed for use in most Dionex IonPac CS15 applications with a larger linear working range
- Improved low sample pH tolerance
- High capacity: 5370 μ eq per column (4 \times 250 mm column)
- Fourfold and 100-fold increase in mass sensitivity, respectively, with 2 mm i.d. microbore and 0.4 mm i.d. capillary formats
- Simplified operation provided by an eluent generator, requiring only a deionized water source to produce methanesulfonic acid (MSA) eluent



- Compatible with organic solvents to enhance analyte solubility, improve peak shapes of more hydrophobic amines, modify column selectivity, or for effective column clean-up
- Sample matrices include environmental waters and soil extracts; power plant waters treated with ammonium, morpholine, or ethanolamine; chemical additives; chemical process solutions; scrubber solutions; plating baths; and solvents

Unique Carboxylate Cation Exchanger

The Dionex IonPac CS16-4 μ m and CS16-Fast-4 μ m columns are unique hydrophobic, high-capacity, carboxylate-functionalized cation exchangers that provide excellent peak shape for alkali and alkaline earth metals and amines. The Dionex IonPac CS16-4 μ m and CS16-Fast-4 μ m column packing is a 4- μ m diameter macroporous particle consisting of ethylvinylbenzene crosslinked with 55% divinylbenzene as shown in Figure 1. The substrate is functionalized with a hydrophobic carboxylic acid layer that permits the elution of mono- and divalent cations using a hydronium ion eluent, such as MSA or sulfuric acid. The Dionex IonPac CS16-4 μ m and CS16-Fast-4 μ m packings are a new advancement in Dionex resin technology. The Dionex IonPac CS16-4 μ m and Dionex IonPac CS16-Fast-4 μ m columns have the same selectivity as the Dionex IonPac CS16 column but use smaller particles, producing higher peak efficiencies and better resolution. Improved resolution makes peak integration easier and more reliable, leading to more accurate results.

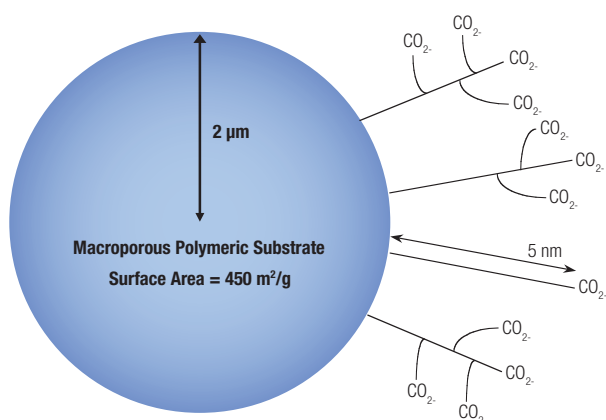


Figure 1. Structure of a Dionex IonPac CS16-4 μ m packing particle.

Improved Resolution

The Dionex IonPac CS16-4 μ m and CS16-Fast-4 μ m columns provide improved resolution among the analyte peaks due to their higher cation-exchange capacity. They were designed specifically for high-to-low ratios of sodium and ammonium in diverse sample matrices. Ratios of up to 10,000:1 can be resolved using a simple isocratic acidic eluent at an elevated temperature (40 °C) coupled with suppressed conductivity detection. The common inorganic cations and ammonium can be resolved in about 20 min on the Dionex IonPac CS16-4 μ m column using 30 mM MSA, as shown in Figure 2.

The Dionex IonPac CS16-Fast-4 μ m column can be used for the fast determination of common inorganic cations and ammonium in about 12 min using 30 mM MSA, also illustrated in Figure 2.

Columns: See chromatogram
 Eluent: 30 mM MSA
 Eluent Source: Dionex EGC 500 MSA cartridge
 Flow Rate: 0.64 mL/min
 Inj. Volume: 15 μ L
 Temperature: 40 °C
 Detection: Suppressed Conductivity, Dionex CERS 500 4 mm, AutoSuppression recycle mode

Peaks: 1. Lithium 0.1 mg/L
 2. Sodium 0.4
 3. Ammonium 0.5
 4. Potassium 1.0
 5. Magnesium 0.5
 6. Calcium 1.0

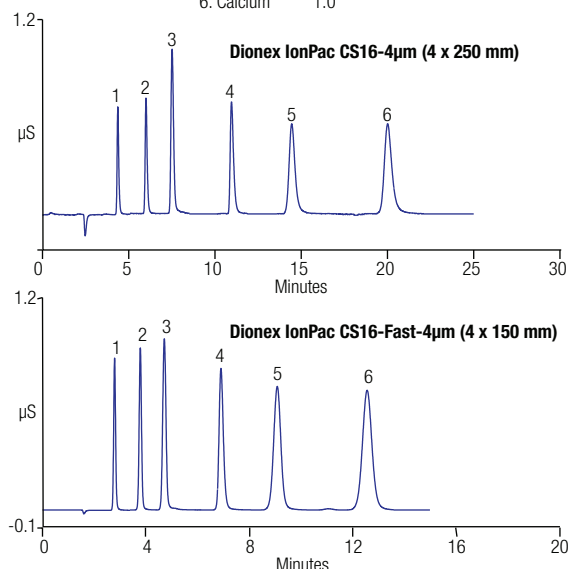


Figure 2. Isocratic separation of common inorganic cations.

Dionex IonPac CS16-4 μ m Capillary Format

The Dionex IonPac CS16-4 μ m and CS16-Fast-4 μ m Capillary columns (0.4 \times 250 mm and 0.4 \times 150 mm) are packed with the same material as the equivalent analytical scale versions, thus producing the same performance as a 4 mm column, but requiring only 1/100th the eluent flow rate. The capillary formats offer the advantage of less eluent consumption, providing reduced operating and disposal costs. Figure 3 illustrates the separation of common inorganic cations using the Dionex IonPac CS16-4 μ m Capillary Column. Excellent retention time reproducibility can be achieved with the capillary format.

Columns: See chromatogram
 Eluent: 30 mM MSA
 Eluent Source: Dionex EGC 500 MSA cartridge
 Flow Rate: 6 $\mu\text{L}/\text{min}$
 Inj. Volume: 0.4 μL
 Temperature: 40 $^{\circ}\text{C}$
 Detection: Suppressed Conductivity, Dionex CCES 300, AutoSuppression recycle mode

Peaks: 1. Lithium 0.1 mg/L
 2. Sodium 0.4
 3. Ammonium 0.5
 4. Potassium 1.0
 5. Magnesium 0.5
 6. Calcium 1.0

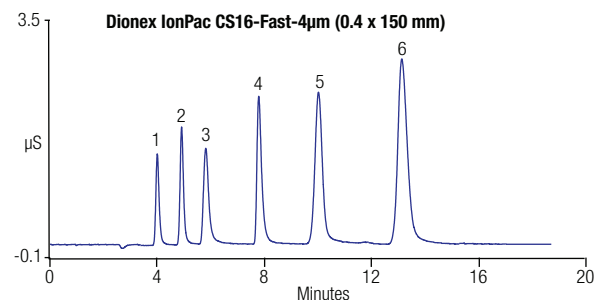
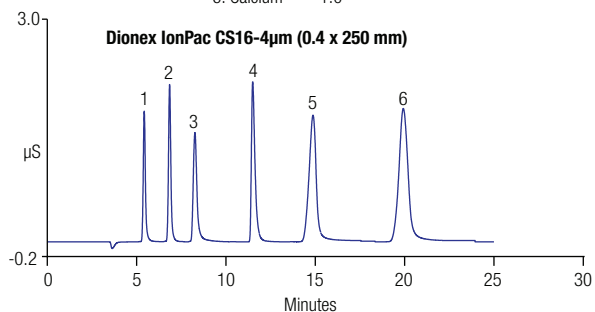


Figure 3. Separation of six cations on the Dionex IonPac CS16-4 μm and CS16-Fast-4 μm capillary columns.

High Loading Capacity for Trace-Level Ammonium in High Sodium Samples

The Dionex IonPac CS16-4 μm and CS16-Fast-4 μm columns are high capacity cation-exchange columns that replace the Dionex IonPac CS15 column for disparate concentration ratios of ammonium and sodium in diverse sample matrices. The Dionex IonPac CS16-4 μm and CS16-Fast-4 μm are ideal for the determination of low concentrations of ammonium in environmental waters. They provide improved resolution of sodium from ammonium and alkanolamines, even for samples with high ionic strength. Figure 4A illustrates the determination of trace-level ammonium in the presence of high sodium at ratios up to 10,000:1 using an isocratic MSA eluent on the Dionex IonPac CS16-4 μm 4 mm column. Resolution can be improved using an MSA gradient as shown in Figure 4B.

Columns: Dionex IonPac CG16-4 μm (4 \times 50 mm)
 Dionex IonPac CS16-4 μm (4 \times 250 mm)
 Eluent A: 30 mM MSA
 Eluent B: 10.5 mM MSA from 0 to 20 mins,
 10.5-56 mM MSA from 20 to 25 mins,
 56 mM MSA from 25 to 33 mins,
 10.5 mM MSA from 33 to 35 mins
 Eluent Source: Dionex EGC 500 MSA cartridge
 Flow Rate: 0.64 mL/min
 Inj. Volume: 15 μL
 Temperature: 40 $^{\circ}\text{C}$
 Detection: Suppressed Conductivity,
 Dionex CERS 500 4-mm,
 AutoSuppression recycle mode

Peaks: 1. Sodium 100 mg/L
 2. Ammonium 0.010

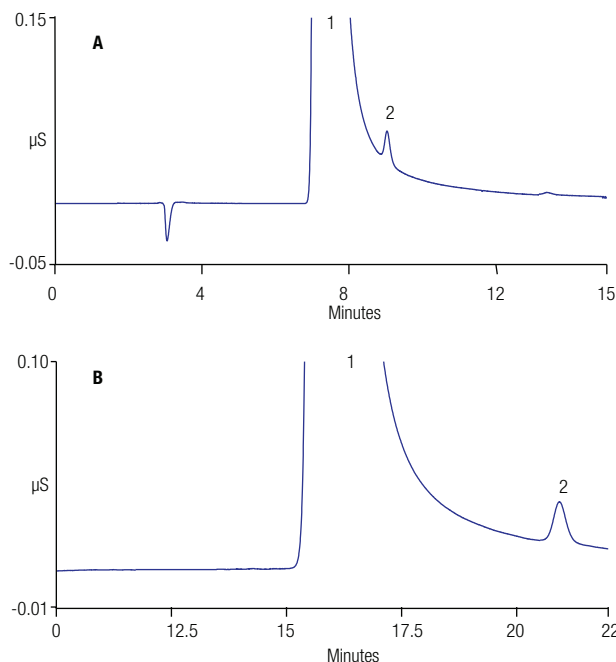


Figure 4. Determination of trace-level ammonium in a high sodium sample using the Dionex IonPac CS16-4 μm column.

High Loading Capacity for Trace-Level Sodium in High Ammonium Samples

The Dionex IonPac CS16-4 μm and CS16-Fast-4 μm columns are also ideal for the determination of trace-level sodium at ng/L (ppt) concentrations in ammonium and amine-treated cooling waters. The high capacity and unique selectivity of the Dionex IonPac CS16-4 μm and CS16-Fast-4 μm columns allow the resolution of trace sodium in the presence of high levels of ammonium and alkanolamines.

Determination of Amines in Complex Matrices

The Dionex IonPac CS16-4 μ m and CS16-Fast-4 μ m columns can be used to monitor the amine content in the quality control of chemical additives, process solutions, plating baths, and scrubber solutions. The Dionex IonPac CS16-4 μ m and CS16-Fast-4 μ m columns are ideal for the determination of amines in a variety of sample matrices. Figure 5 illustrates the separation of short-chained hydrophilic methylamines and Group I and II cations in a single run. For specific amine applications, the eluent conditions can be optimized to resolve the amines of interest and the common inorganic cations.

Columns:	Dionex IonPac CG16-4 μ m (2 \times 50 mm) Dionex IonPac CS16-4 μ m (2 \times 250 mm)																		
Eluent:	See chromatogram																		
Eluent Source:	Dionex EGC 500 MSA cartridge																		
Flow Rate:	0.16 mL/min																		
Inj. Volume:	2.5 μ L																		
Temperature:	40 $^{\circ}$ C																		
Detection:	Suppressed Conductivity, Dionex CERS 500 2 mm, AutoSuppression recycle mode																		
Peaks:	<table> <tbody> <tr> <td>1. Lithium</td> <td>0.30 mg/L</td> </tr> <tr> <td>2. Sodium</td> <td>1.20</td> </tr> <tr> <td>3. Ammonium</td> <td>1.50</td> </tr> <tr> <td>4. Methylamine</td> <td>1.00</td> </tr> <tr> <td>5. Dimethylamine</td> <td>0.80</td> </tr> <tr> <td>6. Potassium</td> <td>3.00</td> </tr> <tr> <td>7. Trimethylamine</td> <td>3.00</td> </tr> <tr> <td>8. Magnesium</td> <td>1.50</td> </tr> <tr> <td>9. Calcium</td> <td>3.00</td> </tr> </tbody> </table>	1. Lithium	0.30 mg/L	2. Sodium	1.20	3. Ammonium	1.50	4. Methylamine	1.00	5. Dimethylamine	0.80	6. Potassium	3.00	7. Trimethylamine	3.00	8. Magnesium	1.50	9. Calcium	3.00
1. Lithium	0.30 mg/L																		
2. Sodium	1.20																		
3. Ammonium	1.50																		
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5. Dimethylamine	0.80																		
6. Potassium	3.00																		
7. Trimethylamine	3.00																		
8. Magnesium	1.50																		
9. Calcium	3.00																		

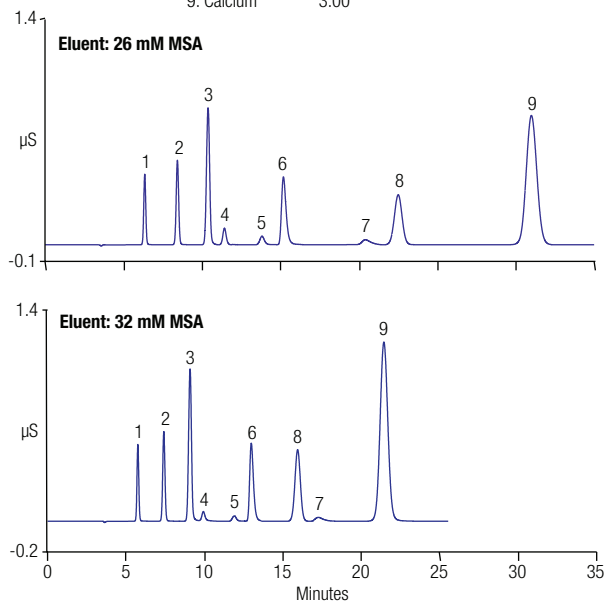


Figure 5. Determination of six common cations and methyl amines using the Dionex IonPac CS16-4 μ m column.

Long-Term Durability

The Dionex IonPac CS16-4 μ m and CS16-Fast-4 μ m packing ensures long-term column stability and trouble-free operation. The columns are compatible with acidic eluents and samples. Performance of the high-capacity Dionex IonPac CS16-4 μ m and CS16-Fast-4 μ m columns does not deteriorate with the injection of acidic samples up to approximately 100 mN hydronium ion. Acid digests or preserved samples can be injected without pH adjustment.

Solvent-Compatible Packing

The Dionex IonPac CS16-4 μ m and CS16-Fast-4 μ m columns are 100% solvent-compatible. Adding acetonitrile to the eluent modifies column selectivity and enables the elution of nonpolar analytes or contaminants from the column. Acetonitrile can be used to enhance sample solubility, reduce retention times, elute more hydrophobic amines, and improve the peak shapes of hydrophobic amines.

System Requirements

The Dionex IonPac CS16-4 μ m and CS16-Fast-4 μ m columns operated in the suppressed conductivity mode are recommended for use with the Thermo Scientific™ Dionex™ ICS-5000+ Reagent-Free™ HPIC™ system or the Thermo Scientific™ Dionex™ Integriion™ HPIC™ system when either is equipped with an eluent generator. Capillary columns (0.4 mm) require the use of a capillary system such as the Dionex ICS-5000+ HPIC system or the Thermo Scientific Dionex ICS-4000 Capillary HPIC system. The eluent generator automatically produces methanesulfonic acid gradients from deionized water.

Suppressor Recommendations

For optimum ease of use and performance, the Dionex IonPac CS16-4 μ m and CS16-Fast-4 μ m analytical columns should be used with the Thermo Scientific™ Dionex™ CERS™ 500 Cation Electrolytically Regenerated Suppressor. The Thermo Scientific™ Dionex™ CCES™ 300 Cation Capillary Electrolytic Suppressor is used with the Dionex IonPac CS16-4 μ m and CS16-Fast-4 μ m capillary columns.

Cation Trap Columns

When using an eluent generator for eluent delivery and to achieve an almost flat baseline when using gradient elution, we recommend installing a Thermo Scientific™ Dionex™ CR-CTC 500 or CR-CTC 600 Continuously Regenerated Cation Trap Column to remove cationic contaminants from the eluent. The Dionex CR-CTC 500 or CR-CTC 600 Continuously Regenerated Cation Trap Column should be installed between the Thermo Scientific™ Dionex™ EGC Eluent Generator Cartridge and the eluent generator degas module. Alternatively, a Thermo Scientific™ Dionex™ IonPac™ CTC 500 Cation Trap Column can be used with 2 mm and 4 mm columns, and is installed between the gradient pump and the injection valve to remove cationic contaminants from the eluent. For capillary applications, the Thermo Scientific™ Dionex™ CR-CTC Continuously Regenerated Cation Trap Column (Capillary) is used to reduce the background conductivity during gradient separations.

Concentrator Columns

For trace cation determinations, use a Thermo Scientific™ Dionex™ IonPac™ Trace Cation Concentrator Column (Dionex IonPac TCC-LP1, TCC-ULP1, or TCC-XLP1) when the sample is delivered via a syringe or autosampler. For concentrator work with a 0.4 mm capillary column, use the Thermo Scientific™ Dionex™ IonSwift™ MCC-100 concentrator column.

Specifications

Column Dimensions

Dionex IonPac CS16-4 μ m Capillary Column:	0.4 \times 250 mm
Dionex IonPac CG16-4 μ m Capillary Guard Column:	0.4 \times 50 mm
Dionex IonPac CS16-4 μ m Analytical Column:	2 \times 250 mm and 4 \times 250 mm
Dionex IonPac CG16-4 μ m Guard Column:	2 \times 50 mm and 4 \times 50 mm
Dionex IonPac CS16-Fast-4 μ m Capillary Column:	0.4 \times 150 mm
Dionex IonPac CG16-Fast-4 μ m Capillary Guard Column:	0.4 \times 35 mm
Dionex IonPac CS16-Fast-4 μ m Analytical Column:	2 \times 150 mm and 4 \times 150 mm
Dionex IonPac CG16-Fast-4 μ m Guard Column:	2 \times 30 mm and 4 \times 30 mm

Maximum Operating Pressure

5000 psi (standard, microbore, and capillary)

Mobile Phase Compatibility

Acidic eluents (pH 0-7), 100% acetonitrile, and 100% acetone. Alcohols should be avoided.

Substrate Characteristics

Bead Diameter: 4 μ m

Crosslinking (%DVB): 55%

Ion-Exchange Group

Grafted carboxylic acid

Functional Group Characteristics

Medium hydrophobic

Column Capacity (μ eq/column)

50 μ eq/column	0.4 \times 250 mm
30 μ eq/column	0.4 \times 150 mm
10 μ eq/column	0.4 \times 50 mm
5 μ eq/column	0.4 \times 35 mm
5370 μ eq/column	4 \times 250 mm
3220 μ eq/column	4 \times 150 mm
1070 μ eq/column	4 \times 50 mm
650 μ eq/column	4 \times 30 mm
1340 μ eq/column	2 \times 250 mm
800 μ eq/column	2 \times 150 mm
270 μ eq/column	2 \times 50 mm
160 μ eq/column	2 \times 30 mm

Column Construction

PEEK with 10-32 threaded ferrule-style end fittings. All components are non-metallic.

Ordering Information

In the U.S., call 1-800-346-6390 or contact the Thermo Fisher Scientific Regional office nearest you. Outside the U.S., order through your local Thermo Fisher Scientific office or distributor. Refer to the following part numbers.

Column	Size	Part Number
Analytical and Guard Columns		
Dionex IonPac CS16-4 μ m Capillary	0.4 \times 250 mm	088615
Dionex IonPac CG16-4 μ m Capillary Guard	0.4 \times 50 mm	088616
Dionex IonPac CS16-4 μ m Analytical	4 \times 250 mm	088584
Dionex IonPac CG16-4 μ m Guard	4 \times 50 mm	088585
Dionex IonPac CS16-4 μ m Analytical	2 \times 250 mm	088582
Dionex IonPac CG16-4 μ m Guard	2 \times 50 mm	088583
Dionex IonPac CS16-Fast-4 μ m Capillary	0.4 \times 150 mm	088641
Dionex IonPac CG16-Fast-4 μ m Capillary Guard	0.4 \times 35 mm	088642
Dionex IonPac CS16-Fast-4 μ m Analytical	4 \times 150 mm	088599
Dionex IonPac CG16-Fast-4 μ m Guard	4 \times 30 mm	088600
Dionex IonPac CS16-Fast-4 μ m Analytical	2 \times 150 mm	088601
Dionex IonPac CG16-Fast-4 μ m Guard	2 \times 30 mm	088602
Cation Trap Columns		
Dionex CR-CTC 500 Continuously Regenerated Cation Trap Column	n.a.	075551
Dionex CR-CTC 600 Continuously Regenerated Cation Trap Column, for use with Dionex Integrion HPIC systems	n.a.	088663
Dionex CR-CTC Continuously Regenerated Cation Trap (Capillary), for use with capillary cation columns	n.a.	072079
Cation Concentrator Columns		
Dionex IonPac TCC-LP1 Trace Cation Concentrator Low Pressure, for use with the 2 mm and 4 mm columns	4 \times 35 mm	046027
Dionex IonPac TCC-ULP1 Trace Cation Concentrator Ultra Low Pressure	5 \times 23 mm	063783
Dionex IonPac TCC-XLP1 Trace Cation Concentrator Extremely Low Pressure	6 \times 16 mm	063889
Dionex IonSwift MCC-100 Monolith Cation Concentrator Column	0.5 \times 80 mm	075462

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