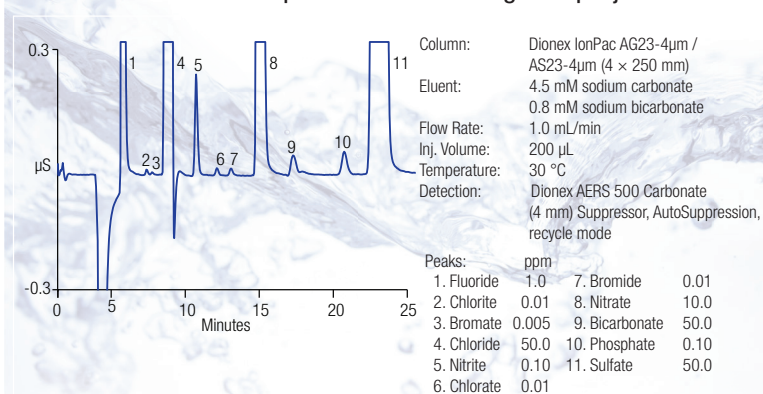


## Thermo Scientific Dionex IonPac AS23-4 $\mu$ m Anion-Exchange Column

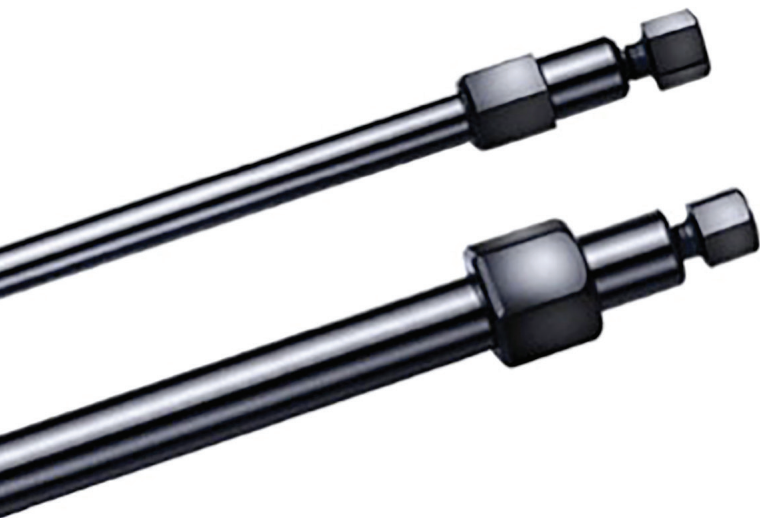
The Thermo Scientific™ Dionex™ IonPac™ AS23-4 $\mu$ m high-capacity, carbonate based anion-exchange column is designed for the determination of oxyhalides and the common inorganic anions including fluoride, chlorite, bromate, chloride, nitrite, chlorate, bromide, nitrate, phosphate, and sulfate in drinking water, groundwater, wastewater, and other diverse sample matrices. The key application for the Dionex IonPac AS23-4 $\mu$ m anion-exchange column is determination of trace bromate, chlorite, and chlorate in drinking water matrices using an isocratic carbonate/bicarbonate eluent with suppressed conductivity detection. The Dionex IonPac AS23-4 $\mu$ m column can be used in combination with Thermo Scientific Dionex Eluent Generators and the Thermo Scientific Dionex Electrolytic pH Modifier (EPM), which automatically produce potassium carbonate/bicarbonate eluents from water.

### Determination of Trace Concentrations of Bromate Using the Dionex IonPac AS23-4 $\mu$ m Column with a Large-Loop Injection



### Meets Regulatory Requirements

The Dionex IonPac AS23-4 $\mu$ m column meets the performance requirements specified in U.S. EPA Methods 300.0, 300.1, ASTM 4327, ISO 10304, and ISO 15061 for the determination of oxyhalides produced as byproducts during the disinfection process for drinking water. The selectivity of the Dionex IonPac AS23-4 $\mu$ m column ensures that bromate, a toxic byproduct of ozone disinfection, can be quantified at low  $\mu$ g/L concentrations using suppressed conductivity detection even in the presence of very high concentrations of chloride, sulfate, and carbonate. The Dionex IonPac AS23-4 $\mu$ m column allows the analysis of most drinking water, disinfected with ozone, without the use of sample pretreatment or preconcentration. Solvent compatibility permits easy column cleanup after the analysis of samples with hydrophobic components. The Dionex IonPac AS23-4 $\mu$ m column is available in 2 mm and 4 mm i.d. formats.



## Superior Chromatographic Performance

- The Dionex IonPac AS23-4 $\mu$ m column offers improved peak efficiencies and resolution compared to the Dionex IonPac AS23 column due to the use of 4  $\mu$ m resin particles.
- Recommended carbonate-eluent-based anion-exchange column for trace bromate in drinking water matrices.
- Optimized isocratic carbonate/bicarbonate eluent for the separation of oxyhalides and inorganic anions in a variety of sample matrices.
- Carbonate peak well resolved from common inorganic anions and oxyhalides.
- Meets performance requirements specified in U.S. EPA Methods 300.0 and 300.1.
- Easily transfer applications from the Dionex IonPac AS23 column to Dionex IonPac AS23-4 $\mu$ m due to the similar selectivity.
- Ideal alternative for Dionex IonPac AS9-HC column oxyhalide and inorganic anion applications.
- Simplified Reagent-Free™ Ion Chromatography (RFIC™) system operation provided by Dionex Eluent Generators and Dionex EPM, which require only a deionized water source to produce potassium carbonate/bicarbonate eluent.
- Simple, accurate eluent preparations with the Dionex IonPac AS23 Eluent Concentrate – just dilute in deionized water and start operation.
- Eluent suppression using the Thermo Scientific™ Dionex™ AERS™ 500 Carbonate Anion Electrolytically Regenerated Suppressor technology provides RFIC operation with low backgrounds and enhanced analyte sensitivity.
- High-capacity: 320  $\mu$ eq/col. (4  $\times$  250 mm column).
- Operate at ambient or elevated temperatures. Column selectivity is optimized for a 30 °C operating temperature to ensure reproducible retention times in all environmental conditions.
- Compatible with organic solvents to enhance analyte solubility, modify column selectivity, or for effective column cleanup.
- Available in standard bore and microbore formats supporting flow rates from 1.5 mL/min to 0.25 mL/min.

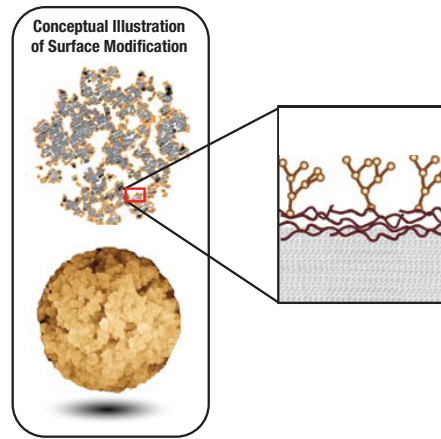


Figure 1. Structure of a Dionex IonPac AS23-4 $\mu$ m packing particle.

## High Efficiency Particle Structure

The Dionex IonPac AS23-4 $\mu$ m column was developed using a unique polymer bonding technology. The stationary phase consists of a novel hyper-branched anion-exchange condensation polymer, electrostatically attached to the surface of a wide-pore polymeric substrate. The substrate is surface-sulfonated in exactly the same manner as is common in Thermo Scientific Dionex latex coated anion-exchange materials. However, in this anion-exchange resin, alternating treatments of epoxy monomer and amines produce a coating which is grown directly off the substrate surface as illustrated in Figure 1. Resin capacity is controlled through the number of alternating coating cycles. The Dionex IonPac AS23-4 $\mu$ m column uses a high-capacity resin (320  $\mu$ eq/4 mm column) with optimized selectivity for the oxyhalides and common inorganic anions in diverse sample matrices. The Dionex IonPac AS23-4 $\mu$ m column has the same selectivity as the Dionex IonPac AS23 column but uses smaller particles, producing higher peak efficiencies and better resolution. Improved resolution makes peak integration easier and more reliable, leading to more accurate results.

## Determination of Oxyhalides and Inorganic Anions in Diverse Sample Matrices

The Dionex IonPac AS23-4 $\mu$ m column is designed for the separation of oxyhalides and the common inorganic anions in a variety of sample matrices. These analytes can easily be separated in approximately 23 min using an isocratic carbonate/bicarbonate eluent coupled with suppressed conductivity detection as shown in Figure 2.

Figure 3 shows the separation of the oxyhalides and the common inorganic anions in a municipal drinking water sample. The chromatograms in Figure 4 show the analysis of a drinking water sample spiked with 1 ppm malonate and succinate using the Dionex IonPac AS23-4 $\mu$ m 4 mm column. Notice the excellent separation of surrogate anions from sulfate.

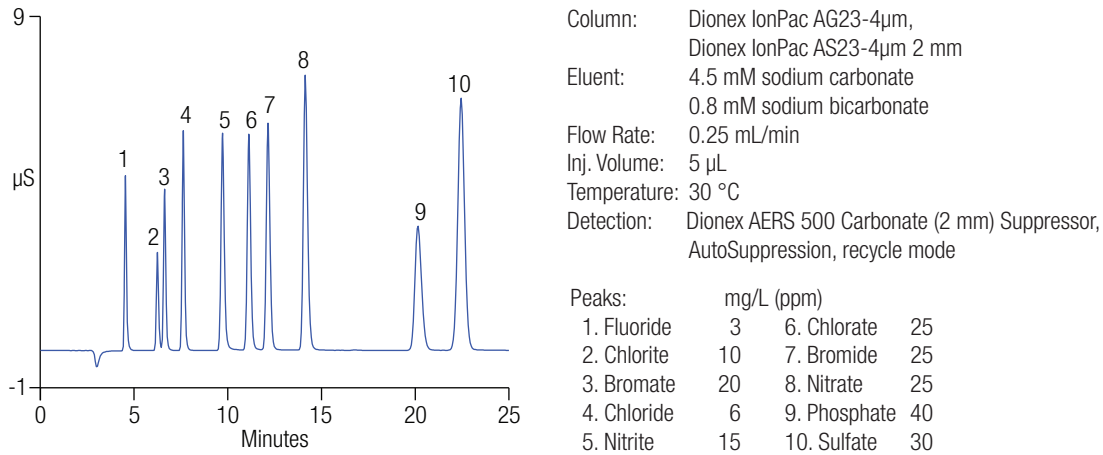


Figure 2. Determination of oxyhalides and inorganic anions using the Dionex IonPac AS23-4 $\mu$ m column.

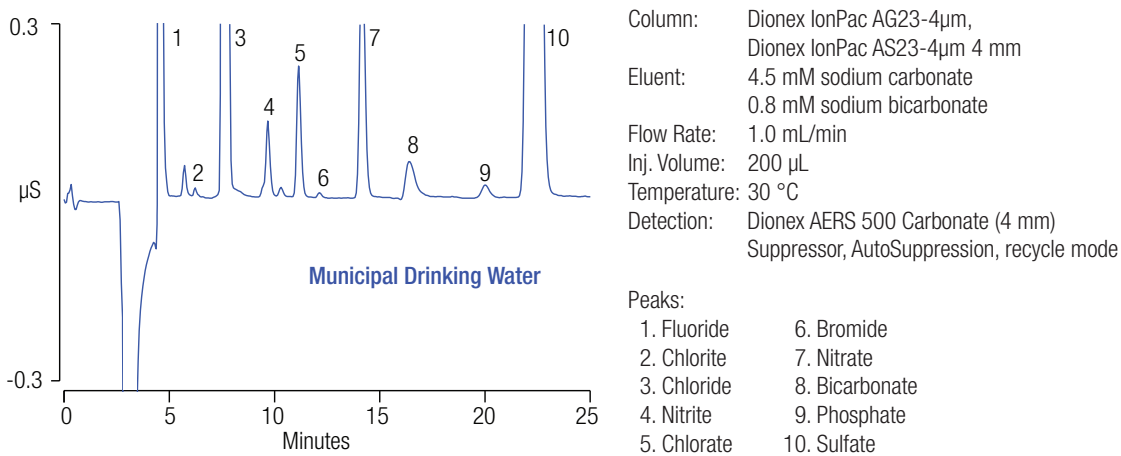


Figure 3. Determination of oxyhalides and inorganic anions in a municipal drinking water sample using the Dionex IonPac AS23-4 $\mu$ m column.

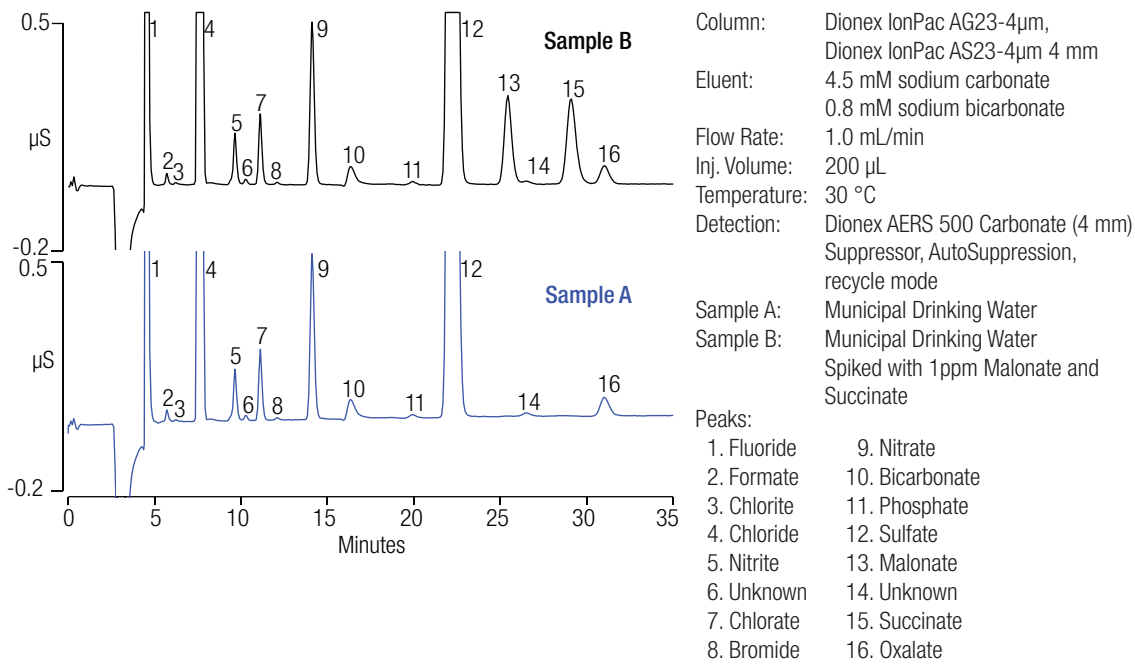


Figure 4. Separation of oxyhalides and common inorganic anions in municipal drinking water samples with and without surrogate anions using the Dionex IonPac AS23-4µm column.

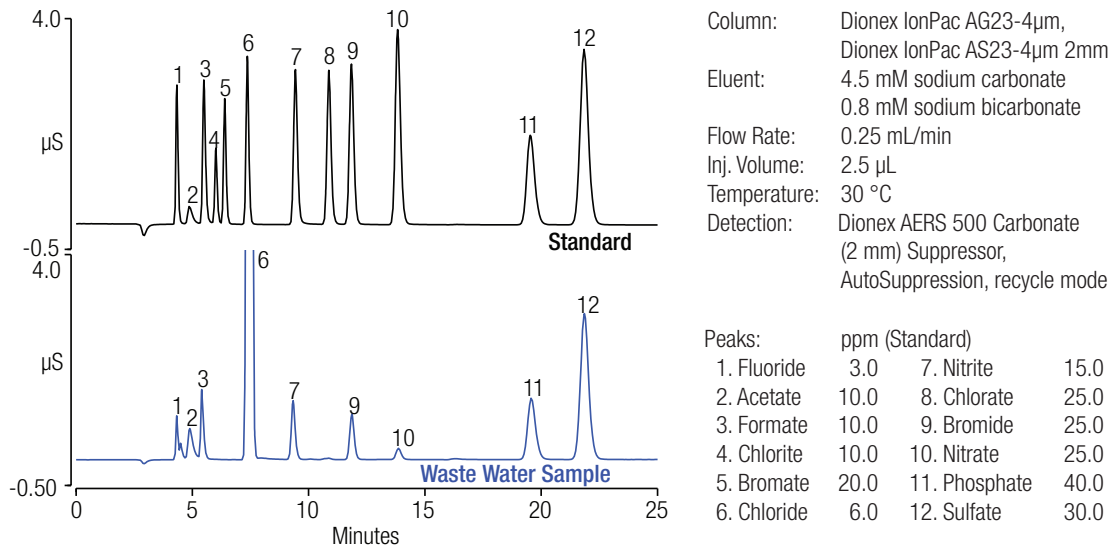


Figure 5. Separation of inorganic anions, oxyhalides, and organic acids in a wastewater sample using the Dionex IonPac AS23-4µm column.

Figure 5 shows the separation of inorganic anions, oxyhalides, and organic acids in a chemical plant wastewater sample.

### Determination of Trace Bromate in Drinking Water Matrices

The high-capacity Dionex IonPac AS23-4 $\mu$ m column can easily determine bromate at low  $\mu$ g/L concentrations in drinking water matrices. Bromate, a byproduct of the ozonation disinfection process for drinking water, has been

cited by the U.S. EPA and the World Health Organization as a potential carcinogen, even at low  $\mu$ g/L concentrations. Treatment plants that use ozone for disinfection are required to monitor bromate, with a MCL of 10  $\mu$ g/L, plus the common inorganic anions. The Dionex IonPac AS23-4 $\mu$ m column allows the analysis of most drinking water, disinfected with ozone, without the use of sample pretreatment or preconcentration. This method uses a large-loop injection with an isocratic carbonate/bicarbonate eluent coupled with suppressed conductivity detection.

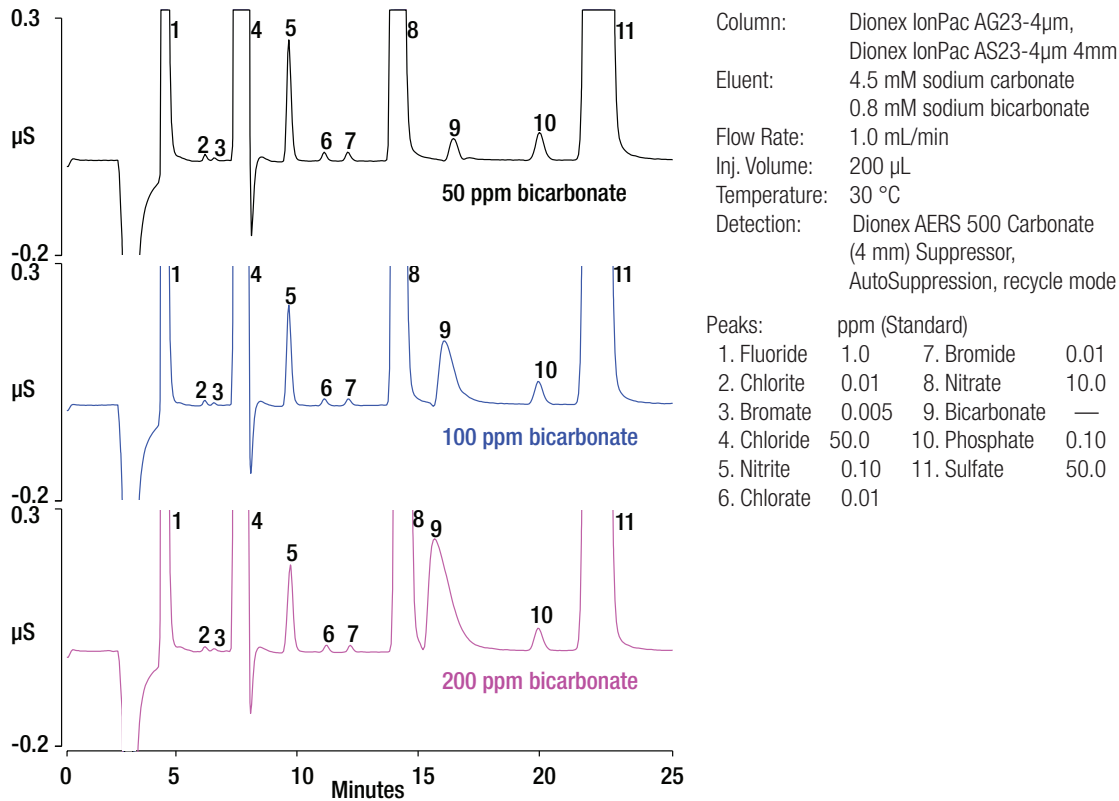
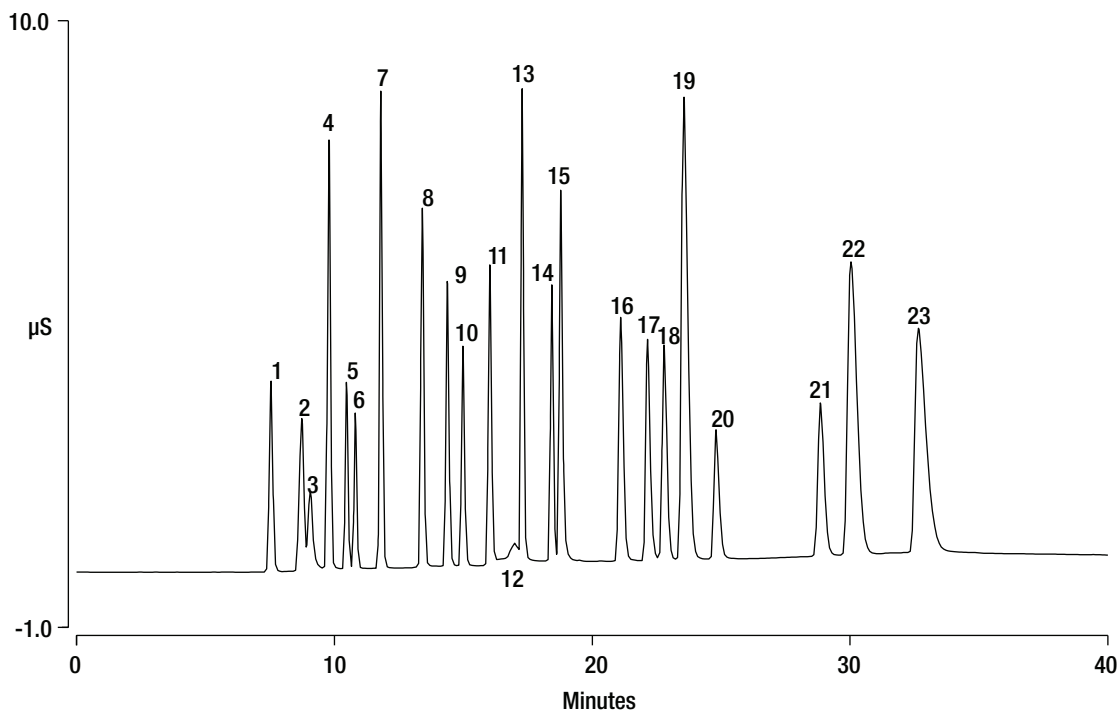


Figure 6. Determination of trace bromate in simulated drinking water samples spiked with increasing amounts of bicarbonate using the Dionex IonPac AS23-4 $\mu$ m column with a large-loop injection.

Figure 6 shows the analysis of trace level bromate in simulated drinking water samples spiked with increasing amounts of bicarbonate using the Dionex IonPac AS23-4 $\mu$ m column.

### Extended Application Capabilities

The unique selectivity and high-capacity of the Dionex IonPac AS23-4 $\mu$ m column make it an ideal column for method development of specialized anion applications. The Dionex IonPac AS23-4 $\mu$ m column provides excellent



Column:	Dionex IonPac AG23-4 $\mu$ m/ AS23-4 $\mu$ m (4 $\times$ 250 mm)	Peaks:	mg/L		
Eluent:	5 mM KOH from 0 to 5 minutes, 5-30 mM KOH from 5 to 15 minutes 30-40 mM KOH from 15 to 30 minutes 40 mM KOH from 30-40 minutes	1. Fluoride	2.0	13. Sulfate	10.0
Eluent Source:	Dionex EGC 500 KOH Cartridge	2. Acetate	10.0	14. Selenate	10.0
Flow Rate:	1.0 mL/min	3. Butyrate	10.0	15. Oxalate	10.0
Inj. Volume:	10 $\mu$ L	4. Formate	10.0	16. Phthalate	20.0
Temperature:	30 $^{\circ}$ C	5. Chlorite	10.0	17. Phosphate	20.0
Detection:	Suppressed Conductivity, Dionex AERS 500 (4 mm) Suppressor, AutoSuppression, recycle mode	6. Bromate	10.0	18. Chromate	20.0
		7. Chloride	5.0	19. Arsenate	20.0
		8. Nitrite	1.0	20. Iodide	20.0
		9. Chlorate	10.0	21. Citrate	30.0
		10. Bromide	10.0	22. Thiocyanate	30.0
		11. Nitrate	10.0	23. Perchlorate	30.0
		12. Carbonate	20.0		

Figure 7. Separation of inorganic anions, organic acids, oxyanions, and oxyhalides using the Dionex IonPac AS23-4 $\mu$ m column with a potassium hydroxide gradient delivered by an eluent generator.

separation of a variety of environmental anions including inorganic anions, oxyhalides, oxyanions, and organic acids using potassium hydroxide eluent. With a hydroxide gradient, these analytes are easily separated in less than 35 min as shown in Figure 7.

### System Requirements

The Dionex IonPac AS23-4 $\mu$ m column is recommended for use with the Thermo Scientific Dionex Integriion HPIC or Thermo Scientific Dionex ICS-5000+ RFIC systems equipped with an eluent generator and EPM. The eluent generator and EPM are used to automatically produce carbonate and bicarbonate eluents from deionized water.

### Suppressor Recommendations

For optimum ease-of-use and performance, the Dionex IonPac AS23-4 $\mu$ m column should be used with the Dionex AERS 500 Carbonate Suppressor.

### Concentrator Columns

For concentrator work with a 2 mm or 4 mm Dionex IonPac AS23-4 $\mu$ m column, use the: Dionex IonPac AG23 guard column; Ultratrace Anion Concentrator Columns (Dionex IonPac UTAC-ULP1, UTAC-XLP1, UTAC-ULP2, or UTAC-XLP2 ) or Trace Anion Concentrator Column (Dionex IonPac TAC-ULP1) when a single piston pump such as the Thermo Scientific Dionex AXP Auxiliary Pump (pulse damper required) is used for sample delivery. In addition to the concentrator columns listed above, use the

## Specifications

Dimensions:	Dionex IonPac AS23-4 $\mu$ m Analytical Column:	2 $\times$ 250 mm and 4 $\times$ 250 mm
	Dionex IonPac AG23-4 $\mu$ m Guard Column:	2 $\times$ 50 mm and 4 $\times$ 50 mm
Maximum Operating Pressure:	5000 psi	
Mobile Phase Compatibility:	pH 0–14; 0–100% HPLC solvents	
Substrate Characteristics:	Analytical Column:	Supermacroporous resin Bead diameter ( $\mu$ m): 4 Pore Size: 2000 Å Cross-linking (%DVB): 55%
	Guard Column:	Microporous resin Bead Diameter ( $\mu$ m): 11 Cross-linking (%DVB): 55%
Ion-Exchange Group:	Functional Group:	Alkanol quaternary ammonium ion
Functional Group Characteristics:	Hydrophobicity:	Ultralow
Capacity:	80 $\mu$ eq (2 $\times$ 250 mm column)	
	1.5 $\mu$ eq (2 $\times$ 50 mm column)	
	320 $\mu$ eq (4 $\times$ 250 mm column)	
	6.0 $\mu$ eq (4 $\times$ 50 mm column)	
Column Construction:	PEEK with 10–32 threaded ferrule-style end fittings. All components are nonmetallic.	

## Ordering Information

Product	Cat. No.
<b>Analytical and Guard Columns</b>	
Dionex IonPac AS23-4µm Analytical Column (4 × 250 mm)	302555
Dionex IonPac AG23-4µm Guard Column (4 × 50 mm)	302556
Dionex IonPac AS23-4µm Analytical Column (2 × 250 mm)	302557
Dionex IonPac AG23-4µm Guard Column (2 × 50 mm)	302558
<b>Trace Anion Concentrator Columns</b>	
Dionex IonPac TAC-2 Trace Anion Concentrator (3 × 35 mm)	043101
Dionex IonPac TAC-LP1 Trace Anion Concentrator (4 × 35 mm)	046026
Dionex IonPac TAC-ULP1 Trace Anion Concentrator (5 × 23 mm)	061400
Dionex IonPac UTAC-LP1 Ultra Trace Anion Concentrator Low-Pressure (4 × 35 mm)	063079
Dionex IonPac UTAC-ULP1 Ultra Trace Anion Concentrator Ultra Low-Pressure (5 × 23 mm)	063475
Dionex IonPac UTAC-XLP1 Ultra Trace Anion Concentrator Extremely Low-Pressure (6 × 16 mm)	063459
Dionex IonPac UTAC-LP2 Ultra Trace Anion Concentrator Low-Pressure (4 × 35 mm)	079917
Dionex IonPac UTAC-ULP2 Ultra Trace Anion Concentrator Ultra Low-Pressure (5 × 23 mm)	079918
Dionex IonPac UTAC-XLP2 Ultra Trace Anion Concentrator Extremely Low-Pressure (6 × 16 mm)	072781
<b>Anion Eluent Concentrates</b>	
Dionex IonPac AS23 Eluent Concentrate (100×), 250 mL	064161

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