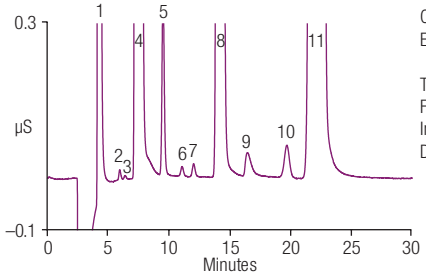
Ion chromatography

Thermo Scientific Dionex IonPac AS23 Anion-Exchange Column

The Thermo Scientific™ Dionex™ IonPac™ AS23 high-capacity, carbonate based anion-exchange column is designed for the analysis 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 anion-exchange column is determination of trace bromate in drinking water matrices using an isocratic carbonate/bicarbonate eluent with suppressed conductivity detection. The Dionex IonPac AS23 column can be used in combination with the 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 Column with a Large-Loop Injection



Column:	Dionex IonPac AG23/AS23 (4 × 250 mm)
Eluent:	4.5 mM Sodium carbonate/ 0.8 mM Sodium bicarbonate
Temperature:	30 °C
Flow Rate:	1.0 mL/min
Inj. Volume:	200 µL
Detection:	Suppressed conductivity, Thermo Scientific™ Dionex™ ASRS™ ULTRA II 4 mm Anion Self-Regenerating Suppressor, Thermo Scientific™ Dionex™ AutoSuppression™ device, external water mode

Peaks:	mg/L (ppm)
1. Fluoride	1.0
2. Chlorite	0.01
3. Bromate	0.005
4. Chloride	50
5. Nitrite	0.1
6. Chlorate	0.01
7. Bromide	0.01
8. Nitrate	10
9. Carbonate	50
10. Phosphate	0.1
11. Sulfate	50

Meets regulatory requirements

The Dionex IonPac AS23 column meets the performance requirements specified in U.S. EPA Methods 300.0 and 300.1 for the determination of oxyhalides produced as byproducts in disinfection of drinking water. The selectivity of the Dionex IonPac AS23 column ensures that bromate, a toxic byproduct in ozone disinfection, can be quantified at low µg/L concentrations using suppressed conductivity detection even in the presence of very high concentrations of chloride, sulfate, and carbonate. The Dionex IonPac AS23 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 column is available in 4 mm and 2 mm i.d. formats.

Superior chromatographic performance

- Recommended carbonate 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.
- Ideal alternative for Thermo Scientific™ Dionex™ IonPac™ AS9-HC Column oxyhalide and inorganic anion applications.
- Simplified Thermo Scientific™ Dionex™ 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 Thermo Scientific™ Dionex™ IonPac AS23 Eluent Concentrate – just dilute in deionized water and start operation.
- Eluent suppression using the Thermo Scientific™ Dionex™ AERS™ 500 Anion Electrolytically Regenerated Suppressor provides RFIC operation with low backgrounds and enhanced analyte sensitivity.
- High-capacity: 320 µeq/col. (4 × 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, microbore formats supporting flow rates from 0.25 to 2.0 mL/min.

High efficiency particle structure

The Dionex IonPac AS23 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 column uses a high-capacity resin (320 µeg/4 mm column) with optimized selectivity for the oxyhalides and common inorganic anions in diverse sample matrices.

Determination of oxyhalides and inorganic anions in diverse sample matrices

The Dionex IonPac AS23 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.

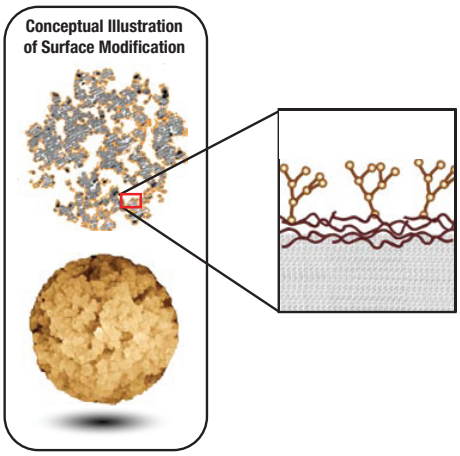
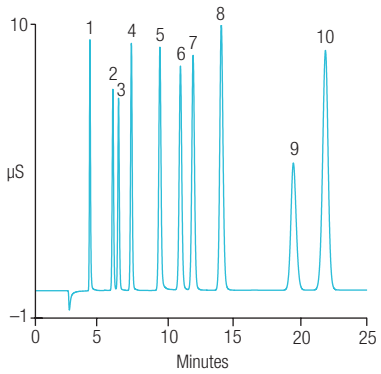


Figure 1. Structure of a Dionex IonPac AS23 packing particle.



Column:	Dionex IonPac AG23/AS23 (4 × 250 mm)
Eluent:	4.5 mM Sodium carbonate/ 0.8 mM Sodium bicarbonate
Temperature:	30 °C
Flow Rate:	1.0 mL/min
Inj. Volume:	25 µL
Detection:	Suppressed conductivity, Dionex ASRS ULTRA II 4 mm Suppressor, Dionex AutoSuppression device, recycle mode

Peaks:	mg/L (ppm)
1. Fluoride	3
2. Chlorite	10
3. Bromate	20
4. Chloride	6
5. Nitrite	10
6. Chlorate	25
7. Bromide	25
8. Nitrate	25
9. Phosphate	40
10. Sulfate	30

Figure 2. Determination of oxyhalides and inorganic anions using the Dionex IonPac AS23 column.

Figure 3 shows the separation of the oxyhalides and the common inorganic anions in a municipal drinking water sample. The high-capacity and selectivity allows for the separation of nitrate from carbonate even in the presence of high concentrations (over 300 mg/L) of carbonate.

Column:	Dionex IonPac AG23/AS23 (4 × 250 mm)
Eluent:	4.5 mM Sodium carbonate/ 0.8 mM Sodium bicarbonate
Temperature:	30 °C
Flow Rate:	1.0 mL/min
Inj. Volume:	200 µL
Detection:	Suppressed conductivity, Dionex ASRS ULTRA II 4 mm Suppressor, Dionex AutoSuppression device, external water mode

Peaks:	mg/L (ppm)
1. Fluoride	0.96
2. Formate	NQ
3. Chlorite	0.01
4. Chloride	9.54
5. Unknown	NQ
6. Nitrite	0.01
7. Unknown	NQ
8. Chlorate	0.19
9. Bromide	0.01
10. Nitrate	0.54
11. Carbonate	NQ
12. Phosphate	0.14
13. Sulfate	21.24
14. Unknown	NQ

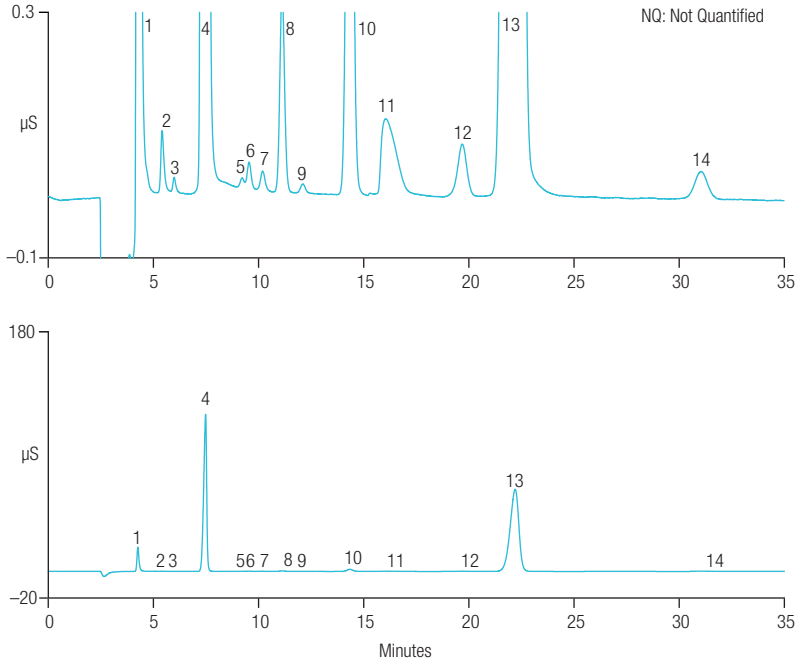


Figure 3. Determination of oxyhalides and inorganic anions in a municipal drinking water sample using the Dionex IonPac AS23 column.

Figure 4 shows the separation of inorganic anions, oxyhalides, and organic acids in a chemical plant wastewater sample. Low levels of inorganic anions can easily be determined even in the presence of high levels of sulfate, chlorate, acetate, and formate. Low levels of fluoride, bromate, chlorate and bromide are easily determined in the presence of relatively high levels of chloride, nitrate and sulfate.

Determination of trace bromate in drinking water matrices

The high-capacity Dionex IonPac AS23 column can easily determine bromate at low µg/L concentrations in drinking water matrices. Bromate, a disinfection 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 µg/L concentrations. Treatment plants that use ozone for disinfection are required to monitor bromate, with a MCL of 10 µg/L, plus the common inorganic anions. The Dionex IonPac AS23 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 as shown in Figure 5.

Column:	Dionex IonPac AG23/AS23 (4 × 250 mm)
Eluent:	4.5 mM Sodium carbonate/ 0.8 mM Sodium bicarbonate
Temperature:	30 °C
Flow Rate:	1.0 mL/min
Inj. Volume:	2.5 µL
Detection:	Suppressed conductivity, Dionex ASRS ULTRA II 4 mm Suppressor, Dionex AutoSuppression device, external water mode

Peaks:	mg/L (ppm)
1. Acetate	877.8
2. Formate	183.2
3. Chloride	61.8
4. Nitrite	0.6
5. Chlorate	213.8
6. Nitrate	1.5
7. Phosphate	1.4
8. Sulfate	1211.1
9. Unknown	NQ

NQ: Not Quantified

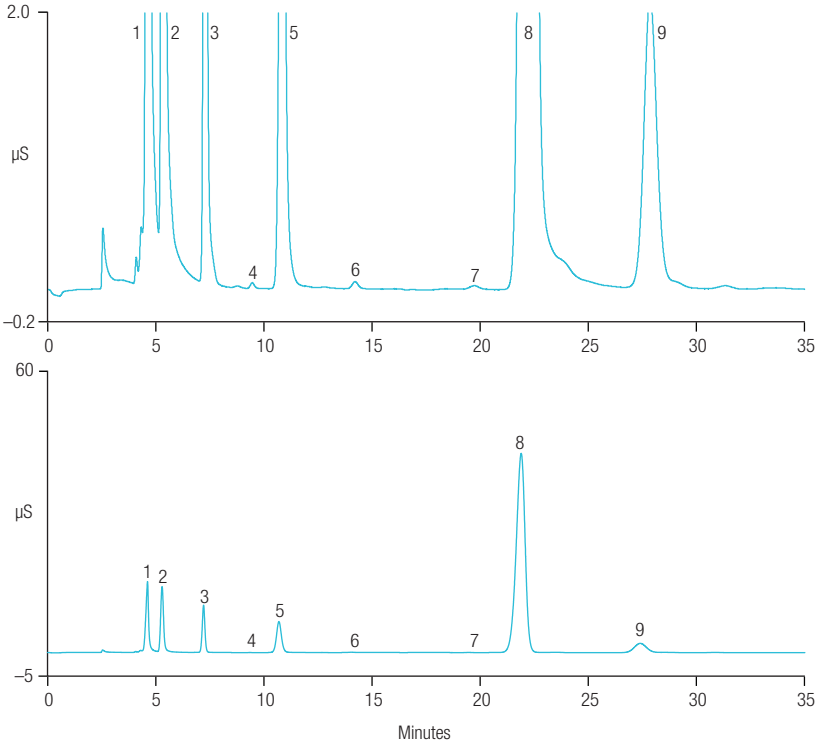


Figure 4. Separation of inorganic anions, oxyhalides, and organic acids in a chemical wastewater sample using the Dionex IonPac AS23 column.

Column:	Dionex IonPac AG23/AS23 (4 × 250 mm)
Eluent:	4.5 mM Sodium carbonate/ 0.8 mM Sodium bicarbonate
Temperature:	30 °C
Flow Rate:	1.0 mL/min
Inj. Volume:	200 µL
Detection:	Suppressed conductivity, Dionex ASRS ULTRA II 4 mm Suppressor, Dionex AutoSuppression device, recycle mode

Peaks:	mg/L (ppm)
1. Fluoride	1.0
2. Chlorite	0.01
3. Bromate	0.005
4. Chloride	50
5. Nitrite	0.1
6. Chlorate	0.01
7. Bromide	0.01
8. Nitrate	10
9. Carbonate	50
10. Phosphate	0.1
11. Sulfate	50

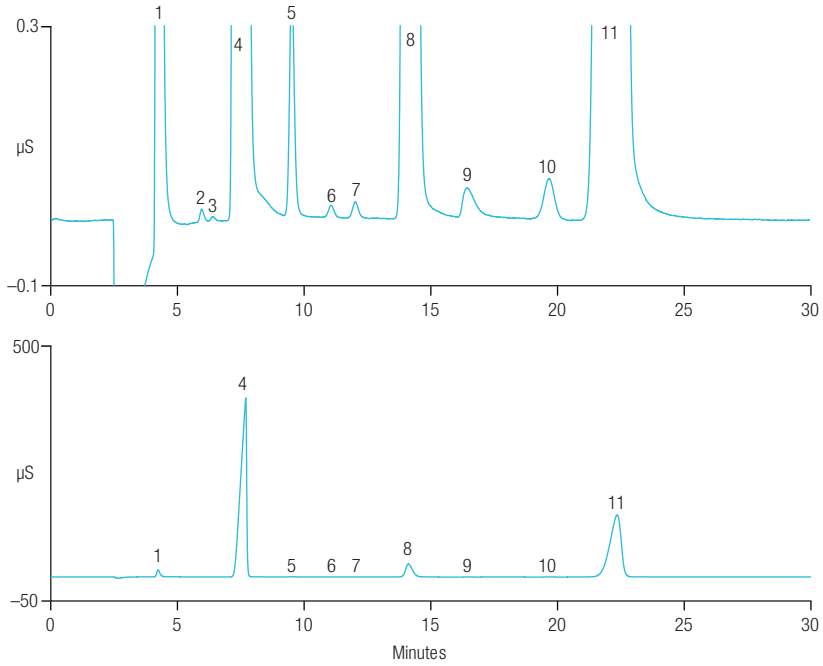


Figure 5. Determination of trace concentrations of bromate using the Dionex IonPac AS23 column with a large-loop injection.

Extended application capabilities

The unique selectivity and high-capacity of the Dionex IonPac AS23 column make it an ideal column for method development of specialized anion applications. The Dionex IonPac AS23 column provides excellent 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 6.

Column:	Dionex IonPac AG23/AS23 (4 × 250 mm)
Eluent:	Potassium hydroxide: 5 mM from 0 to 5 min, 5–30 mM from 5 to 15 min, 30–40 mM from 15 to 30 min
Eluent Source:	Thermo Scientific Dionex EGC II KOH Cartridge with Thermo Scientific Dionex CR-ATC Continuously Regenerated Anion Trap Column
Temperature:	30 °C
Flow Rate:	1.0 mL/min
Inj. Volume:	10 µL
Detection:	Suppressed conductivity, Dionex ASRS ULTRA II 4 mm Suppressor, Dionex AutoSuppression device, recycle mode

Peaks:	mg/L (ppm)	Peaks:	mg/L (ppm)
1. Fluoride	2	13. Sulfate	10
2. Acetate	10	14. Selenate	10
3. Butyrate	10	15. Oxalate	10
4. Formate	10	16. Phthalate	20
5. Chlorite	10	17. Phosphate	20
6. Bromate	10	18. Chromate	20
7. Chloride	5	19. Iodide	20
8. Nitrite	10	20. Arsenate	20
9. Chlorate	10	21. Citrate	20
10. Bromide	10	22. Thiocyanate	20
11. Nitrate	10	23. Perchlorate	30
12. Carbonate	20		

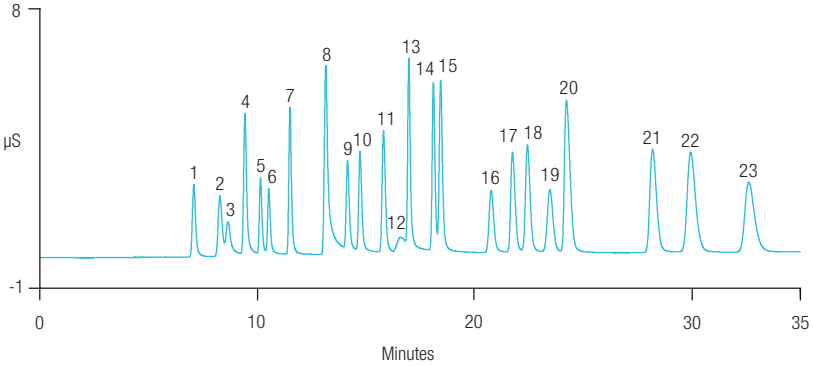


Figure 6. Anion separation including inorganic anions, organic acids, oxyanions, and oxyhalides using the Dionex IonPac AS23 column, using a potassium hydroxide eluent delivered by an eluent generator.

System requirements

The Dionex IonPac AS23 Analytical column is recommended for use with Dionex Reagent-Free IC (RFIC) systems equipped with an eluent generator and EPM. The Dionex IonPac AS23 Analytical column can also be used with older Dionex IC systems equipped with an eluent generator and EPM or a Thermo Scientific™ Dionex™ RFC-30 Reagent-Free Controller. The eluent generator is used to automatically produce carbonate and bicarbonate eluents from deionized water.

Suppressor recommendations

For optimum ease-of-use and performance, the Dionex IonPac AS23 column should be used with the Thermo Scientific™ Dionex™ AERS 500 Suppressor.

Concentrator columns

For concentrator work with a 2 mm or 4 mm Dionex IonPac AS23 column, use the: Thermo Scientific™ Dionex™ IonPac™ AG23 Guard Column; Thermo Scientific™ Dionex™ Ultratrace Anion Concentrator Columns (Dionex IonPac UTAC-ULP1, UTAC-XLP1, UTAC-ULP2, or UTAC-XLP2) or Thermo Scientific™ Dionex™ 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 Dionex IonPac UTAC-LP1, UTAC-LP2 or TAC-LP1 when the sample is delivered using a syringe or a low-pressure autosampler, such as the Thermo Scientific™ Dionex™ AS-DV autosampler.

Specifications	
Dimensions	Dionex IonPac AS23 Analytical Column: 2 × 250 mm and 4 × 250 mm
	Dionex IonPac AG23 Guard Column: 2 × 50 mm and 4 × 50 mm
Maximum operating pressure	3,000 psi
Mobile phase compatibility	pH 0–14; 0–100% HPLC solvents
Substrate characteristics	**Analytical Column:** Supermacroporous resin Bead diameter (µm): 6 Pore Size: 2000 Å Cross-linking (%DVB): 55
	Guard Column: Microporous resin Bead Diameter (µm): 11 Pore Size: <1 Å Cross-linking (%DVB): 55%
Ion-exchange group	Functional Group: Alkanol quaternary ammonium ion
Functional group characteristics	Hydrophobicity: Ultralow
Capacity	80 µeq (2 × 250 mm column)
	1.5 µeq (2 × 50 mm column)
	320 µeq (4 × 250 mm column)
	6.0 µeq (4 × 50 mm column)
Column construction	PEEK with 10–32 threaded ferrule-style end fittings. All components are nonmetallic.

Ordering information

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

Description	Part number
Dionex IonPac AS23 Columns	
Dionex IonPac AS23 Analytical Column (4 × 250 mm)	064149
Dionex IonPac AG23 Guard Column (4 × 50 mm)	064147
Dionex IonPac AS23 Analytical Column (2 × 250 mm)	064145
Dionex IonPac AG23 Guard Column (2 × 50 mm)	064143
Trace Anion Concentrator Columns	
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 Ultratrace Anion Concentrator Low-Pressure (4 × 35 mm)	063079
Dionex IonPac UTAC-ULP1 Ultratrace Anion Concentrator Ultra Low-Pressure (5 × 23 mm)	063475
Dionex IonPac UTAC-XLP1 Ultratrace Anion Concentrator Extremely Low-Pressure (6 × 16 mm)	063459
Dionex IonPac UTAC-LP2 Ultratrace Anion Concentrator Low-Pressure (4 × 35 mm)	079917
Dionex IonPac UTAC-ULP2 Ultratrace Anion Concentrator Ultra Low-Pressure (5 × 23 mm)	079918
Dionex IonPac UTAC-XLP2 Ultratrace Anion Concentrator Extremely Low-Pressure (6 × 16 mm)	072781
Anion Eluent Concentrates	
Dionex IonPac AS23 Eluent Concentrate (100×), 250 mL	064161

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