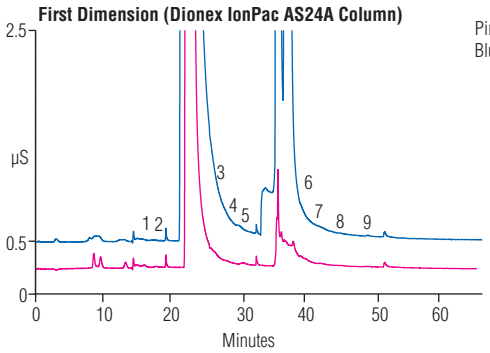
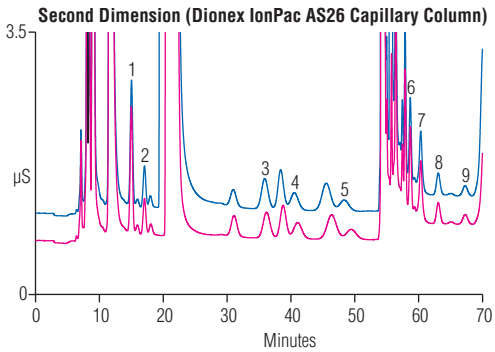
Thermo Scientific Dionex IonPac AS26 Anion-Exchange Column

The Thermo Scientific™ Dionex™ IonPac™ AS26 column is a high-capacity, hydroxide-selective, anion-exchange column designed for separation of haloacetic acids (HAAs) and bromate in drinking water using Two Dimensional Ion Chromatography (2D-IC). The Dionex IonPac AS26 Capillary column was specifically developed for the 2D-IC method. This column can also be used for determination of trace bromate, and is ideal for development of specialized applications using Reagent- Free™ Ion Chromatography (RFIC™) systems with gradient elution. The Dionex IonPac AS26 column formats available include 0.4 × 250 mm, 2 × 250 mm, and 4 × 250 mm, allowing flow rates from 10 µL/min to 2 mL/min.

Analysis of HAAs in Reagent and High-Ionic-Strength Water Using Two Dimensional Ion Chromatography (2D-IC)



Pink Trace: 100 ppm ammonium chloride
Blue Trace: High-Ionic Water (250 ppm chloride, 250 ppm sulfate, 150 ppm bicarbonate, 20 ppm nitrate and 100 ppm ammonium chloride)



Peaks:		
	1. MCAA	5 µg/L
	2. MBAA	5
	3. DCAA	5
	4. BCAA	5
	5. DBAA	5
	6. TCAA	5
	7. BDCAA	5
	8. CDBAA	5
	9. TBAA	5

Superior Chromatographic Performance

- Recommended anion-exchange column for separation of HAAs using 2D-IC
- Optimized for hydroxide mobile phases
- High-capacity: 250 µeq per column (4 × 250 mm)
- The capillary and microbore formats require less eluent thereby reducing operating costs
- Determine HAAs in high-ionic-strength matrices without sample pretreatment
- Can operate at ambient or elevated temperatures; column selectivity is optimized for 15 °C to ensure reproducible recoveries for HAAs
- Compatible with HPLC organic solvents to enhance analyte solubility, modify column selectivity, or for effective column cleanup
- Ready-to-use internal standards for HAA analysis using electrospray ionization–mass spectrometric (ESI-MS) detection with narrow-bore HPLC and UHPLC columns

Thermo SCIENTIFIC

High-Efficiency Particle Structure

The Dionex IonPac AS26 column was developed using a unique polymer-bonding technology. The stationary phase consists of a novel hyperbranched, 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 Thermo Scientific Dionex latex-coated, anion-exchange materials. However, in this anion-exchange resin, alternating treatments of epoxy monomer and amines produce a coating that grows directly off of the substrate surface (Figure 1). The number of alternating coating cycles controls the resin capacity. The resulting polymer is extremely hydrophilic and therefore has excellent selectivity for hydroxide eluents, allowing the use of lower eluent concentrations. The Dionex IonPac AS26 column uses a high-capacity resin with optimized selectivity for HAAs in environmental water matrices.

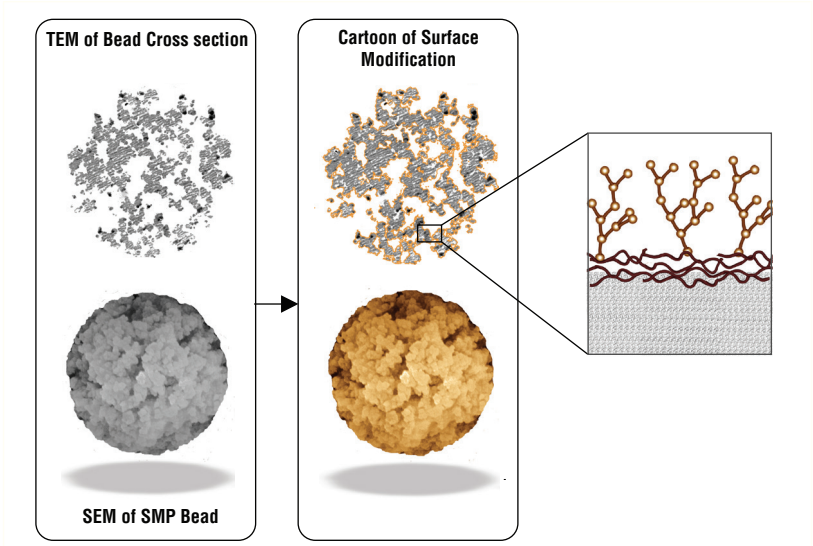


Figure 1. Structure of a Dionex IonPac AS26 column packing particle.

Determination of Haloacetic Acids in Drinking Water Using 2D-IC

HAAs containing chlorine and bromine are formed during the chlorination disinfection of drinking water. The presence of HAAs in drinking water has been linked to several adverse effects including bladder, kidney, and colorectal cancer. The Dionex IonPac AS26 column can separate the following HAAs:

- Monochloroacetic acid (MCAA)
- Dichloroacetic acid (DCAA)
- Trichloroacetic acid (TCAA)
- Monobromoacetic acid (MBAA)
- Dibromoacetic acid (DBAA)
- Tribromoacetic acid (TBAA)
- Bromochloroacetic acid (BCAA)
- Dibromochloroacetic acid (DBCAA)
- Dichlorobromoacetic acid (DCBAA)

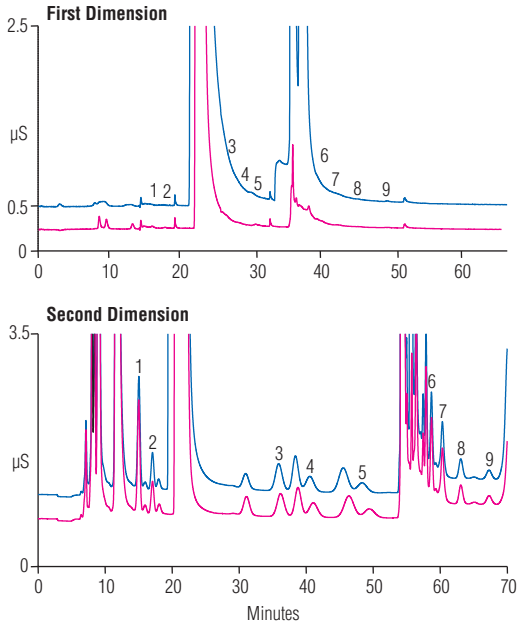
Five HAAs including MCAA, DCAA, TCAA, MBAA, and DBAA are cited in the U.S. EPA haloacetic acid regulation. This regulation requires that the total of these five HAAs does not exceed a maximum concentration limit (MCL) of 60 µg/L. All drinking water plants in the United States must determine the HAA level in drinking water. The Dionex IonPac AS26 Capillary column is designed for analysis of HAAs by 2D-IC in high-ionic-strength matrices. Figure 2 shows the 2D-IC determination of HAAs in high-ionic-strength water sample (blue trace) and ammonium chloride matrix (pink trace) using a potassium hydroxide gradient delivered by the eluent generator. The first dimension uses the high-capacity Dionex IonPac AS24A 4 mm column with a 500 µL injection to provide the initial separation of the haloacetic acid anions and the major matrix ions such as chloride, sulfate and carbonate. For the second dimension, aliquots of the suppressed Dionex IonPac AS24A effluent that contain the HAAs are concentrated on the Thermo Scientific™ Dionex™ IonSwift™ MAC-200 Concentrator Column and separated on the Dionex IonPac AS26 Capillary column. Low µg/L (ppb) levels of HAAs can easily be determined using 2D-IC detection. MBAA, CDBAA and TBAA degrade readily at a high pH. The reaction is temperature dependent. To minimize sample degradation, the separation is performed at subambient temperature, specifically at 15 °C.

First Dimension Conditions

Column:	Dionex IonPac AS24A/AG24A 4 mm
Eluent:	KOH: 7 mM from 0 to 12 min, 7 to 18 mM from 12 to 42 min, step to 65 mM at 42 min
Eluent Source:	Thermo Scientific Dionex EGC III KOH Cartridge
Flow Rate:	1.0 mL/min
Inj. Volume:	500 µL
Temperature:	15 °C
Detection:	Suppressed conductivity, Dionex ASRS 300 Suppressor, Dionex AutoSuppression device, external water mode

Second Dimension Conditions

Column:	Dionex IonPac AS26/AG26 Capillary
Eluent:	KOH: 6 mM from 0 to 50 min, step to 160 mM at 50 min, 160 mM from 50 to 57 min, step to 130 mM at 57 min
Eluent Source:	Dionex EGC-KOH (Capillary) cartridge
Flow Rate:	12 µL/min
Concentrator:	Thermo Scientific™ Dionex™ IonSwift™ MAC-200
Temperature:	15 °C
Detection:	Suppressed conductivity, Dionex ACES 300 Suppressor, Dionex AutoSuppression device, external water mode



Peaks:		
	1. MCAA	5 µg/L
	2. MBAA	5
	3. DCAA	5
	4. BCAA	5
	5. DBAA	5
	6. TCAA	5
	7. BDCAA	5
	8. CDBAA	5
	9. TBAA	5

Pink Trace: 100 ppm ammonium chloride

Blue Trace: High Ionic Water (250 ppm chloride, 250 ppm sulfate, 150 ppm bicarbonate, 20 ppm nitrate and 100 ppm ammonium chloride)

Figure 2. 2D-IC analysis of HAAs in reagent and high-ionic-strength water using the Dionex IonPac AS26 column and the Dionex IonPac AS24A column.

For optimal performance set both the lower DC compartment temperature and the IC Cube temperature to 15 °C. The upper DC compartment temperature must be reduced in order for the Thermo Scientific™ Dionex™ IC Cube™ to maintain 15 °C.

A cooled autosampler capable of maintaining samples at a temperature of less than or equal to 10 °C is also recommended. For further detail on the instrument setup for 2D-IC analysis of HAAs, see the Product Manual for Thermo Scientific Dionex IonPac AS26 Column, Document No. 065444.

Determination of Haloacetic Acids Using Suppressed Conductivity Detection

The Dionex IonPac AS26 column can also be used to analyze HAAs in higher concentrations using a direct injection and suppressed conductivity detection. Figure 3 shows the gradient separation of nine HAAs using the 2 mm Dionex IonPac AS26 column.

Analysis of Drinking Water Using the Dionex IonPac AS26 Column

The high-capacity Dionex IonPac AS26 column can be used to determine inorganic anions and oxyhalides in drinking water. Bromate, a byproduct of the ozonation disinfection process for drinking water, has been cited by the U.S. EPA and World Health Organization as a potential carcinogen, even at low-ug/L concentrations. Treatment plants that use ozone for disinfection are required to monitor bromate at an MCL of 10 ug/L,in addition to the common inorganic anions. The Dionex IonPac AS26 column does not require sample pretreatment or preconcentration. Figure 4 shows the separation of inorganic anions and oxyhalides using a standard injection with a potassium hydroxide gradient coupled with suppressed conductivity detection. Figure 5 shows the analysis of a drinking water sample using a large-loop injection on the Dionex IonPac AS26 column.

		Peaks:		
Column:	Dionex IonPac AG24A/AS24A, 4 mm		1. MCAA	100 µg/L (ppb)
Eluent:	KOH Gradient		2. MBAA	100
	7 mM KOH from 0 to 12 min		3. DCAA	100
	7 mM to 18 mM KOH from 12 to 32 min		4. BCAA	100
	65 mM KOH from 32 to 60 min		5. DBAA	100
Eluent Source:	Dionex EGC III KOH Cartridge		6. TCAA	100
Flow Rate:	1.0 mL/min		7. BDCAA	100
Injection Volume:	1000 µL		8. CDBAA	100
Temperature:	15 °C		9. TBAA	100
Detection:	Suppressed conductivity, Dionex ASRS 300, 2 mm Suppressor, Dionex AutoSuppression device, recycle mode			

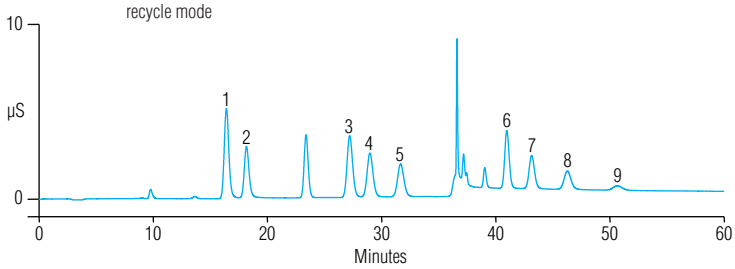


Figure 3. Gradient separation of HAA anions using the Dionex IonPac AS26 column.

		Peaks:	mg/L
Column:	Dionex IonPac AG26/AS26 2 mm	1. Fluoride	3
Eluent:	Dionex EGC III KOH Cartridge with Thermo Scientific™ Dionex™ CR-ATC Continuously Regenerated Anion Trap Column	2. Chlorite	10
		3. Bromate	20
Eluent Source:	Dionex EGC III KOH Cartridge with Dionex CR-ATC	4. Chloride	6
Flow Rate:	0.25 mL/min	5. Sulfate	30
Inj. volume:	2.5 µL	6. Nitrite	15
Temperature:	15 °C	7. Phosphate	40
Detection:	Suppressed conductivity, Dionex ASRS 300, 2 mm Suppressor, Dionex AutoSuppression device, recycle mode	8. Bromide	25
		9. Chlorate	25
		10. Nitrate	25

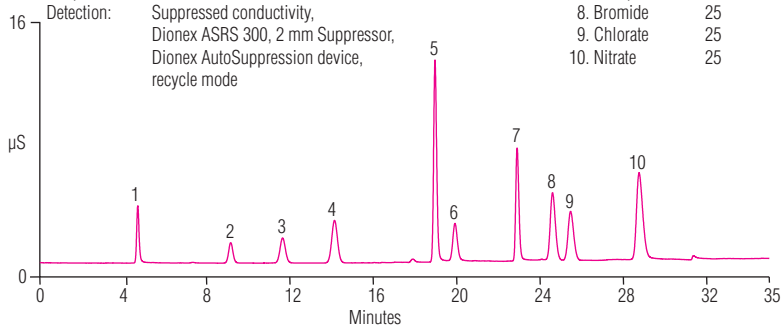


Figure 4. Separation of oxyhalides and inorganic anions using the Dionex IonPac AS26 column with a hydroxide gradient.

		Peaks:	mg/L
Column:	Dionex IonPac AG26/AS26 2 mm	1. Fluoride	0.67
Eluent:	KOH: 12 mM from 0 to 10 min and 12 to 65 mM from 10 to 25 min	2. Formate	—
Eluent Source:	Dionex EGC III KOH Cartridge with Dionex CR-ATC	3. Chloride	11.6
Flow Rate:	0.25 mL/min	4. Carbonate	—
Inj. Volume:	100 µL	5. Sulfate	12.1
Temperature:	15 °C	6. Nitrite	0.03
Detection:	Suppressed conductivity, Dionex ASRS 300, 2 mm Suppressor, Dionex AutoSuppression device, recycle mode	7. Oxalate	—
		8. Phosphate	0.12
		9. Bromide	0.015
Sample:	Drinking water	10. Chlorate	—
		11. Nitrate	0.68

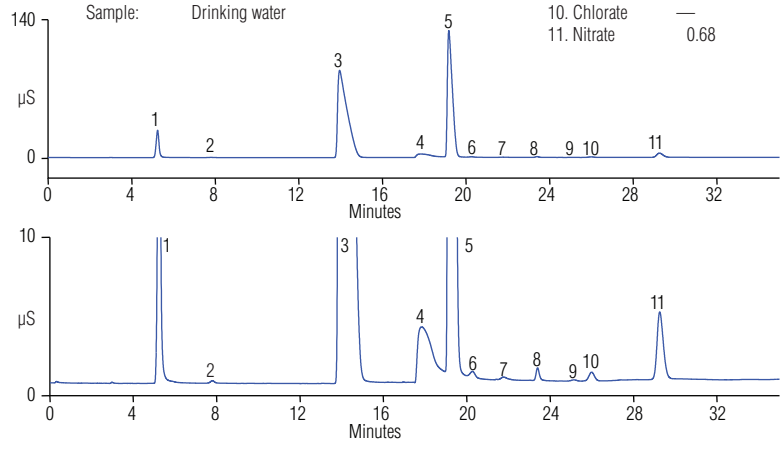


Figure 5. Analysis of drinking water using the Dionex IonPac AS26 column.

Effect of Temperature on Selectivity

While the Dionex IonPac AS26 column is stable up to a temperature of 40 °C, the column is optimized to separate the nine HAAs using a reduced temperature of 15 °C. Figure 6 shows the effect of temperature on the selectivity of the column. At higher temperatures (20 and 25 °C) the resolution of sulfate and chloride is decreased and the phosphate and nitrite pair reverse order. Because of this sensitivity to temperature changes, it is important to verify the oven temperature and to adjust it, if needed, to obtain the optimal resolution.

System Requirements

The Dionex IonPac AS26 column is recommended for use with the Thermo Scientific Dionex ICS-2100 or Thermo Scientific ICS-5000+ RFIC system equipped with an eluent generator. The Dionex IonPac AS26 column can also be used with older Thermo Scientific Dionex IC systems equipped with an eluent generator or a Thermo Scientific Dionex RFC-30 Reagent-Free Controller. The eluent generator is used to automatically produce potassium hydroxide gradients from deionized water. The haloacetic acids MBAA, CDBAA and TBAA degrade under basic conditions at higher temperatures. The use of a column oven capable of maintaining 15 °C and an autosampler capable of maintaining 10 °C is required for optimal performance.

Suppressor Recommendations

For optimum ease-of-use and performance, the Dionex IonPac AS26 column should be used with the Thermo Scientific™ Dionex™ AERS™ 500 Anion Electrolytically Regenerated Suppressor or the Thermo Scientific™ Dionex™ ACES™ 300 Anion Capillary Electrolytic Suppressor.

Anion Trap Columns

When using the eluent generator for eluent delivery, a Dionex CR-ATC Continuously Regenerated Anion Trap Column should be installed between the eluent generator cartridge (EGC) and the degas module. As an alternative for 4 mm and 2 mm systems, a Dionex IonPac ATC-HC Anion Trap Column with Hydoxide Eluent can be installed between the pump outlet and the EGC inlet. Alternatively, when using a manually-prepared sodium hydroxide gradient with the Dionex IonPac AS26 column, the Dionex IonPac ATC-3 Anion Trap column should be installed between the gradient pump and the injection valve to remove anionic contaminants from the eluent.

		Peaks:	mg/L
Column:	Dionex IonPac AS26 column 2 mm	1. Fluoride	2
Eluent:	35 mM KOH	2. Sulfate	15
Eluent Source:	Dionex EGC III KOH cartridge	3. Chloride	3
Flow Rate:	0.3 mL/min	4. Phosphate	15
Inj. Volume:	2.5 µL	5. Nitrite	10
Temperature:	See chromatograms	6. Bromide	10
Detection:	Suppressed conductivity, Dionex ASRS 300, 2 mm Suppressor, Dionex AutoSuppression device, recycle mode	7. Nitrate	10

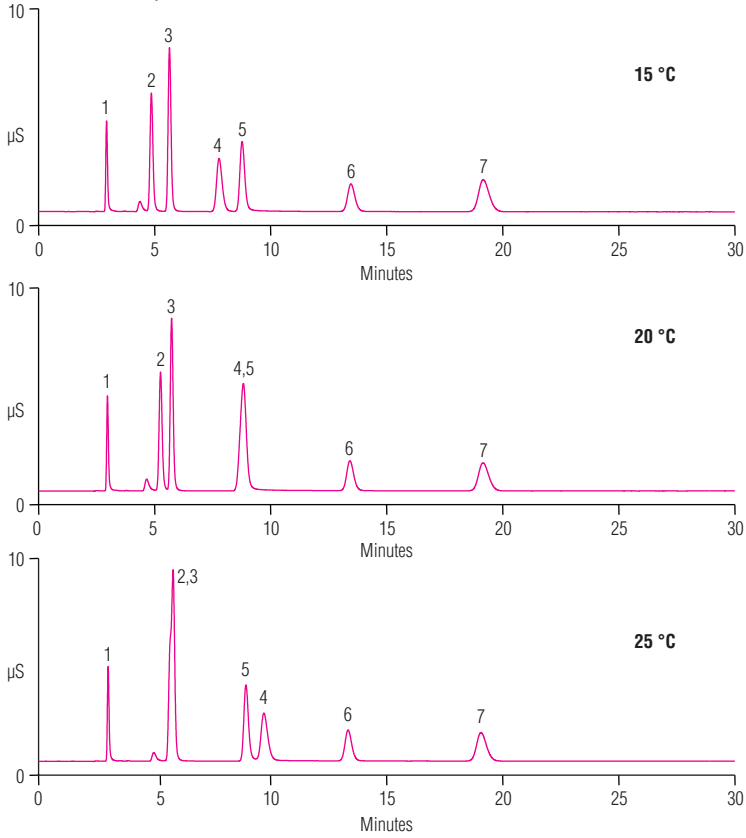


Figure 6. The effect of temperature on selectivity using the Dionex IonPac AS26 column.

Concentrator Columns

For concentrator work with a 4 mm Dionex IonPac AS24A column, use the Dionex IonPac AG24A guard column, the Dionex IonPac UTAC-LP1, UTAC-ULP1, UTAC–XLP1, UTAC-LP2, UTAC-ULP2, or UTAC-XLP2 Ultra Trace Anion Concentrator columns; the Dionex IonPac TAC-ULP1 Trace Anion Concentrator column; or the Dionex IonPac TAC-2 Trace Anion Concentrator column, when a single piston pump such as the Thermo Scientific Dionex AXP Auxiliary Pump (pulse damper required) is used for sample delivery. Use the Dionex IonPac UTAC-LP1, UTAC-LP2 or TAC-LP1 Trace Anion Concentrator column when the sample is delivered with a syringe or with a low pressure autosampler, such asthe Thermo Scientific Dionex AS-DV Autosampler. For concentrator work with a 0.4 mm capillary column, use the Dionex IonPac AG24A Capillary Guard column or the Dionex IonSwift MAC-100 Concentrator column. For 2D-IC methods with a capillary column in the second dimension use the Dionex IonSwift MAC-200 Concentrator column. For 2D-IC methods with the 2-mm column in the second dimension, use one of the Dionex IonPac Ultra Trace Anion Concentrator columns listed above.

SPECIFICATIONS	
Dimensions	Dionex IonPac AS26 Analytical Column: (2 × 150 mm) (4 × 250 mm) Dionex IonPac AG26 Guard Column: (2 × 50 mm) (4 × 50 mm) Dionex IonPac AS26 Capillary Column: (0.4 × 250 mm) Dionex IonPac AG26 Capillary Guard Column: (0.4 × 50 mm)
Maximum Operating Pressure	3000 psi (standard, microbore, and capillary)
Mobile Phase Compatibility	pH 0–14; 0–100% HPLC solvents
Substrate Characteristics	Analytical and Capillary Columns: Super macroporous resin Bead Diameter: 7.5 µm Pore Size: 2000 Å Crosslinking (%DVB): 55% Guard Columns: Microporous resin Bead Diameter: 13 µm Pore Size: < 10 Å Crosslinking (%DVB): 55%
Ion-Exchange Group	Functional Group: Alkanol quaternary ammonium ion
Functional Group Characteristics	Hydrophobicity: Ultralow
Capacity	62.5 µeq (2 × 250 mm) 1.5 µeq (2 × 50 mm) 250 µeq (4 × 50 mm) 6 µeq (4 × 50 mm) 2.5 µeq (0.4 × 250 mm) 0.6 µeq (0.4 × 50 mm)
Column Construction	PEEK with 10–32 threaded ferrule-style end fittings. All components are nonmetallic.

Ordering Information:

In the U.S., call (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.

Analytical, Capillary and Guard Columns	Part Numbers
Dionex IonPac AS26 Analytical Column (2 × 250 mm)	076022
Dionex IonPac AG26 Guard Column (2 × 50 mm)	076023
Dionex IonPac AS26 Analytical Column (4 × 250 mm)	076020
Dionex IonPac AG26 Guard Column (4 × 50 mm)	076021
Dionex IonPac AS26 Capillary Column (0.4 × 250 mm)	076018
Dionex IonPac AG26 Capillary Guard Column (0.4 × 50 mm)	076019
Anion Trap Columns	**Part Numbers**
Dionex CR-ATC 500 Continuously Regenerated Anion Trap Column (for use with systems equipped with an eluent generator or Dionex RFC-30 Reagent-Free Control)	060477
Dionex CR-ATC Continuously Regenerated Anion Trap Column (for use with capillary anion columns)	072078
Dionex IonPac ATC-3 Anion Trap Column (9 × 24 mm) (for use with 4 mm columns)	059660
Dionex IonPac ATC-3 2 mm (4 × 3 5 mm) Anion Trap Column (for use with 2 mm columns)	079932
Dionex IonPac ATC-HC (9 × 75 mm) Anion Trap Column (for use with the Thermo Scientific Dionex EG40 Eluent Generator)	059604
Trace Anion Concentrator Columns	**Part Numbers**
Dionex IonSwift MAC-100 Monolith Anion Concentrator (0.5 x 80 mm)	074702
Dionex IonSwift MAC-200 Monolith Anion Concentrator (0.75 x 80 mm)	075461
Dionex IonPac TAC 2 Trace Anion Concentrator Column	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
Haloacetic Acid Internal Standards	**Part Number**
Thermo Scientific Dionex Monochloroacetic Acid MCAA-2-13C, 1000 mg/L	069406
Thermo Scientific Dionex Monobromoacetic Acid MBAA-1-13C, 1000 mg/L	069407
Thermo Scientific Dionex Dichloroacetic Acid DCAA-2-13C, 1000 mg/L	069408
Thermo Scientific Dionex Trichloroacetic Acid TCAA-2-13C, 1000 mg/L	069409

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Australia +61 3 9757 4486
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Belgium +32 53 73 42 41
Brazil +55 11 3731 5140
China +852 2428 3282
Denmark +45 70 23 62 60
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