

Dionex IonPac Columns for U.S. EPA Methods 300.0 (A) and 300.1 (A) for Compliance Monitoring of Inorganic Anions in Drinking Water

Columns

U.S. EPA Methods 300.0 (A) and 300.1 (A) are used for compliance monitoring of inorganic anions in drinking water samples. The Thermo Scientific™ Dionex™ IonPac™ AS4A column is specified in U.S. EPA Method 300.0 (A) and the Dionex IonPac AS9-HC column is specified in U.S. EPA Method 300.1 (A). However, any anion-exchange column can be used as long as it meets the method performance criteria. The Dionex IonPac AS4A and AS9-HC columns are over 15 years old and there are now better Dionex IonPac Columns that use the latest technology, including high capacity 4 µm particle size resins.

Eluents

Depending on the column, either carbonate or hydroxide eluents can be used to separate the common inorganic anions, including fluoride, chloride, nitrite, sulfate, bromide, nitrate, and phosphate.

Hydroxide eluents are typically used for gradient separations and for determining analytes present at very low concentrations due to the lower background conductivity. Carbonate eluents are used for simpler isocratic separations of well-characterized samples.

Column Length

In general, 250 mm columns are used for higher resolution of more complex matrices while shorter 150 mm columns are used for fast analysis of relatively clean matrices. The longer columns have more ion exchange capacity than their shorter versions allowing the analysis of higher ionic strength samples without dilution. Guard columns (30–50 mm long) are installed in front of the analytical columns to protect them from situations that may damage the analytical columns. Below are the recommended Dionex IonPac columns for performing U.S. EPA Methods 300.0 (A) and 300.1 (A).

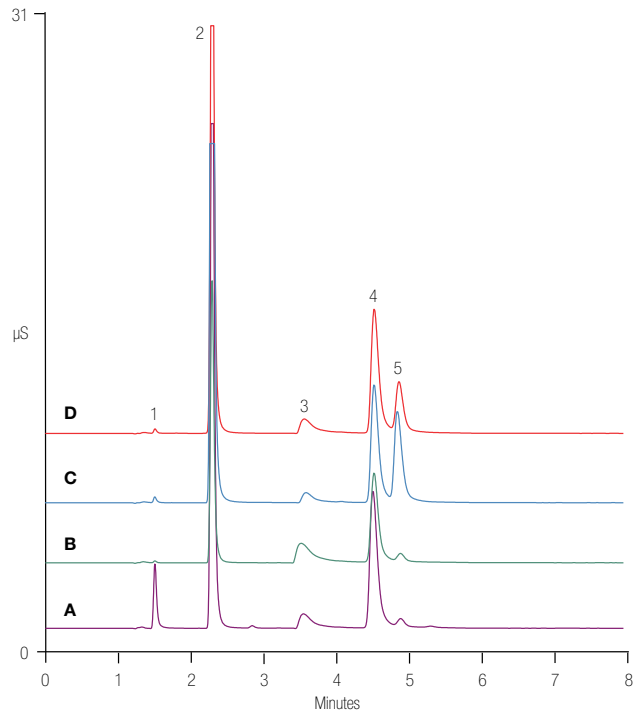
Determination of Common Anions in:	Hydroxide Eluent Column and Guard PN	Carbonate Eluent Column and Guard PN	Formats (mm)
Drinking water, waste water and other complex matrices . The longer column provides higher capacity and more resolving power but produces longer run times .	Dionex IonPac AS18	Dionex IonPac AS22	
	075772	079057	0.4 × 250
	060553	064137	2 × 250
	060549	064141	4 × 250
	Dionex IonPac AG18	Dionex IonPac AG22	
	075773	079058	0.4 × 50
	060555	064135	2 × 50
	060551	064139	4 × 50
Drinking water and relatively clean matrices . The shorter column provides sufficient capacity for these clean matrices and faster run times .	Dionex IonPac AS18-Fast	Dionex IonPac AS22-Fast	
	072062	Not available	0.4 × 150
	075759	079937	2 × 150
	075760	079936	4 × 150
	Dionex IonPac AG18-Fast	Dionex IonPac AG22-Fast	
	072063	Not available	0.4 × 35
	075761	072785	2 × 30
	075762	072784	4 × 30
Drinking water and moderately complex matrices . The combination of the smaller particles and shorter column provide both excellent resolution and the fastest run times . A HPIC system is required.	Dionex IonPac AS18-4µm	Dionex IonPac AS22-Fast-4µm	
	082314	088490	0.4 × 150
	076036	088488	2 × 150
	076034	088486	4 × 150
	Dionex IonPac AG18-4µm	Dionex IonPac AG22-Fast-4µm	
	076033	088491	0.4 × 35
	076037	088489	2 × 30
	076035	088487	4 × 30

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The figures below show an example of a typical analysis for each of the six columns recommended for U.S. EPA Methods 300.0 (A) and 300.1 (A). Note that the 250 mm columns have a longer run time than the shorter columns and also that the 4 μm resin

columns have more efficient peaks than the larger particle columns. The smaller particles produce higher backpressures and therefore systems that can operate up to 5000 psi are recommended when using 4 μm particle columns.

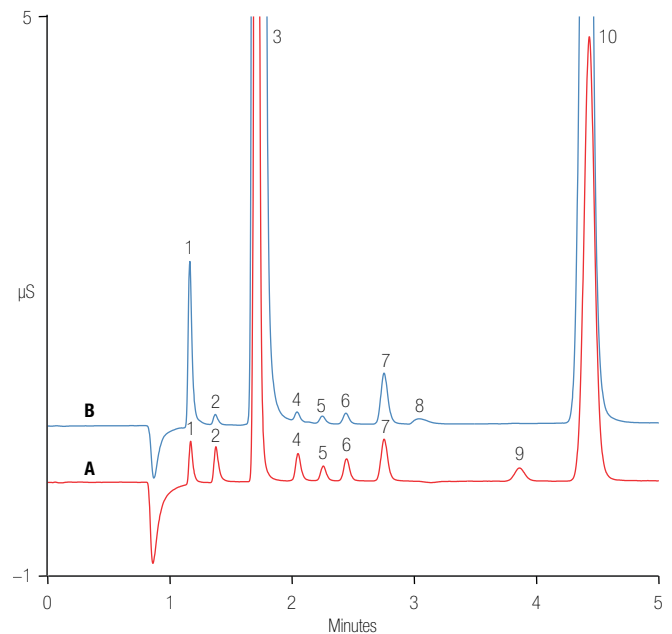
Figure 1. Determination of inorganic anions in municipal drinking and waste water samples using a Dionex IonPac AS18-4 μm column.



Column: Dionex IonPac AG18-4 μm (2 \times 30 mm)/AS18-4 μm (2 \times 150 mm)
 Eluent Source: Thermo Scientific Dionex EGC 500 KOH cartridge
 Eluent: 23 mM KOH
 Flow Rate: 0.38 mL/min
 Inj. Volume: 5 μL
 Column Temp.: 30 $^{\circ}\text{C}$
 Detection: Suppressed conductivity, Thermo Scientific™ Dionex™ ASRS™ 300 Anion Self-Regenerating suppressor, 2 mm, AutoSuppression, recycle mode
 Samples:
 A. City 1 Drinking Water, undiluted
 B. City 2 Drinking Water, 5-fold dilution
 C. City 1 Wastewater, 10-fold dilution
 D. City 2 Wastewater, 10-fold dilution

Peaks:	A	B	C	D
1. Fluoride	0.86	0.11	0.77	0.56 mg/L
2. Chloride	18	36	250	160
3. Carbonate	—	—	—	—
4. Sulfate	12	38	102	110
5. Nitrate	0.57	2.90	84	43

Figure 2. Comparison of an anion standard and a municipal drinking water using a Dionex IonPac AS22-Fast-4 μm column.

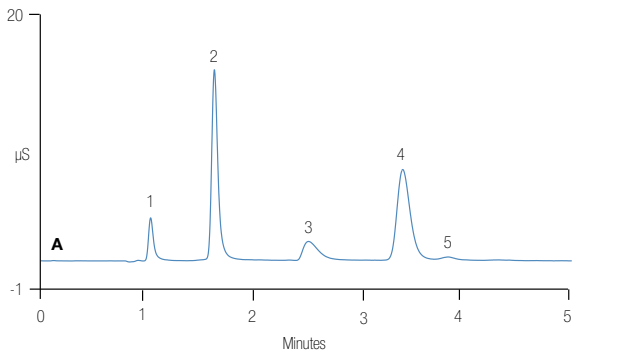


Column: Dionex IonPac AG22-Fast-4 μm (4 \times 30 mm)/AS22-Fast-4 μm (4 \times 150 mm)
 Eluent: 4.5 mM Na_2CO_3 /1.4 mM NaHCO_3
 Flow Rate: 2.0 mL/min
 Inj. Volume: 40 μL
 Temperature: 30 $^{\circ}\text{C}$
 Detection: Suppressed conductivity, Thermo Scientific™ Dionex™ AERS™ 500 Anion Electrolytically Regenerating suppressor, 4 mm, AutoSuppression, recycle mode
 Samples:
 A. Anion Standard
 B. Municipal Drinking Water

Peaks:	Standard mg/L
1. Fluoride	0.25
2. Formate	1.0
3. Chloride	12.5
4. Nitrite	0.5
5. Chlorate	0.5
6. Bromide	0.5
7. Nitrate	1.0
8. Carbonate	NQ
9. Phosphate	1.0
10. Sulfate	12.5

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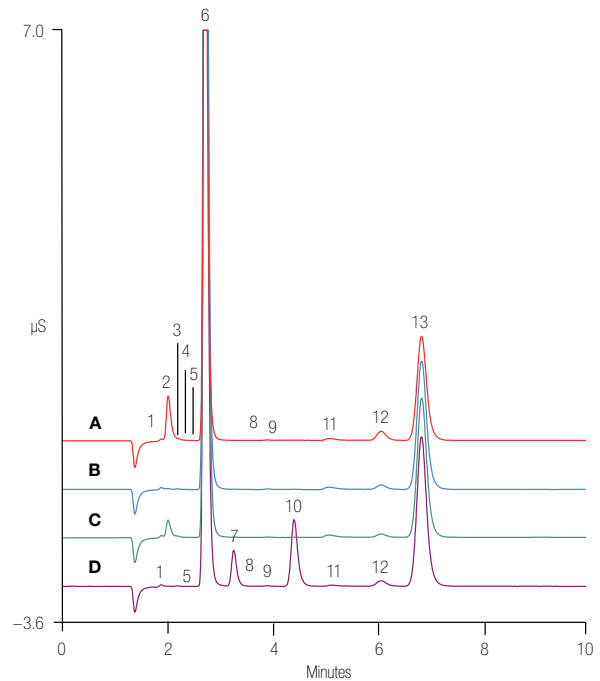
Figure 3. Fast analysis of anions in a municipal drinking water using a Dionex IonPac AS18-Fast column.



Column: Dionex IonPac AG18-Fast (2 × 30 mm)/AS18-Fast (2 × 150 mm)
 Eluent Source: Thermo Scientific Dionex EGC III KOH cartridge
 Eluent: 23 mM KOH
 Column Temp.: 30 °C
 Flow Rate: 0.55 mL/min
 Inj. Volume: 5 μL
 Detection: Suppressed conductivity, Dionex ASRS 300 suppressor, 2 mm, AutoSuppression, recycle mode
 Samples: Municipal Drinking Water

Peaks:	A
1. Fluoride	0.6 mg/L
2. Chloride	8.5
3. Carbonate	46
4. Sulfate	10
5. Nitrate	0.1

Figure 4. Fast anion determinations of diluted municipal drinking and wastewater samples using a Dionex IonPac AS22-Fast column.



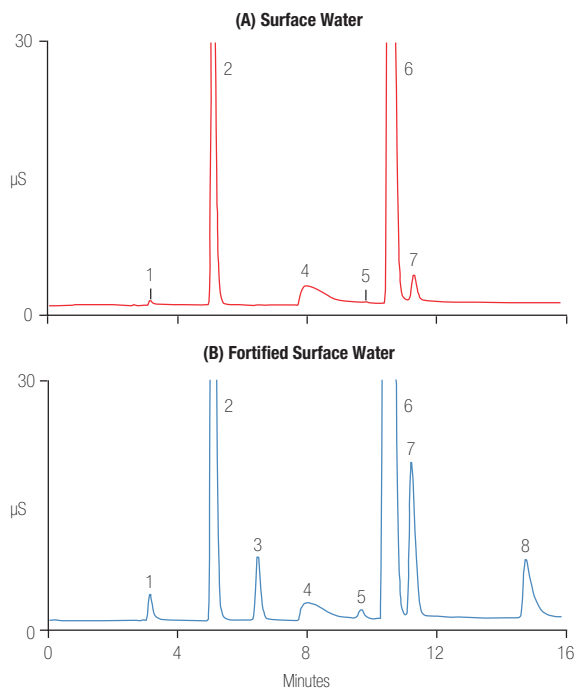
Column: Dionex IonPac AG22-Fast (4 × 30 mm)/AS22-Fast (4 × 150 mm)
 Eluent: 1.4 mM Na₂CO₃ 4.5 mM NaHCO₃
 Flow Rate: 1.2 mL/min
 Inj. Volume: 10 μL
 Column Temp.: 30 °C
 Detection: Suppressed conductivity, Dionex ASRS 300 suppressor, 4 mm, AutoSuppression, recycle mode
 Samples: A: Influent; B: Primary Effluent
 C: Trickling Filter Effluent; D: Final Effluent
 Sample Prep.: 5-fold dilution, filtered, 0.20 μm

Peaks:	A	B	C	D
1. Fluoride	0.25	0.23	0.26	0.26 mg/L
2. Acetate	—*	—*	—*	—*
3. Formate	—	—*	—*	—*
4. Chlorite	—**	—	—**	—
5. Bromate	—	—**	—**	—**
6. Chloride	18.8	37.0	38.8	31.9
7. Nitrite	—	—	—	3.1
8. Chlorate	—	—	4.1	0.0037
9. Bromide	1.7	1.6	1.7	1.6
10. Nitrate	—	—	—	7.0
11. Carbonate	—*	—*	—*	—*
12. Phosphate	5.4	4.1	4.3	4.5
13. Sulfate	11.4	14.6	13.6	15.5

* Not quantified; ** Below the MDL

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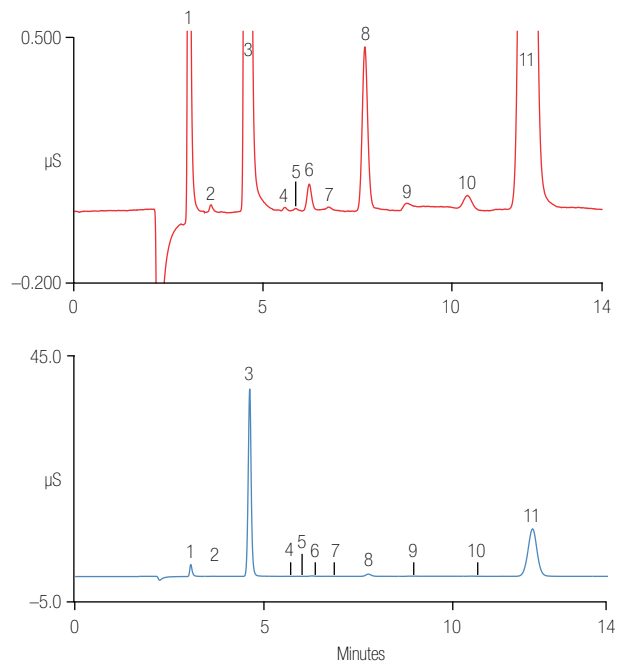
Figure 5. Determination of inorganic anions in (A) surface water and (B) fortified surface water using a Dionex IonPac AS18 column.



Column: Dionex IonPac AG18 (4 × 50 mm)/AS18 (4 × 250 mm)
 Eluent: 22–40 mM KOH from 7–8 min
 Eluent Source: Dionex EGC III KOH cartridge
 Temperature: 30 °C
 Flow Rate: 1.0 mL/min
 Inj. Volume: 25 μL
 Detection: Suppressed conductivity, Dionex ASRS ULTRA suppressor, 4 mm, AutoSuppression, recycle mode

Peaks:	A	B
1. Fluoride	0.14	1.26 mg/L
2. Chloride	28.8	58.4
3. Nitrite- <i>N</i>	—	2
4. Carbonate	—	—
5. Bromide	0.03	2.0
6. Sulfate	99.5	179.3
7. Nitrate- <i>N</i>	0.89	5.88
8. Phosphate- <i>P</i>	—	9.24

Figure 6. Determination of inorganic anions in a municipal drinking water sample using a Dionex IonPac AS22 column.



Column: Dionex IonPac AG22 (4 × 50 mm)/AS22 (4 × 250 mm)
 Eluent: 4.5 mM Na₂CO₃/1.4 mM NaHCO₃
 Flow Rate: 1.2 mL/min
 Inj. Volume: 25 μL
 Temperature: 30 °C
 Detection: Suppressed conductivity, Dionex AERS 500 suppressor, 4 mm, AutoSuppression, recycle mode
 Sample: Municipal Drinking Water

Peaks:	1. Fluoride	0.84 mg/L
	2. Formate	0.03
	3. Chloride	15.59
	4. Nitrite	0.01
	5. Unknown	NQ
	6. Chlorate	0.18
	7. Bromide	0.02
	8. Nitrate	0.89
	9. Carbonate	NQ
	10. Phosphate	0.22
	11. Sulfate	20.45