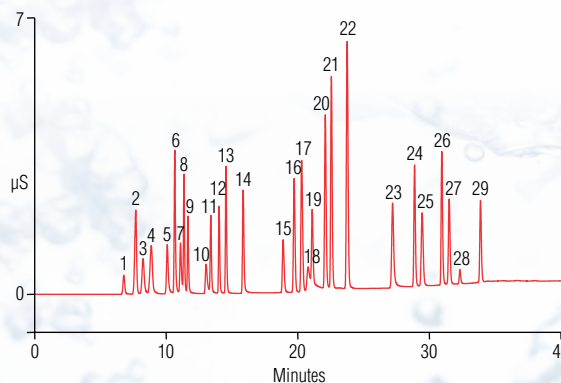


Thermo Scientific Dionex IonPac AS11-HC-4 μ m Anion-Exchange Column

Attain the optimal resolution of organic acids and inorganic anions using the new Thermo Scientific™ Dionex™ IonPac™ AS11-HC-4 μ m anion-exchange column. The Dionex IonPac AS11-HC-4 μ m column is a high-capacity, high-efficiency anion-exchange column that provides excellent resolution of organic acids and inorganic acids in complex matrices using potassium hydroxide gradient elution. Compared to the previous Dionex IonPac AS11-HC column, the new ion-exchange column uses smaller resin particles for more efficient separations resulting in more accurate peak integration and more reliable results.

Column: Dionex IonPac AS11-HC-4 μ m (4 × 250 mm)
 Eluent Source: Thermo Scientific Dionex EGC 500 KOH Cartridge
 Eluent: 1 mM KOH from 0–7 min;
 1–15 mM KOH from 7 to 16 min;
 15 to 30 mM KOH from 16 to 25 min;
 30 to 60 mM KOH from 25 to 33 min
 Flow Rate: 1.5 mL/min
 Inj. Volume: 10 μ L
 Temperature: 30 °C
 Detection: Suppressed conductivity, Thermo Scientific™ Dionex™ ASRS™ 300 Anion Self-Regenerating Suppressor 4 mm, AutoSuppression™, recycle mode

Peaks:	Concentration (mg/L)
1. Quinate	5.0
2. Fluoride	1.5
3. Lactate	5.0
4. Acetate	5.0
5. Propionate	5.0
6. Formate	5.0
7. Butyrate	5.0
8. Methylsulfonate	5.0
9. Pyruvate	5.0
10. Valerate	5.0
11. Monochloroacetate	5.0
12. Bromate	5.0
13. Chloride	2.5
14. Nitrite	5.0
15. Trifluoroacetate	5.0
16. Bromide	5.0
17. Nitrate	5.0
18. Carbonate	—
19. Malonate	7.5
20. Maleate	7.5
21. Sulfate	7.5
22. Oxalate	7.5
23. Tungstate	10.0
24. Phosphate	10.0
25. Phthalate	10.0
26. Citrate	10.0
27. Chromate	10.0
28. <i>cis</i> -Aconitate	—
29. <i>trans</i> -Aconitate	10.0



The Dionex IonPac AS11-HC-4 μ m column is a high-capacity, anion-exchange column with similar selectivity and increased peak efficiencies compared to the Dionex IonPac AS11-HC column. This high-capacity column is designed to resolve a large number of organic acids and inorganic anions in complex matrices, using potassium hydroxide gradient elution. The Dionex IonPac AS11-HC-4 μ m column is ideal for the determination of organic acids in uncharacterized samples. Applications using the Dionex IonPac AS11-HC column can be easily transferred to the Dionex IonPac AS11-HC-4 μ m column with the benefit is increased peak resolution, which provides more reliable results. The Dionex IonPac AS11-HC-4 μ m column is available in 4 mm, 2 mm, and 0.4 mm i.d. formats.

Highlights

- High-resolution separation of a wide variety of organic acids and inorganic anions in complex matrices
- Superior peak efficiency provides easier integration and more accurate results
- High-capacity allows injection of more concentrated samples without overloading and peak broadening

Dionex IonPac AS11-HC-4 μ m Column Features

The Dionex IonPac AS11-HC-4 μ m column uses smaller particles than previous anion-exchange columns resulting in excellent peak efficiencies and higher resolution separations. Improved resolution makes peak integration easier and more reliable leading to more accurate results. The high-capacity Dionex IonPac AS11-HC-4 μ m column allows the injection of more concentrated samples without overloading and peak broadening. A wide range of organic acids and inorganic anions can be separated in approximately 40 min using a sodium hydroxide gradient at a controlled temperature of 30 °C, as illustrated in Figure 1.

Highlights

The Dionex IonPac AS11-HC-4 μ m column is solvent-compatible, which allows for anion-exchange selectivity control and easy column cleanup after the analysis of complex matrices. Typical applications include the determination of organic acids and inorganic anions in diverse sample matrices including:

- Fruit juices and wines
- Foods and beverages
- Fermentation and process solutions
- Chemical additives
- Chemical process solutions
- Wastewater
- Brines
- Power plant waters

Economical Capillary Operation

The Dionex IonPac AS11-HC-4 μ m column is also available in the 0.4 mm i.d. format for capillary operation offering the advantage of reduced operating costs.

- Ideal for limited sample volumes due to higher mass sensitivity.
- One hundred fold reduction in eluent consumption and waste disposal.
- 4 mm applications can be directly transferred to the 0.4 mm format by reducing flow rate by one hundred fold.

Figure 2 shows the high-resolution separation of inorganic anions and organic acids using the Dionex IonPac AS11-HC Capillary column.

Column: Dionex IonPac AG11-HC-4 μ m/AS11-HC-4 μ m (0.4 \times 250 mm)
 Eluent: 1 mM KOH for 0.01 min;
 1–5 mM KOH from 0.01 to 15 min;
 5 to 55 mM KOH from 15 to 25 min
 Eluent Source: Dionex EGC KOH cartridge
 Flow Rate: 15 μ L/min
 Inj. Volume: 0.4 μ L
 Temperature: 30 °C
 Detection: Suppressed conductivity, Dionex ACES 300 Suppressor, AutoSuppression, recycle mode

Peaks:	Concentration (mg/L)
1. Quinate	5.0
2. Fluoride	1.5
3. Lactate	5.0
4. Acetate	5.0
5. 2-Hydroxybutyrate	5.0
6. Propionate	5.0
7. Formate	5.0
8. Butyrate	5.0
9. Methylsulfonate	5.0
10. Pyruvate	5.0
11. Isovalerate	5.0
12. Valerate	5.0
13. Monochloroacetate	5.0
14. Bromate	5.0
15. Chloride	2.5
16. 2-Oxovalerate	5.0
17. Nitrite	5.0
18. Ethylphosphate	5.0
19. Trifluoroacetate	5.0
20. Bromide	5.0
21. Nitrate	5.0
22. Citramalate	7.5
23. Malate	7.5
24. Carbonate	7.5
25. Malonate	7.5
26. Citraconitate	7.5
27. Maleate	7.5
28. Sulfate	7.5
29. alpha-Ketoglutarate	7.5
30. Oxalate	7.5
31. Fumarate	7.5
32. Tungstate	10.0
33. Phosphate	10.0
34. Phthalate	10.0
35. Arsenate	10.0
36. Citrate	10.0
37. Chromate	10.0
38. Isocitrate	10.0
39. cis-Aconitate	—
40. trans-Aconitate	10.0

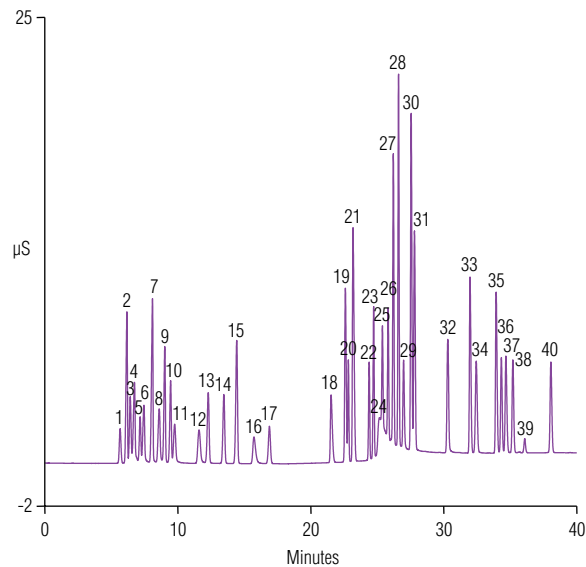


Figure 1. The Dionex IonPac AS11-HC-4 μ m column provides a high-resolution separation of a wide range of organic acids and inorganic acids using sodium hydroxide gradient elution. The excellent peak efficiency allows for the separation more peaks in a single run.

Column: Dionex IonPac AG11-HC/AS11-HC (0.4 \times 250 mm)
 Eluent Source: Dionex EGC-KOH (Capillary) Cartridge
 Eluent: Potassium hydroxide
 1 mM from 0 to 5 min,
 1 mM to 15 mM from 5 to 14 min,
 15 mM to 30 mM from 14 to 23 min,
 30 mM to 60 mM from 23 to 31 min
 Flow Rate: 15 μ L/min
 Inj. Volume: 0.4 μ L
 Temperature: 30 °C
 Detection: Suppressed conductivity, Dionex ACES 300 Suppressor, AutoSuppression, recycle mode

Peaks:	Concentration (mg/L)
1. Quinate	5.0
2. Fluoride	1.5
3. Lactate	5.0
4. Acetate	5.0
5. Propionate	5.0
6. Formate	5.0
7. Butyrate	5.0
8. Methylsulfonate	5.0
9. Pyruvate	5.0
10. Valerate	5.0
11. Monochloroacetate	5.0
12. Bromate	5.0
13. Chloride	2.5
14. Nitrite	5.0
15. Trifluoroacetate	5.0
16. Bromide	5.0
17. Nitrate	5.0
18. Carbonate	—
19. Malonate	7.5
20. Maleate	7.5
21. Sulfate	7.5
22. Oxalate	7.5
23. Tungstate	10.0
24. Phosphate	10.0
25. Phthalate	10.0
26. Citrate	10.0
27. Chromate	10.0
28. cis-Aconitate	—
29. trans-Aconitate	10.0

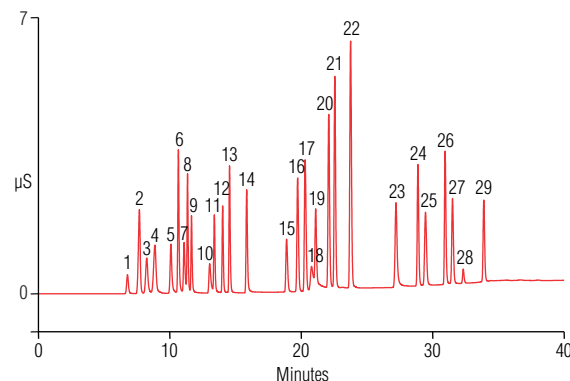


Figure 2. Gradient separation of inorganic anions and organic acids using the Dionex IonPac AS11-HC Capillary column.

High-Efficiency Particle Structure

The Dionex IonPac AS11-HC-4 μ m column packing has unique structures composed of a highly crosslinked core and a Thermo Scientific™ Dionex™ MicroBead™ anion-exchange layer attached to the surface, as shown in Figure 3. The Dionex IonPac AS11-HC-4 μ m column uses a 4 μ m diameter super macroporous resin bead composed of ethylvinylbenzene crosslinked with 55% divinylbenzene.

The anion-exchange layer is functionalized with quaternary ammonium groups. This anion-exchange layer has a controlled thickness, which results in excellent mass transfer characteristics and, consequently, very high-efficiency peaks. The combination of this controlled latex layer on the smaller particle size produces even higher efficiency peaks and better resolution.

Solvent-Compatible Packing

The Dionex IonPac AS11-HC-4 μ m column is 100% HPLC solvent compatible, therefore organic solvents can be used for efficient column cleanup or to enhance sample solubility. Time and expense can be saved through the elimination of time-consuming sample preparation steps. This feature allows complex matrices to be analyzed with minimal sample preparation and extends the utility of the column to new applications requiring solvents. Adding organic solvents to the eluent modifies column selectivity and enables the elution of nonpolar analytes or contaminants from the column.

Determination of Short-Chain Organic Acids

Weakly retained organic acids and inorganic anions commonly encountered in the food, beverage, biopharmaceutical, chemical, and power industries can be determined in a single run using the Dionex IonPac AS11-HC-4 μ m column. Resolution of monovalent organic acids and improved peak shape are two benefits of the high-resolution of the Dionex IonPac AS11-HC-4 μ m column.

Increased Flexibility for Methods Development

The solvent compatibility of the Dionex IonPac AS11-HC-4 μ m column permits the use of HPLC organic solvents in the eluent to modify ion-exchange selectivity. Both hydroxide concentration gradients and organic solvent gradients combined with elevated temperature can be used to achieve optimum resolution of closely eluting analyte pairs. The retention of the more hydrophobic member of the unresolved pair is decreased

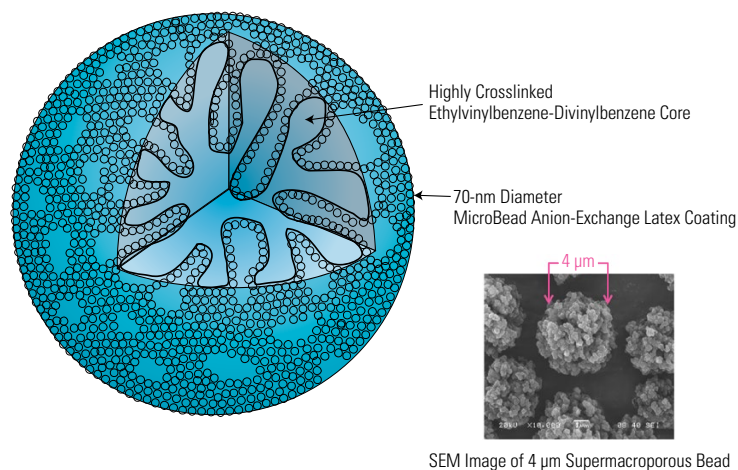


Figure 3. Structure of the Dionex IonPac AS11-HC-4 μ m column packing particle.

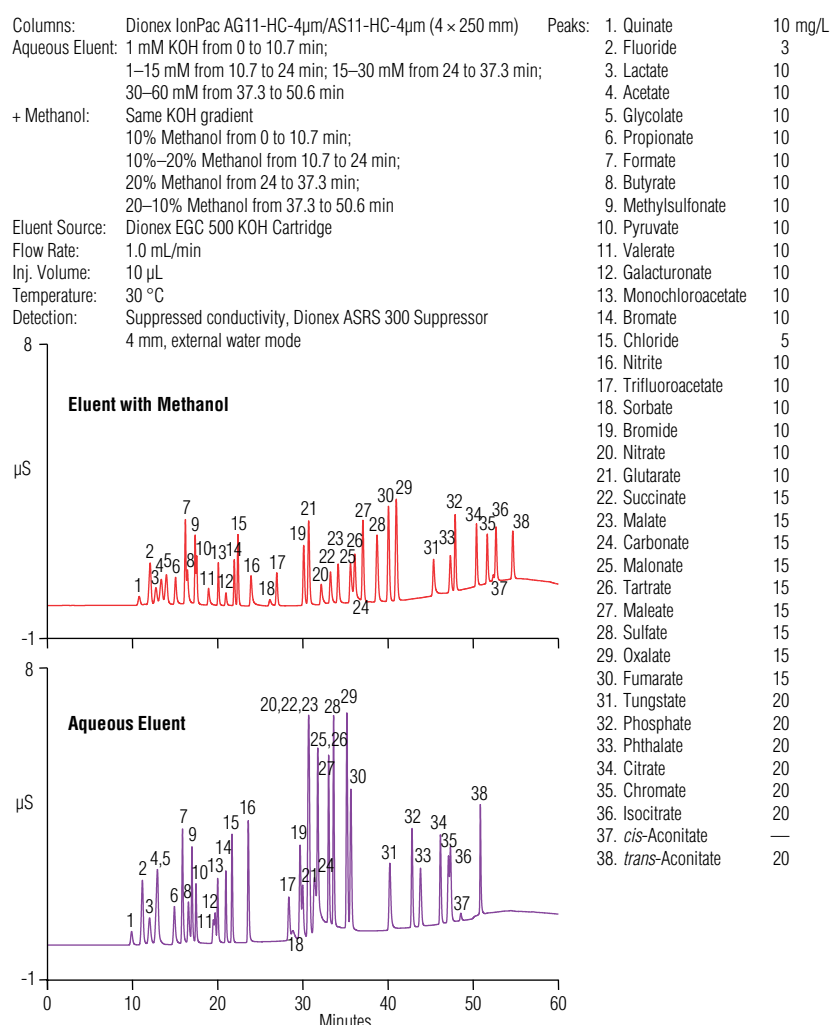


Figure 4. Effect of solvent on Dionex IonPac AS11-HC-4 μ m column selectivity and response.

more by the addition of solvent, which improves resolution. Note that the solvent can also reduce the response of some anions so it should only be used as needed for improved separations. Figure 4 illustrates the effect of solvent on selectivity and response of monovalent and divalent organic

acids on the Dionex IonPac AS11-HC-4 μ m column. The column can be operated at ambient or elevated temperatures. The use of a controlled column temperature ensures reproducible results.

Dionex IonPac AS11-HC-4 μ m Column for Monovalent and Divalent Organic Anions

The Dionex IonPac AS11-HC-4 μ m column provides improved separation of monovalent and divalent organic acids and inorganic anions using a sodium or potassium hydroxide gradient at a controlled temperature of 30 °C. Because higher eluent concentrations can be used to separate monovalent anions, the higher capacity allows injection of more concentrated samples without overloading and provides improved peak shapes for monovalent organic acids in complex matrices, as illustrated in Figure 1.

Determination of Carboxylic Acids in Complex Matrices

The Dionex IonPac AS11-HC-4 μ m column can be used to monitor the organic acid and inorganic anion content in the quality control of foods, wines, and beverages. The high-capacity of the column makes it ideal for the analysis of organic acids and inorganic anions in complex matrices. Samples high in ionic-strength can be injected directly onto the Dionex IonPac AS11-HC-4 μ m column and do not cause overloading problems or poor peak shapes for monovalent organic acids (e.g., lactate, acetate, propionate, formate, and butyrate). Figure 5 shows the analysis of beer using the Dionex IonPac AS11-HC-4 μ m column. Butyrate is an important indicator of deterioration of foods and beverages and can be easily baseline resolved from formate on the Dionex IonPac AS11-HC-4 μ m column with a sodium hydroxide gradient/methanol gradient step change.

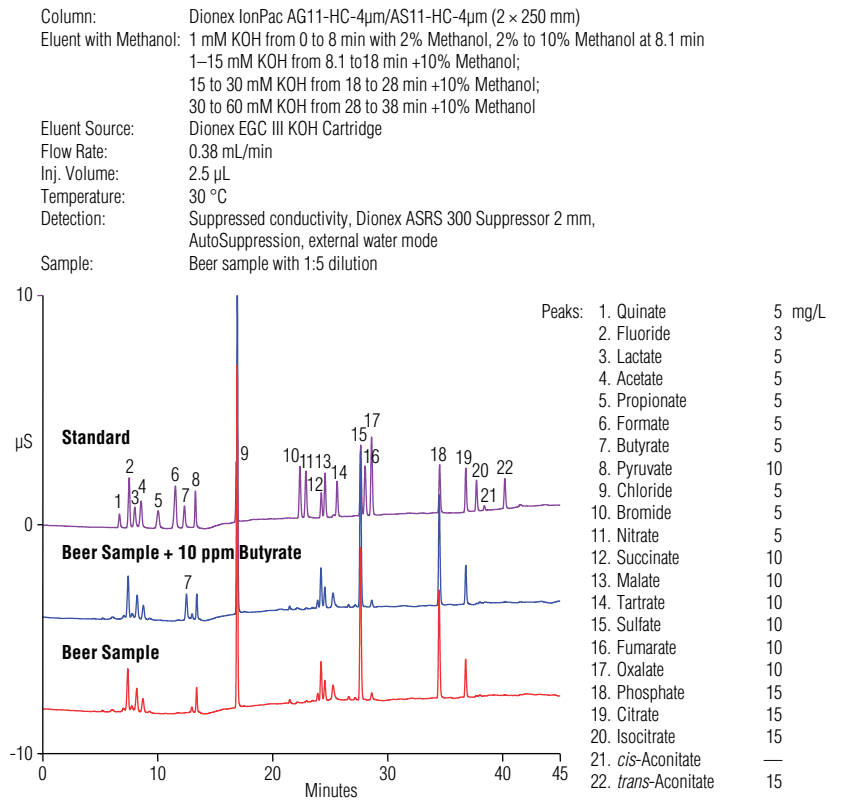


Figure 5. Analysis of beer spiked with 2 mg/L (ppm) butyrate using the Dionex IonPac AS11-HC-4 μ m column.

Figures 6 and 7 illustrate the separation of organic acids and inorganic anions in blush and red wine and apple and cranberry juice using the Dionex IonPac AS11-HC-4 μ m column. This column provides improved resolution over the previous anion-exchange columns for components with widely varying concentration ratios. The Dionex IonPac AS11-HC-4 μ m column resolves succinate and malate, even at very different concentrations in the apple juice, as shown in Figure 7.

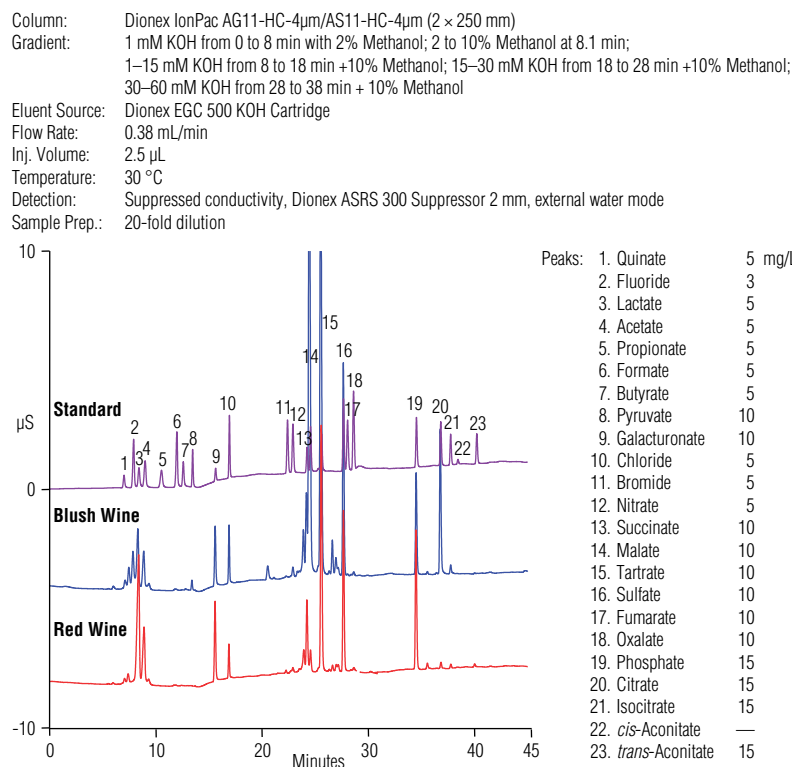


Figure 6. Analysis of blush and red wine using the Dionex IonPac AS11-HC-4 μ m column.

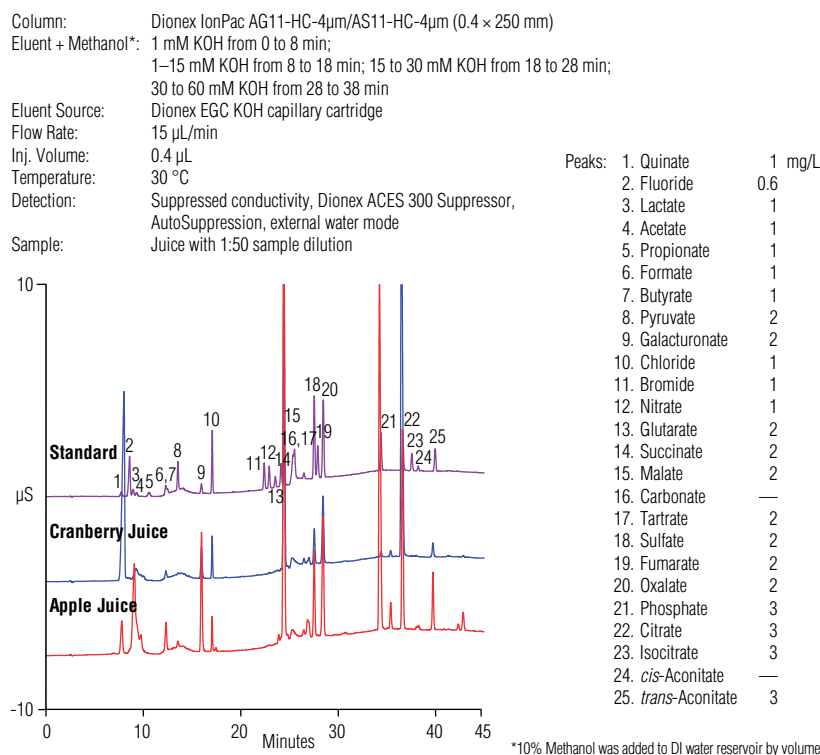


Figure 7. Analysis of apple and cranberry juices using the Dionex IonPac AS11-HC-4 μ m column.

Table 1. Column selection guide.

Analyte	Recommended Column
Fast profiling of mono-, di-, and trivalent organic acids and inorganic anions in well-characterized samples	Dionex IonPac AS11
High-resolution of mono- and divalent organic acids	Dionex IonPac AS11-HC-4 μ m
Monovalent organic acids (lactate, acetate, propionate, formate, butyrate)	Dionex IonPac AS11-HC-4 μ m
Trace components in complex matrices using large-loop injection	Dionex IonPac AS15
Organic acids and inorganic anions in high-ionic-strength matrices	Dionex IonPac AS11-HC-4 μ m
Organic acids in high-ionic-strength matrices (inorganic anions elute in void)	Dionex IonPac ICE-AS6 or Dionex IonPac ICE-AS1
Aromatic acids with conductivity detection	Dionex IonPac AS11
Polarizable anions (iodide, thiocyanate, thiosulfate, perchlorate)	Dionex IonPac AS16
Polyphosphates, polycarboxylates, and polysulfonates	Dionex IonPac AS16
Preservatives (benzoate, citrate, sorbate)	Dionex IonPac AS11-HC-4 μ m

Gradient Separations as Simple as Isocratic Runs with Eluent Generation

The eluent generator (EG) produces high-purity potassium hydroxide eluent electrolytically, eliminating the need for eluent preparation. Only a source of deionized water is required. The potassium hydroxide eluent produced is free of carbonate contamination. The use of carbonate-free hydroxide eluents minimizes baseline shifts during hydroxide gradients, which provides greater retention time reproducibility, lower background conductivity, and lower detection limits for target analytes. Figure 8 illustrates the gradient separation of heat-stable amine salts in water and up to 30% Methyl-diethanolamine solution using the Dionex IonPac AS11-HC-4 μ m column with a potassium hydroxide gradient delivered by an EG. Monitoring of heat-stable salts is important to corrosion inhibition and waste discharge in the refinery industry.

Column: Dionex IonPac AG11-HC-4 μ m/AS11-HC-4 μ m (2 \times 250 mm)
 Eluent Source: Dionex EGC 500 KOH Cartridge
 Gradient: Potassium hydroxide
 1 mM from -10 to 8 min; 1–30 mM from 8 to 28 min; 3–72 mM from 28 to 38 min
 Flow Rate: 0.38 mL/min
 Inj. Volume: 25 μ L
 Column Temp.: 30 $^{\circ}$ C
 Detection: Suppressed conductivity
 Dionex ASRS 300 Suppressor 2 mm, recycle mode
 Samples: Heat stable salts in
 A: Water; B: 10% Methyl-diethanolamine; C: 30% Methyl-diethanolamine

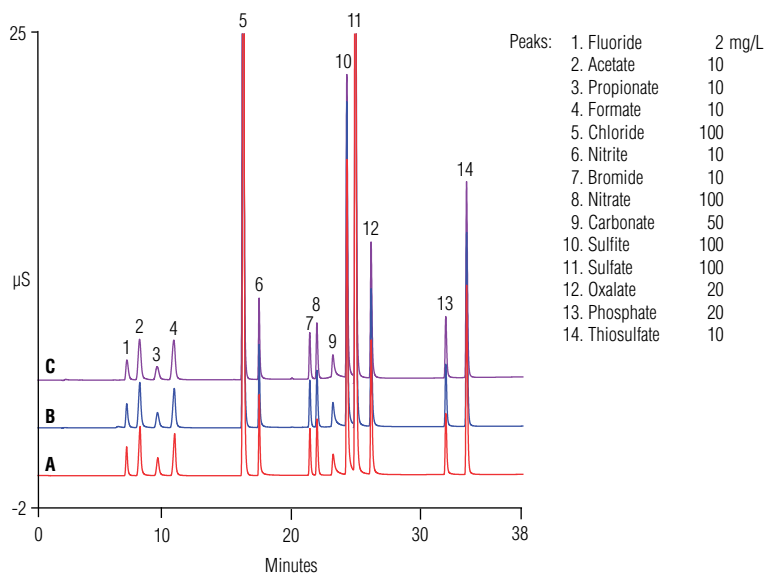


Figure 8. Analysis of heat-stable amine salts using a Dionex IonPac AS11-HC-4 μ m column using a potassium hydroxide gradient delivered by an EG.

SPECIFICATIONS

Dimensions:

Dionex IonPac AS11-HC-4 μ m Analytical Column:	2 \times 250 mm and 4 \times 250 mm
Dionex IonPac AS11-HC-4 μ m Guard Column:	2 \times 50 mm and 4 \times 50 mm
Dionex IonPac AS11-HC-4 μ m Capillary Column:	0.4 \times 250 mm
Dionex IonPac AS11-HC-4 μ m Capillary Guard Column:	0.4 \times 50 mm

Maximum Operating Pressure:

34.5 MPa (5000 psi)

Mobile Phase Compatibility:

pH 0–14; 0–100% HPLC solvents

Substrate Characteristics:

Particle Diameter:	4 μ m
Pore Size:	2000 Å
Crosslinking (%DVB):	55%

Latex Characteristics:

Functional Group:	Alkanol quaternary ammonium ion
Latex Crosslinking:	6%
Latex Diameter:	70 nm
Hydrophobicity:	Medium Low

Capacity:

290 μ eq (4 \times 250 mm Analytical Column)
7 μ eq (4 \times 50 mm Guard Column)
72.5 μ eq (2 \times 250 mm Analytical Column)
1.75 μ eq (2 \times 50 mm Guard Column)
2.90 μ eq (0.4 \times 250 mm Capillary Column)
0.07 μ eq (0.4 \times 50 mm Capillary Guard Column)

Column Construction:

PEEK with 10–32 threaded ferrule-style end fittings. All components are nonmetallic.

System Requirements

The Dionex IonPac AS11-HC-4 μ m Capillary column is recommended for use with the Thermo Scientific Dionex ICS-5000+ Reagent Free™ HPIC™ or Thermo Scientific Dionex ICS-4000 Capillary HPIC system. The Dionex IonPac AS11-HC-4 μ m Analytical column is recommended for use with the Dionex ICS-5000+ HPIC system capable of operating up to 5000 psi.

The smaller particles used in the Dionex IonPac AS11-HC-4 μ m column generate higher backpressure under standard operating conditions and therefore cannot be used with older Thermo Scientific Dionex IC systems.

Suppressor Recommendations

For optimum ease-of-use and performance, the Dionex IonPac AS11-HC-4 μ m 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 EG for eluent delivery, a Thermo Scientific 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 column can be installed between the pump outlet and the EGC inlet. Alternatively, when using a manually prepared sodium hydroxide gradient with the Dionex IonPac AS11-HC-4 μ m 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.

Concentrator Columns

For concentrator work with a 2 mm or 4 mm Dionex IonPac AS11-HC-4 μ m column, use the Dionex IonPac AS11-HC-4 μ m Guard column; Ultra Trace Anion Concentrator columns (Dionex IonPac UTAC-ULP1, UTAC-XLP1, UTAC-ULP2, or UTAC-XLP2 columns) 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 Dionex IonPac UTAC-LP1, UTAC-LP2 or TAC-LP1 columns when the sample is delivered using a syringe or a low-pressure autosampler (e.g., Thermo Scientific Dionex AS-DV Autosampler).

For concentrator work with a 0.4 mm capillary column, use Dionex IonPac AS11-HC-4 μ m Capillary Guard column or the Thermo Scientific™ Dionex™ IonSwift™ MAC-100 Concentrator Column.

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 Number
Dionex IonPac AS11-HC-4µm Analytical Column (4 × 250 mm)	082313
Dionex IonPac AG11-HC-4µm Guard Column (4 × 50 mm)	078034
Dionex IonPac AS11-HC-4µm Analytical Column (2 × 250 mm)	078035
Dionex IonPac AG11-HC-4µm Guard Column (2 × 50 mm)	078036
Dionex IonPac AS11-HC-4µm Capillary Column (0.4 × 250 mm)	078031
Dionex IonPac AG11-HC-4µm Capillary Guard Column (0.4 × 50 mm)	078032
Anion Trap Columns	
Dionex CR-ATC Continuously Regenerated Anion Trap Column (for use with systems equipped with an Eluent Generator or Thermo Scientific Dionex RFC-30 Reagent-Free Controller)	060477
Dionex CR-ATC Continuously Regenerated Anion Trap Column (for use with capillary anion columns)	072078
Dionex IonPac ATC-3 4 mm (9 × 24 mm) Anion Trap Column (for use with 4 mm columns)	059660
Dionex IonPac ATC-3 2 mm (4 × 35 mm) Anion Trap Column (for use with 2 mm columns)	079932
Dionex IonPac ATC-HC (9 × 75 mm) Anion Trap Column (for use with Thermo Scientific Dionex EG40 Eluent Generator)	059604
Trace Anion Concentrator Columns	Part Number
Dionex IonPac TAC-2 Trace Anion Concentrator (3 × 35 mm)	043101
Dionex IonPac TAC-LP1 Trace Anion Concentrator (4 × 35 mm)	046026
Dionex IonSwift MAC-100 Monolith Anion Concentrator (0.5 × 80 mm) (for use with capillary IC)	074702
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

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