

Column: Dionex IonPac AG16-4 μ m / AS16-4 μ m (0.4 \times 250 mm)
 Eluent : 35 mM KOH
 Eluent source: Dionex EGC-KOH (Capillary) Cartridge
 Flow rate: 0.01 mL/min
 Inj. volume: 0.4 μ L
 Temperature: 30 $^{\circ}$ C
 Detection: Suppressed Conductivity, Dionex ACES 300 Suppressor, AutoSuppression, recycle mode

Peaks:	mg/L (ppm)
1. Fluoride	0.5
2. Chloride	0.75
3. Sulfate	1.25
4. Thiosulfate	2.5
5. Iodide	5.0
6. Thiocyanate	5.0
7. Perchlorate	7.5

Thermo Scientific™ Dionex™ IonPac™ AS16-4 μ m Anion-Exchange Column

Improved performance for perchlorate and other polarizable anions

Benefits

- Improved peak efficiencies and resolution compared to the standard Dionex IonPac AS16 column
- Lower detection limits compared to the standard Dionex IonPac AS16 column
- Easily measure trace concentrations of perchlorate in drinking water, surface water, and groundwater matrices using a large-loop injection

Keywords

Anion exchange chromatography, thiosulfate, iodide, thiocyanate, perchlorate, polarizable anions, polyphosphates

Introduction

The Thermo Scientific™ Dionex™ IonPac™ AS16-4 μ m column is a high-capacity, hydroxide-selective, anion-exchange column optimized for the determination of polarizable anions including thiosulfate, iodide, thiocyanate, and perchlorate in a variety of sample matrices. It is ideal for determining trace perchlorate in drinking water in accordance with U.S. EPA Methods 314.0, 314.1, 314.2, and 332.

- Easily transfer methods from the Thermo Scientific™ Dionex™ IonPac™ AS16 column to the Dionex IonPac AS16-4 μ m column due to their similar selectivity
- Ultralow hydrophobicity allows for fast analysis of highly polarizable anions (thiosulfate, iodide, thiocyanate, and perchlorate) with a simple, isocratic eluent
- Ideal for analysis of polyphosphates and polycarboxylates
- Compatible with organic solvents to enhance analyte solubility, modify column selectivity, and allow effective column cleanup

- Available in three formats (4 × 250 mm, 2 × 250 mm, and 0.4 × 250 mm), supporting flow rates from 0.010 to 1.5 mL/min
- Capillary and microbore columns offer reduced eluent consumption and reduced operating costs

High efficiency particle structure

The Dionex IonPac AS16-4µm column packing material is a unique structure composed of a highly crosslinked core and a MicroBead anion-exchange layer attached to the surface as illustrated in Figure 1. The Dionex IonPac AS16-4µm column substrate is composed of supermacroporous, 4µm diameter resin beads consisting of ethylvinylbenzene crosslinked with 55% divinylbenzene.

The anion-exchange layer is functionalized with very hydrophilic quaternary ammonium groups. The latex bead anion-exchange layer has a controlled thickness, which results in excellent mass transfer characteristics and consequently very high-efficiency peaks.

Isocratic separation of polarizable anions

The Dionex IonPac AS16-4µm column has been optimized for the fast, isocratic determination of polarizable anions such as thiosulfate, iodide, thiocyanate, and perchlorate. Figure 2 shows the isocratic separation of these polarizable anions in less than 20 minutes. Separation of the seven common anions can be achieved in the same run with a lower eluent concentration to separate phosphate and thiosulfate. Figure 3 demonstrates the isocratic separation of seven common anions and four polarizable anions. It also demonstrates the effect of flow rate on the separation. Note that the resolution of bromide and nitrate is compromised to achieve good peak shape and peak efficiency for the polarizable anions.

Typical applications for the Dionex IonPac AS16-4µm column include determination of trace perchlorate in environmental samples such as drinking water and groundwater. The Dionex IonPac AS16-4µm column is also optimized for the determination of thiosulfate, iodide, and thiocyanate in chemical samples, including scrubber solutions, process streams, and brines.

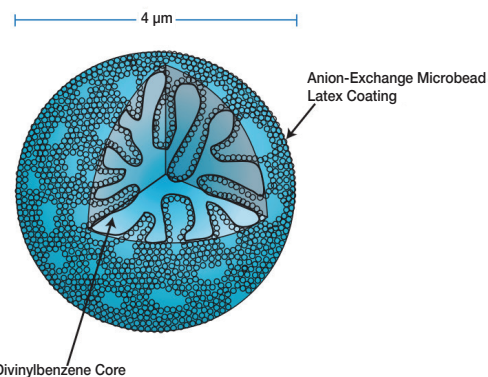


Figure 1. Structure of a Dionex IonPac AS16-4µm resin particle.

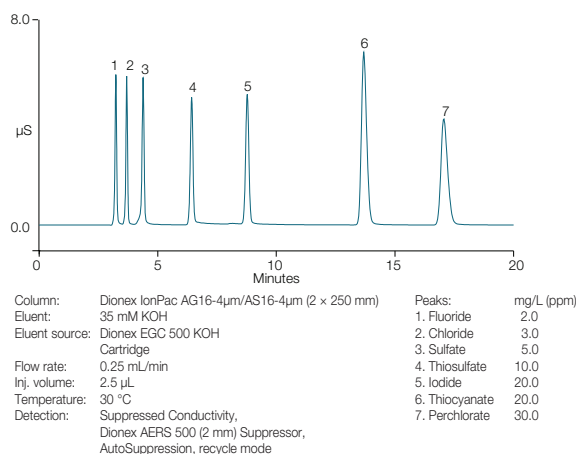


Figure 2. Isocratic separation of polarizable anions and inorganic anions using the Dionex IonPac AS16-4µm column (2 × 250 mm).

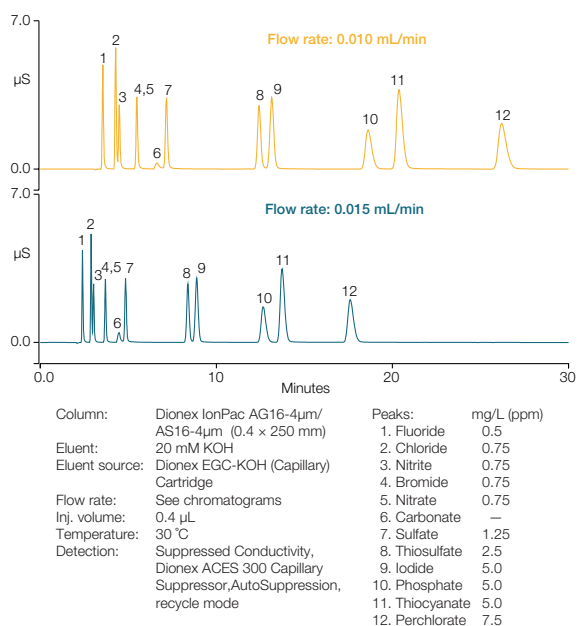


Figure 3. Isocratic separation of seven common anions and four polarizable anions using the Dionex IonPac AS16-4µm capillary column (0.4 × 250 mm).

Economical capillary operation

The Dionex IonPac AS16-4 μ m column is available in a 0.4 mm i.d. format for capillary operation, offering reduced operating costs as capillary IC systems use 100x less eluent than traditional IC systems. The capillary format is ideal for limited sample volumes due to its higher mass sensitivity. Applications developed on 4 mm columns can be directly transferred to 0.4 mm capillary columns by reducing flow rates 100-fold.

Determination of trace perchlorate in drinking water and groundwater

Perchlorate is widely used in the manufacture of rocket propellants, munitions, fireworks, and road flares. It has been found in drinking water near areas where aerospace materials and munitions have been manufactured and tested. Perchlorate has been recognized as a potential health concern because it may interfere with the production of thyroid hormones.

Figure 4 shows the determination of trace perchlorate in a high ionic strength matrix using a large-loop injection with an isocratic hydroxide eluent and suppressed conductivity detection. Low- μ g/L (ppb) levels of perchlorate can easily be quantified using a 1 mL sample loop on a 4 mm Dionex IonPac AS16-4 μ m column.

Figures 5 and 6 illustrate the improved peak efficiencies obtained with the new Dionex IonPac AS16-4 μ m columns compared to standard Dionex IonPac AS16 columns. The higher peak efficiencies may produce detection limits that are 30–50% lower relative to standard Dionex IonPac AS16 columns.

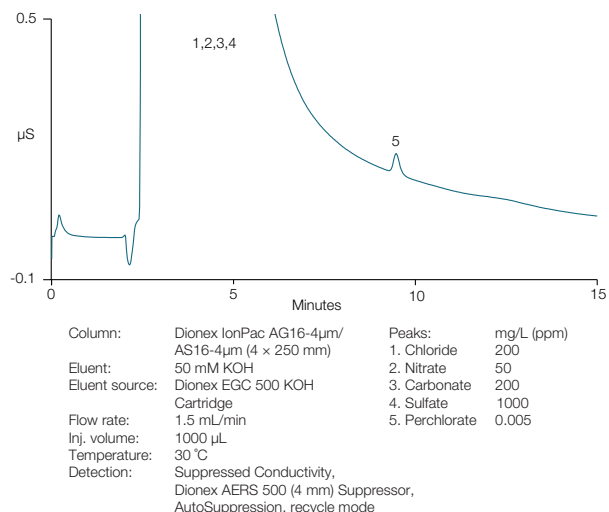


Figure 4. Determination of trace perchlorate in a high ionic strength matrix using a large-loop injection on the Dionex IonPac AS16-4 μ m column (4 \times 250 mm) as described in U.S. EPA Method 314.0.

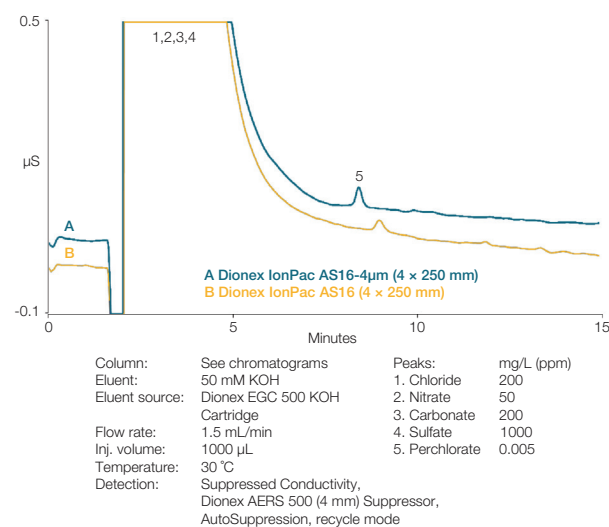


Figure 5. Comparison of perchlorate peak efficiency on a Dionex IonPac AS16-4 μ m column (4 \times 250 mm) and a standard Dionex IonPac AS16 column (4 \times 250 mm).

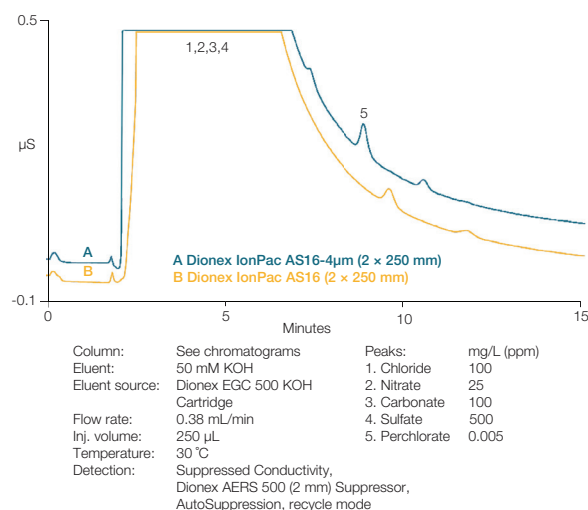


Figure 6. Comparison of perchlorate peak efficiency on a Dionex IonPac AS16-4 μ m column (2 \times 250 mm) and a standard Dionex IonPac AS16 column (2 \times 250 mm).

As shown in Figure 7, the high-capacity Dionex IonPac AS16-4 μ m column can be used to determine trace levels of perchlorate in drinking water with a simple isocratic method.

Gradient separation of polarizable anions and inorganic anions

While the Dionex IonPac AS16-4 μ m column was designed primarily for the determination of polarizable anions, it also provides excellent separation of a wide variety of other anions as shown in Figure 8.

With a potassium hydroxide gradient, 19 inorganic anions and polarizable anions are easily separated in approximately 26 minutes. Note that bromide and nitrate coelute on the Dionex IonPac AS16-4 μ m column. For applications where bromide and nitrate are analytes of interest, please refer to the Thermo Scientific™ Dionex™ IonPac™ AS20 column specification sheet.

Gradient separation of polyphosphates

Polyphosphates are widely used in a variety of industries. They are used for pharmaceutical and detergent formulations, water treatment applications to decrease water hardness, and in cleansers and fertilizers. Polyphosphates are also commonly used as food additives, to control pH, sequester metal ions, and increase the ionic strength of solutions. Figure 9 shows low molecular weight polyphosphates separated in less than 10 minutes with a hydroxide gradient on the Dionex IonPac AS16-4 μ m column.

System requirements

The Dionex IonPac AS16-4 μ m analytical column is recommended for use with the Thermo Scientific™ Dionex™ ICS-5000+ HPIC™ system or Thermo Scientific™ Dionex™ Integrion™ HPIC™ system equipped with an eluent generator. The Dionex IonPac AS16-4 μ m capillary column is recommended for use with the Dionex ICS-5000+ Capillary HPIC system or Thermo Scientific™ Dionex™ ICS-4000 Integrated Capillary HPIC™ system equipped with an eluent generator. Eluent generators automatically produce potassium hydroxide gradients from deionized water. For all systems, the use of Thermo Scientific™ Dionex™ IC PEEK Viper™ fittings is recommended to achieve consistent low dead volume connections and ensure optimum chromatographic performance.

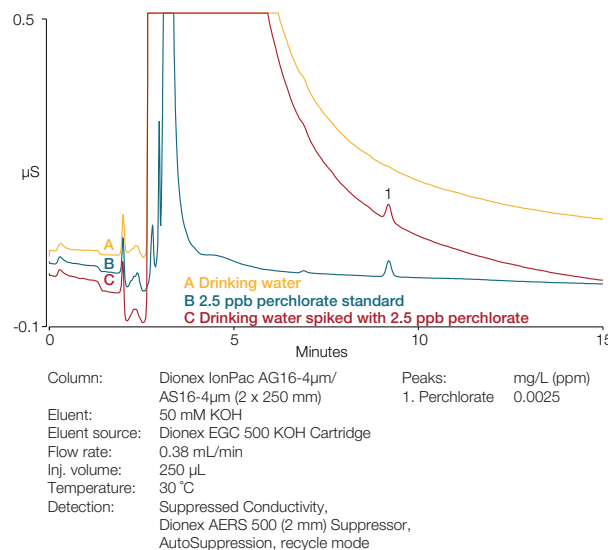


Figure 7. Determination of low-level perchlorate in drinking water using a large-loop injection on the Dionex IonPac AS16-4 μ m column (2 x 250 mm).

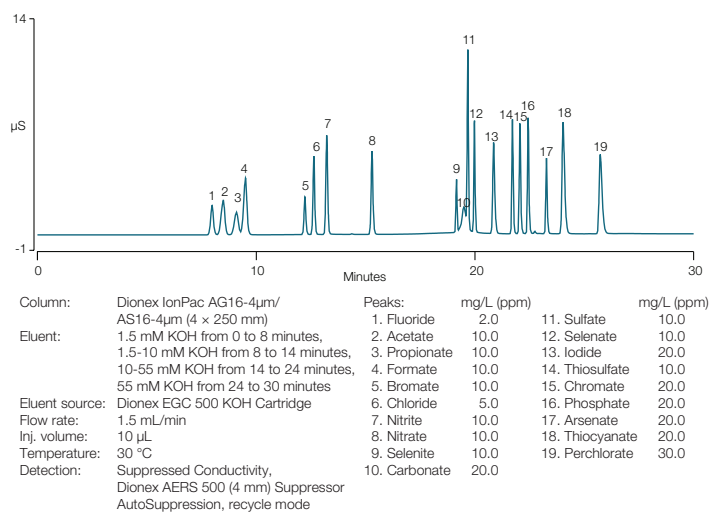


Figure 8. Gradient separation of polarizable anions and inorganic anions on the Dionex IonPac AS16-4 μ m column (4 x 250 mm).

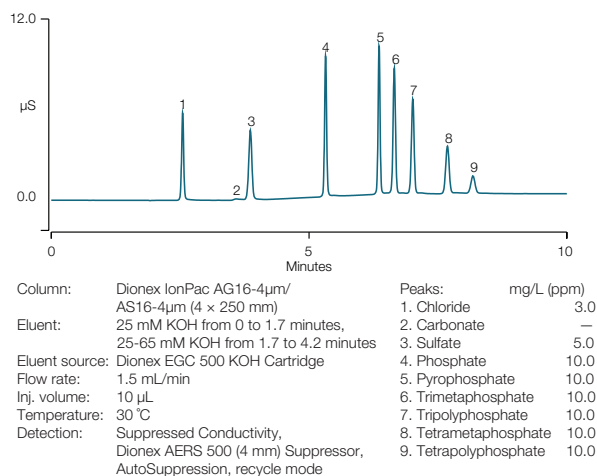


Figure 9. Gradient separation of inorganic anions and polyphosphates using the Dionex IonPac AS16-4 μ m column (4 x 250 mm).

Suppressor recommendations

For optimum ease of use and performance, the Dionex IonPac AS16-4 μ m analytical 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. We recommend operating the Dionex IonPac AS16-4 μ m column at a slightly elevated temperature (30 °C) to ensure reproducible retention times in all environmental conditions.

Anion trap columns

To achieve a more uniform baseline when using gradients delivered by eluent generators, a Thermo Scientific™ Dionex™ CR-ATC 500 Continuously Regenerated Anion Trap Column should be installed between the eluent generator cartridge (EGC) and the EG degas module to remove anionic contaminants from the eluent. A Dionex CR-ATC 600 should be used in Dionex Integrion HPIC systems. For capillary applications, use a Dionex CR-ATC (Capillary) Continuously Regenerated Anion Trap Column. Alternatively, 2 mm and 4 mm systems can use a Thermo Scientific™ Dionex™ IonPac™ ATC-HC 500 Anion Trap Column installed between the pump outlet and the inlet

of the Thermo Scientific™ Dionex™ EGC Eluent Generator Cartridge. For manually prepared eluents, a Thermo Scientific™ Dionex™ ATC 500 Anion Trap Column should be installed between the gradient pump and the injection valve to remove anionic contaminants from the eluent.

Concentrator columns

For trace analysis work with Dionex IonPac AS16-4 μ m analytical columns, use the Thermo Scientific™ Dionex™ IonPac™ AG16-4 μ m guard column, Thermo Scientific™ Dionex™ IonPac™ UTAC-2 Series Ultra Trace Anion Concentrator Columns (UTAC-LP2, UTAC-ULP2 or UTAC-XLP2), or Trace Anion Concentrator Column (TAC-2) when the sample is delivered with a single piston pump such as the Thermo Scientific™ Dionex™ AXP Auxiliary Pump. Use a Thermo Scientific™ Dionex™ IonPac™ UTAC-LP1, UTAC-LP2, or TAC-LP1 concentrator column when the sample is delivered with a syringe or with an autosampler.

For concentrator work with a 0.4 mm capillary column, use the Dionex IonPac AG16-4 μ m capillary guard column or the Thermo Scientific™ Dionex™ IonSwift™ MAC-100 concentrator column.

Specifications

Dimensions:	Dionex IonPac AS16-4 μ m Analytical Columns: 2 x 250 mm and 4 x 250 mm Dionex IonPac AG16-4 μ m Guard Columns: 2 x 50 and 4 x 50 mm Dionex IonPac AS16-4 μ m Capillary Column: 0.4 x 250 mm Dionex IonPac AG16-4 μ m Capillary Guard Column: 0.4 x 50 mm
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Maximum operating pressure:	5000 psi (standard, microbore, and capillary)
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Mobile phase compatibility:	pH 0–14, 0-100% HPLC solvents (e.g., acetonitrile, methanol, and 2-propanol)
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Substrate Characteristics

Analytical columns:	Supermacroporous resin Particle diameter: 4 μ m Pore size: 2000 Å Crosslinking (%DVB): 55%
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Guard columns:	Microporous resin Particle diameter: 10 μ m Pore size: < 10 Å Crosslinking (%DVB): 55%
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Latex:	Functional group: Alkanol quaternary ammonium ion Latex crosslinking: 1% Latex diameter: 55 nm Hydrophobicity: Ultralow
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Capacity (μeq/column):	170 μ eq/column (4 x 250 mm) 42.5 μ eq/column (2 x 250 mm) 1.7 μ eq/column (0.4 x 250 mm) 3.5 μ eq/column (4 x 50 mm) 0.88 μ eq/column (2 x 50 mm) 0.04 μ eq/column (0.4 x 50 mm)
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Column construction:	PEEK with 10-32 threaded ferrule-style end fittings. All components are nonmetallic.
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Analytical, Guard, and Capillary Columns

Dionex IonPac AS16-4µm Analytical Column (2 × 250 mm)	302755
Dionex IonPac AG16-4µm Guard Column (2 × 50 mm)	302756
Dionex IonPac AS16-4µm Analytical Column (4 × 250 mm)	302753
Dionex IonPac AG16-4µm Guard Column (4 × 50 mm)	302754
Dionex IonPac AS16-4µm Capillary Column (0.4 × 250 mm)	302757
Dionex IonPac AG16-4µm Capillary Guard Column (0.4 × 50 mm)	302758

Dionex IC PEEK Viper Fittings Kits

Dionex IC PEEK Viper Fittings Kit for Dionex Integrion systems with conductivity detectors	088798
Dionex IC PEEK Viper Fittings Kit for Dionex ICS-5000+ systems with conductivity detectors	088803
Dionex IC PEEK Viper Fittings Kit for Dionex ICS-5000+ capillary systems with conductivity detectors	088801
Dionex IC PEEK Viper Fittings Kit for Dionex ICS-4000 capillary systems with conductivity detectors	088799

Anion Trap Columns

Dionex CR-ATC 500 Continuously Regenerated Anion Trap Column	075550
Dionex CR-ATC 600 Continuously Regenerated Anion Trap Column for use with Dionex Integrion systems	088662
Dionex CR-ATC (Capillary) Continuously Regenerated Anion Trap Column for use with capillary systems	072078
Dionex IonPac ATC 500 Anion Trap Column (9 × 24 mm) for use with 4 mm columns and manually prepared eluents	075976
Dionex IonPac ATC 500 Anion Trap Column (4 × 35 mm) for use with 2 mm columns and manually prepared eluents	079018
Dionex IonPac ATC-HC 500 Anion Trap Column (9 × 75 mm) for use with eluent generators	075978

Trace Anion Concentrator Columns

Dionex IonPac UTAC-LP1 Ultra Trace Anion Concentrator Low Pressure (4 × 35 mm)	063079
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
Dionex IonPac TAC-2 Trace Anion Concentrator (3 × 35 mm)	043101
Dionex IonPac TAC-LP1 Trace Anion Concentrator Low Pressure (4 × 35 mm)	046026
Dionex IonSwift MAC-100 Monolith Anion Concentrator Column (0.5 × 80 mm) for use with capillary applications	074702

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