

Ion chromatography

Robust IC workflows for nuclear industry water analysis

Minimize corrosion, reduce maintenance costs

Thermo Scientific Dionex Ion Chromatography (IC) Systems

thermoscientific



Thermo Scientific IC workflows for nuclear power plant waters

Tackle matrix interferences, measure trace corrosion-causing contaminants

Nuclear power represents a substantial portion of electricity generation in the United States and European Union, and growing global energy demands and climate change abatement goals are driving more investment, particularly in the Asia-Pacific region. For nuclear power, the ionic purity of water in both the pressurized water reactor (PWR) primary cooling circuit and the boiling water reactor (BWR) secondary circuit is essential to reliable, safe, and economically viable plant operation. In particular, with timely monitoring and control of ionic contaminant levels, facilities can eliminate or reduce damage due to corrosion, scaling, and deposition.

Nothing compares to a Thermo Scientific™ Dionex™ Ion Chromatography (IC) System for the determination of trace concentrations of ionic impurities in nuclear power plant waters. Our IC workflows enable rapid and reliable low-level analysis of a broad range of anions and cations, while eliminating interferences from matrices like borated waters. As the technology leader in IC for over 45 years, you can be confident that you are getting the best with Thermo Scientific IC systems, consumables, service, and support.

Suit your needs with integrated or modular IC

We offer a choice of IC systems to fit the needs of nuclear power plant applications. The Thermo Scientific™ Dionex™ Integrion™ HPIC™ System is ideal for versatile and efficient routine ion analysis. Choose the Thermo Scientific™ Dionex™ ICS-6000 HPIC™ System for more complex analyses and additional method development features.

Accelerate your productivity

Increase throughput and get results faster with a dual-channel Dionex ICS-6000 HPIC system that can run two different analyses simultaneously. Automatically track the usage and performance of IC consumables with Consumables Device Monitor.

Address application challenges with unique columns

Thermo Scientific™ Dionex™ IonPac™ AS28-Fast-4µm and Thermo Scientific™ Dionex™ IonPac™ AS15 IC Columns are designed for trace-level analysis of inorganic anions and low molecular weight organic acids in high-purity power plant waters. Dionex IonPac AS28-Fast-4µm columns use smaller 4 µm resin particles packed into a shorter column body for faster, more efficient separations with shorter run times.

Experience simplicity and reproducibility

Thermo Scientific™ Dionex™ Reagent-Free™ Ion Chromatography (RFIC™) Systems have been widely adopted in nuclear power plants due to their ease of use, reproducibility, and “always on” capability. RFIC systems automatically generate high-purity eluents electrolytically using Thermo Scientific™ Dionex™ EGC Eluent Generator Cartridges and high-purity deionized water.

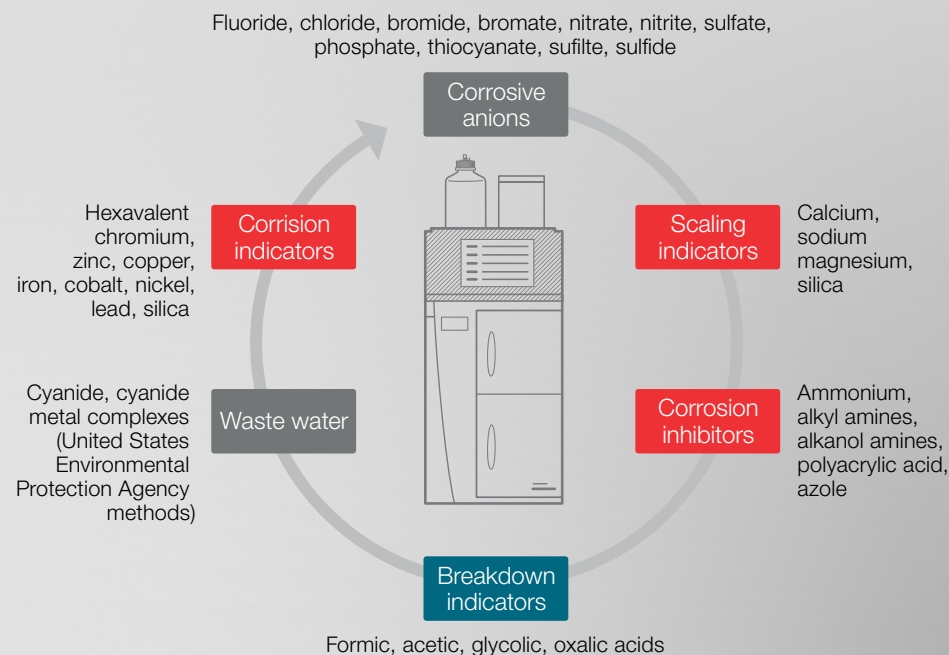
Eliminate matrix interferences with Continuously Regenerated Trap Columns

Thermo Scientific™ Dionex™ CR-TC Continuously Regenerated Trap Columns remove ionic interferences so they don't interfere with trace-level detection. Use the Thermo Scientific™ Dionex™ CR-CTC III Continuously Regenerated Cation Trap Column to remove interfering cations like lithium (Li) in borated PWR waters.

Nuclear power plant water-IC applications

- Pure water
- Pure water with amine additives
- Borated water
- Secondary-circuit feed water
- Effluent water environmental analysis

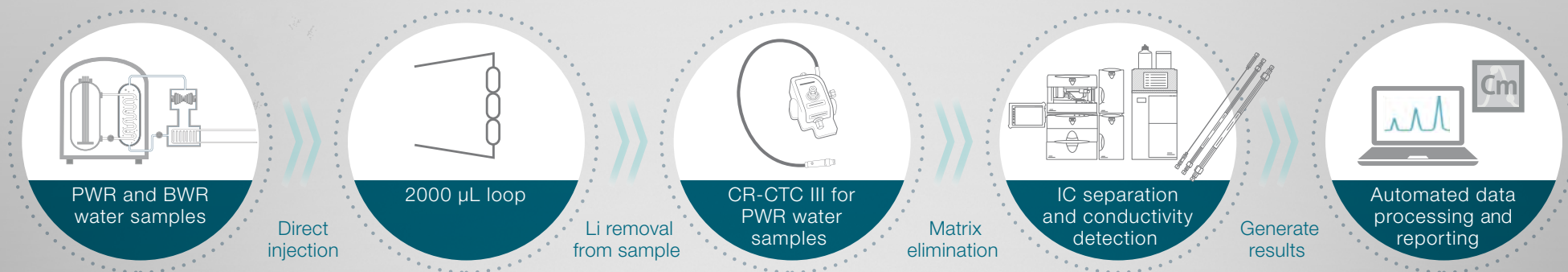
Dionex Integrion HPIC system or Dionex ICS-6000 system



Industry-proven workflow, state-of-the-art IC technology

Nuclear power plant water-IC workflow

PWR and BWR water analysis can be challenging, but the right IC instruments, accessories, and consumables can help. Our nuclear power plant water-IC workflow provides proven reliability based on integrated high-performance IC components sold and supported by a single trusted manufacturer—Thermo Fisher Scientific.



Water samples can be directly injected into the IC system for separation and subsequent conductivity detection. Automated data processing and reporting are used to generate results.



Routine to complex IC analyses— reproducibility, speed, and ease

Obtain reliable results faster and easier. With a choice of either the Dionex ICS-6000 HPIC system or the Dionex Integrion HPIC system you are empowered to overcome the challenges associated with ion analysis in nuclear power plant waters.

Both systems offer:

- Flexible detector configurations to meet your analytical needs today and tomorrow, protecting your investment
- High-pressure capabilities that allow faster analysis without compromising data quality
- Reduced labor and solvent costs, and highly reproducible separations when configured as an RFIC system
- Interactive instrument wellness features including automated consumables tracking
- Method development software for efficient column and separation optimization
- Reusable finger-tight connections minimize dead volume and make connections easier



The Dionex ICS-6000 HPIC system provides you with the freedom to develop, explore, and run different methods simultaneously.



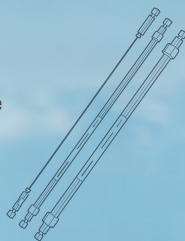
The Dionex Integrion IC system is easy to learn and operate, with a user interface that is intuitive to navigate, even for those new to IC.

Unmatched column technologies for power plant waters

Analytical columns

Dionex IonPac AS15 IC columns are designed for determination of trace anions in the high-purity water matrices used in power generation. They deliver superior resolution of early-eluting anions (e.g., fluoride, glycolate, and acetate), are optimized for use at 30 °C, and are ideal for large-loop injections.

Dionex IonPac AS28-Fast-4 μ m columns improve upon the power of Dionex IonPac AS15 columns with faster, higher-efficiency, higher-resolution separations. The columns use 4- μ m resin particles for more efficient separations that result in improved peak integration, peak identification, and reliability of results. You can use faster flow rates to reduce run times without compromising data quality. High capacity allows injection of concentrated samples without column overloading.



Trap columns

Designed for RFIC systems, Dionex CR-TC trap columns remove ionic interferences from eluents without the need for manual preparation of chemical regenerants and offline regeneration. The trap column is installed in the eluent line prior to the injection valve to prevent spurious chromatographic peaks.

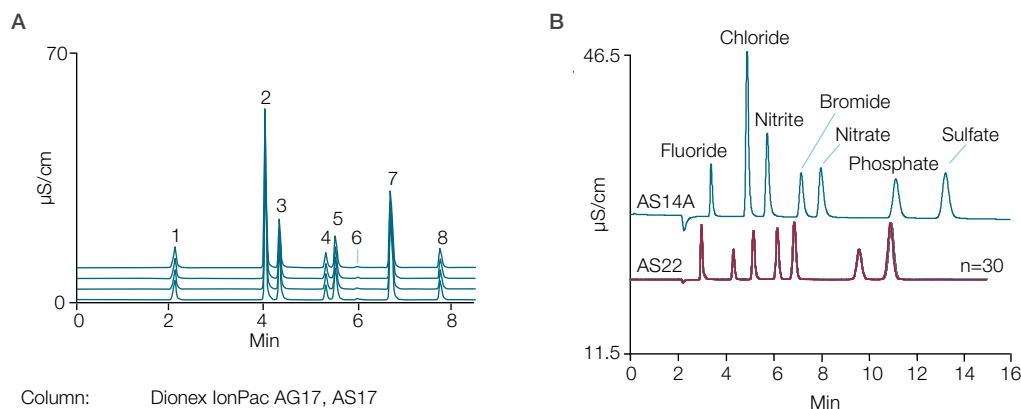
The Thermo Scientific™ Dionex™ CR-ATC Continuously Regenerated Anion Trap Column removes trace anion contaminants from hydroxide or borate eluents. The 100% carboxylate resin Dionex CR-CTC trap column provides optimum performance for nuclear power plant water analysis, including 99% lithium removal in borated waters.



RFIC saves time, increases consistency

Avoid the labor, hazard, and variability of manual eluent preparation with high-purity RFIC. RFIC systems combine automated eluent generation (EG) and electrolytically regenerated suppressors to create the eluents and regenerants required for IC without manual intervention. Simply plumb in a clean source of deionized water and the RFIC-EG system does the rest.

Eluent is suppressed electrolytically with the Thermo Scientific™ Dionex™ DRS 600 Dynamically Regenerated Suppressor. Precise, accurate electrolytic eluent generation prevents baseline shift and increases sensitivity and resolution, ensuring consistent peak integration for excellent method reproducibility.



Column: Dionex IonPac AG17, AS17

Eluent: KOH gradient, 1 mM for 1.5 min,
1 mM to 20 mM from 1.5 to 5 min,
20 mM to 40 mM from 5 min to 7 min

Eluent Source: Thermo Scientific™ Dionex™ EGC-KOH Cartridge

Peaks:

Peak	Anion	Concentration (mg/L)
1	Fluoride	2
2	Chloride	20
3	Nitrite	10
4	Bromide	5
5	Nitrate	10
6	Carbonate	—
7	Sulfate	20
8	Phosphate	10

RFIC-EG system reproducibility with the Dionex IonPac AS22 column

	F	Cl	NO ₂	Br	NO ₃	PO ₄	SO ₄
RT% RSD	0.08	0.76	0.05	0.04	0.04	0.05	0.13
Area % RSD	1.40	0.20	0.40	0.09	0.15	0.14	0.11

(A) RFIC-EG systems produce consistent run-to-run eluent concentrations for highly reproducible retention times and peak areas. **(B)** Separation of seven anions on 4-mm Dionex IonPac AS14A and AS22 columns using a Thermo Scientific Dionex IC system with RFIC-EG to generate carbonate eluent.



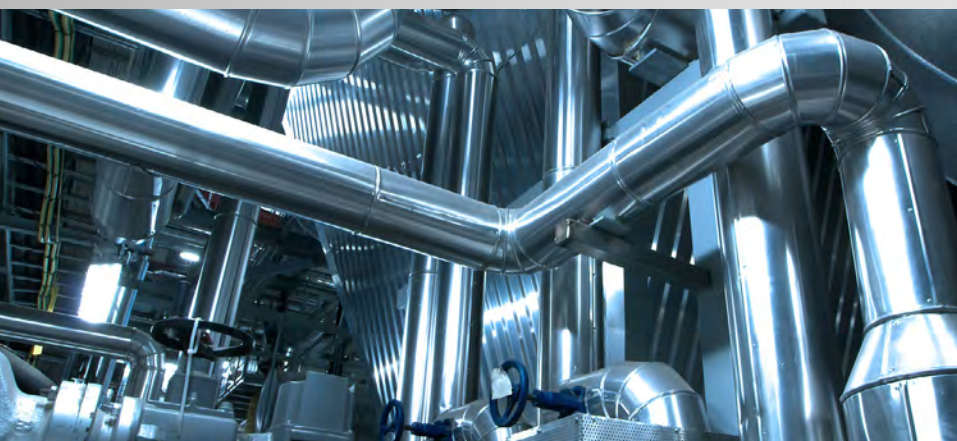
Chromeleon CDS software streamlines workflows



Enhance your workflow efficiencies using Thermo Scientific™ Chromeleon™ Chromatography Data System (CDS) Software. Built with both the lab and IT in mind, the software delivers superior compliance tools, networking capabilities, multi-vendor instrument control, automation, data processing, and more. It's an enterprise solution designed for tracking, accountability, and QA/QC that is incredibly easy to use, with fewer mouse clicks, and more "right-first-time" results. It's also designed to scale globally and provide strong return on investment.

Monitor your power plant water chemistry, control corrosion

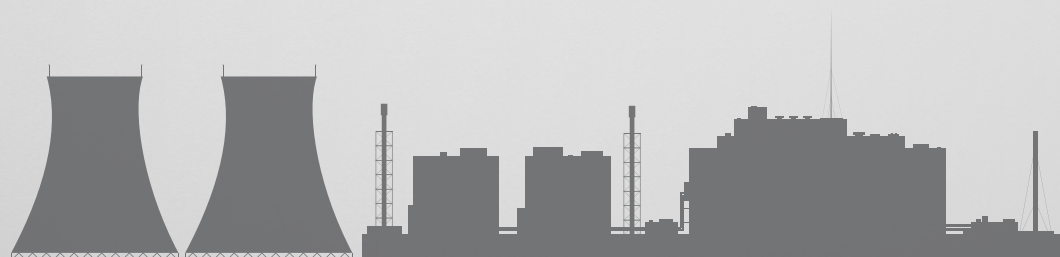
Our IC workflow enhances water analysis with a comprehensive and unique set of capabilities that include ultra-trace analyte determinations, quantification of an extensive array of anions, cations, and amines, and the ability to handle challenging matrices.



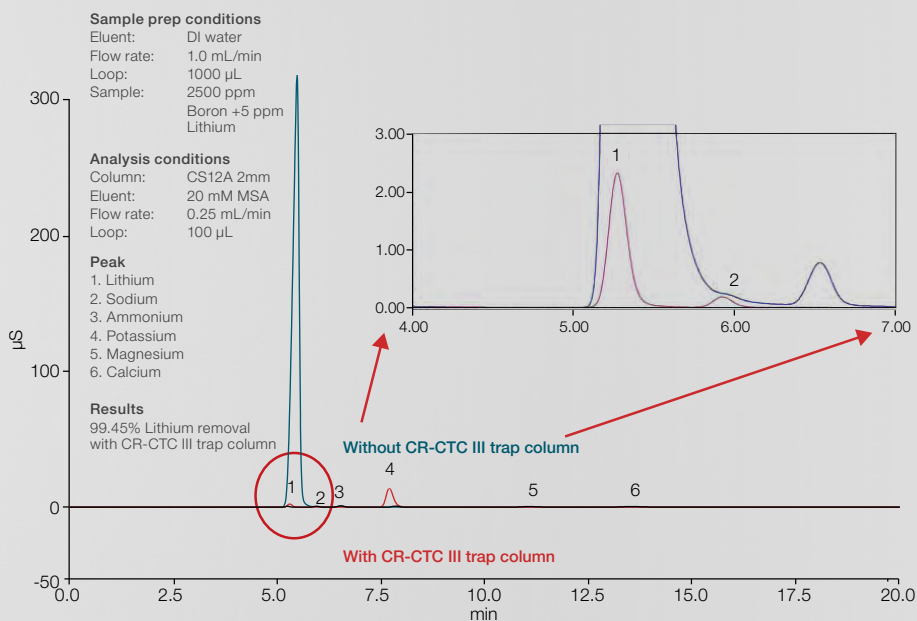
Tackle matrix interferences: rapid ultra-trace analysis of anions in lithium-borated waters

In PWR-based facilities, boric acid is added to the coolant as a neutron absorber to control the nuclear reaction in the primary reactor. At the high temperature and pressure in the PWR, boric acid can cause deposition of metal oxides on the fuel rods. To prevent this, lithium hydroxide (LiOH) is added to increase the pH to 6.9 or higher. However, trace anionic impurities at low- or sub- $\mu\text{g/L}$ (ppb) concentrations in the water source, or materials such as ion-exchange polisher resins, can still catalyze corrosion. Therefore, determination of sub- $\mu\text{g/L}$ anionic contaminants in boric-acid-treated waters is key to minimizing or inhibiting corrosion and reducing maintenance costs.

Matrix components such as borate and lithium can interfere with IC quantification of ionic compounds. Our IC workflow uses RFIC and the Dionex CR-CTC III trap column to overcome these interferences with automated inline matrix elimination of borate and neutralization of LiOH. Combining direct injection with electrolytically generated hydroxide eluent and high efficiency Dionex IonPac AS28-Fast- $4\mu\text{m}$ columns enables rapid determination of target anions.



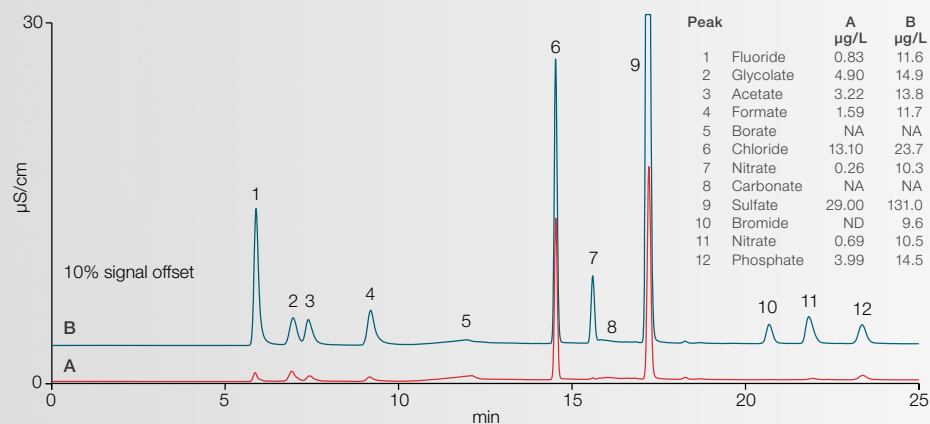
Benefits of CR-CTC III trap column for lithium removal



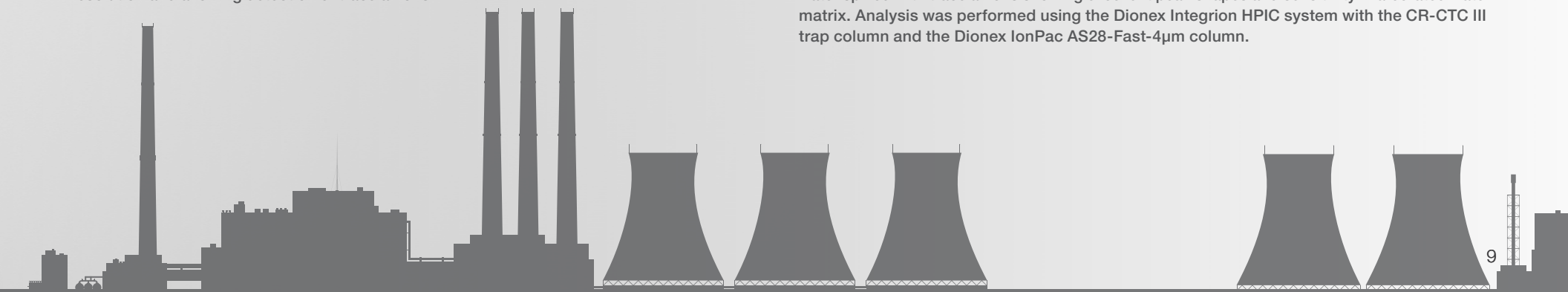
The Dionex CR-CTC III trap column provides over 90% Li removal (peak 1), enhancing resolution and allowing detection of trace anions.

Benefits of the Dionex CR-CTC III trap column

- Achieves lower detection limits to facilitate ultra-trace analysis
- Easier integration of early-eluting analytes versus large-loop methods that introduce a large void volume in the baseline
- Removes matrix interferences while retaining analytes of interest

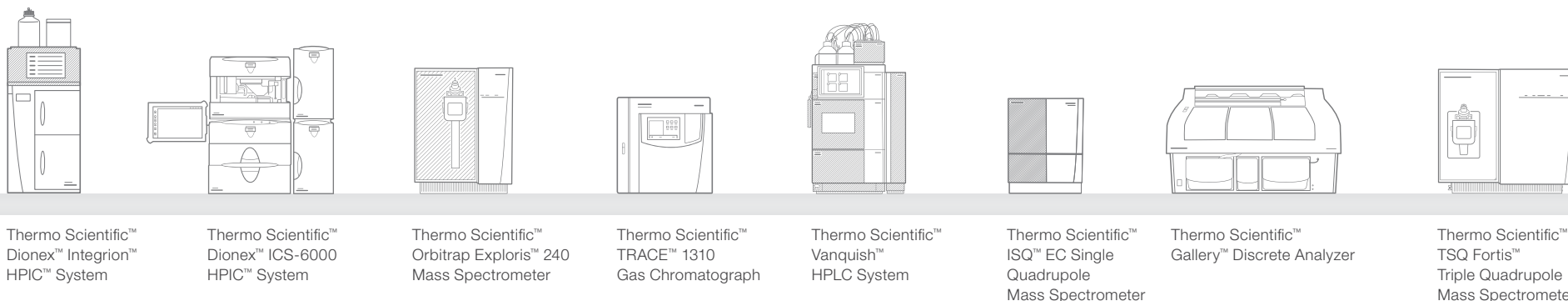


Chromatograms of (A) borated water (2500 mg/L boron +5.0 mg/L lithium), and (B) borated water spiked with trace anions showing excellent peak shapes and sensitivity in a borated water matrix. Analysis was performed using the Dionex Integration HPIC system with the CR-CTC III trap column and the Dionex IonPac AS28-Fast-4µm column.



Providing innovative chromatographic workflow solutions

Thermo Fisher Scientific offers a comprehensive portfolio of ion chromatography, gas chromatography, and liquid chromatography systems, discrete industrial analyzers, and mass spectrometers to help you solve complex analytical challenges. Our leading-edge workflow solutions—from sample preparation, chromatographic separation, and seamless integration with mass spectrometry, to data management and analysis—help you meet today's increasing demands for analytical performance, productivity, and ease of use.



Protecting your investments: unparalleled laboratory services

Unity™ Lab Services provides a single source for integrated lab service, support, and supply management. Our customized service offerings and world-class service experts have the flexibility and experience to effectively address your laboratory's business needs. We provide a complete portfolio of services and support solutions designed to help you improve productivity, reduce total cost of ownership, and ensure performance throughout your laboratory—from instrument and equipment acquisition to disposition. For more information about scalable solutions for your unique needs, visit unitylabservices.com.

 Learn more at thermofisher.com/IC

© 2022 Thermo Fisher Scientific Inc. All rights reserved. All trademarks are the property of Thermo Fisher Scientific and its subsidiaries. This information is presented as an example of the capabilities of Thermo Fisher Scientific products. It is not intended to encourage use of these products in any manners that might infringe the intellectual property rights of others. Specifications, terms and pricing are subject to change. Not all products are available in all countries. Please consult your local sales representatives for details. **BR000740-EN 0422M**