Ion chromatography

Thermo Scientific Dionex PC10 Postcolumn Delivery System

The Thermo Scientific™ Dionex™ PC10 Postcolumn Delivery System is a simple pneumatic reagent delivery system that ensures a constant pulseless flow of reagent. Postcolumn reagent chemistries often can be used to extend the detection limits of various ions that would exhibit limited sensitivity by molecules that require postcolumn derivatization for sensitive detection. The Dionex PC10 system assures optimal flow by applying constant pressure, eliminating the need for a pump and its associated moving parts, labor, and expense.

Superior design

- Simple and compact system for adding postcolumn reagent.
- Specifically designed to fit neatly into the Thermo Scientific™ Dionex™ ICS-3000 Ion Chromatography System stacking pattern (Figure 1).
- Lined reagent chamber in the Postcolumn Reagent Organizer contains spills and leaks.
- Chemically inert for maximum sensitivity.
- Eliminates contamination problems associated with metallic hardware.

Optimal delivery

- Provides pulseless reagent delivery, which is essential for high sensitivity determinations.
- Programmable on/off flow control using Thermo Scientific™ Chromeleon™ Chromatography Data System (CDS).
- Major applications include determination of transition metals, silica, amino acids, carbohydrates, and sequestering agents.
- Complete mixing of reagent/eluent with the mixing tee and knitted reaction coil.



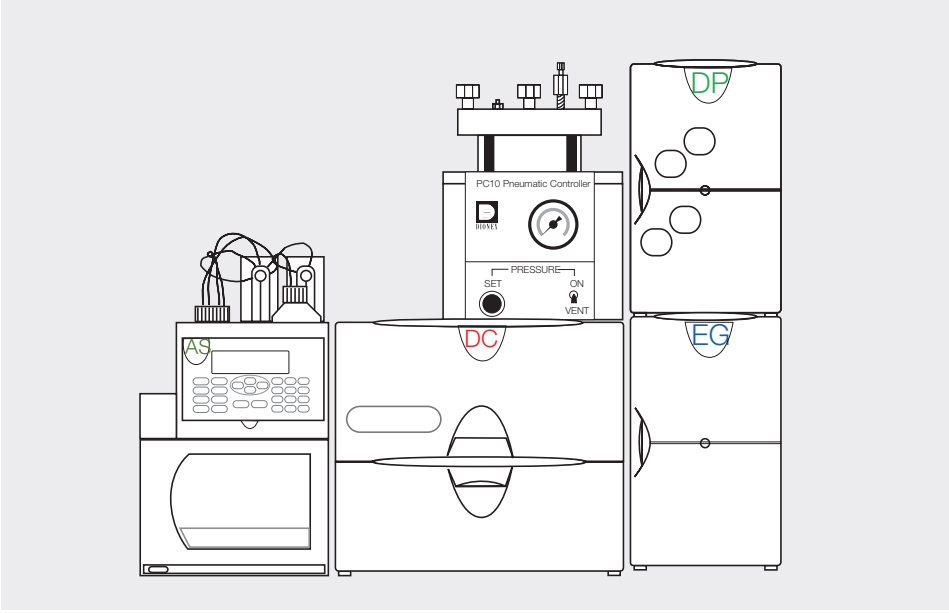


Figure 1. The Dionex PC10 postcolumn pneumatic controller with the Dionex ICS-3000 system.

Thermo Scientific™ Dionex™ PC10 Automation Kit (optional)

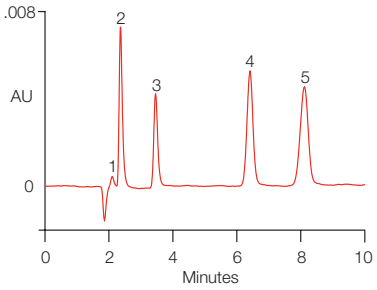
- Automates on/off flow control.
- Includes a pneumatically controlled, two-way valve that is activated by the pump.
- Easily programmed with Chromeleon CDS.

Components of the Dionex PC10 postcolumn delivery system

- Pressurizable chamber
- Postcolumn pneumatic controller
- Knitted reaction coil (375 µL)
- Mixing tee
- Postcolumn reagent organizer

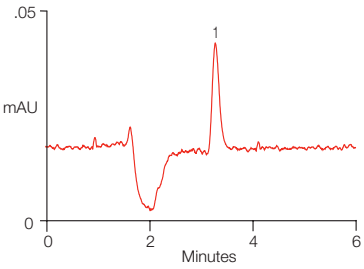
Applications

- Analysis of silica (Figure 2)
- Determination of chelating agents
- Transition metals and lanthanide
- Aluminum
- Hexvalent chromium
- Polyphosphonate scale inhibitors



Column: Thermo Scientific™ Dionex™ IonPac™ AS7
Eluent: 30 mN nitric acid
Eluent Flow Rate: 0.8 mL/min
Postcolumn
Reagent: 1g/L $Fe(NO_3)_3 \cdot 9\ H_2O$
2% (v/v) $HClO_4$
0.8 mL/min
Inj. Volume: 25 µL
Detection: UV, 330 nm
Peaks: 1. Phosphate –
2. Dequest 2010 50 mg/L (ppm)
3. Dequest 2051 50
4. Dequest 2000 50
5. Dequest 2041 50

Figure 2. Determination of silica.



Columns: Thermo Scientific™ Dionex™ IonPac™ AG4A-SC, 2 mm
Thermo Scientific™ Dionex™ IonPac™ AS4A-SC, 2 mm
Concentrator
Column: Thermo Scientific™ Dionex™ IonPac™ AG4, 4 mm
Eluent: 10 mM Boric acid, 10 mM Sodium hydroxide
Flow Rate: 0.38 mL/min
Postcolumn
Reagent: 20 mM Sodium molybdate, 0.2 N Nitric acid,
5 mM Sodium lauryl sulfate
PCR Flow Rate: 0.150 mL/min
Detector: Visible, 410 nm
Coil: 375 µL knitted reaction coil
Preconcentrated
Volume: 20 mL
Detection: UV, 330 nm
Peaks: 1. Silicate 50 ng/L (ppt)

Figure 3. Determination of silicate.

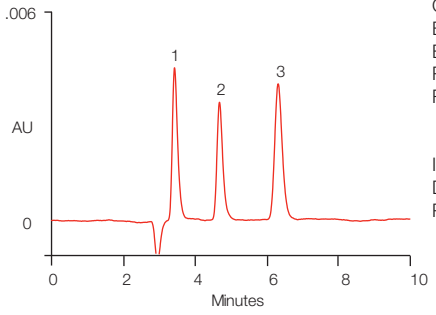
Analysis of silica

Ultrapure water can be monitored for silica in the form of silicate as a high-level contaminant or as low-level early breakthrough product of a water purification system. In Figure 3, silica is monitored at very low concentrations as a breakthrough product.

Determination of highly charged anions

The determination of highly charged anions such as ethylenediaminotetraacetic acid (EDTA), nitrilotriacetic acid (NTA), polyphosphates, and polyphosphonates is possible with the postcolumn addition of ferric nitrate and UV detection. This method can be used to determine polyphosphates in a variety of matrices, including pharmaceutical and detergent samples, waste waters, boiler waters, cooling waters, cleansers, and fertilizers.

Figure 4 illustrates the determination of chelating agents with the postcolumn addition of ferric nitrate and UV detection at 330 nm.



Column: Dionex IonPac AS7, AG7
Eluent: 24 mM Nitric acid
Eluent Flow Rate: 0.5 mL/min
Postcolumn
Reagent: 1g/L $Fe(NO_3)_3 \cdot 9\ H_2O$
2% (v/v) $HClO_4$
0.5 mL/min
Inj. Volume: 25 µL
Detection: UV, 330 nm
Peaks: 1. Phosphate 100 mg/L (ppm)
2. NTA 20
3. EDTA 10

Figure 4. Determination of chelating agents with postcolumn addition of ferric nitrate coupled with UV detection.

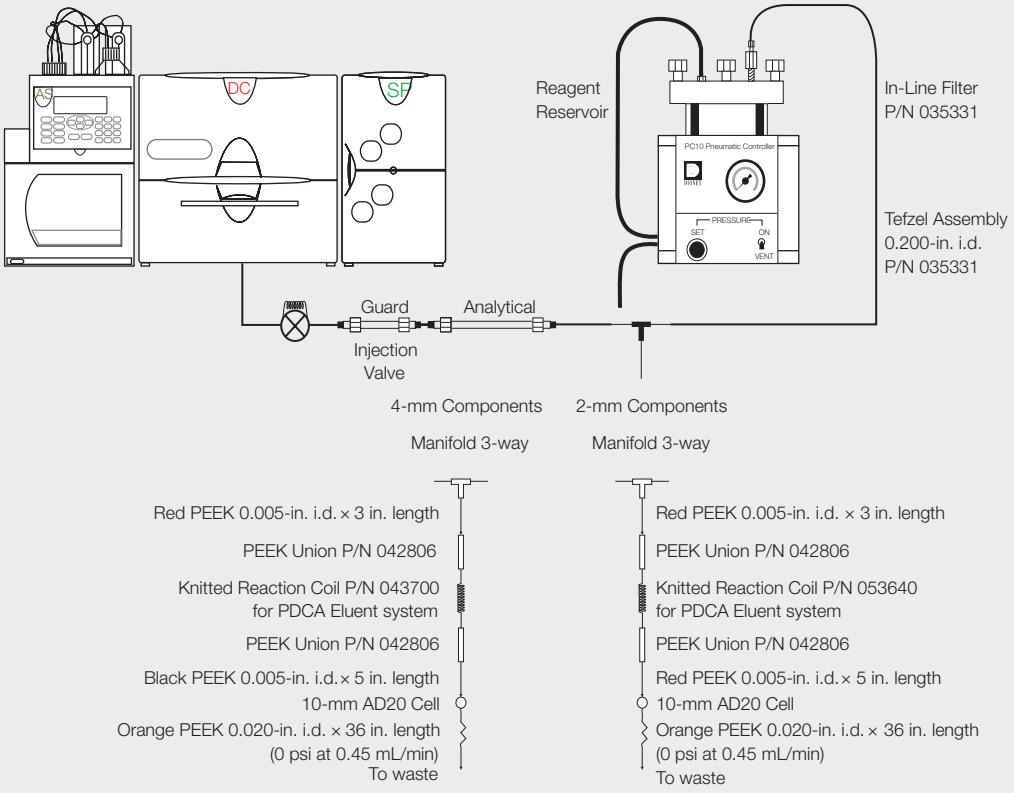
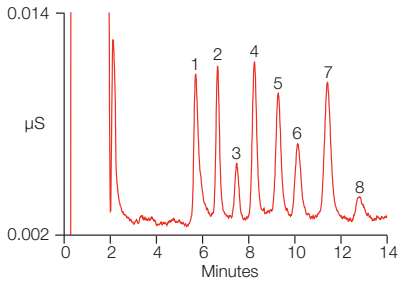


Figure 5. Transition metals benchtop system with pneumatic postcolumn delivery.

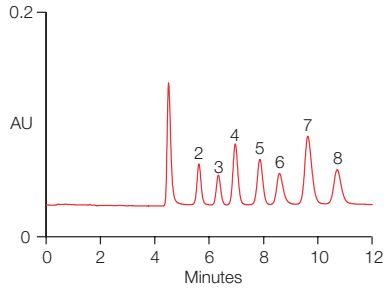
Transition metals and lanthanide

The Dionex PC10 postcolumn delivery system can be set up for the determination of transition metals as seen in Figure 5. Figures 6-9 illustrate the separation of transition metals using varying parameters. After separation, a colorimetric indicator, 4-(2-pyridylazo) resorcinol (PAR), is added to the eluent stream with the PC10 postcolumn delivery system (Figure 10). PAR forms a highly colored complex with the transition elements, which can be monitored with an absorbance detector. The advantages of using ion chromatography versus atomic spectroscopy include the ability to speciate individual oxidation states of certain metals and perform on-line analysis and multi-element determinations at µg/L concentrations.



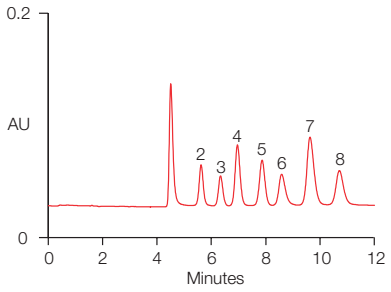
Column:	Dionex IonPac GC5A, CG5A
Eluent:	Thermo Scientific™ Dionex™ MetPac™ PDCA eluent
Flow Rate:	1.2 mL/min
Inj. Volume:	1 mL
Detection:	Absorbance, 520 nm with PAR in Thermo Scientific™ Dionex™ MetPac™ Postcolumn Reagent Dilute
Peaks:	1. Iron (000) 5.0 µg/L
	2. Copper 3.0
	3. Nickel 5.0
	4. Zinc 3.0
	5. Cobalt 3.0
	6. Cadmium 15.0
	7. Manganese 6.0
	8. Iron (II) 2.0

Figure 6. Determination of trace transition metals by direct injection.



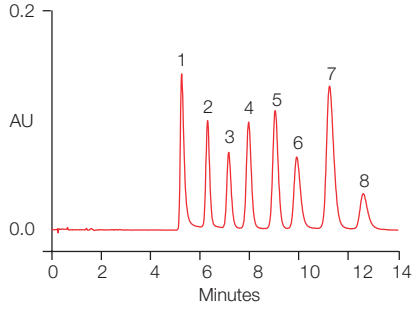
Column:	Dionex IonPac GC5A, CG5A, 2 mm
Eluent:	PDCA
Flow Rate:	0.3 mL/min
PAR:	0.06 g
PAR Flow Rate:	0.15 mL/min
Detection:	530 nm, 10 mm cell
Column Temp:	30°C
Inj. Volume:	1000 µL
Peaks:	1. Fe^{3+} 2 µg/L
	2. Cu^{2+} 1
	3. Ni^{2+} 2
	4. Zn^{2+} 2
	5. Co^{2+} 1
	6. Cd^{2+} 5
	7. Mn^{2+} 3
	8. Fe^{2+} 2

Figure 7. Large sample loop injection of µg/L levels of transition metals using a 2-mm system with pneumatic postcolumn delivery.



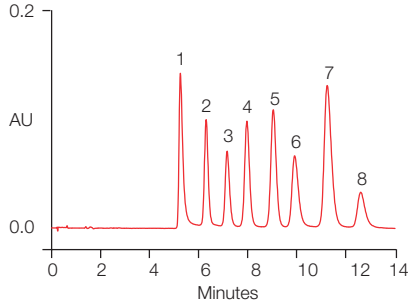
Column:	Dionex IonPac GC5A, CG5A, 2 mm
Eluent:	PDCA
Flow Rate:	0.3 mL/min
PAR:	0.06 g
PAR Flow Rate:	0.15 mL/min
Detection:	530 nm, 10 mm cell
Column Temp:	30°C
Inj. Volume:	2.8 µL
Peaks:	1. Fe^{3+} 4 µg/L
	2. Cu^{2+} 3
	3. Ni^{2+} 4
	4. Zn^{2+} 4
	5. Co^{2+} 2
	6. Cd^{2+} 10
	7. Min^{2+} 6
	8. Fe^{2+} 4

Figure 8. Determination of mg/L levels of transition metals with a 2-mm system with pneumatic postcolumn delivery.



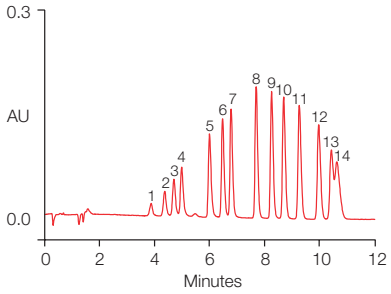
Column:	Dionex IonPac GC5A, CG5A
Eluent:	Dionex MetPac PDCA eluent
Flow Rate:	1.2 mL/min
Inj. Volume:	1 mL
Detection:	Absorbance, 530 nm with PAR in Dionex MetPac Postcolumn Reagent Diluent
Peaks:	1. Iron (III) 1.3 mg/L
	2. Copper 1.3
	3. Nickel 2.6
	4. Zinc 1.3
	5. Cobalt 1.3
	6. Cadmium 6.0
	7. Manganese 2.6
	8. Iron (II) 1.3

Figure 9. Separation of transition metals by anion exchange using the Dionex MetPac PDCA eluent concentrate. The postcolumn reagent, 4-(2-pyridylazo) resorcinol, is delivered using the Dionex PC10 postcolumn delivery system.



Column:	Dionex IonPac GC5A, CG5A
Eluent:	Dionex MetPac PDCA eluent
Flow Rate:	1.2 mL/min
Inj. Volume:	50 µL
Detection:	Absorbance, 530 nm with PAR in Dionex MetPac Postcolumn Reagent Diluent
Peaks:	1. Iron (III) 1.3 mg/L
	2. Copper 1.3
	3. Nickel 2.6
	4. Zinc 1.3
	5. Cobalt 1.3
	6. Cadmium 6.0
	7. Manganese 2.6
	8. Iron (II) 1.3

Figure 10. Determination of transition metals by anion-exchange chromatography with the Dionex PC10 postcolumn delivery system.



Column:	Dionex IonPac GC5A, CG5A, 4 mm
Eluent:	Oxalic acid, diglycolic acid gradient
Flow Rate:	1.2 mL/min
Inj. Volume:	50 µL
Detection:	Absorbance, 530 nm with PAR in Dionex MetPac Postcolumn Reagent Diluent

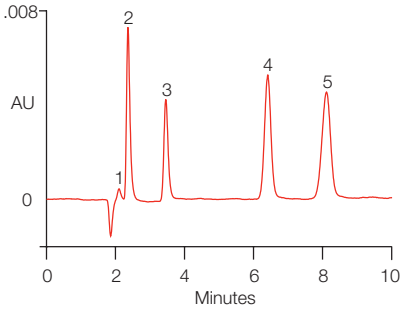
Peaks:

1. Lanthanum	5 mg/L
2. Cerium	5
3. Praseodymium	5
4. Neodymium	5
5. Samarium	5
6. Europium	5
7. Gadolinium	5
8. Terbium	5
9. Dysprosium	5
10. Holmium	5
11. Erbium	5
12. Thulium	5
13. Ytterbium	5
14. Lutetium	5

Figure 11. Separation of lantahanide metals using oxalic acid/diglycolic acid as the complexing agent.

Polyphosphonate scale inhibitors

Oilfield waters can be treated with chemicals to inhibit the formation of scale. Treatments include polyphosphates, polyacrylates, and polyphosphonates. Figure 12 demonstrates a method for the determination of several polyphosphonate scale inhibitors. The phosphonates are separated by anion exchange, and ferric nitrate is added postcolumn. The complexes formed between the phosphonates and ferric ion are detected by UV absorbance at 330 nm.



Column:	Dionex IonPac AS7
Eluent:	30 mN nitric acid
Eluent Flow Rate:	0.8 mL/min
Postcolumn Reagent:	1g/L $Fe(NO_3)_3 \cdot 9\ H_2O$ 2% (v/v) $HClO_4$ 0.8 mL/min
Inj. Volume:	25 µL
Detection:	UV, 330 nm

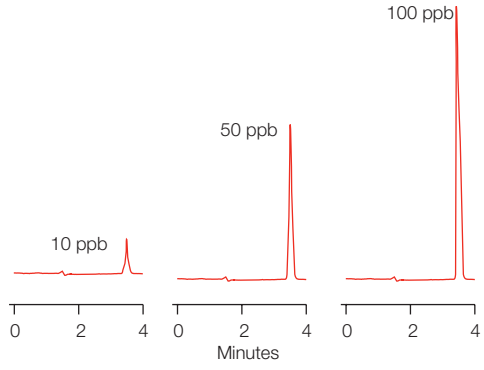
Peaks:

1. Phosphate	–	
2. Dequest	2010	50 mg/L (ppm)
3. Dequest	2051	50
4. Dequest	2000	50
5. Dequest	2041	50

Figure 12. Determination of polyphosphonate scale inhibitors.

Separation of hexavalent chromium

Hexavalent chromium, a known carcinogen, is determined by anion-exchange separation followed by postcolumn reaction and visible detection. Hexavalent chromium can be monitored in various environmental matrices, including wastewater, drinking water, ambient air, hazardous waste dump site soils, and leachates. Figure 13 shows the separation of hexavalent chromium using the Dionex IonPac AS7 column with the postcolumn addition of diphenylcarbazide (DPC) and detection at 530 nm. This method is very selective and sensitive for hexavalent chromium.



Column:	Dionex IonPac AS7
Eluent:	250 mN $(NH_4)_2\ SO_4$ 100 mM NH_4OH
Flow Rate:	1.5 mL/min
Postcolumn Reagent:	2 mM Diphenylcarbazide 10% CH_3OH 1N $H_2\ SO_4$
Detection:	UV–Vis (530 nm)

Figure 13. Separation of hexavalent chromium with postcolumn addition of diphenylcarbazide (made possible by the Dionex PC10 postcolumn delivery system) coupled with visible detection.

Determination of aluminum

The determination of trace metals in complex matrices has traditionally been a difficult analytical challenge. High levels of interfacing species combined with the nonspecificity of concentration and detection schemes have led to severe compromises in the detection limits for many elements. As shown in Figure 14, chelation ion chromatography using the Dionex PC10 postcolumn delivery system has been used successfully for the analytical determination of aluminum in complex matrices.

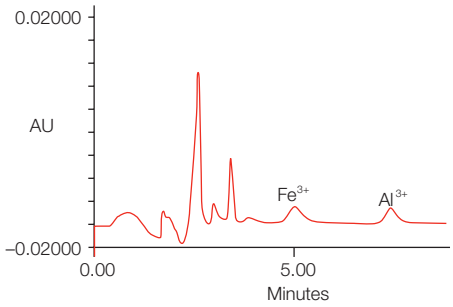


Figure 14. Analysis of river water SLRS-1 (Canadian Standard Reference Material) 12 mL concentrated.

Selective preconcentration of aluminum takes place on an iminodiacetate chelating resin (Dionex MetPac CC-1). At pH 5.5, this resin has high selectivity for aluminum relative to alkali and alkaline-earth metals. While alkaline-earth metals are concentrated, they are subsequently eluted to waste using 2.0 M ammonium acetate. Following the concentration of aluminum and selective elution of alkaline-earth metals, the Dionex MetPac CC-1 chelating column is switched in line with the analytical eluent (0.75 M HCl). At the very low pH of the analytical eluent, aluminum is eluted from the Dionex MetPac CC-1 and separated from other transition metals on a Dionex IonPac CS5 column.

Specifications	
Reservoir operating pressure	689 kPa (100 psi), maximum on/vent toggle valve
Reservoir volume	1 L
Dimensions	17 cm × 22.5 cm × 21 cm
Air requirements	689 kPa (100 psi) air supply; helium preferred when using oxidizable reagents

Ordering information

To order in the U.S., call 1-800-346-6390, or contact the Thermo Fisher Scientific office nearest you. Outside the U.S., order through your local Thermo Fisher Scientific office or distributor. Refer to the following part numbers.

Description	Part number
Dionex PC10 Postcolumn Delivery Package, 4 mm	050601
Dionex PC10 Postcolumn Delivery Package, 2 mm	053591
Dionex PC10 Pneumatic Controller	043903
Pressurizable Chamber	037460
Dionex PC10 Postcolumn Reagent Organizer	22107-60001
Postcolumn Reaction Components	
4-mm, Knitted reaction coil, 374 µL, unpotted	043700
2-mm, Knitted reaction coil, 125 µL, unpotted	053640

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