



## PRODUCT MANUAL

### IONPAC® CG3 GUARD COLUMN (4 x 50 mm, P/N 037025)

### IONPAC® CS3 ANALYTICAL COLUMN (4 x 250 mm, P/N 037024)

#### QUICKSTART STEPS AND LINKS

Click blue text below to get started.

1. See [Section 3, "Operation"](#). Note operation precautions and chemical purity requirements.
2. See ["Quality Assurance Report"](#). Run the Production Test Chromatogram as a system check.
3. See [Section 4, "Example Applications"](#) for example applications.
4. See ["Column Care"](#) for column cleanup and long-term storage recommendations.

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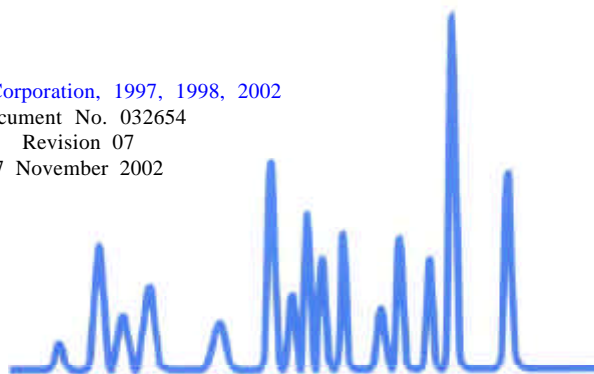
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## **SECTION 1 - INTRODUCTION**

The IonPac CS3 Column (P/N 037024) is designed specifically for the analysis of alkali metals and alkaline-earth metals.

The 4 mm x 250 mm IonPac CS3 Column has an ion exchange capacity of approximately 30  $\mu\text{eq}/\text{column}$ . This resin is composed of 10 micron polystyrene/divinylbenzene substrate agglomerated with cation exchange latex and has nominal efficiency for sodium using standard operating conditions of 18,000 plates/meter.

The IonPac CS3 Column can be operated at flow rates up to 2.0 mL/min with eluents that contain less than 5% organic solvents. Optimally, the IonPac CS3 Column should generate a system backpressure of approximately 1000 psi when operated with an eluent flow rate of 1.0 mL/min.

### **1.1 Initial Inspection**

As soon as you unpack the column, inspect it for shipping damage. Because many carriers limit the claim period to 10 days after the delivery date, Dionex recommends that you report any shipping damage to the incoming carrier immediately. To request help in assessing shipping damage, or to report a missing or damaged part, contact the Dionex office nearest you.

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## SECTION 2 - INSTALLATION

### 2.1 System Requirements

The IonPac CS3 Column must be run on a Series 2000i or 4000i Ion Chromatograph (IC) with a Cation MicroMembrane Suppressor (CMMSIII, P/N056752).

#### NOTE

Do not substitute either a Cation Fiber Suppressor or a packed-bed suppressor column for the Cation MicroMembrane Suppressor (CMMS). None of the eluents required for the IonPac CS3 Column will work satisfactorily with these suppressors. To save regenerant preparation time, consumption, and waste, it is recommended that the AutoRegen Accessory be used.

An IonPac CG3 Guard Column (P/N 037025) may be used with the IonPac CS3 Column. However, retention times will increase by approximately 20%.

This manual assumes that you already know how to install and operate the Ion Chromatograph and the Cation MicroMembrane Suppressor. If you do not, familiarize yourself with the operator's manuals for these products before beginning an analysis.

When performing any cation analysis that involves a gradient, an IonPac Cation Trap Column (CTC-1, P/N040192) should be used in the system to remove cationic contaminants from the eluent. The CTC-1 helps to maintain a low background conductivity and minimizes the baseline change as the eluent concentration is increased during the gradient. The CTC-1 is filled with high capacity cation exchange resin to prevent trace cationic contaminants from reaching the separator. It is placed between the pump and the injection valve in lieu of a second GM-2 mixer which is usually installed in this position in the eluent flow path.

Although not required, it is also recommended that the CTC-1 be used in isocratic analyses of cations to protect the analytical columns from cationic contamination.

**Do not run any suppressor over 40°C. If an application requires a higher temperature, place the suppressor outside of the oven.**

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## SECTION 3 - OPERATION

### 3.1 IonPac CS3 Operation Precautions

**< 4000 psi**  
**< 5% Organic Solvent**  
**Filter and Degas Eluents**  
**Filter Samples**

The recommended regenerant for the Cation MicroMembrane Suppressor is 100 mM tetrabutylammonium hydroxide (TBAOH). The use of Dionex Cation Regenerant Solution (P/N 039602) is highly recommended. There are several important operating precautions that must be observed in order to successfully use the Cation MicroMembrane Suppressor. Study the operator's manual for the suppressor carefully before beginning an analysis.

### 3.2 Standard Operating Conditions

Eluent flow rate:	1 mL/min
Regenerant flow rate:	5-10 mL/min
Detector range:	30 $\mu$ S full scale
Chart speed:	0.5 cm/min
Sample loop:	50 $\mu$ L

### 3.3 Chemicals Required

It is very important for the eluent to be as free of impurities as possible. The chemicals and water required to prepare the eluent should be of the highest purity available. Use deionized water with a specific resistance of 18.2 megohm-cm.

- A. Only use concentrated HCl, Ultrex grade or Baker Instra-Analyzed for Trace Metals.
- B. Dionex DAP Reagent for Cation Eluents (P/N 039670) is highly recommended as the source of the DL-2,3-diaminopropionic acid monohydrochloride (DAP·HCl) used in preparing the eluents.
- C. Dionex Cation Regenerant Solution (P/N 039602) is highly recommended as the tetrabutylammonium hydroxide (TBAOH) regenerant solution.
- D. Use reagent grade  $ZnCl_2$  or better.
- E. Use deionized water with a specific resistance of 18.2 megohm-cm to make all standards, eluents and regenerants.

### 3.4 Solutions Required

#### WARNING

**Hydrochloric acid (HCl) vapors are very corrosive. Avoid breathing the vapors. Dilutions of HCl from the concentrated acid (38%) should be made in a fume hood.**

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- A. **1.0 M HCl stock solution:** Calculate the amount (in grams) of concentrated hydrochloric acid (HCl) that you need to add to a 1 liter volumetric flask by using the % HCl composition stated on the label of the particular bottle of HCl you are using. For example, if the HCl concentration is 38%, you need to weigh out 95.95 grams of concentrated HCl. Carefully add this amount of HCl to a 1 liter volumetric flask containing about 500 mL of deionized water with a specific resistance of 18.2 megohm-cm and then dilute to the 1 liter mark.
- B. **0.1 M ZnCl<sub>2</sub> in 10 mM HCl stock solution:** Add 13.63 grams of ZnCl<sub>2</sub> (FW 136.28) with 100 mL of the 1.0 M HCl stock solution prepared in Section 3.4.A in a 1 L volumetric flask. Add deionized water with a specific resistance of 18.2 megohm-cm until the volume of the solution is approximately 600 to 800 mL.

Mix thoroughly until all of the ZnCl<sub>2</sub> is dissolved and then fill the flask to the 1 L mark with additional deionized water. Mix this final dilution thoroughly before using.

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## SECTION 4- EXAMPLE APPLICATIONS

### 4.1 Sample Preconcentration

Detection limits can be enhanced through preconcentration of the sample onto a concentrator column and using this column in lieu of the sample loop. The sample should be pumped into the concentrator column in the **OPPOSITE** direction of the eluent flow, otherwise the chromatography will be compromised.

The following columns can be used for preconcentration with the IonPac CS3 Column:

- A. The IonPac Trace Cation Concentrator (TCC-1, P/N 037032) provides the least baseline disturbance when the preconcentrator column is switched in line during analysis due to its low internal volume which reduces backpressure fluctuation, however its column capacity will be a limiting factor.
  - B. The IonPac CG3 Guard Column (P/N 037025) has higher capacity than the IonPac Trace Cation Concentrator, but will create a larger baseline disturbance due to backpressure fluctuation because of its appreciably larger internal volume.
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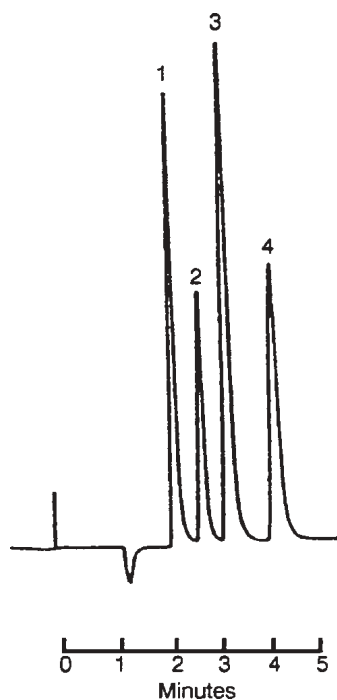
## 4.2 Isocratic Elution of Ammonia and Alkali Metals ( $\text{Li}^+$ , $\text{Na}^+$ , $\text{NH}_4^+$ , $\text{K}^+$ )

### Eluent Preparation

#### Eluent: 25 mM HCl/0.25 mM DAP·HCl

- Prepare a 10 mM DAP·HCl stock solution by dissolving 0.141 g DL-2,3-diamino-propionic acid monohydrochloride (DAP·HCl) to a total of 100 mL using deionized water with a specific resistance of 18.2 megohm-cm in a 100 mL volumetric flask.
- Transfer 25 mL of the 10 mM DAP·HCl stock solution into a 1 liter volumetric flask.
- Add 25 mL of 1 M HCl stock solution to the flask.
- Use deionized water to dilute the eluent to 1 liter Mix thoroughly to dissolve.

Analyte	mg/L
1. Lithium	0.7
2. Sodium	3.0
3. Ammonium	20
4. Potassium	10



**Figure 1**  
Isocratic Elution of Ammonia and Alkali Metals ( $\text{Li}^+$ ,  $\text{Na}^+$ ,  $\text{NH}_4^+$ ,  $\text{K}^+$ )



### 4.3 Isocratic Elution of Selected Alkali Metals and Alkaline-earth Metals (Na<sup>+</sup>, K<sup>+</sup>, Mg<sup>2+</sup>, Ca<sup>2+</sup>)

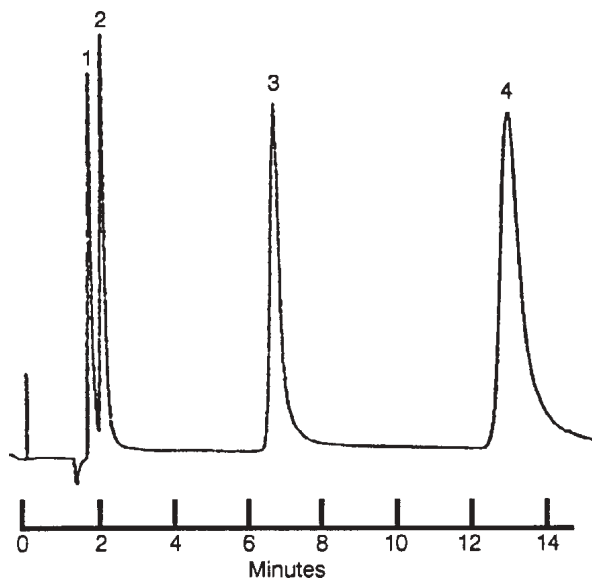
This eluent is intended for applications where only Na<sup>+</sup>, K<sup>+</sup>, Mg<sup>2+</sup> and Ca<sup>2+</sup> are of interest. This is adequate for most surface and ground water samples, since ammonia will probably not be present. If ammonia is present in the sample there will be no significant error in the Na<sup>+</sup> or K<sup>+</sup> values unless the ammonia concentration exceeds that of Na<sup>+</sup> or K<sup>+</sup>, which rarely occurs.

#### Eluent Preparation

##### Eluent: 30 mM HCl/6.0 mM DAP·HCl

- A. Weigh 0.85 g DL-2,3-diaminopropionic acid monohydrochloride (DAP·HCl) into a 1 liter volumetric flask.
- B. Add 30.0 mL 1 M HCl to the flask.
- C. Use deionized water with a specific resistance of 18.2 megohm-cm to dilute the eluent to 1 liter. Mix thoroughly to dissolve.

Analyte	mg/L
1. Sodium	2
2. Potassium	4
3. Magnesium	3
4. Calcium	10



**Figure 2**  
**Isocratic Elution of Selected Alkali Metals and Alkaline-Earth Metals**

#### 4.4 Gradient Elution of Ammonia, Alkali Metals and Alkaline-earth Metals (Li<sup>+</sup>, Na<sup>+</sup>, NH<sub>4</sub><sup>+</sup>, K<sup>+</sup>, Mg<sup>2+</sup>, Ca<sup>2+</sup>)

The analysis of ammonia, alkali metals and alkaline-earth metals (Li<sup>+</sup>, Na<sup>+</sup>, NH<sub>4</sub><sup>+</sup>, K<sup>+</sup>, Mg<sup>2+</sup>, Ca<sup>2+</sup>) requires a step change in eluent. Make the switch from weak eluent (E1) to the strong eluent, (E2), at 5.0 minutes after injection. Return to E1, the weak eluent, when calcium elutes (in about 18 minutes). Magnesium and calcium can be eluted earlier by making the step change to E2 earlier, however, do not change to E2 earlier than about 2.0 minutes into the chromatogram.

A baseline shift is typical during eluent changes and should not interfere with either sensitivity or quantitation. To minimize baseline shift, an IonPac Cation Trap Column (CTC-1, P/N 040192) should be placed between the analytical pump and the injection valve. However, when working at high sensitivities, where a baseline shift is unacceptable use the eluent described in Section 4.5 instead.

If only the divalent alkaline-earth metal cations (Mg<sup>2+</sup> and Ca<sup>2+</sup>) are of interest, the strong eluent (E2) may be used isocratically, without eluent switching. Under these eluent conditions, ammonia and the monovalent alkali metal cations will all elute unresolved near the column void volume.

Eluent switching is compatible with all Gradient Pump Module (GPM) configurations. It may, however, require a modification to an Analytical Pump Module (APM). If your APM contains the four-valve eluent manifold assembly (P/N 038231), any of the valves may be used. If your APM contains a different assembly, replumb V5 (the orange valve) as described in Appendix A to bypass the eluent selection valves before beginning an analysis. In this configuration, eluent select valves 1, 2, 3, and 4 cannot be used.

Eluent switching with the APM may be controlled manually or by using either an Autolon 100 Controller (P/N 035230) or the Autolon 400 Controller.

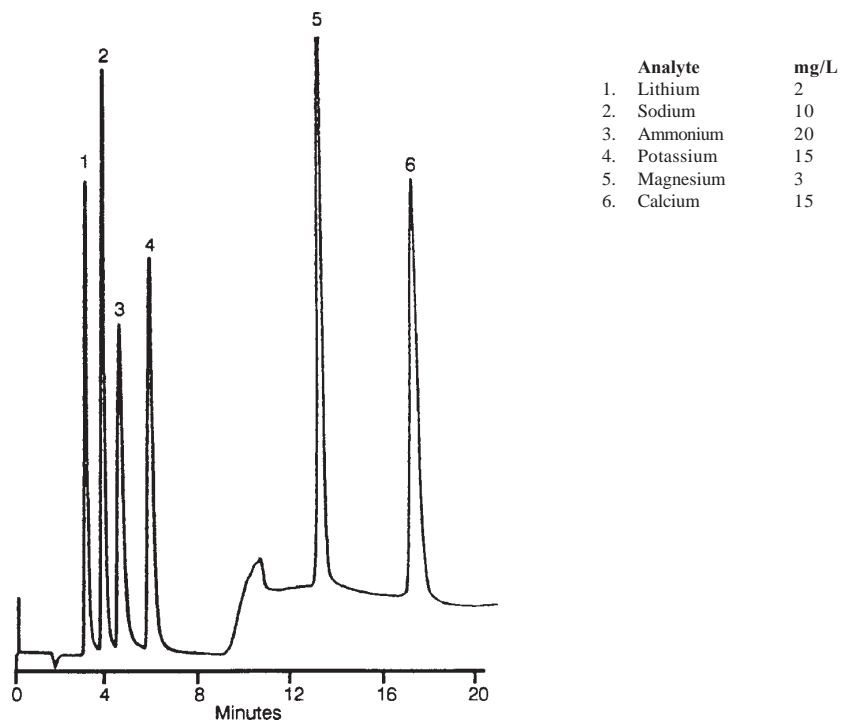
##### Eluent Preparation

##### E2 Strong Eluent: 48 mM HCl / 8 mM DAP·HCl

- A. Weigh 1.13 g DL-2,3-diaminopropionic acid monohydrochloride (DAP·HCl) into a 1 liter volumetric flask.
- B. Add 48 mL 1 M HCl to the flask.
- C. Use deionized water with a specific resistance of 18.2 megohm-cm to dilute the eluent to 1 liter. Mix thoroughly to dissolve.

##### E1 Weak Eluent: 12 mM HCl / 0.5 mM DAP·HCl

- A. Place 63 mL of strong eluent in a 1 liter volumetric flask.
  - B. Add 9 mL 1 M HCl to the flask.
  - C. Use deionized water with a specific resistance of 18.2 megohm-cm to dilute the eluent to 1 liter. Mix thoroughly to dissolve.
-



**Figure 3**  
**Gradient Elution of Ammonia, Alkali Metals and Alkaline-Earth Metals ( $\text{Li}^+$ ,  $\text{Na}^+$ ,  $\text{NH}_4^+$ ,  $\text{K}^+$ ,  $\text{Mg}^{2+}$ ,  $\text{Ca}^{2+}$ )**

#### 4.5 Isocratic Elution of Ammonia, Alkali Metals and Alkaline-Earth Metals (Li<sup>+</sup>, Na<sup>+</sup>, NH<sub>4</sub><sup>+</sup>, K<sup>+</sup>, Mg<sup>2+</sup>, Ca<sup>2+</sup>)

This method is used for the isocratic elution of ammonia, alkali metals and alkaline earth metals (Li<sup>+</sup>, Na<sup>+</sup>, NH<sub>4</sub><sup>+</sup>, K<sup>+</sup>, Mg<sup>2+</sup>, Ca<sup>2+</sup>)

##### Eluent Preparation

Eluent: 25 mM HCl / 2 mM DAP·HCl / 1 mM ZnCl<sub>2</sub>,

- Weigh 0.282 g DL-2,3-diaminopropionic acid monohydrochloride (DAP·HCl) into a 1 liter volumetric flask.
- Add 25 mL of 1 M stock HCl solution and 10 mL of 0.1 M ZnCl<sub>2</sub> stock solution to the flask.
- Use deionized water with a specific resistance of 18.2 megohm-cm to dilute the eluent to 1 liter. Mix thoroughly to dissolve.

Analyte	mg/L
1. Lithium	0.2
2. Sodium	1
3. Ammonium	3
4. Potassium	3
5. Magnesium	3
6. Calcium	15

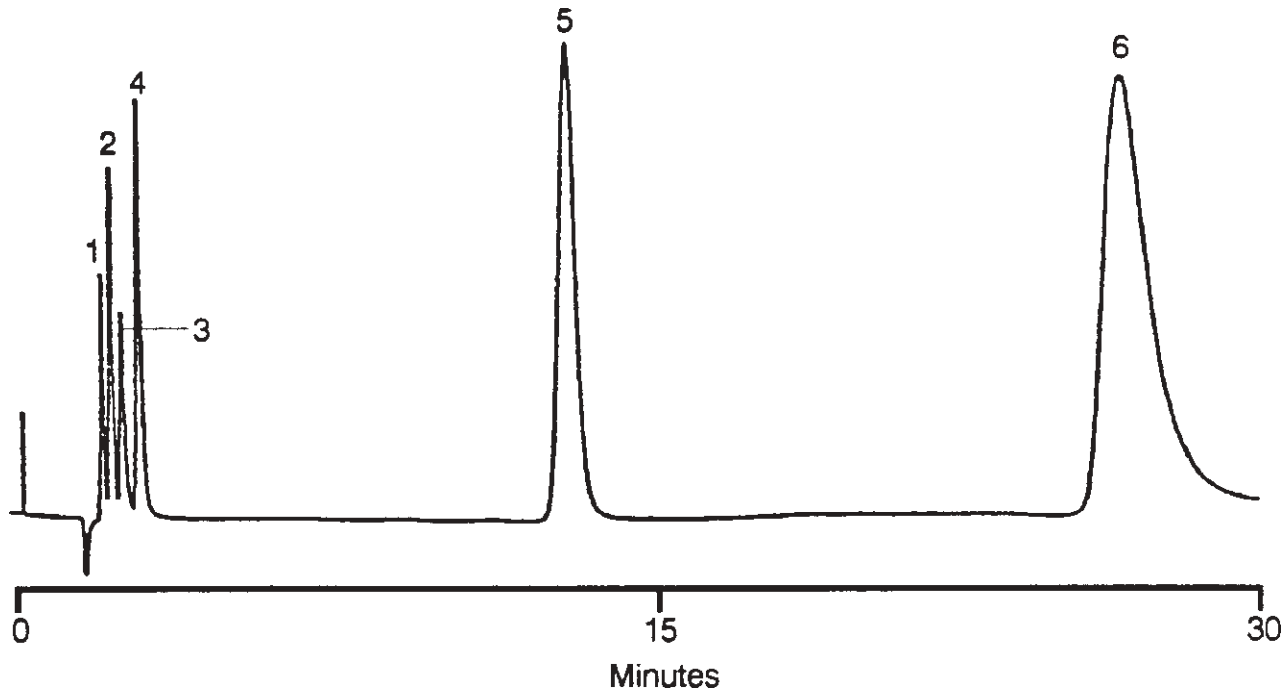


Figure 4  
Isocratic elution of ammonia, Alkali Metals and Alkaline Earth Metals  
(Li<sup>+</sup>, Na<sup>+</sup>, NH<sub>4</sub><sup>+</sup>, K<sup>+</sup>, Mg<sup>2+</sup>, Ca<sup>2+</sup>)

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## SECTION 5 - TROUBLESHOOTING GUIDE

The purpose of the Troubleshooting Guide is to help you solve operating problems that may arise while using the IonPac CS3 Column. For more information on problems that originate with the Ion Chromatograph or the Cation MicroMembrane Suppressor, refer to the Troubleshooting Guide in the appropriate operator's manual. If you cannot solve the problem on your own, call the Dionex Service Office nearest you.

### 5.1 High Backpressure

#### 5.1.1 Zn(OH)<sub>2</sub> Precipitate in the Cation MicroMembrane Suppressor (CMMS)

The eluent described in Section 4.5.1 contains ZnCl<sub>2</sub> and DAP. If the ZnCl<sub>2</sub> concentration is too high or the DL-2,3-diaminopropionic acid monohydrochloride (DAP·HCl) concentration is too low, the zinc can precipitate as Zn(OH)<sub>2</sub> in the Cation MicroMembrane Suppressor (CMMS) and cause excessive backpressure.

- A. Zn(OH)<sub>2</sub> can be removed by pumping 1 M HCl through the eluent ports of the CMMS at 1 mL/min for 10 minutes. The purpose of ZnCl<sub>2</sub> in the eluent is to provide adequate resolution of sodium, ammonium and potassium (see Section 5.2).
- B. If this procedure does not clear precipitate from the CMMS, reverse the flow of the 1 M HCl. The blockage should be removed in about 30 seconds.
- C. Before resuming operation, remake the eluent. Be sure to use the correct concentrations of zinc and DAP (see Section 4.5.1).

#### 5.1.2 Contaminated Bed Support

If the IonPac CS3 Column displays high backpressure, the bed support in the column inlet may be contaminated. Follow the instructions below to change the bed support assembly, using one of the two spare bed support assemblies included in the ship kit provided with the column.

- A. Disconnect the column from the system.
- B. Using two open-end wrenches, carefully unscrew the inlet (top) column end fitting.
- C. Turn the end fitting over and tap it against a bench top or other hard, flat surface to remove the bed support and seal assembly. Discard the old assembly.
- D. Place a new bed support assembly (P/N 042955) into the end fitting (P/N 052809). Use the end of the column to carefully start the bed support assembly into the end fitting.
- E. Screw the end fitting back onto the column. Tighten it fingertight and then using two open-end wrenches, tighten it an additional 1/4 turn (25 in x lb). Tighten further only if leaks are observed.

#### NOTE

**It any of the column packing becomes lodged between the end of the column and the bed support washer assembly, no amount of tightening will seal the column. Make sure that the washer and the end of the column are clean before screwing the end fitting back onto the column.**

- F. Reconnect the column to the system and resume operation.

### 5.2 Wrong Selectivity for Ammonia

The wrong zinc level in the eluent described in Section 4.5.1 can cause a shift in the location of ammonia relative to sodium and potassium.

---

- A. Remake the eluent, being especially careful that the concentrations of  $\text{Zn}(\text{Cl})_2$  and DL-2,3-diaminopropionic acid monohydrochloride ( $\text{DAP}\cdot\text{HCl}$ ) are correct.
- B. If the problem persists, it is probably caused by variations in the dryness of  $\text{Zn}(\text{Cl})_2$  which is rather hygroscopic. In general, increasing the  $\text{Zn}(\text{Cl})_2$  concentration slightly causes the ammonia peak to shift toward potassium. Decreasing the  $\text{Zn}(\text{Cl})_2$  concentration slightly shifts the ammonia peak toward sodium.

#### NOTE

**Do not vary the concentration of  $\text{Zn}(\text{Cl})_2$  by more than 25% from the concentration recommended in Section 4.5.1. Excessive  $\text{Zn}(\text{Cl})_2$  can cause precipitation of  $\text{Zn}(\text{OH})_2$  in the Cation MicroMembrane Suppressor (see Section 5.1.1).**

### 5.3 High Background Noise

In a properly working system, the background level using the operating conditions described in Section 4 should be below 10  $\mu\text{S}$ .

A system with a high background will probably also have high noise, with the resulting increase in detection limits.

- A. Make sure that the eluents and regenerant are correctly formulated.
- B. Make sure that the eluents are made from chemicals with the recommended purity.
- C. Make sure that deionized water used to prepare the reagents has 18.2 megohm-cm specific resistance.
- D. Remove the column from the system. Is the background still high? To make sure it is not contaminated hardware causing the high background, use deionized water with a specific resistance of 18.2 megohm-cm as eluent. The background should be low (less than 2  $\mu\text{S}$ ).
- E. If the above items have been checked and the problem still persists, the suppression system is probably causing the problem. See the Cation MicroMembrane Suppressor (CMMS) and AutoRegen manuals for troubleshooting the suppressor.

### 5.4 Poor Peak Resolution

Poor peak resolution can be due to the loss of column or system efficiency. It can also be observed if the column loses capacity or selectivity.

- A. The loss of column efficiency:
  1. Check to see if headspace has developed in the column (e.g., due to improper use of column, like using the column with organic solvents or submitting the column to high pressures). Remove the column's inlet end fitting from the column (see Section 5.1.2 for instructions). If the resin does not fill the column body all the way to the top, it means that the resin bed has collapsed, creating a headspace. If this is the case, the column will have to be replaced.
  2. Extra column effects can result in sample band dispersion making the peaks look less efficient. Make sure that you are using 0.012 inch ID tubing, and that the tubing lengths are as short as practically possible. Check for leaks.
- B. Shortened solute retention times will compromise resolution. Potential reasons for shorter retention times are the following:
  1. Eluent flow rate is faster than 1.0 mL/min. Check the eluent flow rate after the analytical column.
  2. Incorrect eluent component composition ratio or concentration will change retention times. A too strong eluent will make the peaks elute sooner. Prepare fresh eluent. If you are using a Gradient Pump Module (GPM) to proportion the eluent components from two or three different eluent reservoirs, the resulting eluent composition might not be accurate enough for this application. Use one reservoir containing the correct eluent composition to see if this is

the problem.

- C. Column contamination can lead to a loss of column capacity because all of the cation exchange sites will no longer be available for the sample ions. Polyvalent cations could be concentrating on the column (see Section 6.4. 1). Possible sources of column contamination are:
1. Gradient Mixers (GM-2) in the Gradient Pump Module with S/N before 6500. If present they should be removed from the system when using eluents containing DL-2,3-diaminopropionic acid monohydrochloride (DAP·HCl) and replaced with mixers having serial numbers greater than 6500.
  2. Impurities in chemicals and in the deionized water used. Be especially careful to make sure that the recommended chemicals are used. The deionized water should have a specific resistance of 18.2 megohm-cm.
  3. The system should be as metal-free as possible. Gripper tubing fittings in the system are a potential source for metal contamination of the column. The new Dionex ThermoFlare fittings are preferred. Inspect the eluent pumps periodically for any signs of leakage.
  4. Glass eluent reservoirs can be a source of sodium contamination in the eluent. Two liter polyethylene eluent reservoirs (P/N 039163) are preferred.
  5. The installation of an IonPac Cation Trap Column (CTC-1, P/N 040192) between the pump and the injection valve is highly recommended for all cation analyses. The CTC-1 strips the eluent of strongly retained cation contaminants that will bind strongly to the analytical column resulting in the loss of column capacity and interferences with desired cation analyses.
- D. Diluting the eluent will improve peak resolution but will also increase the analytes' retention times. If a 10% dilution of the eluent is not sufficient to obtain the desired peak resolution, or if the resulting increase in retention times is unacceptable, clean the column (see, "Column Care").

After cleaning the column, install it in the system, and let it equilibrate with eluent for about 30 minutes. The column is equilibrated when consecutive injections of the standard give reproducible retention times. The original column capacity should have been restored by this treatment, since the contaminant metals should have been eluted from the column.

## 5.5 Spurious Peaks

Spurious peaks can be due to:

- A. Column contamination. If the samples contain an appreciable level of polyvalent cations and the column is used with a weak eluent system (e.g., the eluent described in Section 4.2. 1), the polyvalent cations may be contaminating the column. The retention times for the analytes will then decrease, and spurious, normally inefficient peaks could show up at unexpected times.

Clean the column as indicated in "Column Care." If the rate of contamination is fast, it is recommended that one of the eluents; described in Section 4.3.1, 4.4. 1, or 4.5.1 be used. Any of these eluents will ensure the polyvalent cations are eluted before the next sample is injected.

- B. Baseline upsets. When an injection valve or a column switching valve are activated, the possibility of creating a baseline disturbance exists. This baseline upset can show as a peak of varying sizes and shapes, and it will happen when the particular valve needs to be cleaned or torqued (see system manual). Small baseline disturbances at the beginning or at the end of the chromatogram can be overlooked as long as they do not interfere with the quantitation of the peaks of interest.

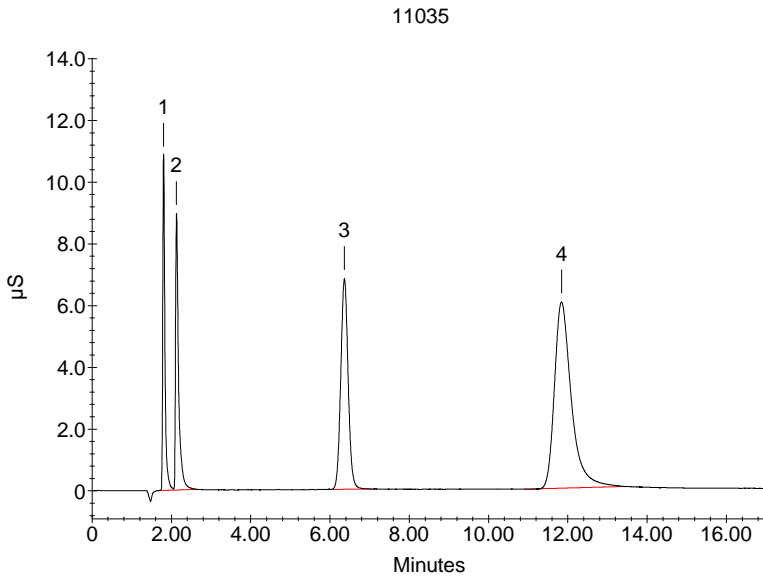
If cleaning and retorquing the valve does not help, replace the valve. A Dionex High Pressure inert valve is recommended (3 or 4-way, as needed).

**IonPac® CS3**  
**Analytical (4 x 250 mm)**  
**Product No. 37024**

Serial No. : 11035

Pressure (PSI) : 700

Date : 7/21/00 7:51:56 AM



**Eluent:** 30.0 mM HCl, 6.0 mM DL-2,3-diaminopropionic acid monohydrochloride

**Eluent Flow Rate:** 1.0 mL/min

**Regenerant:** 100mM Tetrabutylammonium hydroxide (TBAOH)

**Regenerant Flow Rate:** 10.0 mL/min.

**Detection:** Suppressed Conductivity at 30 μSFS

**Injection Volume:** 50 μL

**Storage Solution:** Eluent

Peak Information : Found Components

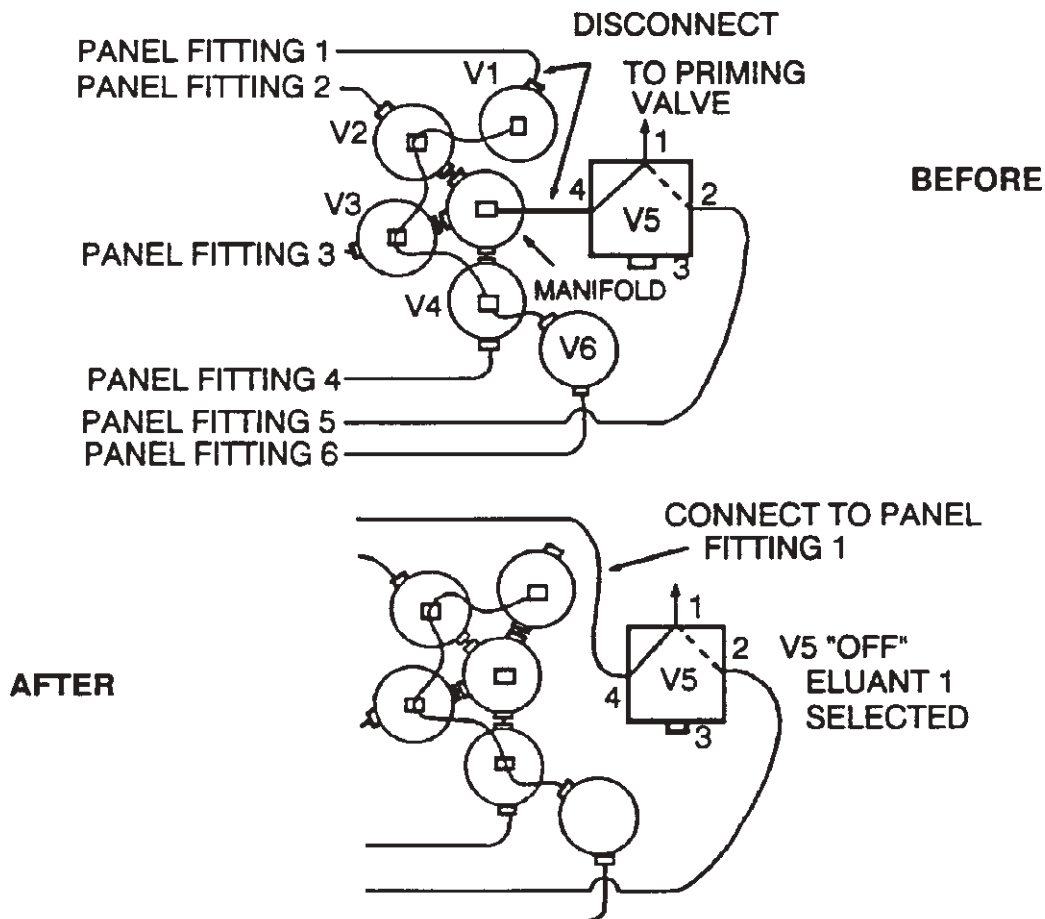
Peak No.	Retention Time	Name	(mg/L)	Efficiency	Asymmetry (10%)	Resolution
1	1.80	Sodium	5.0	5590	2.0	2.97
2	2.13	Potassium	5.0	4659	3.1	18.28
3	6.36	Magnesium	10.0	5602	1.1	10.21
4	11.84	Calcium	10.0	4136	1.7	n/a



## APPENDIX B - REPLUMBING THE ANALYTICAL PUMP MODULE (APM)

When using the eluents described in Section 4.4 it may be necessary to replumb the Analytical Pump Module (APM) to provide for switching between the weak eluent (E-1) and the strong eluent (E2).

- A. Press STOP/START to turn off the pump. Slide the pump forward out of the enclosure.
- B. Remove the line connecting V5 to the eluent valve manifold. Disconnect the line between the rear of panel fitting #1 and eluent valve #1 at the panel.
- C. Install fittings on both ends of a length of 1/8 inch OD tubing (see Section 5.3.2 of the APM manual for instructions).
- D. Use the 1/8 inch OD tubing with end fittings to connect the rear of panel fitting# 1 to port 4 of V5.
- E. Plumb the weak eluent (E1) to panel fitting #1 and the strong eluent (E2) to panel fitting #5 (see Section 4.4.1 for instructions on eluent preparation). In this configuration turning off V5 selects eluent 1. Turning on V5 selects eluent 2.
- F. Turn off the ELUENT INTERLOCK switch on the rear panel of the Analytical Pump Module (APM).



## COLUMN CARE

### RECOMMENDED OPERATING PRESSURES

Operating a column above its recommended pressure limit can cause irreversible loss of column performance. The maximum recommended operating pressure for the IonPac CS3 Column is 3000 psi.

### COLUMN START-UP

The column is shipped with eluant as the storage solution. This eluant is the same one shown in the test chromatogram. If you are using an eluant other than the test eluant, first rinse the column with 50 mM NaOH at 1 mL/min for 10 minutes.

Then equilibrate the column with the desired eluant for 30 to 60 minutes. You will know the column is equilibrated when two consecutive injections of standard produce the same retention times.

#### NOTE

**Whenever changing from one eluant system to another, It is recommended for faster equilibration to first rinse the column with 50 mM NaOH at 1 mL/min.**

### COLUMN STORAGE

The column's storage solution should be the eluant used for the particular application. If the column will not be used for one week or more, prepare it for long term storage. Flush the column for a few minutes with the eluant. Cap both ends securely, using the plugs supplied with the column.

### COLUMN CLEANUP

#### CAUTION

**Do not use more than 5% v/v acetonitrile or methanol solvents in water at any time or irreversible column damage will result.**

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## POLYVALENT CATIONS AND ACID SOLUBLE CONTAMINANTS

- A. Disconnect the column from the Cation MicroMembrane Suppressor (CMMS) and the detector.
- B. Connect a container of 1 M HCl + 0.1 M KCl (prepared from concentrated HCl, Baker Instra-Analyzed for (Trace Metals only) directly into the bottom of the pump's (APM or GPM) priming block so that all the eluant select valves are by-passed.
- C. Set the flow rate to 1 mL/min and pump 60 mL of the HCl solution through the column, followed by 10 mL of deionized water with a specific resistance of 18 megohm-cm. Make sure you have an appropriate waste container for the column effluent.
- D. An alternate cleanup procedure is to use a 10 times eluant concentrate. Pump 60 mL of this solution through the column at 1 mL/min. This can be especially advantageous when you have such a solution at hand for eluant stock or for proportioning with deionized water and an eluant concentrate in a Gradient Pump Module. However, this method is not as effective as the method described in Step C for cleaning the column.
- E. After cleaning, reinstall the column in the system and let it equilibrate with eluant for 30-60 minutes. The column is equilibrated when consecutive injections of the standard give reproducible retention times.

## BASE SOLUBLE CONTAMINANTS

- A. To remove any base soluble contaminants, the column can be washed with 0.1 M NaOH for 30-60 minutes at 1.0 mL/min. After the NaOH treatment, wash the column for 10 minutes at 1.0 mL/min with deionized water with a specific resistance of 18 megohm-cm. Then equilibrate with eluant for 30-60 minutes.

0.1 M NaOH is usually sufficient to clean the column, however, concentrations up to 1.0 M NaOH can be tolerated by the column.

## ORGANIC CONTAMINANTS

It is possible to remove organic contaminants by adding up to 5% v/v acetonitrile or methanol to either the acid or base clean up solution and then following the instructions in Section 6.4.1 or 6.4.2. However, this procedure should be considered only as a last resort. Adding organic solvents to the clean up solution may disrupt the packed resin bed of the column, thus irreversibly damaging the column.

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