



**Thermo Scientific**

# **Dionex CRS 500**

**Product Manual**

**P/N: 031727-07**

**March 2015**

# **Product Manual**

**for**

## **Dionex Chemically Regenerated Suppressor 500**

Dionex ACRS 500, 4 mm, (P/N 085090)

Dionex CCRS 500, 4 mm, (P/N 085092)

Dionex ACRS 500, 2 mm, (P/N 085091)

Dionex CCRS 500, 2 mm, (P/N 085093)

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Revision History:

Revision 06, January, 2015 – Rebranded for Thermo Scientific. Product name changed from Dionex MMS 300 to CRS 500.

Revision 07, March, 2015 – Typo and formatting corrections.

## Safety and Special Notices

Make sure you follow the precautionary statements presented in this guide. The safety and other special notices appear in boxes.

Safety and special notices include the following:



**SAFETY**

*Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.*



**WARNING**

*Indicates a potentially hazardous situation which, if not avoided, could result in damage to equipment.*



**CAUTION**

*Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. Also used to identify a situation or practice that may seriously damage the instrument, but will not cause injury.*



**NOTE**

*Indicates information of general interest.*

**IMPORTANT**

*Highlights information necessary to prevent damage to software, loss of data, or invalid test results; or might contain information that is critical for optimal performance of the system.*

**Tip**

*Highlights helpful information that can make a task easier.*

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# 1. Introduction

Suppressor: The role of a suppressor in Ion Chromatography is to remove the eluent and sample counterions and replace this with regenerant ions thereby converting the eluent to a weakly dissociated form prior to detection. Detection of analyte ions particularly with conductivity detection is therefore feasible against a low background. The suppressor not only reduces the background signal but also the noise associated with the signal. Furthermore, the analytes are converted to the more conductive acid or base form, which enhances the signal, particularly for fully dissociated species. Thus overall improvement in detection limits as observed from the signal to noise ratio is achieved. When compared to single column ion chromatography, i.e., applications that do not use a suppressor, the improvement in noise with suppressed ion chromatography far exceeds the noise performance of single column chromatography applications. Hence the suppressor has become an integral part of the ion chromatography instrument.

The suppressors from Thermo Fisher Scientific are designed for continuous operation and do not require any switching or offline regeneration. Furthermore, the standards and the samples are always exposed to the same suppressor device when pursuing ion analysis, thus ensuring that the analytical parameters are consistent between calibration and analysis. From a simplistic perspective there are two types of suppressors offered for continuous operation, namely, electrolytically regenerated suppressors and chemically regenerated suppressors. The electrolytic suppressors operate continuously with a water source as a regenerant. In the recycle mode of operation the water source is derived from the suppressed eluent, thereby making the suppressor operation facile. The chemical suppressors operate continuously with an external regenerant source.

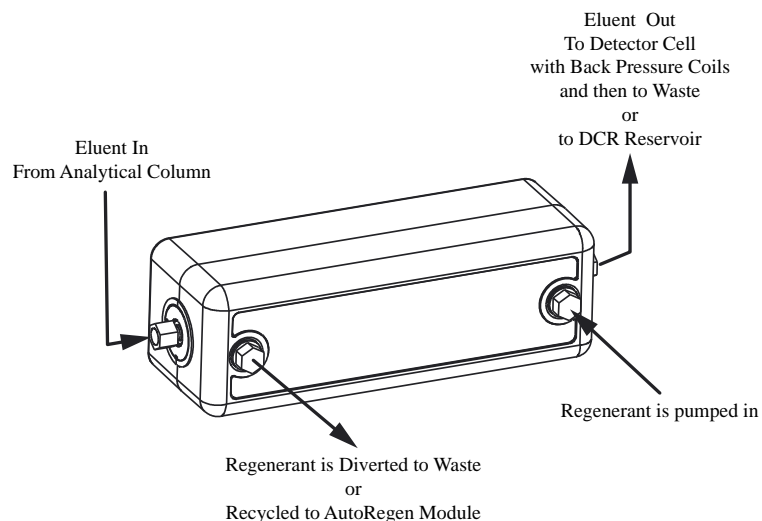
The electrolytic suppressor also is a device that permits recycle of the eluent when installed in a system with Eluent Recycle (ER) system.

## 1.1 Chemically Regenerated Suppressor

The Thermo Scientific™ Dionex™ Chemically Regenerated Suppressor (Dionex CRS™ 500) replaces the Dionex MicroMembrane Suppressor (MMS 300) product line. The Dionex CRS 500 is a chemical suppressor with a new hardware design that allows the suppressor to be more pressure tolerant than previous generation suppressor devices. The suppressor flow pathway has been redesigned to optimize band dispersion, improve the flow and sealing properties. The Dionex CRS 500 continues to use the same cleaned ion exchange components (screens and membranes) as the Dionex MMS 300 suppressor devices; however the Dionex CRS 500 eluent channel uses an ion exchange resin bed as opposed to a gasketed screen.

The Chemically Regenerated Suppressor (CRS 500) is available in two versions: the Anion Chemically Regenerated Suppressor (Dionex ACRS™ 500) or Cation Chemically Regenerated Suppressor (Dionex CCRS™ 500) to support anion and cation analysis applications.

Figure 1 The Chemical Suppression System



The Dionex Chemically Regenerated Suppressors, Dionex Anion Chemically Regenerated Suppressor (Dionex ACRS 500) and the Dionex Cation Chemically Regenerated Suppressor (Dionex CCRS 500), provide a high performance, highly reliable, low maintenance chemical suppression system for Ion Chromatography.

The chemical suppression system consists of the Dionex CRS 500 and a source of chemical regenerant. Through an ion exchange based neutralization reaction in the Dionex CRS 500 Suppressor device, the eluent is converted to a weakly dissociated lower conductivity form while the analytes are converted typically to a more conductive form.

The Dionex CRS 500 is a non-electrolytic device and therefore requires no power supply. Installation of equipment (either the Displacement Chemical Regeneration (DCR) kit, a pressurized bottle delivery system, additional pump or the AutoRegen Accessory) is needed in conjunction with the Dionex CRS 500. This equipment facilitates the delivery of the regenerant to the Dionex CRS 500 suppressor. A regenerant controller Thermo Scientific™ Dionex™ SRD-10 Suppressor Regenerant Detector is recommended to monitor the chemical regenerant flow and trigger when to replace the chemical regenerant. If the regenerant flow is restricted or stops the SRD-10 automatically disables the eluent pump.

The Dionex CRS 500 provides high capacity suppression while adding minimum dead volume to the analytical system. The ability of the Dionex ACRS 500 to provide continuous suppression of traditional eluents, and more concentrated eluents up to 100 mM NaOH, significantly expands the capabilities and simplifies the operation of anion exchange Ion Chromatography. The ability of the Dionex CCRS 500 to provide continuous suppression of traditional eluents, and more concentrated eluents up to 75 mM HCl, significantly expands the capabilities and simplifies the operation of cation exchange Ion Chromatography.

The Dionex ACRS 500 and Dionex CCRS 500 are available in both 4 mm and 2 mm formats for use with 4 mm and 2 mm Ion Chromatography columns and systems respectively. The 4 mm Dionex CRS 500 is designed to ensure optimum performance with 4 and 5 mm columns. The 2 mm Dionex CRS 500 is designed with reduced internal volume to ensure optimum performance with, 2 and 3 mm columns and systems.



**NOTE**

*For assistance, contact Technical Support for Dionex Products. In the U.S., call 1-800-346-6390. Outside the U.S., call the nearest Thermo Fisher Scientific office.*

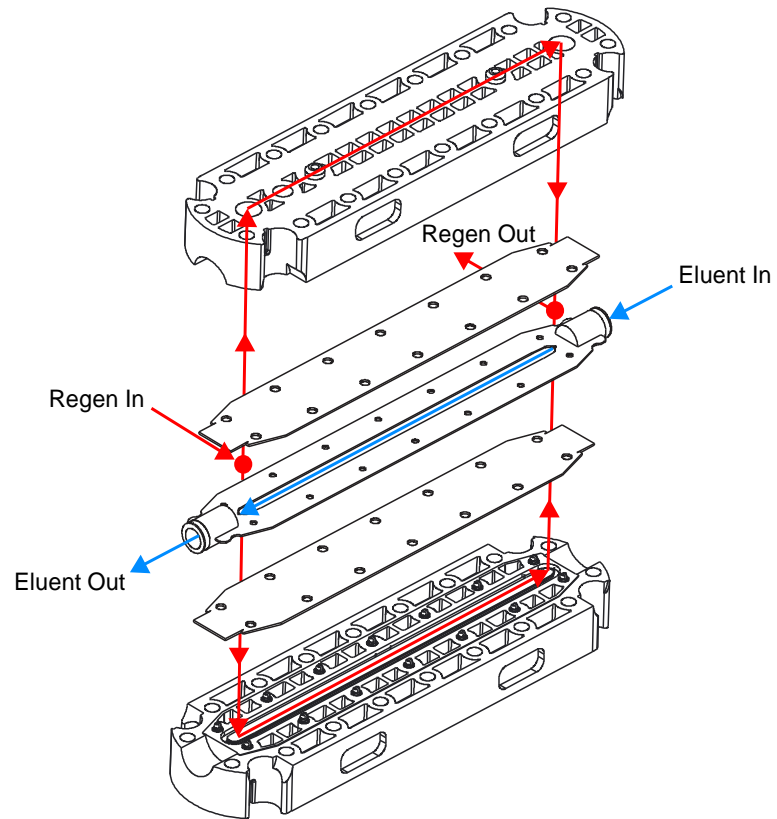
## 1.2 Dionex Chemically Regenerated Suppressor Assembly Schematic

The Dionex CRS 500 includes two regenerant compartments and one eluent compartment separated by ion exchange membranes. The central channel is the eluent channel and the two side channels are regenerant channels. Two PEEK plates form the outer walls of the regenerant channels and have the ¼-28 ports for connecting the regenerant liquid lines. The eluent channel is defined by a PEEK plate that seals against the ion exchange membrane and a thin elastomeric o-ring installed on the regenerant PEEK plates. The eluent in and out ports are independent ports that define the fluidic pathway, which is similar to a column. The regenerant flow direction is opposite to the eluent flow direction. This orientation ensures complete regeneration of the device.

The regenerant channels are flushed with a regenerant that supplies hydronium or hydroxide ions that are required for the suppression reaction. For the Dionex ACRS 500, the ion exchange membranes provide the transport pathway for the hydronium ions into the eluent channel while providing a transport pathway for the sodium or potassium ions out of the eluent channel. For the Dionex CCRS 500, the ion exchange membranes provide the transport pathway for the hydroxide ions into the eluent channel while providing a transport pathway for the sulfate or MSA ions out of the eluent channel. In the Dionex CRS 500 the regenerant channel is fitted with unfunctionalized neutral regenerant screens that facilitate excellent transport of ions to and from the ion exchange membranes without any retention in the regenerant channel. The net result for both the Dionex ACRS 500 and the Dionex CCRS 500 is suppression or conversion of the eluent from a highly conductive form to a weakly conductive form and conversion of most analytes into highly conductive forms.

For example, for the Dionex ACRS 500, sodium hydroxide eluent with residual carbonate is converted to water and a weakly conductive carbonic acid background, while sodium chloride analyte is converted to a highly conductive hydrochloric acid form. Thus the analyte, chloride, is detected as the highly conductive HCl form against a low conductivity water and residual carbonic acid background. For the Dionex CCRS 500, methanesulfonic acid eluent is converted to water and the analyte, sodium chloride, is converted to sodium hydroxide. Thus sodium is detected as the highly conductive NaOH form against a low conductivity water background. It should be noted that the background of the suppressed eluent may be elevated due to chemical leakage of the regenerant into the eluent; therefore optimization of the regenerant type, concentration and flow rate may be needed to minimize this effect.

Figure 2 Membrane and Flow Chamber Configuration in the Dionex Chemically Regenerated Suppressors

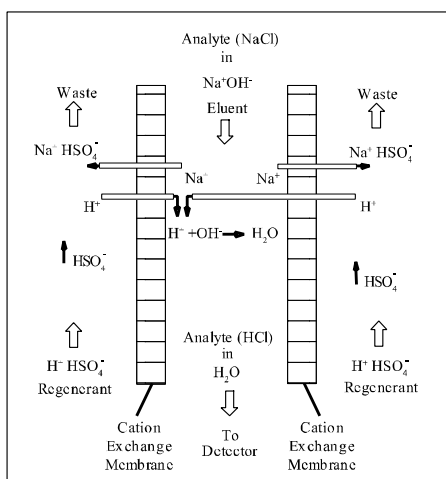


### 1.3 Chemical Suppression Schematic

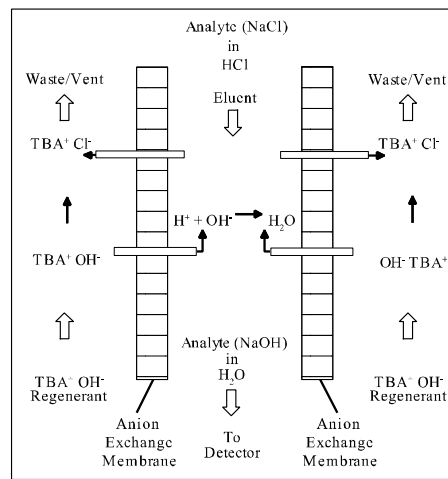
Chemical Suppression with the Dionex ACRS 500 is a neutralization reaction and selective desalting process carried out across a pair of cation exchange membranes. The cation exchange membranes facilitate the selective exchange of cations in the suppressor. With sodium hydroxide as the eluent, sodium ions are continuously exchanged for hydronium ions from the regenerant acid and combine with the eluent hydroxide to form water. The sodium ions are removed continuously from the suppressor by the regenerant acid stream thus effecting continuous suppression.

Chemical Suppression with the Dionex CCRS 500 is a neutralization reaction and selective desalting process carried out across a pair of anion exchange membranes. The anion exchange membranes facilitate the selective exchange of anions in the suppressor. With methanesulfonic acid as the eluent, the methanesulfonate ions are continuously exchanged for hydroxide ions from the regenerant base (TBAOH) and combine with the eluent hydronium to form water. The methanesulfonate anions are removed continuously from the suppressor by the regenerant base stream thus effecting continuous suppression.

**Figure 3**  
**Chemical Suppression with the**  
**Dionex Anion Chemically Regenerated**  
**Suppressor (Dionex ACRS 500)**



**Figure 4**  
**Chemical Suppression with the**  
**Dionex Cation Chemically Regenerated**  
**Suppressor (Dionex CCRS 500)**



## 1.4 Shipment and Storage

### 1.4.1 Shipment



**CAUTION**

*The Dionex Chemically Regenerated Suppressors (Dionex ACRS 500 and Dionex CCRS 500) should not be subjected to temperatures above 60°C during shipment, storage or operation for extended periods of time.*

### 1.4.2 Storage



**CAUTION**

*Ensure the suppressor is stored in a temperature controlled environment away from direct exposure to sunlight or other sources of heat. Do not store the suppressor in a non-temperature controlled environment where temperatures in excess of 40°C are commonly experienced, such as a parked car, a tool shed, or a lab-bench in close proximity to an open window with direct sunlight.*

## 1.5 Overview of Suppression Modes

Three basic modes of suppression can be used with the Dionex Chemically Regenerated Suppressor (Dionex CRS 500):

### **Displacement Chemical Regeneration Mode:**

This mode is a self-contained means of dispensing regenerant into the Dionex CRS 500 without any added pumps or delivery systems. The suppressed effluent from the suppressor is directed from the cell outlet into a closed bottle containing the regenerant. A second line is connected back from the bottle into the REGEN IN port of the suppressor. Thus the cell effluent drives the regenerant out of the bottle and into the Dionex CRS 500; the difference in density of the eluent and regenerant solutions prevent mixing of the two. In this mode, the eluent flow rate determines the regenerant flow rate.

The density of the cell effluent and the regenerant determines the exact location of the line inside the bottle. For detailed plumbing and operation instructions refer to the DCR Kit Manual (Document No. 031664).

### **External Chemical Mode:**

This mode in the simplest form uses an external regenerant reservoir that is gas pressurized and dispenses regenerant into the suppressor. The pressure on the container, the liquid level and the back pressure of the Dionex CRS 500 suppressor and associated tubing determines the flow rate of the regenerant into the suppressor. An external pump could also be used to dispense the regenerant, provided the pump is substantially pulse free or has a suitable pulse damper installed.

### **AutoRegen Suppression Mode:**

This mode has been discontinued by Thermo Scientific and is only included here for legacy operators.

AutoRegen Suppression mode recycles the regenerant thus enabling continuous operation. A pump is required in this mode to pump the expended regenerant back into an AutoRegenerant cartridge to exchange the cations for hydronium ions (Dionex ACRS 500) or the anions for hydroxide ions (Dionex CCRS 500). Thus, fresh regenerant is made available for the suppression function.

The following sections explain which mode to use for an application. Once the mode of operation is determined, more detailed plumbing configuration and operating instructions can be found in Section 3, “Dionex Chemically Regenerated Suppressor (Dionex CRS 500) Operation.”

## 1.6 Mode of Operation Selection

The Dionex ACRS 500 uses sulfuric acid as the preferred regenerant to achieve eluent suppression. The Dionex CCRS 500 uses tetrabutylammonium hydroxide (TBAOH) as the preferred regenerant to achieve eluent suppression. Both the Dionex ACRS 500 and Dionex CCRS 500 mode of operation is highly dependent on the ionic strength or concentration of the eluent used and the analysis sensitivity requirements.

**Table 1 Eluent Composition and Suppression Mode Compatibility**

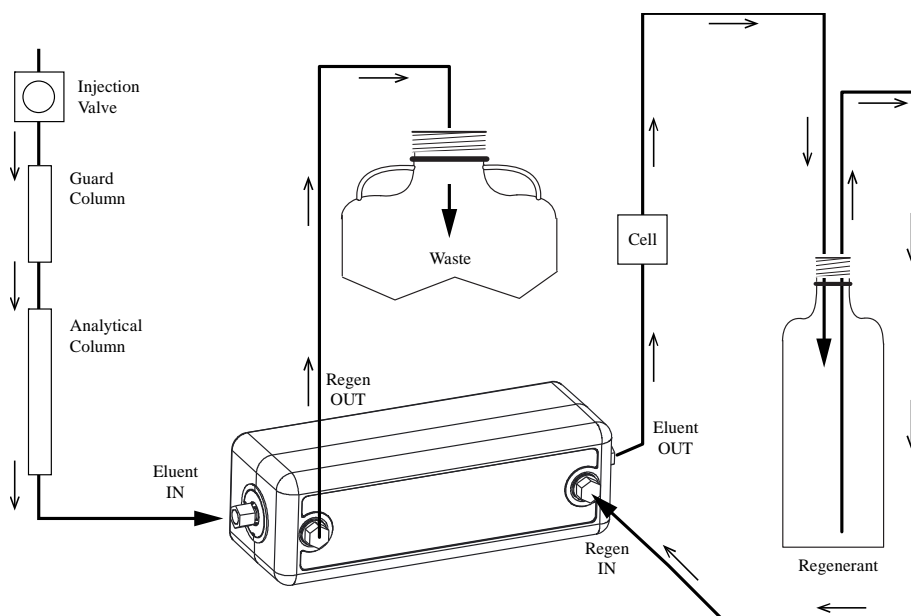
<b>Eluent Composition</b>	<b>Displacement Chemical Regeneration Mode</b>	<b>External Chemical Mode</b>	<b>AutoRegen Suppression</b>
Aqueous Eluents	Yes	Yes	Yes
Eluents Containing Organic Solvents	Yes	Yes	Yes
Eluents Containing Ion Pair Reagents with/without Solvents	Yes	Yes	Yes

### 1.6.1 The Displacement Chemical Regeneration (DCR) Mode

The DCR Mode is the easiest mode to implement and provides convenient and economical operation in which the regenerant is displaced from the regenerant reservoir using the conductivity cell effluent. This mode delivers regenerant to the suppressor at a flow rate equal to the eluent flow rate. In this mode the regenerant bottle is completely filled with regenerant upon startup. As the cell effluent is pumped into reservoir it displaces the regenerant solution into the Dionex CRS regenerant chambers. No additional pump or pressure is required. Eluent and regenerant bottles are of equivalent volumes ensuring that the regenerant solution lasts as long as the eluent; thus new regenerant needs to be prepared only when new eluent is prepared.

The DCR Mode is recommended for low to medium suppression applications ( $< 50 \text{ ueq/min}$ ) and provides adequate dynamic capacity for the majority of applications. Because regenerant flow rate is limited to the same flow rate as the eluent, the concentration of the regenerant may need to be adjusted to achieve full suppression; this may result in increased background conductivity compared to other modes where the flow rate can be adjusted. As a general rule the regenerant concentration in mN should be 2 to 5 times the eluent concentration in mN.

Figure 5 The Displacement Chemical Regeneration (DCR) Mode Diagram



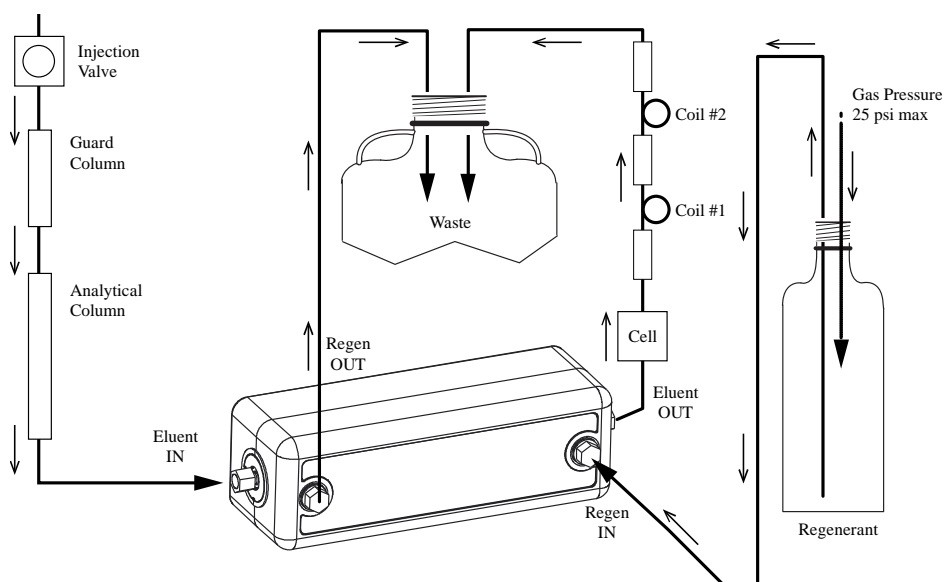
### 1.6.2 The External Chemical Mode

The External Chemical Mode is an easy to implement configuration that dispenses regenerant using a pressurized regenerant reservoir directly into the suppressor. The concentration of the regenerant dictates the leakage into the eluent stream therefore lower concentration of the regenerant is preferred in this mode. The flow rate needs to be adjusted to provide the equivalent concentration required for suppression. **Generally higher flow rates are employed in this mode resulting in higher waste generation.** The regenerant dynamic concentration (mN x mL/min) should be approximately 7 times the eluent dynamic concentration (mN x mL/min).

The External Chemical Mode is highly recommended for high suppression applications (> 70 µeq/min) and provides the highest dynamic capacities required for these applications.

An external pump could be used for dispensing the regenerant provided the pump is substantially pulse dampened using a suitable pulse damper. Thermo Scientific recommends the use of a Peristaltic Pump P/N 064230 along with a Peristaltic Pump Kit (P/N 064911) for this application.

**Figure 6 The External Chemical Mode with the Dionex Chemically Regenerated Suppressor (Dionex CRS 500)**





### 1.6.3 The AutoRegen Suppression Mode

This mode has been discontinued by Thermo Scientific and is only included here for legacy operators.

The **AutoRegen Suppression Mode** is another mode for implementing chemical suppression. This mode is designed to recycle the regenerant and reduce regenerant consumption for high suppression applications. For the Dionex ACRS 500, the AutoRegen Suppression mode requires the installation of the AutoRegen Accessory equipped with an AutoRegen Regenerant Cartridge to convert the spent regenerant back to sulfuric acid regenerant. For the Dionex CRS 500, the AutoRegen Suppression mode requires the installation of the AutoRegen Accessory equipped with an AutoRegen Regenerant Cartridge to convert the spent regenerant back to TBAOH regenerant. The AutoRegen Suppression Mode is recommended for applications that require continuous operation without user intervention. The AutoRegen Mode however, is not recommended for applications requiring low noise or high sensitivity.

## 2. Installation

### 2.1 System Requirements

The Dionex Anion or Cation Chemically Regenerated Suppressor (Dionex CRS 500) is designed to be run on any Dionex Ion Chromatograph (IC) equipped with an ion exchange column set and suppressed conductivity detection. **The Dionex CRS 500 is installed immediately after the analytical column and before the conductivity detector cell.** The following components are required for the installation of the Dionex CRS 500 in a Dionex Ion Chromatograph:

<b>Required Installation Components</b>	
<b>P/N</b>	<b>Description</b>
<b>Back pressure coils:</b>	
45877	Backpressure coil 4 mm
45878	Backpressure coil 2 mm
<b>Also Found in:</b>	
46297	ED40 Shipkit
46298	CD20 Shipkit
45935	CDM-3 On-Line Ship Kit
50130	DX-120 Ship Kit
<b>Tubing for 4 mm systems:</b>	
45825	Standard tubing (containing tubing, fittings and 4 mm backpressure coils required for plumbing a 4 mm systems)
<b>Tubing for 2 mm / 3 mm systems:</b>	
52324	Microbore tubing (containing tubing, fittings and 2 mm backpressure coils required for plumbing a 2 mm and 3 mm systems)
<b>Regenerant Options:</b>	
	Pressurized Water Delivery System (used with the External Pressurized Bottle Mode, the Chemical Suppression Mode, or the MPIC Suppression Mode)
38018	Dionex CRS/SRS Installation Kit
64230	Peristaltic Pump
64911	Peristaltic Pump Kit
<b>AutoRegen Accessory (used with the Chemical Suppression Mode)</b>	
39594	115 V ac Version
39608	230 V ac Version
39564	Anion Regenerant Cartridge
39563	Cation Regenerant Cartridge
<b>Displacement Regeneration Kit</b>	
56882	Displacement Regeneration 2 Liter Kit
56884	Displacement Regeneration 4 Liter Kit

**NOTE**

*During the course of installing and using the Dionex CRS 500, it may be necessary to assemble 1/4-28 or 10-32 ferrule/bolt style liquid lines. See, “Dionex Liquid Line Fittings,” for complete details.*

## 2.2 Back Pressure Coils for the Dionex CRS 500

All detector cells require enough back pressure to prevent eluent in the cell from out-gassing due to abrupt volume changes between the small inner diameter of the connecting tube and the relatively larger volume of the cell. Out-gassing creates bubbles in the cell and disrupts detector responsiveness. Back pressure coils help to prevent gases from out-gassing and prevents formation of bubbles in the detector cell. For example, carbonate eluent is suppressed to carbonic acid which is CO<sub>2</sub> gas in equilibrium with DI water; CO<sub>2</sub> gas can come out of solution if adequate pressure is not applied. The above out-gassing can trap bubbles in the cell causing high noise. Therefore Dionex recommends addition of 30-40 psi of backpressure for most applications.

Back pressure coil components are located in the detector Ship Kits as part of the Gas Separator Waste Tube Assembly/Back Pressure Coils Kit, P/N 045825. For 4 mm systems, locate assembly P/N 045877. For 2 mm systems, the backpressure coils are available in the microbore tubing kit, P/N 052324. For 2 mm systems, locate assembly P/N 045878. Alternatively, lengths and diameters of tubing necessary for proper back pressure are given in Table 2, “Coils for Dionex CRS 500 Back Pressure Requirements.” Adjust the tubing length to achieve a backpressure of approximately 40 psi.

**CAUTION**

*If back pressure coils become damaged or plugged, they may cause irreversible damage to the suppressor.*

Assemble as follows:

- A.** Slip PEEK liquid line bolts and ferrules onto the ends of the tubing. Refer to Table 2, “Coils for Dionex CRS 500 Back Pressure Requirements,” and determine the correct number of coils required for your application based on the eluent flow rate.
- B.** After assembly of the coils, see Figure 8, “Configuration of the External Chemical Mode with the Dionex CRS 500 Suppressor,” for the proper placement of the assembled coils and couplers after the detector cell and before the waste container.

Table 2 Coils for Dionex CRS 500 Back Pressure Requirements

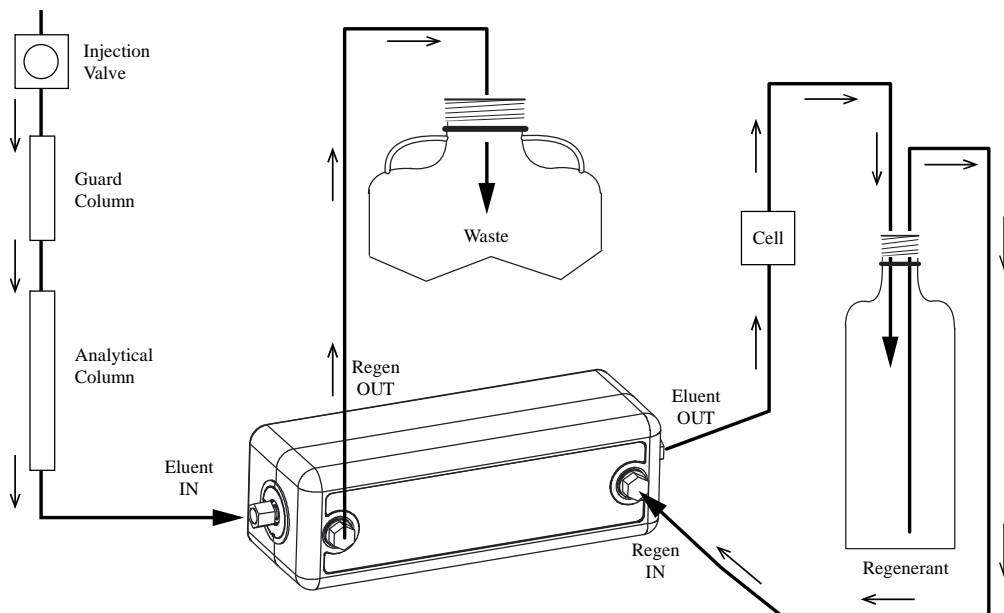
Dionex CRS III Type	Flow Rate	I.D. of Tubing	Appropriate Length of Each Coil	Number of Coils
4 mm	0.5–1.5 ml/min	0.010" (Black)	2.5 feet	2
4 mm	1.5–3.0 ml/min	0.010" (Black)	2.5 feet	1
2 mm	0.12–0.25 ml/min	0.005" (Red)	6.0 inches	2
2 mm	0.25–0.75 ml/min	0.005" (Red)	6.0 inches	1

**CAUTION**

*The above recommended length of tubing may vary depending on the I.D. of the tubing.  
The correct amount of back pressure for optimum operation is 40 psi.  
Back pressure over 150 psi after the Dionex CRS 500 can cause irreversible damage!*

## 2.3 Plumbing for Displacement Chemical Regeneration (DCR) Mode of Operation

Figure 7 The Displacement Chemical Regeneration (DCR) Mode Plumbing Diagram



The **Displacement Chemical Regeneration Mode** is the easiest method of operation. As the eluent passes through the suppressor, it is neutralized to produce its weakly ionized form. After passing through the conductivity cell, this effluent can be redirected to the regenerant bottle, thus displacing the regenerant (see Figure 7, “The Displacement Chemical Regeneration (DCR) Mode Plumbing Diagram”). The main advantage of this mode is its simplicity and ease of use. It is not necessary to use a pump or pressurized bottle.

Depending on the specific components (analytical column, conductivity cell, back pressure coils) in the system, 1/4-28 or 10-32 ferrule/bolt liquid lines may be required. All necessary tubing and fittings are supplied in the detector or Ship Kits. To purchase or assemble 1/4-28 or 10-32 ferrule/bolt liquid lines, refer to, “Dionex Liquid Line Fittings.” Always use 0.005" i.d. PEEK tubing with 10-32 ferrule/bolt fittings on 2 mm systems. Wherever possible use 0.010" i.d. PEEK tubing with 10-32 ferrule/bolt fittings on 4 mm systems.

- A. **Install the Dionex Chemically Regenerated Suppressor (Dionex CRS 500) in the Chromatography Module.**
- B. **Connect the outlet of the analytical column to the ELUENT IN of the Dionex CRS 500.** See Figure 7, “The Displacement Chemical Regeneration (DCR) Mode Plumbing Diagram.” To avoid adding dead volume to the system, make the length of all eluent lines as short as practically possible. Be sure to butt the tubing tight in the end fitting as the fitting is tightened.
- C. **Connect the ELUENT OUT port of the Dionex CRS 500 to the inlet of the conductivity cell.** See Figure 7, “The Displacement Chemical Regeneration (DCR) Mode Plumbing Diagram.” To avoid adding dead volume to the system, make the length of all eluent lines as short as practically possible. Refer to the DCR Kit Manual (P/N 031664) for DCR plumbing details.
- D. **Connect the back pressure line from the cell to the DCR bottle.** Connect the second line from the DCR bottle to the **REGEN IN** port on the suppressor

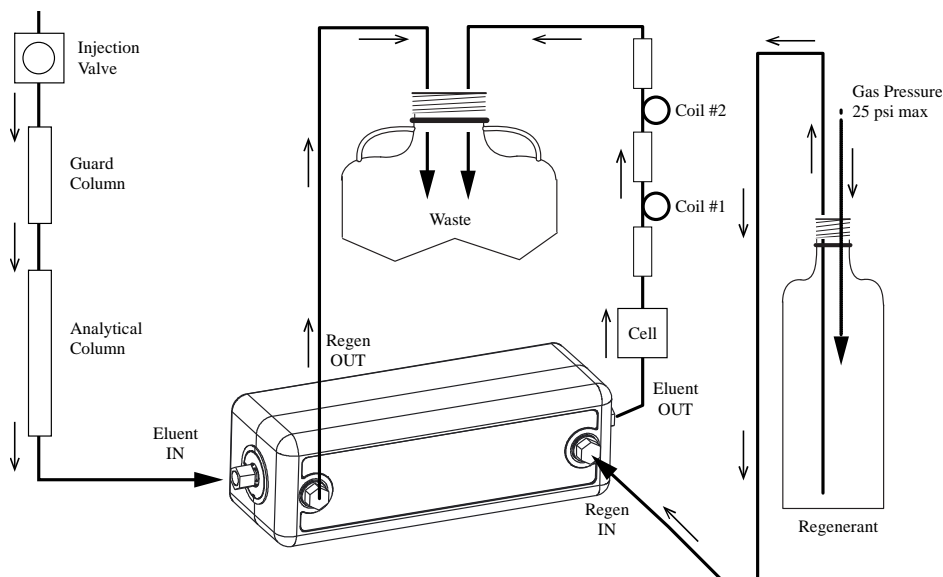


**NOTE**

*The correct tubing orientation in the DCR bottle depends on the difference in the density of the cell effluent versus the chemical regenerant. Refer to the DCR Kit Manual (P/N 031664)*

## 2.4 Plumbing for External Chemical Mode of Operation

**Figure 8** Configuration of the External Chemical Mode with the Dionex CRS 500 Suppressor



The **Dionex CRS/ERS Installation Kit** (P/N 038018) contains all of the components needed to install and operate the Dionex CRS 500 with a pressurized regenerant reservoir. The kit contains the **Installation Parts Kit** (P/N 039055), a 25 psi regulator (P/N 038201) and a 4-liter reservoir (P/N 039164).

**A. Make the following air line connections:**

1. Locate the pieces of red 1/8" o.d. plastic tubing (P/N 030089) supplied in the Installation Parts Kit.
2. Push the end of one piece of 1/8" o.d. tubing over the barbed fitting of the regulator. Connect the other end of the tubing to the source of air pressure.
3. Push one end of the second piece of 1/8" o.d. tubing over the other barbed fitting of the regulator. Push the other end of this tubing over the barbed fitting (P/N 030077) in the pressure inlet of the plastic reservoir. See Figure 8, "Configuration of the External Chemical Mode with the Dionex CRS 500 Suppressor."

- B. **Make the following liquid line connections.** See Figure 8, “Configuration of the External Chemical Mode with the Dionex CRS 500 Suppressor.”
1. Use a coupler (P/N 039056) to connect one end of the 30" tubing assembly (P/N 035727) that comes in the Installation Kit to the water reservoir. Connect the other end of this tubing to the **REGEN IN** port of the Dionex Chemically Regenerated Suppressor.
  2. Using a coupler (P/N 039056) and a 1/8" o.d. piece of tubing (P/N 035728) from the Installation Kit, connect one end of this tubing to the REGEN OUT port and direct the other end to waste.
- C. **Fill the regenerant reservoir with the recommended regenerant (Refer to Tables 3 or 4, “Matching the Regenerant concentration and flow rate to eluent concentration and flow rate”).** Make sure that the O-ring is inside the cap of the reservoir before screwing the cap onto the reservoir. Screw the cap onto the reservoir tightly and place the reservoir near the Chromatography Module.
- D. **Adjust the regenerant flow rate to approximately 5–10 mL/min. for the Dionex CRS 500 4 mm and 5–8 mL/min for the Dionex CRS 500 2 mm.**



**NOTE**

*A safety relief valve on the reservoir regulator prevents pressure greater than 25 psi from being applied to the reservoir.*

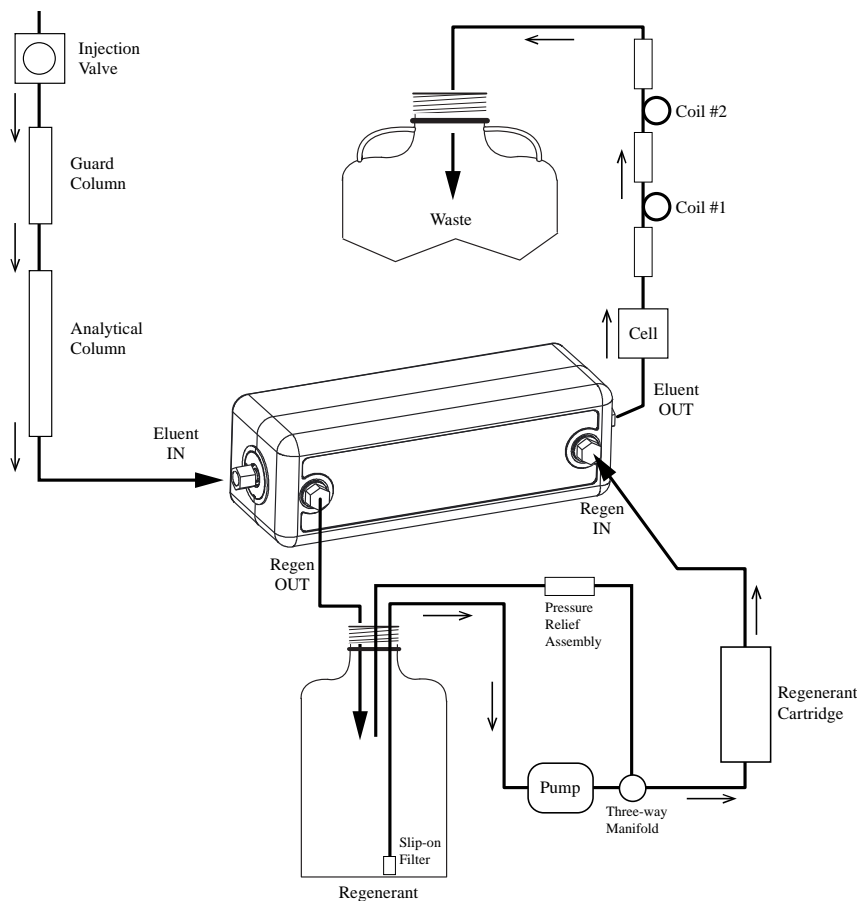
## 2.5 Peristaltic Pump installation

For detailed installation instructions please refer to the MASTERFLEX® C/L® Peristaltic Pump Quick Start Guide (Document No. 065203)



## 2.6 Plumbing for AutoRegen Suppression Mode of Operation

Figure 9 Configuration of the Dionex CRS 500 Suppressor Using AutoRegen



This mode has been discontinued by Thermo Scientific and is only included here for legacy operators.

The **AutoRegen Suppression Mode** requires the use of an acid regenerant to neutralize the eluent. Choose the appropriate sulfuric acid concentration as described in Tables 3 or 4, "Matching Regenerant Concentration and Flow Rate to Eluent Concentration and Flow Rate." The following installation instructions assume that your system is configured with an AutoRegen Accessory equipped with an Anion AutoRegen Regenerant Cartridge.

To save regenerant preparation time, consumption, and waste, it is recommended that the AutoRegen Accessory (115 V ac version, P/N 039594; 230 V ac version P/N 039608) be purchased. The AutoRegen Accessory is designed to be used specifically with Dionex Chemically Regenerated Suppressors. The AutoRegen Accessory should be equipped with either an Anion AutoRegen Regenerant Cartridge (P/N 039564) for the Dionex ACRS 500 or with a Cation AutoRegen Regenerant Cartridge (P/N 039564) for the Dionex CRS 500. Refer to the AutoRegen Accessory Manual (Document No. 032853) for complete installation instructions.

- A. Connect the 1/8" o.d. tubing from the top of the AutoRegen Regenerant Cartridge to the **REGEN IN** port of the Dionex Chemically Regenerated Suppressor.
- B. Connect the 1/8" o.d. tubing from the regenerant reservoir cap to the **REGEN OUT** port of the Dionex Chemically Regenerated Suppressor.
- C. Turn ON the ON/OFF switch on the front of the pump. The unit is ready for equilibration and operation.

## 3. Operation

This section provides instructions for the start-up and operation of the Dionex Chemically Regenerated Suppressor (Dionex CRS 500). The selection and description of each of the suppression modes of operation are covered.

### 3.1 Chemical Purity Requirements

Obtaining precise and accurate results requires eluents that are free of ionic impurities. Chemicals and deionized water used to prepare eluents must have the purities described below. Low trace impurities and low particulate levels in eluents and regenerants also help protect your Dionex CRS 500 and system components from contamination. Dionex cannot guarantee proper Dionex CRS 500 performance when the quality of the chemicals and water used to prepare eluents has been compromised.

#### 3.1.1 Inorganic Chemicals

Reagent Grade inorganic chemicals should always be used to prepare ionic eluents. Whenever possible, inorganic chemicals that meet or surpass the latest American Chemical Society standard for purity (universally accepted standard for reagents) should be used. These inorganic chemicals will detail the purity by having an actual lot analysis on each label.

For ease of regenerant preparation and guaranteed purity, use Dionex Anion Regenerant Concentrate (P/Ns 037164, 039601). Sulfuric acid is the recommended regenerant for use with the Dionex ACRS 500. With the DCR Kit, use Anion Regenerant Concentrate 75 mL of 2.0 N Sulfuric Acid (P/N 057559) or the 4-Pak (P/N 057555).

Tetrabutylammonium hydroxide (TBAOH) is the recommended regenerant for use with the Dionex CRS 500. For ease of regenerant preparation and guaranteed purity, use Dionex Cation Regenerant Concentrate (P/N 039602). With the DCR Kit, use Cation Regenerant Concentrate 100 mL of 2.06 M TBAOH (P/N 057561) or the 4-Pak (P/N 057556).

#### 3.1.2 Solvents

Since solvents used with the Dionex CRS 500 are added to ionic eluents to modify the ion exchange process or improve sample solubility, the solvents used must be free of ionic impurities. However, since most manufacturers of solvents do not test for ionic impurities, it is important that the highest grade of solvents available be used. Currently, several manufacturers are making ultrahigh purity solvents that are compatible for HPLC and spectrophotometric applications. These ultrahigh purity solvents will usually ensure that your chromatography is not affected by ionic impurities in the solvent. Currently at Thermo Fisher Scientific, we have obtained consistent results using High Purity Solvents manufactured by Burdick and Jackson<sup>®</sup> and Optima<sup>™</sup> Solvents by Fisher Chemical.

#### 3.1.3 Deionized Water

The deionized water used to prepare eluents should be **degassed Type I Reagent Grade Water** with a specific resistance of 18.2 megohm-cm. The deionized water should be free of ionized impurities, organics, microorganisms and particulate matter larger than 0.2  $\mu\text{m}$ . It is good practice to filter eluents through a 0.2  $\mu\text{m}$  filter whenever possible. Bottled HPLC-Grade Water should not be used since most bottled water contains an unacceptable level of ionic impurities. Finally, thoroughly degas all deionized water prior to preparing any eluents or regenerants.

## 3.2 Start Up

The Dionex CRS 500 is installed in the column compartment of the chromatography module after the analytical column and before the conductivity detector cell. On all Dionex Ion Chromatography Systems instruments, the Dionex CRS 500 mounts on tabs on the component panel. Orient the Dionex CRS 500 according to the flow diagram provided with your system; align the slots on the back of the Dionex CRS 500 with the tabs on the panel. Press in, and then slide to lock the Dionex CRS 500 in place. Slide and pull out to remove the Dionex CRS 500. Make sure the Dionex CRS 500 is plumbed properly, according to the selected mode of operation. Refer to Section 2, “Installation,” for complete installation instructions.



**CAUTION**

***The membranes, resin and screens in the Dionex CRS 500 must be completely hydrated to maintain liquid seals and chromatographic performance. This requirement is achieved by maintaining the regenerant cavities full of the appropriate regenerant solution to ensure that the membranes remain properly hydrated. Occasionally some of the regenerant solution evaporates during mid to long term storage. Before starting an analysis, install your new Dionex CRS 500 and pump regenerant solution through the suppressor until you see no more bubbles. Turn off the flow and let the Dionex CRS 500 sit for at least 20 minutes to ensure that the membranes are fully hydrated before pumping eluent through the suppressor.***



**CAUTION**

***The correct amount of back pressure for optimum operation is 40 – 60 psi. Connect the back pressure coil(s) appropriate for your column I.D. and flow rate. Back pressures over 150 psi after the Dionex CRS 500 can cause poor peak shapes. Back pressures over 300 psi after the Dionex CRS 500 can cause irreversible damage!***

### 3.3 Optimizing Regenerant Concentration and Flowrate

#### 3.3.1 Anion Regenerant Concentration for Optimized Operation in External Chemical and AutoRegen Modes

The Dionex ACRS 500 has the ability to provide continuous suppression of eluents using chemical regeneration with an acid such as sulfuric acid (H<sub>2</sub>SO<sub>4</sub>). Tables 3 or 4, “Matching Regenerant Concentration and Flow Rate to Eluent Concentration and Flow Rate”, list the eluent concentrations and flow rates of standard eluents used in anion separations and the regenerant concentrations and flow rates required to suppress them. Optimal operation of the Dionex ACRS 500 requires a constant flow of the regenerant over the membrane, in a direction that is countercurrent to the flow of the eluent. A standard regenerant flow rate of 5–10 mL/min is recommended for the External Chemical Mode of operation.

This flow rate is adequate for most applications. For applications that require stronger than typical eluent strengths, the regenerant flow rate may be increased. The level of chemical leakage increases with increasing concentration hence it is critical that the concentration of regenerant be as low as possible in order to achieve low backgrounds.

**Table 3** Matching Regenerant Concentration and Flow Rate to Eluent Concentration and Flow Rate for the 4 mm Dionex ACRS 500 in the Chemical Suppression Mode

Eluent	Eluent Flow Rate (mL/min)	Regenerant Flow Rate (mL/min)	Regenerant Conc (mN H <sub>2</sub> SO <sub>4</sub> )
1.8 mM Na <sub>2</sub> CO <sub>3</sub> /1.7 mM NaHCO <sub>3</sub>	0.5–2.0	3–5	25
2.7 mM Na <sub>2</sub> CO <sub>3</sub> /0.3 mM NaHCO <sub>3</sub>	0.5–2.0	3–5	25
3.5 mM Na <sub>2</sub> CO <sub>3</sub> /1.0 mM NaHCO <sub>3</sub>	0.5–2.0	3–5	25
9.0 mM Na <sub>2</sub> CO <sub>3</sub>	0.5–2.0	3–5	50
1.0 - 100 mM NaOH	0.5–1.5	3–10	50–100
1.0 - 100 mM KOH	0.5–1.5	3–10	50–100
1.0 - 20 mM Na <sub>2</sub> B <sub>4</sub> O <sub>7</sub>	0.5–2.0	5–10	50
20 - 50 mM Na <sub>2</sub> B <sub>4</sub> O <sub>7</sub>	0.5 - 1.5	5–10	50-100

**Table 4** Matching Regenerant Concentration and Flow Rate to Eluent Concentration and Flow Rate for the 2 mm Dionex SCRS 500 in the Chemical Suppression Mode

Eluent	Eluent Flow Rate (mL/min)	Regenerant Flow Rate (mL/min)	Regenerant Conc (mN H <sub>2</sub> SO <sub>4</sub> )
1.8 mM Na <sub>2</sub> CO <sub>3</sub> /1.7 mM NaHCO <sub>3</sub>	0.10–0.50	3–5	25
2.7 mM Na <sub>2</sub> CO <sub>3</sub> /0.3 mM NaHCO <sub>3</sub>	0.10–0.50	3–5	25
3.5 mM Na <sub>2</sub> CO <sub>3</sub> /1.0 mM NaHCO <sub>3</sub>	0.10–0.50	3–5	25
9.0 mM Na <sub>2</sub> CO <sub>3</sub>	0.10–0.50	3–5	50
1.0 - 100 mM NaOH	0.10–0.50	3–8	50
100 - 150 mM NaOH	0.10–0.50	5–8	50–100
1.0 - 100 mM KOH	0.10–0.50	3–8	50
100 - 150 mM KOH	0.10–0.50	5–8	50–100
1.0 - 30 mM Na <sub>2</sub> B <sub>4</sub> O <sub>7</sub>	0.10–0.50	5–8	50
30 - 75 mM Na <sub>2</sub> B <sub>4</sub> O <sub>7</sub>	0.10–0.38	5–8	50–100

**NOTE**

*For the lower eluent concentration in a given range, choose lower corresponding regenerant concentration; for higher eluent concentration choose higher regenerant concentration.*

Most solvents such as methanol have little or no effect on the Anion Regenerant Solution when using an AutoRegen Accessory unit.

For the best signal-to-noise ratio and the best overall performance when using an AutoRegen Cartridge to supply regenerant, Dionex recommends that the Anion Regenerant Solution used with the Dionex ACRS 500 be replaced on a regular basis. The time interval between changing the regenerant will depend on both the time that the instrument is in operation and the specific application. As a guideline, the regenerant should be replaced whenever the background conductivity drifts to higher levels than those observed in the initial chromatograms. See the Installation Instructions and Troubleshooting Guide for the analytical column being used in your application for a guideline on the expected background conductivity. Tables 3 or 4, “Matching Regenerant Concentration and Flow Rate to Eluent Concentration and Flow Rate,” list the appropriate regenerant concentration for selected eluents.

### 3.3.2 Cation Regenerant Concentration for Optimized Operation for External Chemical and AutoRegen Modes

The Dionex CCRS 500 has the ability to provide continuous suppression of eluents using chemical regeneration with a base. Tables 5 or 6, “Practical Maximum Eluent Concentration Suppression Guidelines,” list the practical maximum eluent concentrations and flow rates of standard eluents used in cation separations versus the regenerant concentrations and flow rates required to suppress them. The operation of the Dionex CCRS 500 requires a constant flow of the regenerant over the membrane, in a direction that is countercurrent to the flow of the eluent. A standard regenerant flow rate of 5–10 mL/min is recommended for the External Chemical Mode of operation.

This flow rate is adequate for most applications. For applications that require stronger than typical eluent strengths, the regenerant flow rate may be increased. The level of leakage increases with increasing concentration hence it is critical that the concentration of regenerant be as low as possible in order to achieve low backgrounds.

**Table 5**     **Dionex CCRS 500 4 mm Practical Maximum Eluent Concentration Suppression Guidelines Regenerant Flow Rate = 10 mL/min**

Eluent	Eluent Flow Rate (mL/min)	Maximum Eluent Concentration (mM)	Regenerant Concentration (mM TBAOH)
MSA	1	65	100
Hydrochloric acid	1	75	100
Sulfuric Acid	1	30	100
Nitric Acid	1	50	150
HSA	1	5	100
HSA + 10% ACN	1	7	100
OSA	1	2	100
OSA + 10% ACN	1	2	100

\* For suppressing higher concentrations than listed above, the regenerant concentrations may be increased to 150 mM TBAOH

**Table 6** Dionex CCRS 500 2 mm Practical Maximum Eluent Concentration Suppression Guidelines Regenerant Flow Rate = 8 mL/min

Eluent	Eluent Flow Rate (mL/min)	Maximum Eluent Concentration (mM)	Regenerant Concentration (mM TBAOH)
MSA	0.5	45	100
MSA	0.3	70	100
MSA	0.25	95	100
Hydrochloric acid	0.5	75	100
Hydrochloric acid	0.3	100	100
Hydrochloric acid	0.25	110	100
Sulfuric Acid	0.5	20–25	100
Sulfuric Acid	0.3	25–30	100
Sulfuric Acid	0.25	30–35	100
Nitric Acid	0.25	75	100
HSA	0.25	5	100
HSA + 10% ACN	0.25	7	100
OSA	0.25	2	100
OSA + 10% ACN	0.25	2	100

For customers with older systems that use HCl-DAP eluents, the following tables list the practical eluent concentrations and flow rates of standard DAP/HCL eluents versus the regenerant concentrations and flow rates required to suppress them.

**Table 7** Dionex CCRS 500 4 mm Regenerant Concentration and Flow Rate Versus Eluent Concentration and Flow Rate for DAP/HCl Eluents

Eluent	Eluent Flow Rate (mL/min)	Regenerant Flow Rate (mL/min)	Regenerant Conc (mM TBAOH)
5-25 mM HCl	1.0–3.0	3–5	50
25-50 mM HCl	0.5–1.5	5–10	100
25 mM HCl/ 0.25 mM DAP	1.0–2.0	3–5	50
40-50 mM HCl/2-8 mM DAP	0.5–1.5	5–10	100

**Table 8** Dionex CCRS 500 2 mm Regenerant Concentration and Flow Rate Versus Eluent Concentration and Flow Rate for DAP/HCl Eluents

Eluent	Eluent Flow Rate (mL/min)	Maximum Suppressible (mM)	Regenerant Conc (mM TBAOH)
5-25 mM HCl	0.1–0.50	3–5	50
25-50 mM HCl	0.1–0.50	5–10	100
50-75 mM HCl	0.1–0.40	5–10	100
25 mM HCl/0.25 mM DAP	0.1–0.50	3–5	50
40-60 mM HCl/2-10 mM DAP	0.1–0.40	5–10	100

where:

DAP = DL-2,3-Diaminopropionic acid monohydrochloride (P/N 039670)

**NOTE**

*For the lower eluent concentration in a given range, choose lower corresponding regenerant concentration; for higher eluent concentration choose higher regenerant concentration.*

For the best signal-to-noise ratio and the best overall performance, when using an AutoRegen Cartridge to supply regenerant, Dionex recommends that the Cation Regenerant Solution used with the Dionex CRS 500 be replaced on a regular basis. The time interval between changing the regenerant will depend on both the time that the instrument is in operation and the specific application. As a guideline, the regenerant should be replaced whenever the background conductivity drifts to higher levels than those observed in the initial chromatograms. See the Product Manual for the analytical column being used in your application for a guideline on the expected background conductivity.

### 3.3.3 Calculations for Regenerant Concentration

The regenerant dynamic concentration (mN x mL/min) should be approximately 7 times the eluent dynamic concentration.

$$7.(\text{eluent mN})(\text{eluent mL/min})=(\text{regenerant mN})(\text{regenerant mL/min})$$

Therefore:

$$(\text{regenerant mL/min})=\frac{7.(\text{eluent mN})(\text{eluent mL/min})}{(\text{regenerant mN})}$$

**Example #1** Eluent: 50 mN NaOH  
Eluent Flow Rate: 1.5 mL/min

A. Regenerant Concentration = 50 mN H<sub>2</sub>SO<sub>4</sub>

$$(\text{regenerant mL/min})=\frac{7.(50 \text{ mN})(1.5 \text{ mL/min})}{(50 \text{ mN})}=10 \text{ mL/min}$$

B. Regenerant Concentration = 100 mN H<sub>2</sub>SO<sub>4</sub>

$$(\text{regenerant mL/min})=\frac{7.(50 \text{ mN})(1.5 \text{ mL/min})}{(100 \text{ mN})}=5 \text{ mL/min}$$

**Example #2** Eluent: 2.8 mM NaHCO<sub>3</sub>/2.2 mM Na<sub>2</sub>CO<sub>3</sub>  
Eluent Flow Rate: 2.0 mL/min

A. Regenerant Concentration = 50 mN H<sub>2</sub>SO<sub>4</sub>  
Eluent Concentration = 2.8 mN + (2 x 2.2) mN = 7.2 mN

$$(\text{regenerant mL/min})=\frac{7.(7.2 \text{ mN})(2.0 \text{ mL/min})}{(50 \text{ mN})}=2 \text{ mL/min}$$

**NOTE**

*Do not assume that the flow rate arrived at by using the above equations is necessarily the optimum flow rate. Instead, consider it a good starting point. By monitoring the suppressor performance, background and noise and by either increasing or decreasing the flow rate as required, you should be able to determine the optimum flow rate.*



- B. Dionex Anion Regenerant Concentrate (P/Ns 037164, 039601) should be used to make regenerants for the Dionex Anion Chemically Regenerated Suppressors because of its ease of use and guaranteed high purity. With the DCR Kit, use Anion Regenerant Concentrate 75 mL of 2.0 N Sulfuric Acid (P/N 057559) or the 4-Pak (P/N 057555).
- C. Solutions such as methanol and acetonitrile, have little or no effect on the Anion Regenerant Solution using an AutoRegen System. And, most solvents such as methanol have little or no effect on the Cation Regenerant Solution when using an AutoRegen Accessory unit.
- D. For the best signal to noise ratio and the best overall performance, Dionex recommends that the Anion Regenerant Solution used with the Dionex Anion Chemically Regenerated Suppressors be replaced on a regular basis. Tables 3 or 4, “Matching Regenerant Concentration and Flow Rate to Eluent Concentration and Flow Rate,” lists the appropriate regenerant concentrations for selected eluents.

### 3.3.4 Regenerant Concentration for DCR Mode

For anion analysis, X equivalents of eluent requires at least a factor of 2X equivalents of regenerant in the DCR mode of operation. For cation analysis, X equivalents of eluent requires at least a factor of 5X equivalents of regenerant in the DCR mode of operation. Since the flow is constant, this mode provides improved performance. Refer to DCR Kit Manual (P/N 031664) for detailed information on the regenerant concentrations.

## 3.4 Storage

The Dionex Chemically Regenerated Suppressor (Dionex CRS 500) is shipped with DI water as the storage solution. If a suppressor will not be used for more than one week, prepare it for storage. The screens and membranes in the Dionex CRS 500 must be completely hydrated to maintain liquid seal and chromatographic performance.

### 3.4.1 Short Term Storage (1 to 5 days)

- A. Plug both eluent ports. Using a plastic syringe, gently push deionized water through the REGEN In port until all bubbles are removed. Plug both regenerant ports.
- B. To resume operation, connect the suppressor to the system. Allow the system to equilibrate before starting your analysis.



**NOTE**

*If the eluent last used contained organic solvents, flush the Dionex CRS 500 with deionized water for 10 minutes through both chambers before plugging the fitting ports.*

### 3.4.2 Long Term Storage

- A. Flush the Dionex CRS 500 with deionized water for 10 minutes.
- B. Plug the Dionex CRS 500 eluent ports and regenerant ports.
- C. To resume operation, connect the suppressor to the system. Turn on the regenerant flow and allow regenerant to flow until no more bubbles exit the regen out port. Turn off the regenerant flow and allow the suppressor to hydrate for at least 20 minutes.
- D. Allow the system to equilibrate before starting analysis.
- E. If small analyte peak areas are observed when using the DCR mode, perform steps A–C as outlined in APPENDIX B, “QuickStart for the Displacement Regenerant Mode.”

## 4. Troubleshooting Guide

The purpose of the Troubleshooting Guide is to help you solve operating problems that may arise while using the Dionex Chemically Regenerated Suppressor (Dionex CRS 500). For more information on problems that originate with the Ion Chromatograph or the specific Anion exchange column set in use, refer to the Troubleshooting Guide in the appropriate Installation Manual. If you cannot solve the problem on your own, contact the Dionex Regional Office nearest you (see, “Dionex Worldwide Offices”).

### 4.1 Small Analyte Peak Areas

If small peak areas are observed when working with a pressurized reservoir

- A. Stop the eluent flow while flowing regenerant flow into the suppressor for 5 minutes
- B. If peak response has not recovered then perform quick start procedure as outlined in APPENDIX A, “QuickStart for the External Chemical Mode and the AutoRegen Mode.”
- C. In the DCR mode if the above problem is observed then follow instructions outlined in APPENDIX B, “QuickStart for the Displacement Regenerant Mode.”
- D. If the correct peak areas are not observed following two injections of a standard test solution, contact the nearest Thermo Scientific Regional Office (see, “Thermo Scientific Worldwide Offices”).

### 4.2 High Background Conductivity

- A. Check that the regenerant is flowing from the waste line at the proper flow rate.
  1. If there is no flow from the waste line, disconnect the 0.012" i.d. tubing connected to the waste line. If the regenerant lines and the suppressor are filled with regenerant and there are no restrictions in the regenerant line, the regenerant should flow freely from the 1/8" o.d. waste line. If there is no flow, make sure the reservoir cap is tight and that there are no audible air leaks. Also make sure that the regenerant reservoir is pressurized. If it is, trace the regenerant lines backward from the reservoir to find and remove any blockage.
  2. If there is flow from the waste line, but it is less than the desired flow rate, increase the flow rate by shortening the 0.012" i.d. waste line tubing or by increasing the reservoir pressure. If the flow rate is correct, go on to the next step.
  3. If the regenerant is flowing at the desired rate, either the selected regenerant flow rate is too slow or the regenerant is too dilute to suppress the eluent concentration at the set eluent flow rate. Refer to Tables 3 or 4, “Matching Regenerant Concentration and Flow Rate to Eluent Concentration and Flow Rate,” for the Dionex ACRS 500 or to Tables 5 and 6, “Practical Maximum Eluent Concentration Suppression Guidelines,” for the Dionex CCRS 500 and then increase the regenerant flow rate or increase the regenerant concentration.

- B. Check for eluent flow out of the suppressor **ELUENT OUT** port.
1. If there is no flow out of the Dionex CRS 500 **ELUENT OUT** port, make sure that eluent is entering the suppressor at the **ELUENT IN** port. If there is no flow at this point, trace the eluent flow path backward through the system to find and remove the blockage.
  2. If there is flow of eluent into the Dionex CRS 500 but not out, and there are no visible leaks from the side seams of the suppressor, a break in the o-ring seal or the membrane is probably allowing eluent to leak into the regenerant. If this is the case, then the Dionex CRS 500 must be replaced.



**CAUTION**

**Do NOT attempt to disassemble the Dionex Chemically Regenerated Suppressor!**

3. If there is flow from the **ELUENT OUT** port, but no eluent suppression, the membrane may have been contaminated. Try to restore system performance by cleaning the membrane (see Section 5, “Suppressor Cleanup”).
- C. Remake the regenerant to be sure that the concentration is correct and that the solution has been freshly prepared. Be sure that chemicals of the required purity were used to make the regenerant (see Section 3.1, “Chemical Purity Requirements”). If the regenerant concentration is too high or too old, it can cause high background conductivity.
- For the Dionex ACRS 500, Dionex recommends the use of Dionex Anion Regenerant Concentrate (P/Ns 037164, 039601) for the best performance. With the DCR Kit, use Anion Regenerant Concentrate 75 mL of 2.0 N Sulfuric Acid (P/N 057559) or the 4-Pak (P/N 057555).
- For the Dionex CRS 500, Dionex recommends the use of Dionex Cation Regenerant Concentrate (P/N 039602) for the best performance. With the DCR Kit, use Cation Regenerant Concentrate 100 mL of 2.06 M TBAOH (P/N 057561) or the 4-Pak (P/N 057556).
- D. Remake the eluent to be sure that the concentration is correct. Be sure that chemicals of the required purity were used to make the eluent (see Section 3.1, “Chemical Purity Requirements”). If the eluent concentration is too high, the Dionex CRS 500 will not be able to suppress it, resulting in high background conductivity. Refer to Tables 3 or 4, “Matching Regenerant Concentration and Flow Rate to Eluent Concentration and Flow Rate,” for the Dionex ACRS 500 or to Tables 5 and 6, “Practical Maximum Eluent Concentration Suppression Guidelines,” for the Dionex CCRS 500 and then increase the regenerant flow rate or increase the regenerant concentration.
- E. If the background conductivity remains high, and you cannot solve the problem on your own, contact the Thermo Scientific Regional Office nearest you (see, Thermo Scientific Worldwide Offices).

### 4.3 Drifting Baseline

If the baseline drifts steadily upward, increase the regenerant flow rate, or if using DCR Mode increase the regenerant concentration to reduce the background conductivity. As the background conductivity decreases, the baseline usually levels.

## 4.4 Decreased Sensitivity

- A. Check for leaks throughout the system. If a fitting is leaking, tighten it carefully until the leak stops. Do not overtighten. If the Dionex CRS 500 is observed to be leaking from the center or bottom seam, see Section 4.6, “Liquid Leaks.” If you cannot cure the problem yourself, call the nearest Dionex Regional Office (see, “Dionex Regional Offices”) for assistance.
- B. Ensure that the injection valve is operating correctly. Refer to the valve manuals that accompany the chromatography module for troubleshooting assistance. Be sure to check the slider port faces for damage.
- C. If sensitivity remains low, clean the suppressor membrane (see Section 5, “Suppressor Cleanup”).
- D. Replace the Dionex CRS 500 if cleaning the suppressor membrane does not restore sensitivity.
- E. Check the backpressure coils. Verify that they are not exceeding 40 psi in the current plumbing configuration and flow rate.
- F. Contact the nearest Thermo Scientific Regional Office (see, “Thermo Scientific Worldwide Offices”) if you cannot solve the problem on your own.

## 4.5 System Back Pressure Increases Over Time

- A. If the increased back pressure does not affect system performance, no maintenance is necessary.
- B. Check the inlet frits on the guard and analytical column and replace them if necessary. The most common cause of increasing system back pressure is a contaminated frit in the analytical or guard column inlet end fitting. The complete instructions for replacing column bed support assemblies are in column Product Manuals. Recheck the system back pressure. If it remains high, go on to the next step.
- C. Check the backpressure coils. If removing the backpressure coils lowers the pressure by more than 40 psi, replace the coils or remove the blockage causing the increased pressure. Backpressure over 125 psi after the suppressor can cause irreversible damage.
- D. Find and eliminate any system blockage. Bypass the Dionex CRS 500 by coupling the lines attached to the **ELUENT IN** and **ELUENT OUT** ports. If the back pressure decreases by less than 150 psi with the Dionex ACRS 500 out of line, a blockage in the system rather than in the Dionex CRS 500 is causing the high pressure.
- E. Remove a blockage from Dionex CRS 500 by reversing the eluent flow. If the back pressure decreases by more than 150 psi with the Dionex CRS 500 out of line, the high pressure may be caused by a blockage in the Dionex Chemically Regenerated Suppressor. Reverse the direction of flow of the eluent or both the eluent and the regenerant through the Dionex Chemically Regenerated Suppressor. After the pressure drops, allow eluent, or eluent and regenerant, to flow to waste for several minutes after the pressure drops. Perform step A of Section 3.2, “Start Up,” and reinstall the Dionex CRS 500 in the appropriate configuration.
- F. Clean the suppressor membranes if reversing the flow through the Dionex CRS 500 does not decrease the pressure. (See Section 5, “Suppressor Cleanup”).
- G. Replace the Dionex CRS 500 if cleaning the suppressor membrane does not reduce the pressure.
- H. Contact the nearest Thermo Scientific Regional Office (see, “Thermo Scientific Regional Offices”) if you cannot solve the problem on your own.

## 4.6 Liquid Leaks

- A. If there is leakage from the ports of the Dionex CRS 500, carefully tighten the fittings in the ELUENT and REGEN IN and OUT ports – be careful not to over-tighten the fittings. If tightening the fittings does not stop the leak, replace the fittings and ferrules.
- B. If there is leakage from the side seam of the Dionex CRS 500, check the cell and backpressure coil backpressure.
  - 1. If the backpressure is greater than 200 psi, the leaks are caused by excessive backpressure downstream from the Dionex CRS 500. Find and eliminate the source of the pressure.
  - 2. If the backpressure is less than 150 psi, the Dionex CRS 500 is the cause of high backpressure; follow step C or go to Chapter 5, Suppressor Cleanup. Do not disassemble the Dionex CRS 500 and attempt to repair it yourself!
- C. If the Dionex CRS 500 is leaking due to excessive internal backpressure (>200 psi), the suppressor may need to be back-flushed.
  - 1. Turn off the pump.
  - 2. Disconnect the Column Out line from the Suppressor Eluent In port. Disconnect the Suppressor Eluent Out port.
  - 3. Connect the Column Out line to the Suppressor Eluent Out port.
  - 4. Connect a piece of tubing to the Suppressor Eluent In port and run this line to waste.
  - 5. Turn the pump on and pump eluent through the suppressor at the standard flow rate for 5 minutes; ensure the power to the suppressor is turned off during this step.
  - 6. Turn off the pump.
  - 7. Reconnect the Eluent In and Eluent Out connections in their correct orientation.
- D. For issues with DCR operation, refer to the DCR Kit Manual (P/N 031664).
- E. For issues with AutoRegen operation, refer to the AutoRegen Cartridge Manual (P/N 032852).

## 5. Suppressor Cleanup

This section describes routine cleanup procedures for the Dionex Chemically Regenerated Suppressors (Dionex CRS 500) in the case of contamination. Consult the Troubleshooting Guide (see Section 4, “Troubleshooting Guide”) to first determine that the system is operating properly. If the Dionex CRS 500 is determined to be the source of higher than normal back pressure, higher than anticipated conductivity, decreased suppression capacity or decreased sensitivity, cleaning the membrane may restore the performance of the system. Use the following procedures to clean the membrane.

Metal Contaminants or Precipitates with the Dionex CRS 500 Disconnect the analytical (and guard) column(s) from the injection valve and the Dionex CRS 500. Refer to the specific analytical column Installation Instructions and Troubleshooting Guide for column cleanup procedures.

- A. Turn off the external regenerant and disconnect the external regenerant line from the Dionex CRS 500 REGEN IN port.
- B. Disconnect the liquid line from the Dionex CRS 500 ELUENT OUT port to the cell at the cell fitting and reconnect it to the REGEN IN port.
- C. Pump a solution of 0.2 M oxalic acid through the Dionex CRS 500 eluent chamber at 1 – 2 mL/min (4 mm) or 0.25 – 0.5 mL/min (2 mm). If using the eluent pump, connect a temporary line from the priming block or the low-pressure tee of the pump to the oxalic acid container to avoid contaminating the pump manifolds.



**NOTE**

*Bypassing internal pump manifolds when temporarily pumping high concentration cleaning solutions significantly reduces the time required to re-equilibrate the system to low concentration eluents.*

- D. Flush the Dionex CRS 500 with deionized water for 10 minutes.
- E. Perform a QuickStart procedure as outlined in Section 3.2, “Start Up.”
- F. Install the Dionex CRS 500 unit back on the system and pump regenerant through the regenerant chamber. Turn on the eluent after flushing the regenerant chamber. In the DCR mode, turning on the eluent flow is needed to push the regenerant into the Dionex CRS 500.
- G. Flush the Dionex CRS 500 with eluent for 10 minutes.
- H. Reinstall the analytical (and guard) column(s). Begin pumping eluent through the system at the flow rate required for your analysis and equilibrate the system.

## 5.1 Base-Soluble Contaminants or Precipitates with the Dionex CRS 500

- A. Disconnect the analytical (and guard) column(s) from the injection valve and the Dionex CRS 500. Refer to the specific analytical column Product Manual for column cleanup procedures.
- B. Turn off the regenerant and disconnect the regenerant line from the Dionex CRS 500 REGEN IN port.
- C. Disconnect the liquid line from the Dionex CRS 500 ELUENT OUT port to the cell at the cell and reconnect it to the REGEN IN port.
- D. Pump a solution of 0.1 M NaOH through the Dionex CRS 500 eluent chamber at 1 – 2 mL/min (4 mm) or 0.25 – 0.5 mL/min (2 mm). If using the eluent pump, connect a temporary line from the priming block or the low-pressure tee of the pump to the sodium hydroxide container to avoid contaminating the pump manifolds.



### NOTE

*Bypassing internal pump manifolds when temporarily pumping high concentration cleaning solutions significantly reduces the time required to re-equilibrate the system to low concentration eluents.*

- E. Flush the columns and the Dionex CRS 500 separately with deionized water, having a specific resistance of 18.2 megohm-cm, for 10 minutes.
- F. Perform a QuickStart procedure as outlined in Section 3.2, “Start Up.”
- G. Install the Dionex CRS 500 unit back on the system and pump regenerant through the regenerant chamber. Turn on the eluent after flushing the regenerant chamber. In the DCR mode, turning on the eluent flow is needed to push the regenerant into the Dionex CRS 500.
- H. Flush the Dionex CRS 500 with eluent for 10 minutes.
- I. Reinstall the analytical (and guard) column(s). Begin pumping eluent through the system at the flow rate required for your analysis and equilibrate the system.

## 5.2 Organic Contaminants with the Dionex ACRS 500 or Dionex CCRS 500

- A. Disconnect the analytical (and guard) column(s) from the injection valve and the Dionex CRS 500. Refer to the specific analytical column Product Manual for column cleanup procedures.
- B. If you are running in the External Chemical Mode, turn off the external regenerant and disconnect the external regenerant line from the Dionex CRS 500 REGEN IN port. If you are running in the Displacement Chemical Regeneration Mode, proceed to D.
- C. Disconnect the liquid line from the Dionex CRS 500 ELUENT OUT port to the cell at the cell fitting and reconnect it to the REGEN IN port.
- D. For the Dionex ACRS 500, connect a temporary line from the priming block or the low-pressure tee on the isocratic or gradient pump to a container with a solution of freshly prepared 10% 1.0 M HCl/90% acetonitrile or methanol. HCl/acetonitrile solutions are not stable during long term storage so this cleanup solution must be made immediately before each column cleanup. Alternatively, it can be proportioned from a bottle containing 1.0 M HCl and another bottle containing 100% acetonitrile.

For the Dionex CCRS 500, connect a temporary line from the priming block or the low-pressure tee on the isocratic or gradient pump to a container with a solution of 90% acetonitrile or methanol in water.

Pump the appropriate solution given above through the Dionex CRS 500 (4 mm) at 1-2 mL/min for 30 minutes. For 2 mm systems, pump this solution through the Dionex CRS 500 (2 mm) at 0.25–0.50 mL/min for 30 minutes.



### NOTE

*Bypassing internal pump manifolds (when temporarily pumping high concentration cleaning solutions) will significantly reduce the time required to re-equilibrate the system to low concentration eluents.*

- E. Flush the Dionex CRS 500 with deionized water for 10 minutes.
- F. Perform a QuickStart procedure as outlined in Section 3.2, “Start Up.”
- G. Install the Dionex CRS 500 unit back on the system and pump regenerant through the regenerant chamber. Turn on the eluent after flushing the regenerant chamber. In the DCR mode, turning on the eluent flow is needed to push the regenerant into the Dionex CRS 500.
- H. Flush the Dionex CRS 500 with eluent for 10 minutes.
- I. Reinstall the analytical (and guard) column(s). Begin pumping eluent through the system at the flow rate required for your analysis and equilibrate the system.