

# Suppressors

## Carbonate Removal Device 300 (CRD 300) for Carbonate Eluents



Since the introduction of suppressed conductivity in 1975, carbonate eluents have been extensively employed in anion separations because they are easily suppressed to relatively low-conductivity carbonic acid species. However, the residual conductivity of the carbonic acid has several undesirable effects on the performance of ion chromatography (IC) employing a carbonate eluent. At trace levels, carbonic acid can mask small peaks, decreasing the limit of detection (LOD). In a background of carbonic acid, the linear range of most species is limited. The residual background conductivity creates a large void dip which can hamper the integration of early eluting species, such as fluoride, acetate, and formate. The CRD 300 is a device used to remove the carbonic acid from the suppressed eluent, providing hydroxide-like detection to systems using carbonate eluents.

The CRD 300 is installed between the suppressor and the conductivity detector cell. This placement reduces the background caused by the residual conductivity of suppressed carbonate and carbonate/bicarbonate eluents.

- The CRD 300 provides the following:
- Removal of carbonic acid generated by the suppression of carbonate eluents
  - Lower limits of detection for most analyte species
  - Improved integration and quantification of early eluting analyte peaks, particularly fluoride, acetate, and formate
  - Wider linearity range

For optimal performance, Dionex recommends using the CRD 300 with a Reagent-Free™ Ion Chromatography system with Eluent Generation (RFIC-EG™ system) equipped with an EluGen® EGC II K<sub>2</sub>CO<sub>3</sub> cartridge and Eluent pH Modifier (EPM), an ASRS® 300 or AMMS® 300 suppressor, and a carbonate compatible column (such as the Ion-Pac® AS4A-SC, AS9-HC, AS12A, AS14, AS14A, AS22, or AS23). For systems employing hydroxide or borate eluents, Dionex recommends the CRD 200.

Now sold under the  
Thermo Scientific brand

**Thermo**  
SCIENTIFIC



Passion. Power. Productivity.

## Solutions to Analytical Challenges

For more than 30 years carbonate has been the eluent of choice for many IC operators because it acts as a relatively strong eluting species, has good pH buffering characteristics when carbonate and bicarbonate mixtures are used, resists absorption of CO<sub>2</sub> from the air, and suppresses very easily to the relatively low-conductivity species carbonic acid. In recent years many analysts have abandoned carbonate as an eluent in favor of hydroxide because the residual background conductivity of carbonate eluents limits the level of detection, causes a large void dip that interferes with the integration and quantification of early eluting peaks, and has a relatively narrow linearity range. However, some analysts have not been successful in the migration to hydroxide eluents for various reasons, including rigid SOPs and cost of ownership issues. Removing the residual carbonic acid prior to detection eliminates the detection limitations of running carbonate eluents and provides ‘hydroxide-like’ detection.

Hydroxide still remains the eluent of choice for many applications because of its compatibility with gradient eluent profiles. Although the CRD 300 enables ‘hydroxide-like’ detection with carbonate eluents, it does not enable gradient carbonate eluent profiles. For the ultimate in separation, selectivity, and sensitivity, hydroxide eluents coupled with the CRD 200 are still the recommended solution.

### CRD 300 Design and Operation

The CRD 300 is based on the same design as the CRD 200. Both consist of a gas permeable membrane that has a silicone coating selective to CO<sub>2</sub> (Figure 2). However, the increased length of the CRD 300’s gas permeable membrane increases its carbonic acid removal capacity. The CRD 300, like the CRD 200, is plumbed between the suppressor module and the detector cell. The regenerant channel that encloses the

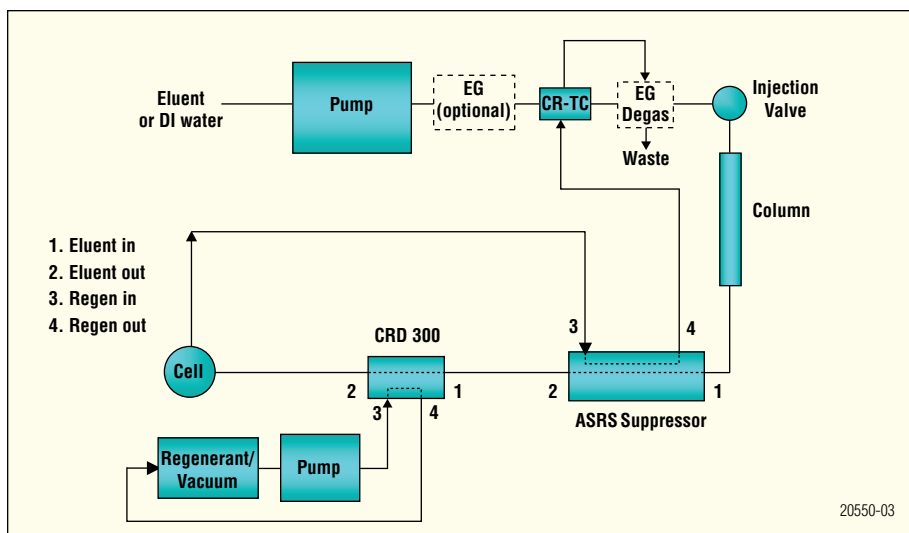


Figure 1. CRD 300 plumbing schematic.

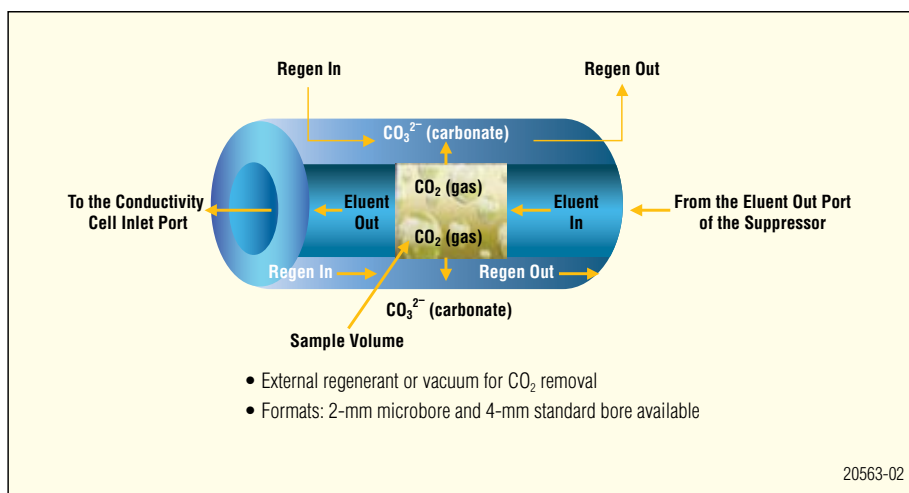
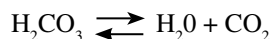


Figure 2. CRD 300 design and operation.

CRD 300 membrane is either flushed with a basic solution provided by an external pump, or evacuated with a vacuum pump and flushed with a slow bleed of air, to aid the removal of the carbonic acid as CO<sub>2</sub>.

The CRD 300 removes the carbonic acid as CO<sub>2</sub> from the suppressed eluent as per the following equilibrium:



As the carbon dioxide is removed by the CRD 300 membrane, the equilibrium shifts to the right, facilitating further removal of carbonic acid. Additionally, if base is pumped through the regenerant

channel, this basic environment allows a quick conversion of the removed CO<sub>2</sub> to carbonate anion. If the regenerant channel is kept evacuated and a slow bleed of air flushed through the channel, the CO<sub>2</sub> is swept away. The net result of these steps is a significant reduction in background conductivity.

The CRD 300 can remove high levels of carbonate (up to 15 mM), resulting in a background conductivity below 1 μS/cm for the suppressed eluent.

## System Compatibility

The CRD 300 can be installed easily in any Dionex IC system equipped with an ASRS 300 or AMMS 300 suppressor and requires no software control. If base is pumped through the regenerant channel (chemical regeneration mode), then an external pump is required. Dionex provides a two-channel peristaltic pump for this application. If the regenerant channel is to be evacuated with an air bleed (vacuum mode) then an external vacuum pump is required. Dionex provides a vacuum pump with bleed tube assembly for this application. The CRD 300 is available in 4-mm (for 4- and 5-mm columns) and 2-mm (for 2- and 3-mm columns) formats.

## Recommended Applications

The CRD 300 is recommended for both routine and trace level work with carbonate and carbonate/bicarbonate eluents when 'hydroxide-like' detection is required. Figure 3 compares the background signals of anion separations using carbonate eluents, with and without using a CRD 300. The background signal is more than an order of magnitude lower with the CRD 300, and the void dip is virtually eliminated. Fluoride analysis (peak 1) is simplified when void dip interference is minimized.

Both vacuum mode and base regenerant mode provide low backgrounds and low noise, as shown in Figure 4. Vacuum mode is recommended for the analysis of trace anions in ammoniated waters. For cation analyses, the CRD 300 can also be used in vacuum mode to remove ammonia from the sample before it is injected into the system. This is useful in reducing the ammonium peak and improving quantification of analytes that would otherwise be interfered with by ammonium.

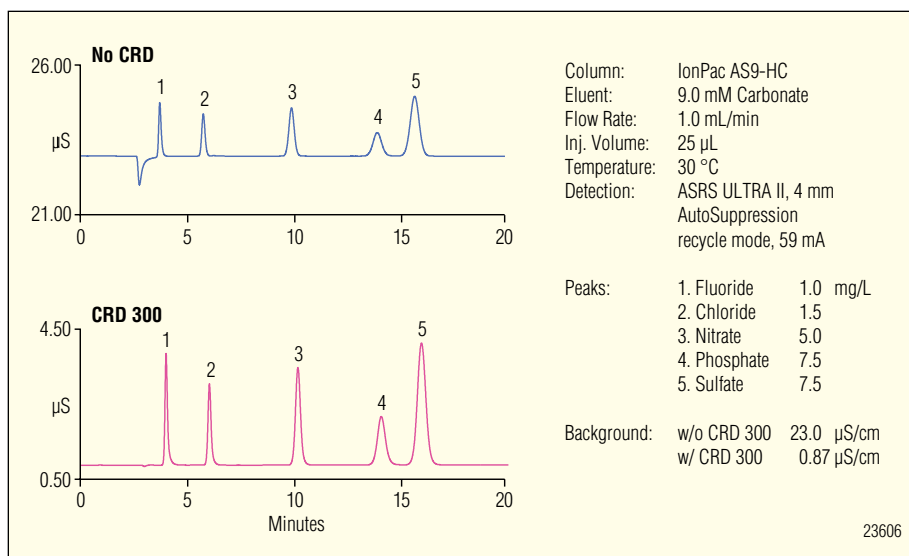


Figure 3. The CRD 300 reduces the background conductivity of suppressed carbonate and carbonate/bicarbonate eluents to levels similar to those achieved using suppressed hydroxide eluents.

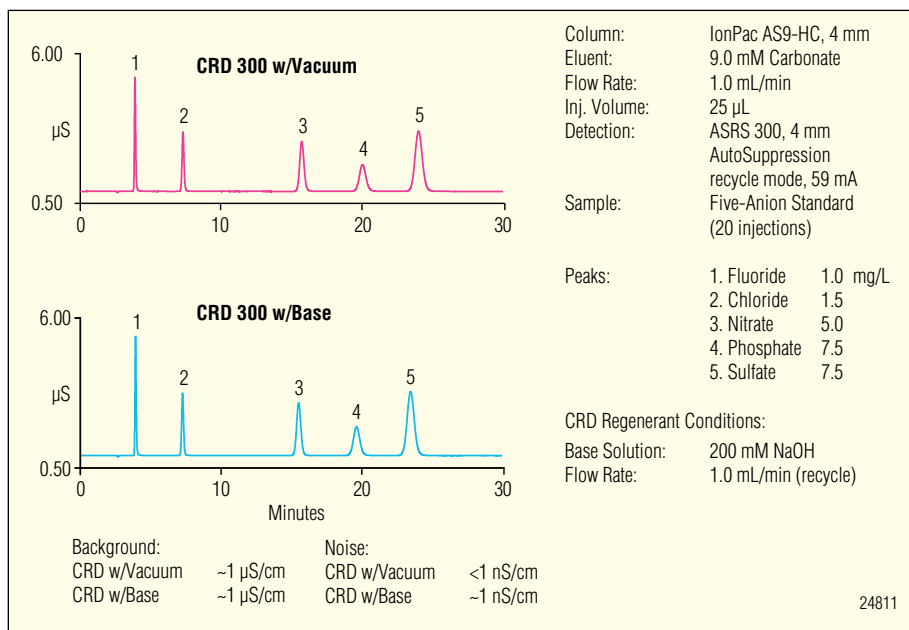


Figure 4. Comparison of CRD 300 operation using vacuum and base for carbonate removal. Vacuum mode may perform better in some cases, such as pursuing trace anion analysis in ammoniated waters.

## Summary

The benefits of using carbonate eluents are well established. The CRD 300 Carbonate Removal Device improves detection when using carbonate eluents to 'hydroxide-like' levels. The CRD 300 reduces background conductivity to less than 1  $\mu\text{S}/\text{cm}$ , improves the limit of detection for most analytes, simplifies integration and quantification of early eluting peaks by minimizing or eliminating the void dip, and widens the detection linearity range.

## CRD 300 Configurations

The CRD 300 is available in both 2-mm and 4-mm formats for use with 2-, 3-, 4-, and 5-mm ion chromatography columns. The 4-mm CRD 300 has a typical delay volume of 225  $\mu\text{L}$  and is recommended for 4- or 5-mm column applications. The 2-mm CRD 300 has a typical delay volume of 80  $\mu\text{L}$  and is recommended for 2- or 3-mm column applications.

## CRD 300 SPECIFICATIONS

### Hardware Dimensions ( $h \times w \times d$ ):

2.0 cm  $\times$  4.4 cm  $\times$  7 cm  
(0.8 in.  $\times$  1.7 in.  $\times$  2.8 in.)

### Void Volume:

2 mm: 80  $\mu\text{L}$   
4 mm: 225  $\mu\text{L}$

### Membrane Dimensions:

2 mm: Length = 200 cm  
i.d. = 209  $\mu\text{m}$   
4 mm: Length = 300 cm  
i.d. = 300  $\mu\text{m}$

## ORDERING INFORMATION

To order, using the following part numbers, contact your local Dionex office or distributor nearest you. In the U.S., call (800) 346-6390. In other regions, refer to the phone numbers below.

Description	Part Number
CRD 300 (4 mm) Carbonate Removal Device.....	064637
CRD 300 (2 mm) Carbonate Removal Device.....	064638
CRD 300 (4 mm) with Peristaltic Pump .....	064905
CRD 300 (2 mm) with Peristaltic Pump .....	064906
Santoprene Tubing for Peristaltic Pump.....	068518
Peristaltic Pump/CRD 300 Ship Kit.....	064911
(One ship kit is included with parts 064905 and 064906. Order an additional ship kit if configuring two CRD 300s with one peristaltic pump.)	
CRD 300 (4 mm) with VP Vacuum Pump.....	068475
CRD 300 (2 mm) with VP Vacuum Pump.....	068474

Reagent-Free, RFIC, and RFIC-EG are trademarks and AMMS, ASRS, EluGen, and IonPac are registered trademarks of Dionex Corporation.

Passion. Power. Productivity.



### Dionex Corporation

1228 Titan Way  
P.O. Box 3603  
Sunnyvale, CA  
94088-3603  
(408) 737-0700

### North America

U.S. (847) 295-7500  
Canada (905) 844-9650

### South America

Brazil (55) 11 3731 5140

### Europe

Austria (43) 1 616 51 25 Benelux (31) 20 683 9768; (32) 3 353 4294  
Denmark (45) 36 36 90 90 France (33) 1 39 30 01 10 Germany (49) 6126 991 0  
Ireland (353) 1 644 0064 Italy (39) 02 51 62 1267 Switzerland (41) 62 205 9966  
United Kingdom (44) 1276 691722

### Asia Pacific

Australia (61) 2 9420 5233 China (852) 2428 3282 India (91) 22 2764 2735  
Japan (81) 6 6885 1213 Korea (82) 2 2653 2580 Singapore (65) 6289 1190  
Taiwan (886) 2 8751 6655

[www.dionex.com](http://www.dionex.com)



LPN 1978-01 PDF 04/08  
©2008 Dionex Corporation