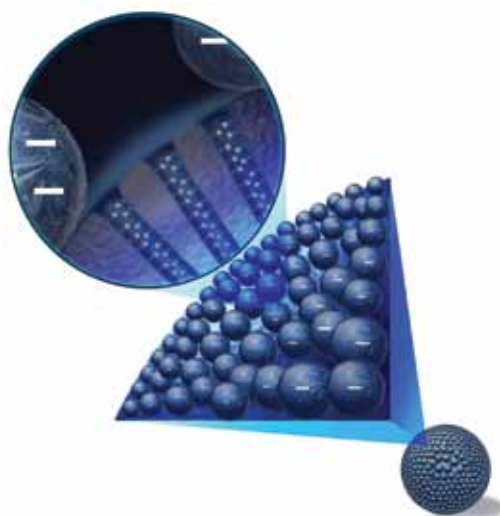


## Acclaim Trinity P1 Column Superior Pharmaceutical and Counterion Separations



The Acclaim Trinity P1 column is based on Nanopolymer Silica Hybrid technology.

### Superior Performance for Pharmaceutical Applications

*The Acclaim® Trinity™ P1 is a unique, high-efficiency, silica-based column specifically designed for simultaneous separation of pharmaceutical drug substances and counterions, as well as mixtures of acidic, basic, and neutral drugs.*

*Innovative nanopolymer silica hybrid (NSH) technology results in unparalleled chromatographic performance and maximum flexibility in adjusting selectivity during method development.*

### Column Chemistry

The Acclaim Trinity P1 column is based on NSH technology, which consists of high-purity porous spherical silica particles coated with charged nanopolymer particles. The inner-pore area of the silica bead is modified with a covalently bonded organic layer that provides both reversed-phase and anion-exchange retention properties. Outer surface is modified with cation-exchange functionality. This chemistry ensures spatial separation of the anion-exchange and cation-exchange regions,

and allows both retention mechanisms to function simultaneously and be controlled independently.

### Chromatographic Features

The Acclaim Trinity P1 column provides solutions for easy and straightforward method development because selectivity can be optimized by adjusting the mobile phase ionic strength, pH, and organic solvent—independently or concurrently.



Passion. Power. Productivity.

NSH column technology provides the Acclaim Trinity P1 column with the following features:

- Multiple retention mechanisms including reversed-phase, anion-exchange, and cation-exchange
- Adjustable selectivity by changing mobile phase ionic strength, electrolyte type, pH, and organic solvent
- Ideal selectivity for simultaneous separation of basic, neutral, and acidic analytes
- Retention of ionic and ionizable analytes without using ion-pairing reagents

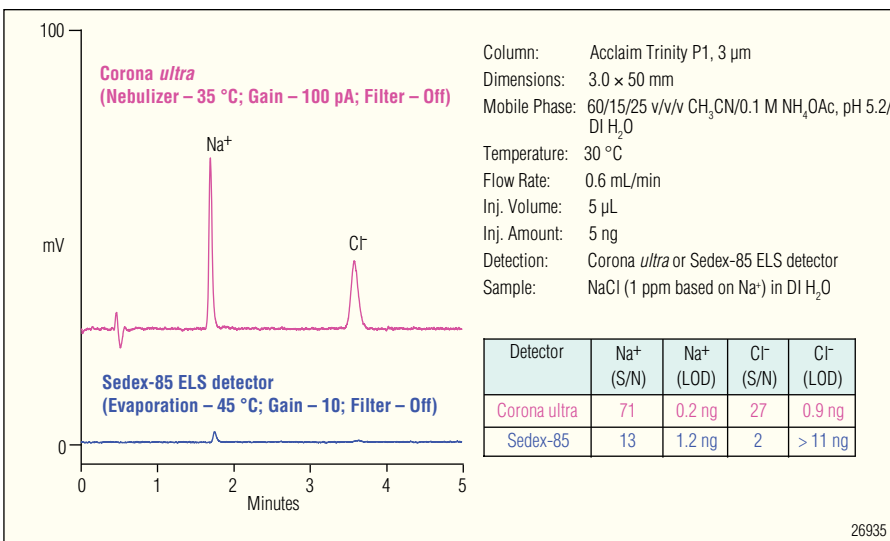


Figure 1. Simultaneous separation of Na<sup>+</sup> and Cl<sup>-</sup> ions.

## Pharmaceuticals

The Acclaim Trinity P1 column provides optimum selectivity for various pharmaceutical counterions and drug substances using volatile mobile phases (e.g., ammonium acetate). Detection methods include Corona<sup>®</sup> Charged Aerosol Detection<sup>®</sup> (CAD<sup>®</sup>), Evaporative Light Scattering Detection (ELSD), Ultra-violet (UV), and Mass Spectroscopy (MS). Other HPLC mobile phases, such as phosphate buffers, can also be used depending on the specific application. The Corona CAD detector uses a unique and innovative detection method to detect nonvolatile analytes, and offers performance benefits unequaled by refractive index (RI), UV, ELS and chemiluminescence nitrogen (CLN) detectors. These benefits include high sensitivity (sub to single digit nanogram), excellent injection-to-injection reproducibility, wide dynamic range, and gradient compatibility. Therefore, the Corona CAD detector is the preferred detector for the Acclaim Trinity P1 column for simultaneous determination of Active Pharmaceutical Ingredients (API) and their counterions.

### Determinations of Pharmaceutical Counterions

Salt formation is a critical step in drug development because it provides improved biopharmaceutical and physicochemical properties, ease of purification and handling. Consequently,

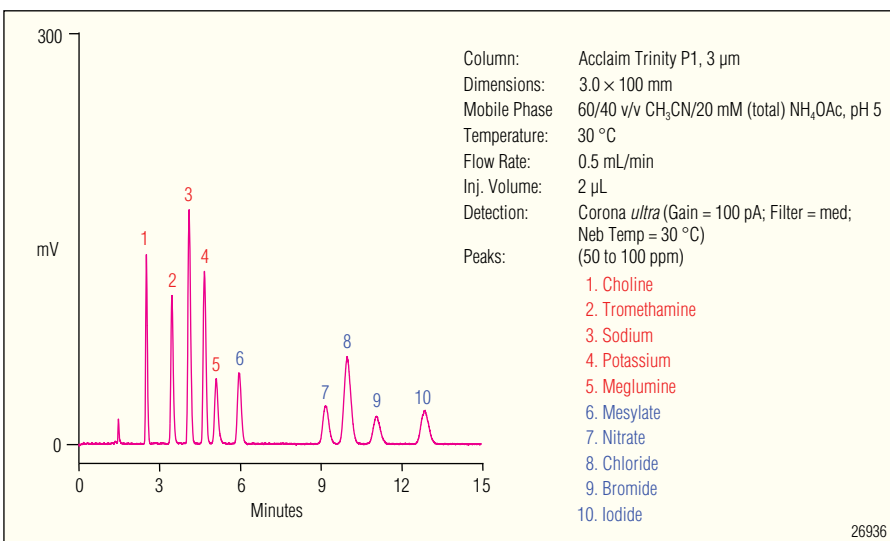


Figure 2. Simultaneous separation of pharmaceutical counterions (isocratic method).

approximately 50% of all drug molecules used in medicinal therapy are administered as salts.

In pharmaceutical formulations, the most commonly used counterions are sodium and chloride ions. While no other reversed-phase column can retain or separate them, the Acclaim Trinity P1 column overcomes this challenge by providing excellent separation and peak shapes for both analytes (Figure 1). The Corona detector exhibits superior, sub-ppm sensitivity compared to ELS detectors—5x better detection limits for sodium ion and 13x better for chloride ion.

Figure 2 demonstrates that the Acclaim Trinity P1 column provides ideal selectivity for separating pharmaceutical counterions (including both cations and anions) using acetonitrile/ ammonium acetate mobile phase and a Corona *ultra*<sup>™</sup> detector. Baseline separation of five cations and five anions is achieved within a single run. Note that column selectivity is designed such that cations elute before anions. This is the first and only column available that separates both cations and anions simply and reliably. The excellent selectivity for pharmaceutical counterions is also illustrated in Figure 3, where 16

commonly used pharmaceutical counterions (6 cations and 10 anions) are baseline resolved on a 50 mm column.

Basic amino acids are often used as pharmaceutical counterions or in pharmaceutical formulation. Figure 4 demonstrates the baseline separation of three amino acids (histidine, lysine, and arginine) and their counterion anion chloride, on a Trinity P1 column within 4 min.

### Simultaneous Separation of API and Counterions

In pharmaceutical development, determinations of APIs and counterions are two important assays. Due to the charge and/or hydrophobicity differences, APIs and counterions are usually analyzed by different chromatographic methods that require different separation columns and/or different instrumentation platforms. For example, reversed-phase liquid chromatography (RPLC) is most commonly used for analyzing APIs with intermediate to higher hydrophobicity, but it often fails to provide adequate retention for hydrophilic counterions. Ion chromatography (IC) provides a reliable, selective, and highly sensitive solution for counterions. As shown in Figures 5 and 6, simultaneous separations of hydrophobic and hydrophilic acidic drugs and respective counterions (naproxen sodium salt and penicillin G potassium salt) can be achieved with baseline resolution and excellent peak shapes on a 50 mm Trinity P1 column.

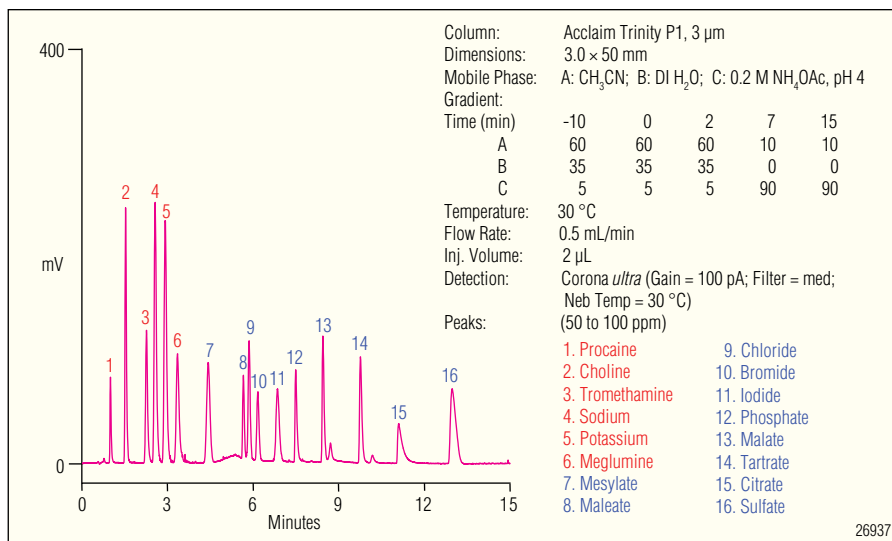


Figure 3. Simultaneous separation of pharmaceutical counterions (gradient method).

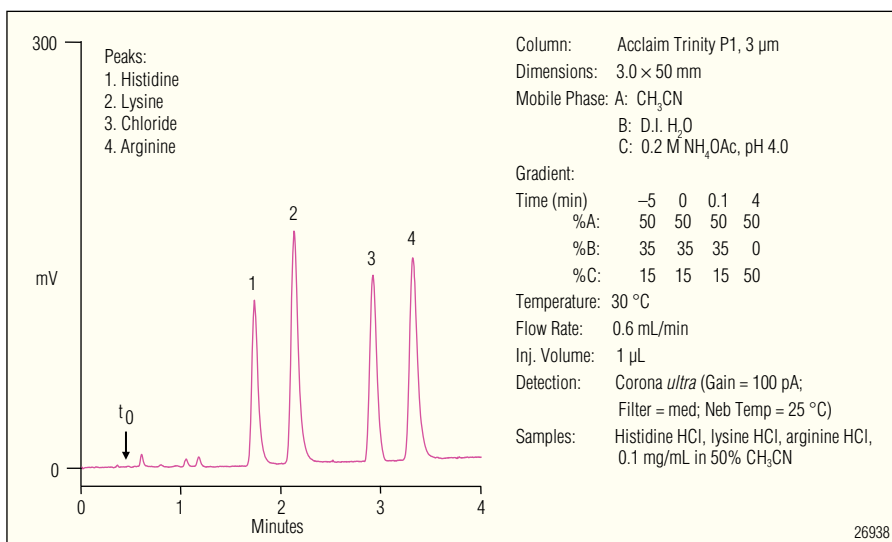


Figure 4. Separation of basic amino acids and chloride.

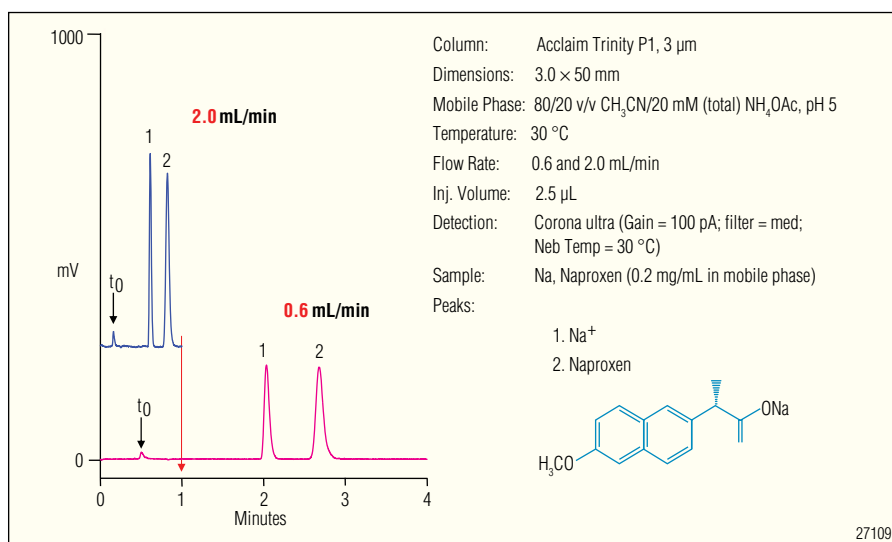


Figure 5. Separation of hydrophobic acidic API and the counterion (naproxen sodium salt).

Similarly, the Trinity P1 column can retain and separate both hydrophobic and hydrophilic basic APIs (trimipramine and dimethylbiguanide, respectively) with corresponding counterions (maleate and chloride) using simple isocratic methods (Figures 7 and 8).

### Drug Formulations

Figure 9 shows separation of Aleve® Sinus and Headache formula, which contains pseudoephedrine•HCl salt and naproxen sodium salt as active ingredients. Considering the charge difference and the significant difference in hydrophobicity, a gradient method is justified. First, the Na<sup>+</sup> ion elutes with low buffer concentration and low organic solvent followed by elution of pseudoephedrine. The Cl<sup>-</sup> ion elutes after simultaneously increasing both buffer and organic solvent and high buffer concentrations. Because pseudoephedrine cannot be observed by CAD due to its volatility, UV and CAD detectors are used in series to provide for complementary detection.

Another example is the separation of a mixture of basic and acidic drug substances in an Advil Allergy and Sinus medication that contains pseudoephedrine, trimipramine maleate, and ibuprofen (Figure 10). Using a gradient elution with acetonitrile and ammonium acetate buffer, all analytes of interest are well separated, baseline resolved, and free of interferences in < 3 min.

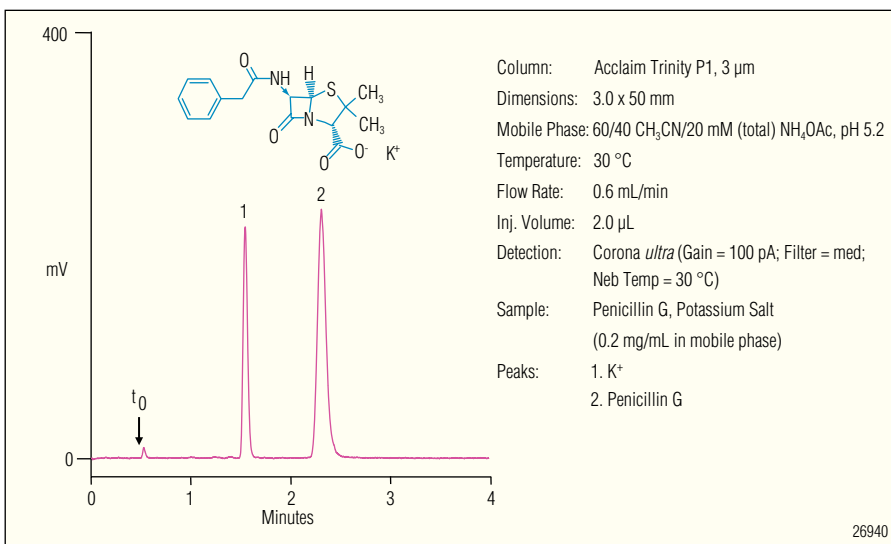


Figure 6. Separation of hydrophilic acidic API and the counterion (penicillin G potassium salt).

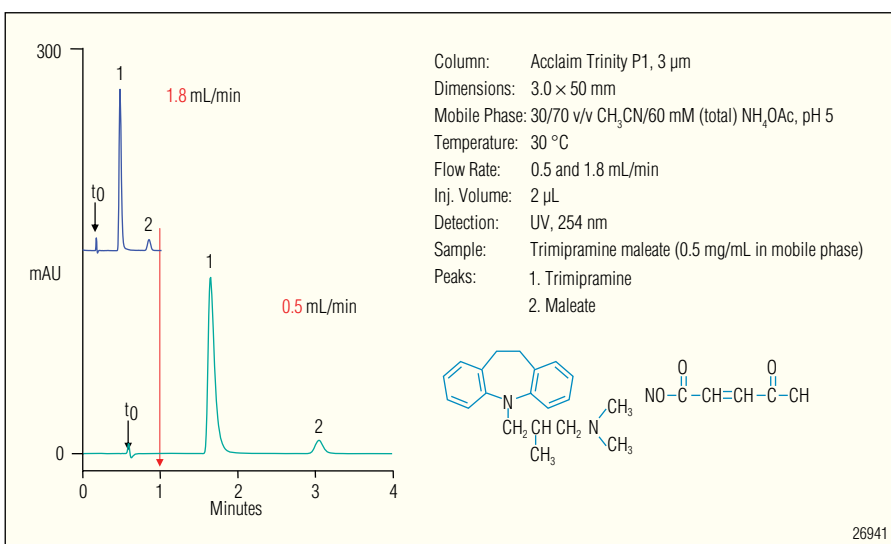


Figure 7. Separation of hydrophobic basic API and the counterion (trimipramine maleate).

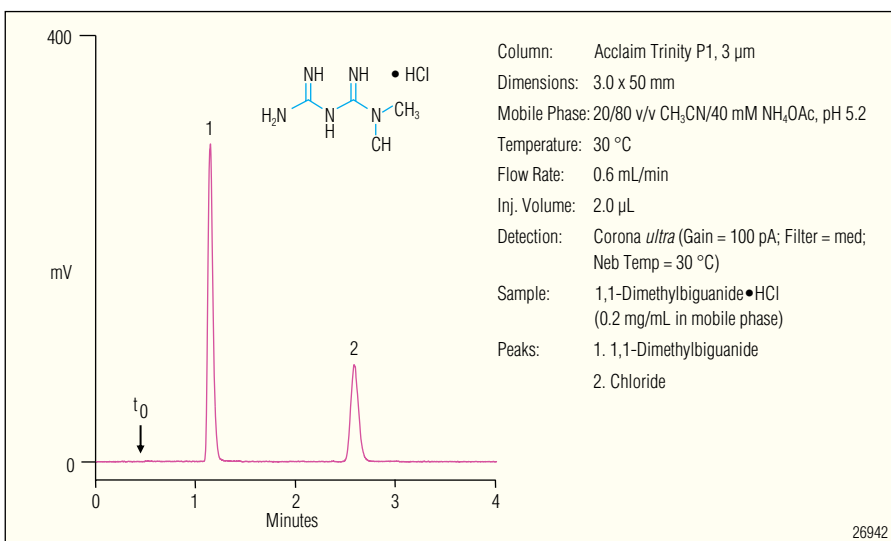


Figure 8. Separation of hydrophilic basic API and the counterion C<sub>4</sub>H<sub>11</sub>N<sub>5</sub>.

## High-Throughput Analysis

The adjustable selectivity of the Acclaim Trinity P1 column makes it useful for high-throughput analysis. Figure 5 shows the Na<sup>+</sup> ion and naproxen separated within 3 min (lower trace). Figure 6 shows the separation of the basic drug trimipramine and its counterion, maleate, increasing flow rate can accelerate the analysis from 3.2 min to < 1 min (Figure 7).

## Reproducible Manufacturing

Each Acclaim Trinity P1 column is manufactured to strict specifications to ensure column-to-column reproducibility. Each column is individually tested and shipped with a qualification assurance report.

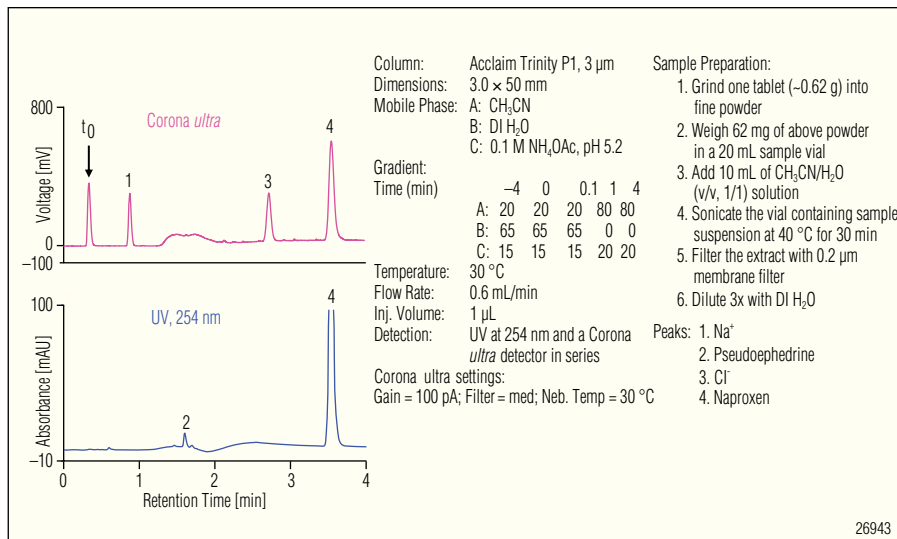


Figure 9. Separation of mixture of acidic and basic APIs and counterions: Aleve™ Sinus and Headache (OTC).

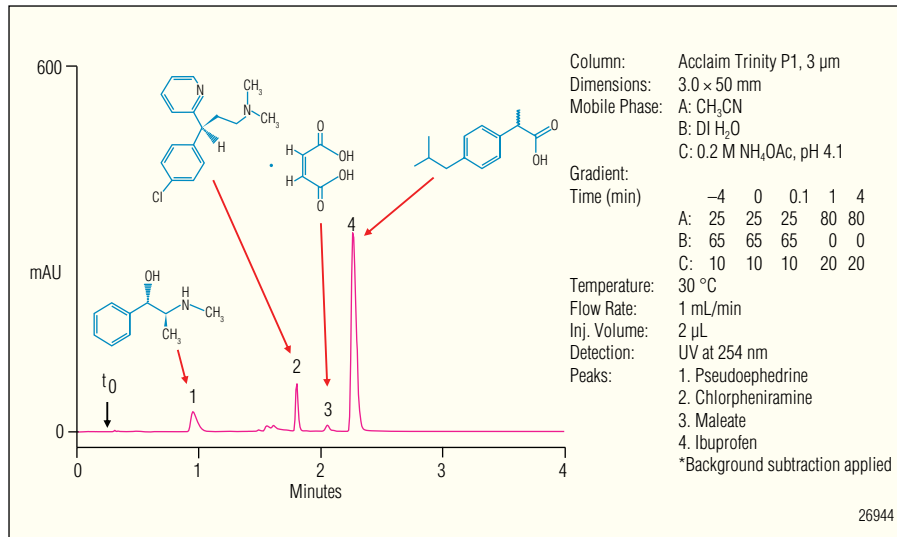


Figure 10. Separation of mixture of acidic and basic APIs and counterions: Advil Allergy and Sinus (OTC).

## SPECIFICATIONS

<i>Column Chemistry:</i> SCX, WAX, and RP Mixed-Mode	<i>Operating flow rate range (recommended):</i> 0.30–1.60 (0.4 to 1.0) mL/min for 3.0 mm i.d. formats
<i>Operating Pressure Limit:</i> 4500 psi	<i>Operating flow rate range (recommended):</i> 0.15–0.80 (0.2 to 0.5) mL/min for 2.1 mm i.d. formats
<i>Operating pH range (recommended):</i> 2.5–7.0 (3.0 to 6.0)	

## ORDERING INFORMATION

In the U.S., call (800) 346-6390 or contact the Dionex Regional Office nearest you. Outside the U.S., order through your local Dionex office or distributor. Refer the following part numbers:

Acclaim Trinity P1 Columns	Part Numbers
Acclaim Trinity P1, 3 µm 3.0 × 100 mm .....	071387
Acclaim Trinity P1, 3 µm 3.0 × 50 mm .....	071388
Acclaim Trinity P1, 3 µm 2.1 × 100 mm .....	071389
Acclaim Trinity P1, Guard, 3 µm 3.0 × 10 mm (2 ea.) .....	071390
Acclaim Trinity P1, Guard, 3 µm 2.1 × 10 mm (2 ea.) .....	071391
Acclaim SST Guard Cartridge Holder V-2 .....	069580
Acclaim SST Guard Holder Kit, V-2 (Holder V2 and Coupler) .....	069707
Acclaim SST Guard Coupler (V-2) .....	074188

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Advil is a registered trademark of Wyeth Corporation.

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