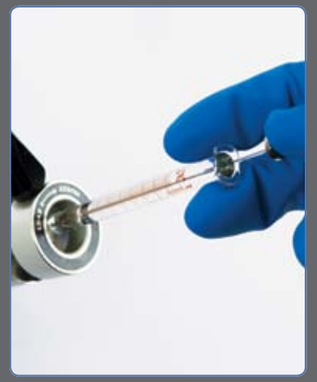
Innovation and excellence in chromatography

Hamilton Company has been developing and manufacturing pressure-stable polymeric high performance liquid chromatography (HPLC) columns for nearly 35 years. We are an established name in science whose products are found in most of the world's top chromatography labs. From columns to syringes to septa and more, Hamilton Company offers a full line of off-the-shelf and custom chromatography products for HPLC, gas chromatography (GC) and thin layer chromatography (TLC).

You can trust your results to Hamilton—The Measure of Excellence®

Custom columns built to your exact need

See more on page 48



HPLC syringes for every application

See more on page 53

PRP-C18 columns: Excellent for extreme pH conditions

See more on page 14

Table of Contents

For more information on the full portfolio of Hamilton HPLC columns and other chromatography products, please visit www.hamiltoncompany.com/HPLC or refer to the back of this catalog for additional contact details.

A LEADER IN HPLC

Hamilton: A Leader in HPLC

Founded on the invention of the Microliter™ syringe, Hamilton Company has been designing and innovating the industry's best syringes since 1953—not commercial, mass produced medical syringes, but syringes designed for precision sample measurement in chromatography instrumentation. Hamilton syringes have been trusted by chromatographers for nearly 60 years and for good reason—they are The Measure of Excellence.

Need a custom method? The Hamilton HPLC team is happy to help design your unique application. Give us a call to learn more.

The commitment to chromatography expanded into HPLC columns about 34 years ago. Hamilton was one of the first companies to understand the unique qualities of polymer-based columns and how the technology could advance the field of HPLC. Following significant research and advancements by its team of engineers and scientists, Hamilton's first line of pressure-stable polymeric HPLC columns was created, making it a pioneer in the development and manufacturing of polystyrene-divinylbenzene (PS-DVB) polymers for HPLC applications.

Types of HPLC columns

Hamilton offers 17 different polymer-based HPLC columns for reversed-phase, anion exchange, cation exchange and ion exclusion separations, and two silica-based C8 and C18 columns for traditional reversed-phase separations.

The supports in a polymer-based column combine the inertness and pH stability of polymeric resins with the pressure stability and durability of silica-based materials. With Hamilton Polymeric Reversed-Phase (PRP™) HPLC columns and resins, the sample dictates the necessary separation conditions, not the limitations of the column.

Superior polymeric HPLC columns, resins and applications are a Hamilton specialty.

Nineteen different column packing materials are available for almost any challenging separation, including:

- Reversed-phase
- Anion exchange
- Cation exchange
- Ion exclusion

Specialty resins are available for a variety of difficult separations, including:

- Pharmaceuticals
- Herbicides
- Carbohydrates
- Proteins
- Alcohols

Bulk resins, column hardware and guard columns

Hamilton offers a variety of HPLC accessories to complement its column line.

- Hamilton HPLC column resins are available in bulk from 1 gram to kilogram quantities
- Column hardware in an array of specifications
  - Inside diameters: From 1.0–100 mm
  - Lengths: 30–305 mm
  - Hardware materials: Stainless steel and PEEK (polymer plastic)
- Guard columns are available to match the functionality of the analytical to preparative column sizes
  - Available dimensions: 3.0 x 8.0 mm, 2.0 x 20 mm, 4.6 x 20 mm
  - Available hardware materials: Stainless steel and PEEK

From autosampler syringes to manual injection and more, Hamilton has the chromatography syringe you need. View the full portfolio of HPLC, GC and TLC syringes at www.hamiltoncompany.com/syringes.

Hamilton: Understanding Polymer Supports

What are polymer-based columns, and how are they different than silica?

Silica has its limitations. It requires functionalization for reversed-phase separations and is prone to chemical and pH degradation. Polymer resin manufacturing employs a unique process to produce, but it is this special science that makes them a truly viable and attractive alternative to silica-based materials. Polymer-based columns work comparably to silica-based columns, and, in many applications, perform even better. They can last for years, making them an easy and long-term cost savings alternative.

Basic polymer structure

Polymer columns come in steel or PEEK hardware, just like silica-based columns, but the particles inside are a rigid polymer matrix rather than silica. Styrene (vinyl benzene) readily forms a polymer because the vinyl groups link together to form a chain. Cross-linking within the styrene groups occurs with the addition of divinyl benzene (DVB), which has a second vinyl group (i.e., meta or para to the first one). Cross-linking forms a much stronger and more rigid polymer. For HPLC applications, sufficient DVB is used to give a high density of cross-links thereby creating a more robust polymer support available for HPLC. This reaction is precisely controlled, allowing the formation of small spherical particles with a very narrow particle size distribution (within ± 1 µm).

Advantages of polymers

Hamilton HPLC columns combine the best characteristics of silica-based and polymeric columns to arrive at a column that is highly inert and long-lasting. These characteristics are especially true for difficult analyses that require high pH (8–13), labile or reactive samples (e.g., irreversible adsorption), high aqueous purifications (80–100% water) and separations with ion pairing reagents.

POLYMER SUPPORTS

Alkaline pH stability

Mobile phase pH is a powerful tool in methods development, particularly for separation of neutral forms of amines or other organic bases under alkaline conditions. Although some recent C18 columns boast stability in alkaline pH, all silica-based supports experience measurable degradation at pH > 6, where column life is still considerably shorter than if used under more favorable conditions.

Polymeric columns, on the other hand, have genuine pH and chemical stability. The stationary phase stands up to prolonged exposure to concentrations as high as 1 M NaOH and H_2SO_4, with no measurable decrease in performance. Because the support does not strip, bleed, or dissolve at any pH, it can be expected to perform reliably and reproducibly throughout the extended life of the column, regardless of mobile phase conditions.

Durable, long life polymers

Some polymers are prone to swelling in high organic solvents, rendering higher back pressures, but this is not the case with Hamilton's materials since a high degree of cross-linking prevents this from happening. Hamilton's PS-DVB supports are cross-linked to prevent shrinking or swelling, making them pressure stable up to 5,000 psi. Since the support is entirely polymeric with no silica to deteriorate, typical polymer column lifetime is approximately one year as compared to 3–4 months for an equivalent silica-based C8 or C18 column under routine or extreme method conditions.

Long column life

The highly inert polymeric support resists chemical attack from organic solvents and aqueous buffers (0–100% aqueous or organic; pH 1–13), effectively lengthening column life. If column performance deteriorates (e.g., peak broadening and a loss of symmetry), a regeneration protocol will usually return the chromatography to its original state. Even caustics can be used in extreme column fouling situations to reverse the adverse effects. This durability is especially important since it gives the chromatographer the ability to clean and regenerate a more expensive preparative column without the need to replace it.

Wide application utility

The pH stability of Hamilton's polymer HPLC columns allows samples to be analyzed at basic pH (8–13). Some samples show a dramatic increase in their absorbance characteristics at basic pH. Altering the pH of the separation may not only increase a sample's detectability, it can also radically alter a compound's retention and the elution order of a sample. Changes in elution order can be used to determine sample purity and identity.

Cleaning and more

Polymer columns can be cleaned with 1.0 M sodium hydroxide or 100% organic solvent to remove strongly retained material and can be operated at much higher temperatures as compared to silica-based materials. They provide excellent sample recoveries due to the lack of acidic silanol groups associated with silica-based materials. Swelling in organic solvents such as THF or chloroform is negligible because of cross-linking.

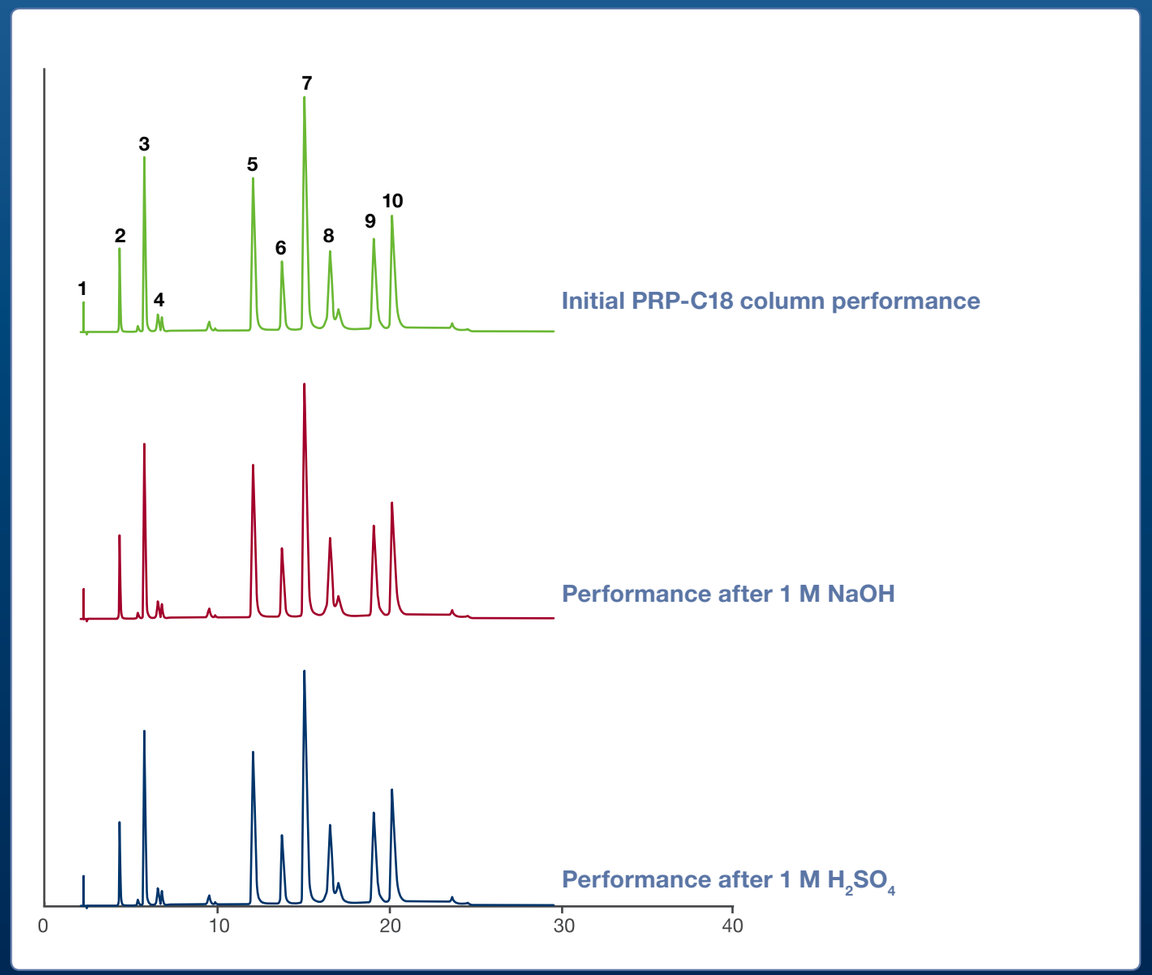
PS-DVB resins are similar in retention characteristics to silica C18 but do have a slightly different selectivity in some cases.

PRP-C18 Performance:
Before and after harsh conditions

To demonstrate the rugged, pH-stability of Hamilton polymeric HPLC columns, a 10-component test mixture was run on a PRP-C18 column to obtain an initial separation. The column was then subjected to 200 column volumes of 1 M sodium hydroxide and then tested once again with the initial conditions to demonstrate that there was no measurable deterioration. After the sodium hydroxide flush, the column was then subjected to 200 column volumes of 1 M sulfuric acid and then tested once again with the initial conditions to demonstrate that there was still no measurable deterioration.

These tests demonstrate that polymer-based columns, unlike silica-based columns, can be freed of otherwise irreversibly bound contaminants under conditions that normally shorten column life.

Hamilton is your partner. From determining the correct column for your application to post-purchase support and troubleshooting, the HPLC team is standing by and ready to help.



HPLC Columns by USP Listing

This guide identifies all Hamilton HPLC columns according to their United States Pharmacopeial Convention (USP) listing.

L17 Strong cation exchange resin consisting of sulfonated cross-linked styrene-divinylbenzene copolymer in the hydrogen form, 7 to 11 µm in diameter

L19 Strong cation exchange resin consisting of sulfonated cross-linked styrene-divinylbenzene copolymer in the calcium form, about 9 µm in diameter

L21 A rigid, spherical styrene-divinylbenzene copolymer, 3 to 10 µm in diameter

L22 A cation exchange resin made of porous polystyrene gel with sulfonic acid groups, about 10 µm in size

L23 An anion exchange resin made of porous polymethacrylate or polyacrylate gel with quaternary ammonium groups, about 10 µm in size

L34 Strong cation exchange resin consisting of sulfonated cross-linked styrene-divinylbenzene copolymer in the lead form, about 9 µm in diameter

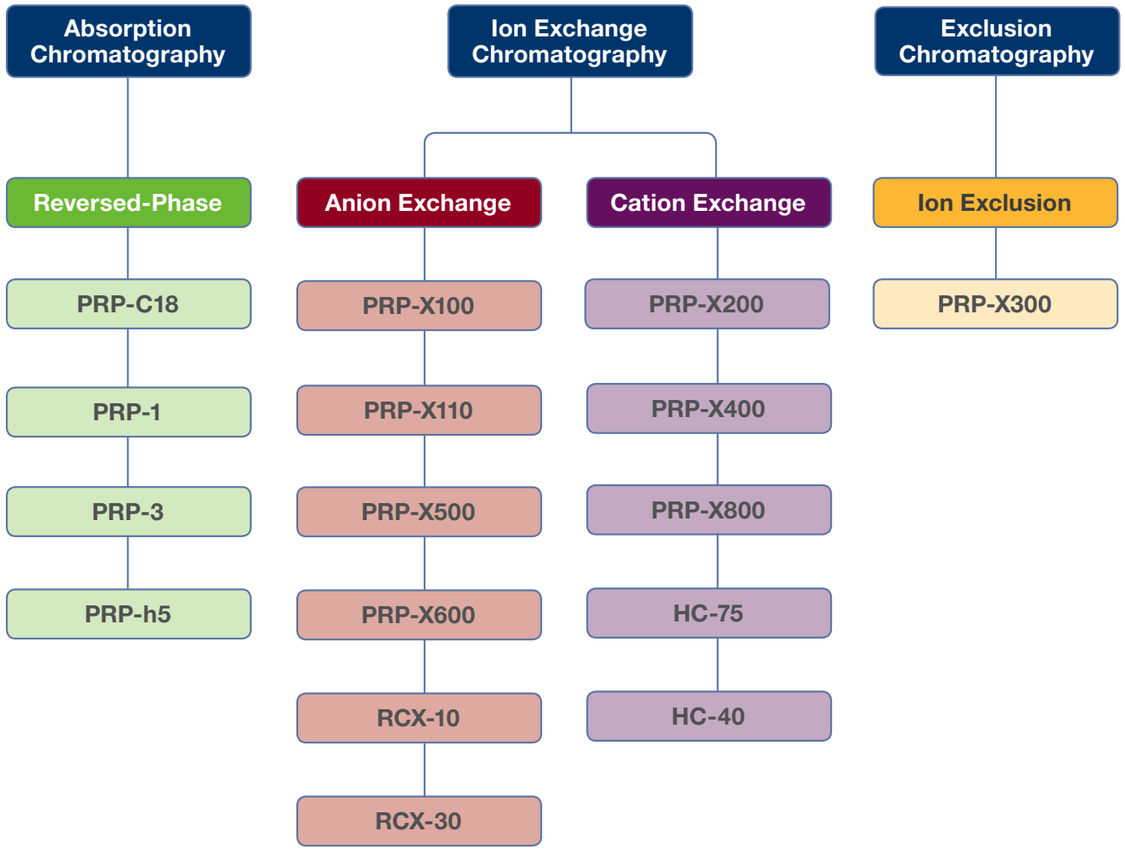
L47 High capacity anion exchange microporous substrate, fully functionalized with trimethylamine groups, 8 µm in diameter

At-a-Glance Product Selection Charts

From molecular weight to separation type to product families, these simple, at-a-glance guides help determine the right Hamilton HPLC column for any need.

For easy reference, each style of chromatography has a corresponding color that is also present in its product section within the catalog.

Products by separation mechanism



PRODUCT SELECTION CHARTS

Products by molecular weight