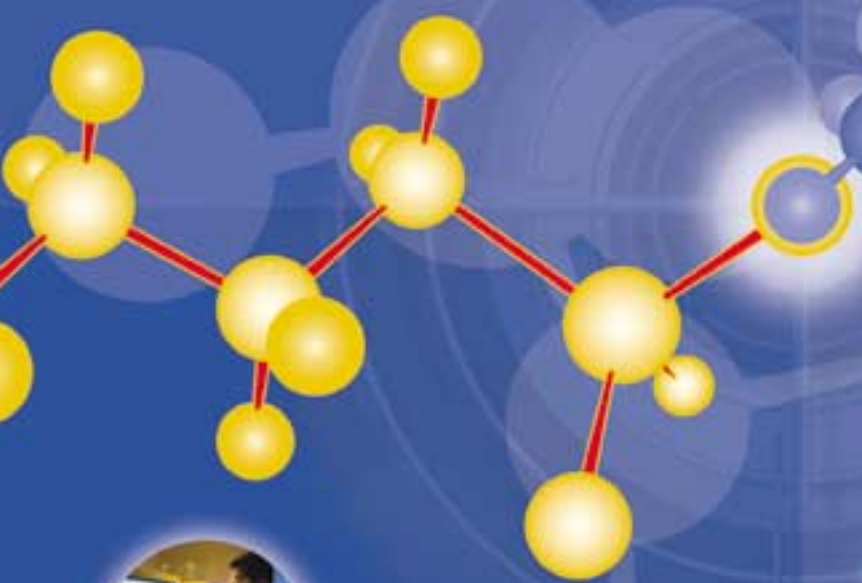
Chromatography Catalog



REGIS® TECHNOLOGIES, INC.

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Regis Technologies, Inc.

Regis Technologies, Inc. is proud of its continued growth and leadership role in its three areas of business:

- technically advanced chromatography products
- custom bulk pharmaceuticals and other fine organic chemicals
- chromatographic separations.

Chromatography

Regis has a long tradition of serving the analytical needs of scientists and researchers worldwide with its vast array of chromatography products and technical assistance. Regis manufactures an extensive line of chromatography stationary phases and high purity GC derivatization reagents. Regis is the exclusive manufacturer for the Pirkle-Type Chiral Stationary Phases for analytical, semi-preparative and preparative applications and separations. Regis is also the exclusive manufacturer of many other specialty HPLC phases.

Research and development are essential parts of our chromatography business that allows us to introduce new and innovative products that meet the needs of our customers.

Custom Synthesis

In addition to chromatography products, Regis manufactures Active Pharmaceutical Ingredients (APIs) and intermediates on a custom basis. Regis is committed to meeting the customer's needs through initial process development, scale-up and ongoing production. Our facility is run according to current Good Manufacturing Practices (cGMP) and is routinely inspected by the FDA. All pharmaceutical intermediates and final products are manufactured and tested to customer specifications. All technology developed for the customer is owned by the customer and all batch records are provided to the customer as well. In addition to APIs, Regis also produces and catalogs a number of fine organic chemicals. For a complete list, check our Web site at www.registech.com/portfolio.html.

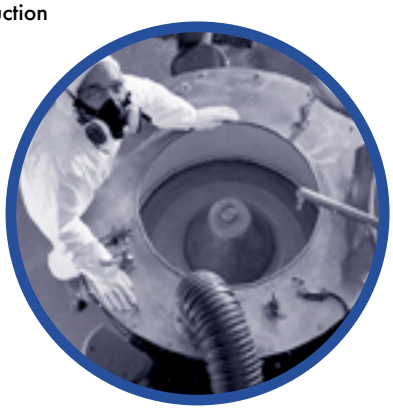
Preparative Chromatographic

Regis' production department includes a pilot plant dedicated to cGMP chromatography. Glass gravity columns are available in diameters of 4″, 6″, 9″ and 12″, with capacities of up to 50 kg of packing material. In addition, Regis has some preparative HPLC capability. We are currently limiting the use of the chromatography equipment to projects involving both custom synthesis and separations. Regis no longer accepts projects requiring only separations.

Regis Technologies, Inc.

Expanded Manufacturing Facility

The management at Regis continuously reinvests in the company. Between 1995 and 2001, Regis expanded and improved every lab and manufacturing area. This included a new production facility with six dedicated reactor suites, individual kilo lab suites, an expanded quality control department and the installation of a cryogenic reactor. Plans are underway for increasing capacity with additional production labs, individual kilo lab suites and reactor suites. The net result is repeat business from satisfied customers and low turnover because of satisfied employees. For updates on our expansion, check our Web site at www.registech.com/gmp/.



Quality Products and Services

Our high purity reagents and HPLC columns are manufactured on-site according to controlled manufacturing procedures and must meet strict quality control specifications before release. A full customer service and sales staff is available to answer questions and take orders. Regis also has a complete applications laboratory and knowledgeable technical support staff. With years of chromatography experience, our support staff is dedicated to assisting customers with method development, and column or reagent selection.

Regis is committed to its customer. With this in mind, you can expect Regis Technologies to provide the highest quality products, services and technical support as it continues to grow and meet the challenges of the future.

Conventional HPLC Columns

Conventional HPLC Columns

REXCHROM™ — Rugged and Reproducible

Regis applies its wealth of synthetic expertise in developing bonded stationary phases with superior chromatographic properties.

The REXCHROM stationary phases, with all parameters independently controlled and highly reproducible, satisfy our customers' demands for efficiency. Both 3 µm and 5 µm diameter particles have 200 m^2/g surface area, 100Å mean pore diameters and 0.5 cc/g pore volume.

In an effort to bring ruggedness and reproducibility to liquid chromatography, Regis pioneered the first reversible flow HPLC column. The advent of reversibility brought forth a more uniform, efficient, highly reproducible, and dependable column with extended life. Today, Regis continues to manufacture reversible flow columns in a wide variety of bonded phases.

The First Reversible Flow Column

Regis introduced the first truly reversible HPLC column in the early 1980s. Until that time, HPLC columns routinely carried specific flow direction indicators, and users were cautioned that flow in the opposite direction would destroy the column.

The ability to reverse flow direction is an important and distinctive feature of all Regis-manufactured columns. Routine reversal of flow direction leads to the following benefits, all of which can extend column life:

- **Cleaner outside frit surfaces**—reverse flow washes away dirt from the entrance frit
- **Deposit-free columns**—reverse flow, especially with pure solvents, dissolves and removes column deposits that may have built up near the column entrances
- **Fine-free inside frit surfaces**—periodic flow reversal holds fines near their point of origin rather than allowing them to accumulate at the exit frit.

All Regis columns are manufactured using an exclusive packing process resulting in an extensive line of high quality, highly reproducible HPLC columns available in a variety of column lengths, particle sizes, and bonded phases.

Quality Assurance

Regis manufactures its columns to the highest quality standards. Each column is packed and tested in accordance with specific control standards. Column performance reports along with care-and-use guides are included with each column.

For questions regarding applications, method development, or custom columns, contact Regis' Sales or Technical Service Department, or e-mail us at **sales@registech.com**.

REXCHROM Reversible Column Series

REXCHROM Conventional Columns

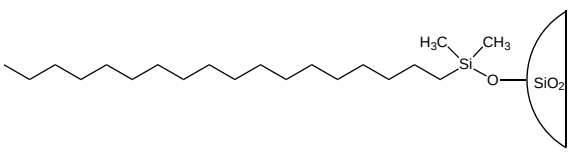
From its introduction as the first explicitly reversible HPLC column, the Regis REXCHROM Reversible has been the column of choice for efficiency, dependability, quality, and extended life. Each REXCHROM phase has a very uniform bonding chemistry. The specifications for the REXCHROM Column Series are detailed in the adjacent chart. These columns have demonstrated effective separations in a variety of applications.

Phase	Specifications Phase Loading, µmol/m² 5 µm	3 µm	Endcapping
ODS (C18)	2.9 ± 0.3	2.9 ± 0.3	Trimethylsilyl
Octyl (C8)	3.2 ± 0.3	3.2 ± 0.3	Trimethylsilyl
Phenyl	3.2 ± 0.3	3.2 ± 0.3	Trimethylsilyl
SAX	2.3 ± 0.5	2.3 ± 0.5	None
SCX	2.8 ± 0.5	2.8 ± 0.5	None
Nitrile	3.5 ± 0.3	3.5 ± 0.3	Trimethylsilyl
Amino	3.1 ± 0.3	3.1 ± 0.3	None

ODS (C18)

REXCHROM ODS Columns

This highly retentive phase is useful for the resolution of nonpolar and moderately polar compounds. For samples that require additional retention, this phase can easily be used in ion pair chromatography. The fully endcapped REXCHROM ODS not only provides high chromatographic efficiency but also excellent sample recovery for many compounds.



Product	Particle Size	Column Length and i.d.	Product #	U.S. Price
ODS (Little Champ II)	3 µm, 100Å	5 cm x 4.6 mm i.d.	731421	$275.00
ODS	3 µm, 100Å	10 cm x 4.6 mm i.d.	727118	$300.00
ODS	5 µm, 100Å	15 cm x 4.6 mm i.d.	728118	$300.00
ODS	5 µm, 100Å	25 cm x 4.6 mm i.d.	728218	$350.00
ODS	5 µm, 100Å	25 cm x 10.0 mm i.d.	728418	$925.00

Separation of Penicillins

Column: REXCHROM ODS, 5 µm, 100Å 25 cm x 4.6 mm i.d.

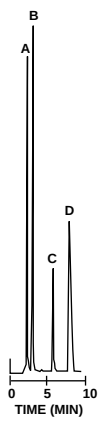
Mobile Phase: (77/23) 0.02 M potassium phosphate buffer, pH 6.8/ acetonitrile

Flow Rate: 1.0 mL/min

Load: 10 µL

Detection: UV 254 nm

Peak Identities:
A. Amoxicillin
B. Ampicillin
C. Benzyl Penicillin
D. Penicillin V



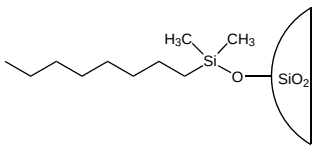
Product information and applications are available online at: **www.registech.com/hplc/.**

REXCHROM Reversible Column Series

Octyl (C8)

REXCHROM Octyl Columns

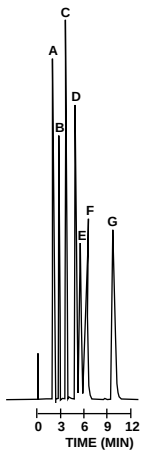
Similar to the highly popular ODS (C18) phase, this monomeric octyl stationary phase can easily resolve both low and moderately polar compounds without compromising column efficiency. Ideal for analyses that require rapid elution time, the fully endcapped octyl stationary phase is often used for herbicide, pharmaceutical, and amino acid applications.



Product	Particle Size	Column Length and i.d.	Product #	U.S. Price
Octyl	3 µm, 100Å	10 cm x 4.6 mm i.d.	727108	$300.00
Octyl	5 µm, 100Å	15 cm x 4.6 mm i.d.	728108	$300.00
Octyl	5 µm, 100Å	25 cm x 4.6 mm i.d.	728208	$350.00
Octyl	5 µm, 100Å	25 cm x 10.0 mm i.d.	728408	$925.00

Separation of Carboxylic Acids

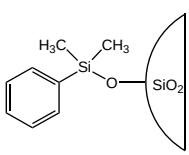
Column: REXCHROM Octyl (C8), 5 µm, 100Å
25 cm x 4.6 mm i.d.
Mobile Phase: 0.1 M phosphoric acid
Flow Rate: 1.5 mL/min
Load: 10 µL
Detection: UV 200 nm
Peak Identities:
A. Tartaric acid
B. Malic acid
C. Acetic acid
D. Maleic acid
E. Citric acid
F. Succinic acid
G. Propionic acid



Phenyl

REXCHROM Phenyl Columns

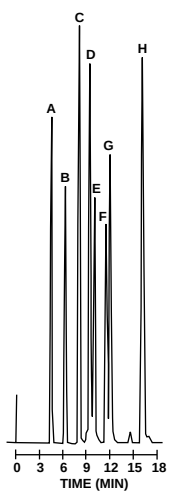
The phenyl bonded phases provide π–π interaction between the stationary phase and the analyte. This interaction permits excellent resolution and selectivity for polar aromatic compounds, such as chlorophenol and nitroanilines.

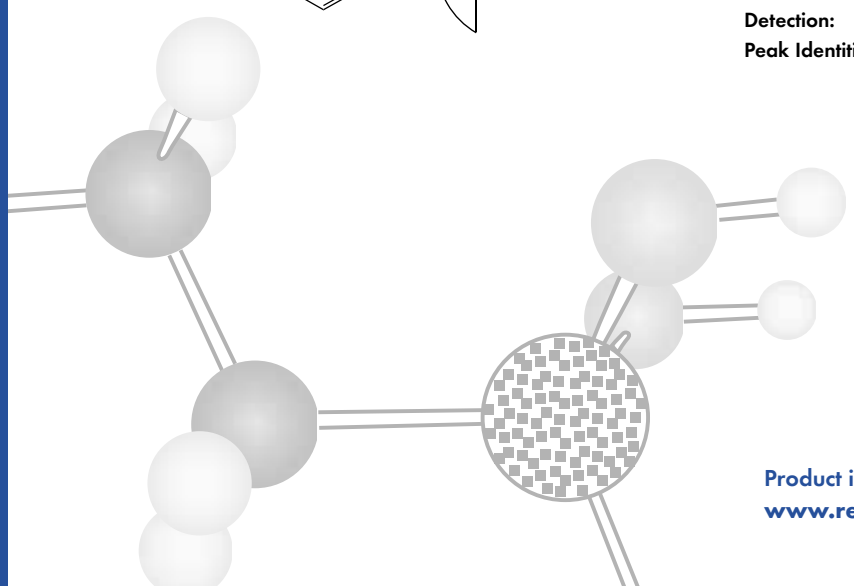


Product	Particle Size	Column Length and i.d.	Product #	U.S. Price
Phenyl	3 µm, 100Å	10 cm x 4.6 mm i.d.	727107	$300.00
Phenyl	5 µm, 100Å	15 cm x 4.6 mm i.d.	728107	$300.00
Phenyl	5 µm, 100Å	25 cm x 4.6 mm i.d.	728207	$350.00
Phenyl	5 µm, 100Å	25 cm x 10.0 mm i.d.	728407	$925.00

Separation of Aromatics

Column: REXCHROM Phenyl, 5 µm, 100Å
25 cm x 4.6 mm i.d.
Mobile Phase: (73/27) acetonitrile/water
Flow Rate: 1.0 mL/min
Load: 10 µL
Detection: UV 254 nm
Peak Identities:
A. Benzene
B. Naphthalene
C. Biphenyl
D Phenanthrene
E. Anthracene
F. Fluoranthrene
G. Pyrene
H. Chrysene





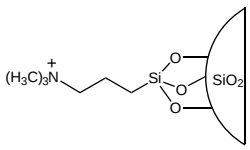
Product information and applications are available online at: www.registech.com/hplc/.

REXCHROM Reversible Column Series

SAX

REXCHROM SAX Columns

The quaternary ammonium functionality of this strong anion exchange (SAX) phase maintains a constant positive charge, thus allowing retention and separation of anionic analytes, such as oligonucleotides.



Product	Particle Size	Column Length and i.d.	Product #	U.S. Price
SAX	3 µm, 100Å	10 cm x 4.6 mm i.d.	727120	$300.00
SAX	5 µm, 100Å	15 cm x 4.6 mm i.d.	728120	$300.00
SAX	5 µm, 100Å	25 cm x 4.6 mm i.d.	728220	$350.00
SAX	5 µm, 100Å	25 cm x 10.0 mm i.d.	728420	$925.00

Separation of a Base Mixture

Column: REXCHROM SAX, 5 µm, 100Å
25 cm x 4.6 mm i.d.

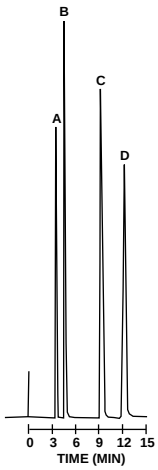
Mobile Phase: 0.05 M sodium dihydrogen phosphate buffer, pH 3.0

Flow Rate: 1.0 mL/min

Load: 10 µL

Detection: UV 254 nm

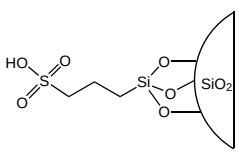
Peak Identities:
A. Cytidine
B. Adenosine
C. Uridine
D. Guanosine



SCX

REXCHROM SCX Columns

The strong cation exchange (SCX) phase relies on the negatively charged sulfonic acid functionality for separation of catecholamines, prostaglandins, and amino acids.



Product	Particle Size	Column Length and i.d.	Product #	U.S. Price
SCX	3 µm, 100Å	10 cm x 4.6 mm i.d.	727130	$300.00
SCX	5 µm, 100Å	15 cm x 4.6 mm i.d.	728130	$300.00
SCX	5 µm, 100Å	25 cm x 4.6 mm i.d.	728230	$350.00
SCX	5 µm, 100Å	25 cm x 10.0 mm i.d.	728430	$925.00

Separation of a Nucleotide Mixture

Column: REXCHROM SCX, 5 µm, 100Å
25 cm x 4.6 mm i.d.

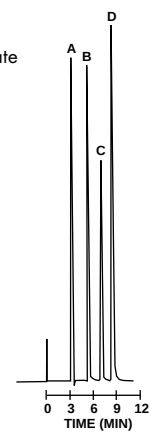
Mobile Phase: (95/5) 0.2 M ammonium dihydrogen phosphate buffer, pH 3.0/acetonitrile

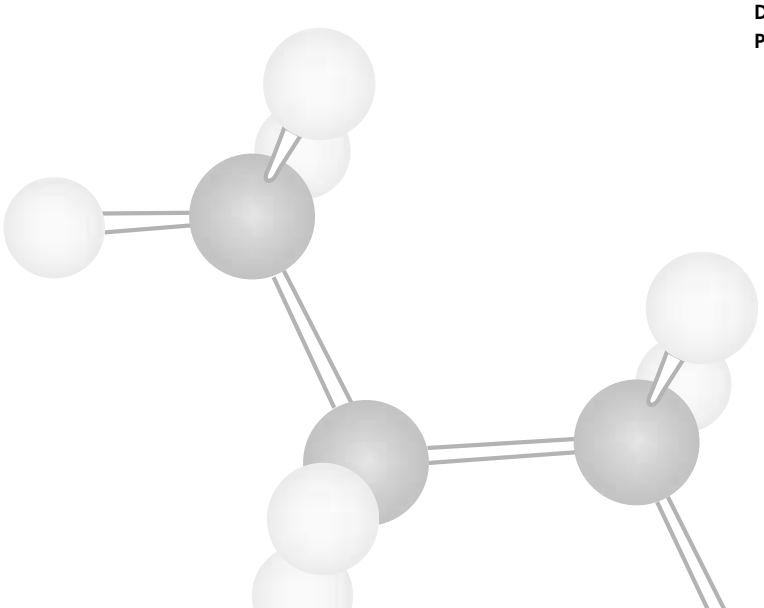
Flow Rate: 1.0 mL/min

Load: 10 µL

Detection: UV 254 nm

Peak Identities:
A. Uracil
B. Guanine
C. Cytosine
D. Adenine





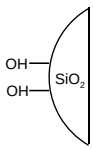
Product information and applications are available online at: www.registech.com/hplc/.

REXCHROM Reversible Column Series

Silica

REXCHROM Silica Columns

Most closely resembling the phases used in thin layer chromatography (TLC), silica columns easily separate compounds containing polar functional groups, such as steroids and sterols.

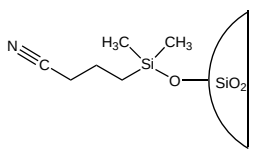


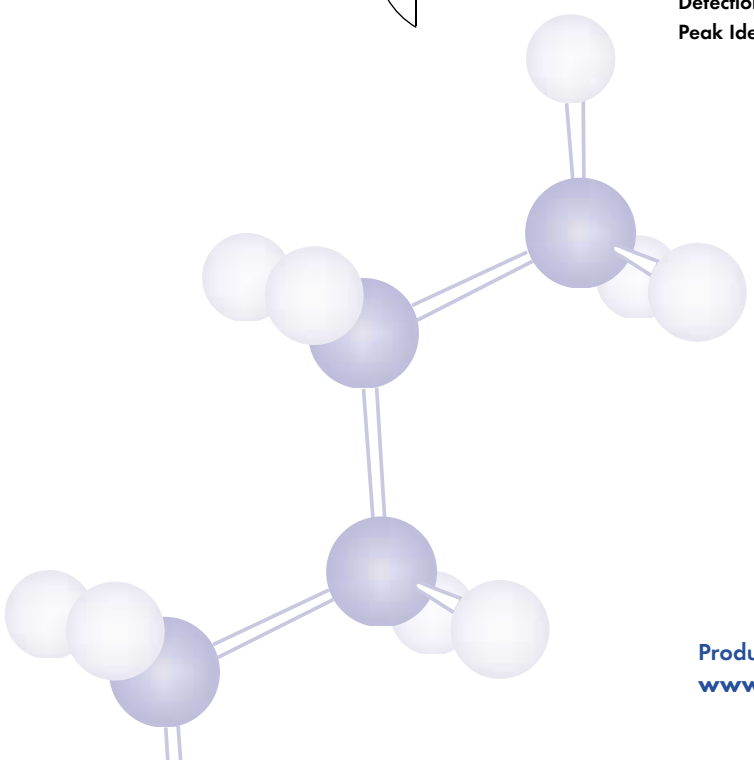
Product	Particle Size	Column Length and i.d.	Product #	U.S. Price
Silica	5 µm, 100Å	15 cm x 4.6 mm i.d.	728100	$280.00
Silica	5 µm, 100Å	25 cm x 4.6 mm i.d.	728200	$325.00
Silica	5 µm, 100Å	25 cm x 10.0 mm i.d.	728400	$825.00

Nitrile

REXCHROM Nitrile Columns

When used in normal-phase applications, nitrile bonded phases are often preferred over silica. They are less polar than silica, exhibit different selectivity and yield faster separations. Nitrile phases, in reversed-phase modes, behave as short chain alkyls with increased selectivity.





Product	Particle Size	Column Length and i.d.	Product #	U.S. Price
Nitrile	3 µm, 100Å	10 cm x 4.6 mm i.d.	727105	$300.00
Nitrile	5 µm, 100Å	15 cm x 4.6 mm i.d.	728105	$300.00
Nitrile	5 µm, 100Å	25 cm x 4.6 mm i.d.	728205	$350.00
Nitrile	5 µm, 100Å	25 cm x 10.0 mm i.d.	728405	$925.00

Separation of Anticonvulsants

Column: REXCHROM Nitrile, 5 µm, 100Å
25 cm x 4.6 mm i.d.

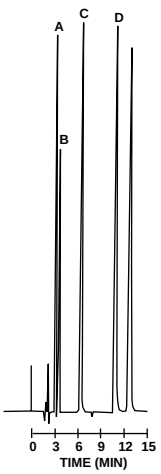
Mobile Phase: (78/22) 0.01 M sodium dihydrogen phosphate buffer/acetonitrile

Flow Rate: 1.5 mL/min

Load: 10 µL

Detection: UV 254 nm

Peak Identities:
A. Ethosuximide
B. Primidone
C. Phenobarbital
D. Carbamazepine
E. Diphenylhydantoin

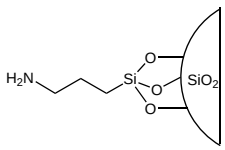


Product information and applications are available online at: www.registech.com/hplc/.

Amino

REXCHROM Amino Columns

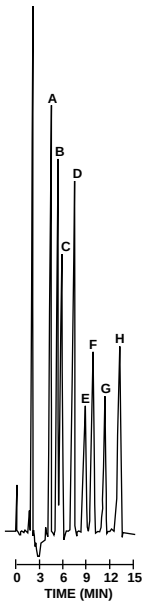
This amino phase possesses unique characteristics that allow it to be used in normal-phase, reversed-phase, and weak anion exchange applications. In reversed-phase conditions, this phase can resolve samples containing polyaromatic hydrocarbons. However, it should not be used with amine-reactive solutes such as aldehydes, ketones, or peroxides.

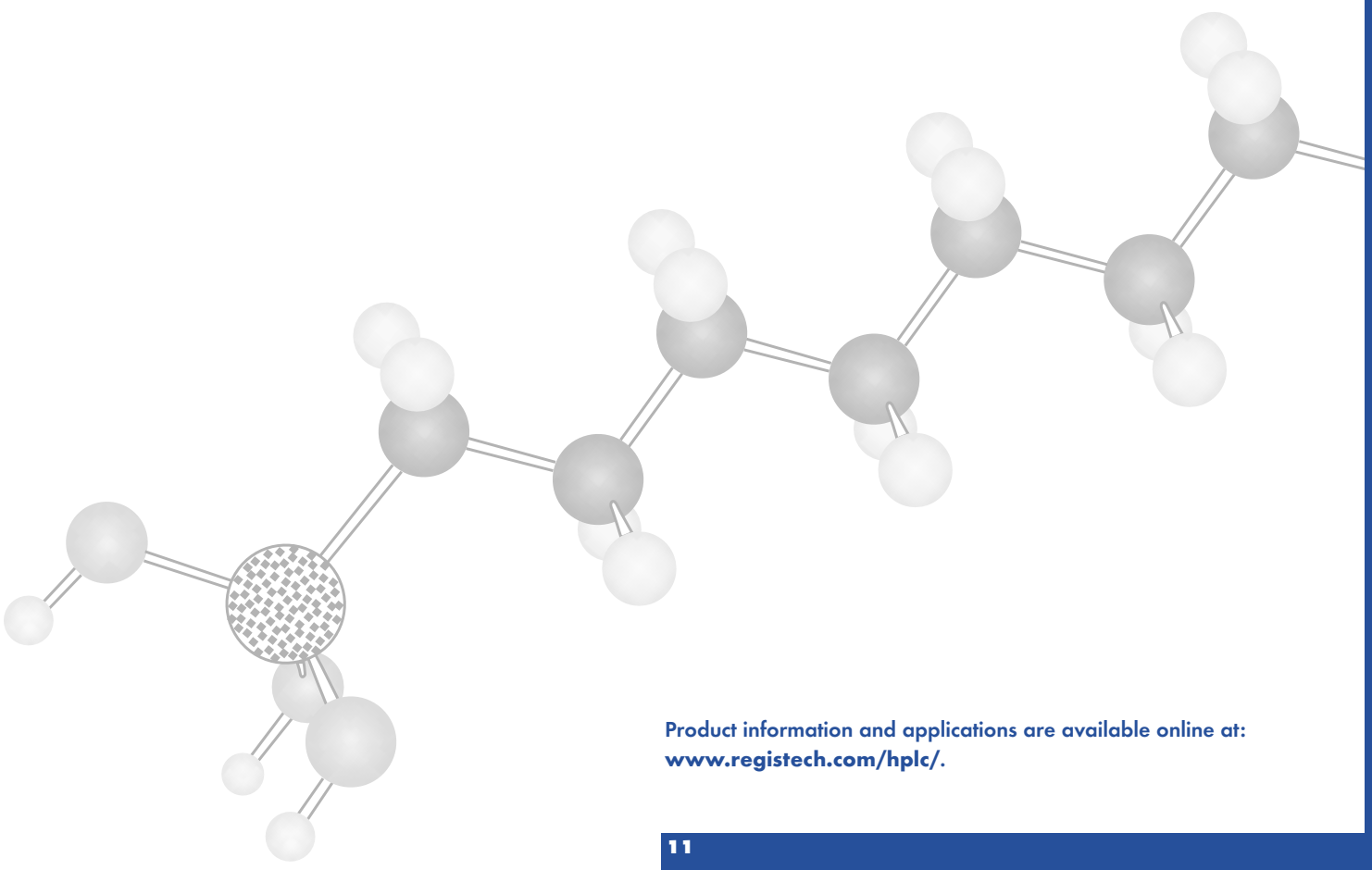


Product	Particle Size	Column Length and i.d.	Product #	U.S. Price
Amino	3 µm, 100Å	10 cm x 4.6 mm i.d.	727103	$300.00
Amino	5 µm, 100Å	15 cm x 4.6 mm i.d.	728103	$300.00
Amino	5 µm, 100Å	25 cm x 4.6 mm i.d.	728203	$350.00
Amino	5 µm, 100Å	25 cm x 10.0 mm i.d.	728403	$925.00

Separation of Sugars

Column: REXCHROM Amino, 5 µm, 100Å
25 cm x 4.6 mm i.d.
Mobile Phase: (72/28) acetonitrile/water
Flow Rate: 1.5 mL/min
Load: 10 µL
Detection: UV 192 nm
Peak Identities:
A. Xylose
B. Fructose
C. Glucose
D. Sucrose
E. Maltose
F. Lactose
G. Melezitose
H. Raffinose





Product information and applications are available online at:
www.registech.com/hplc/.

Little Champ II

Little Champ II Columns

As the first commercially available 5 cm, 3 µm ODS column, the Regis Little Champ became well accepted for its rapid, efficient, and effective separations. No other product could match the versatility of this column.

Like its predecessor (the Little Champ), the Little Champ II is a popular choice with chromatographers. Starting with 3 µm silica and improved ODS bonding chemistry, this multifaceted column repeatedly outperforms larger columns and yields clean separations in minimal time. The Little Champ II has demonstrated application excellence in:

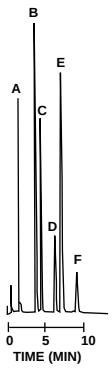
- Process monitoring
- Routine analysis
- Enzyme separations
- Combinatorial chemistry

Recently, the Little Champ II has proven to be effective in combinatorial chemistry, where it has been used in automated high throughput separations. These separations are easily scaled up to the larger 10 mm i.d. preparative version of this column.

Product	Particle Size	Column Length and i.d.	Product #	U.S. Price
Little Champ II	3 µm, 100Å	5 cm x 4.6 mm i.d.	731421	$275.00

Rapid Separation of Catecholamines

Column: REXCHROM Little Champ II (ODS), 3 µm, 100Å 5 cm x 4.6 mm i.d.
Mobile Phase: (82/18) 0.005 M S8 ion pair concentrates/ methanol, pH 2.5
Flow Rate: 1.0 mL/min
Load: 10 µL
Detection: UV 280 nm
Peak Identities:
A. 3,4-Dihydroxyphenylacetic acid
B. Norepinephrine
C. Epinephrine
D. 3,4-Dihydroxybenzylamine
E. 3,4-Dihydroxyphenylalanine
F. Dopamine



Val-U-Pak HP

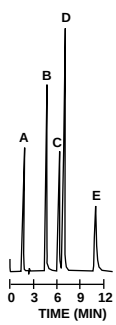
Val-U-Pak HP Columns

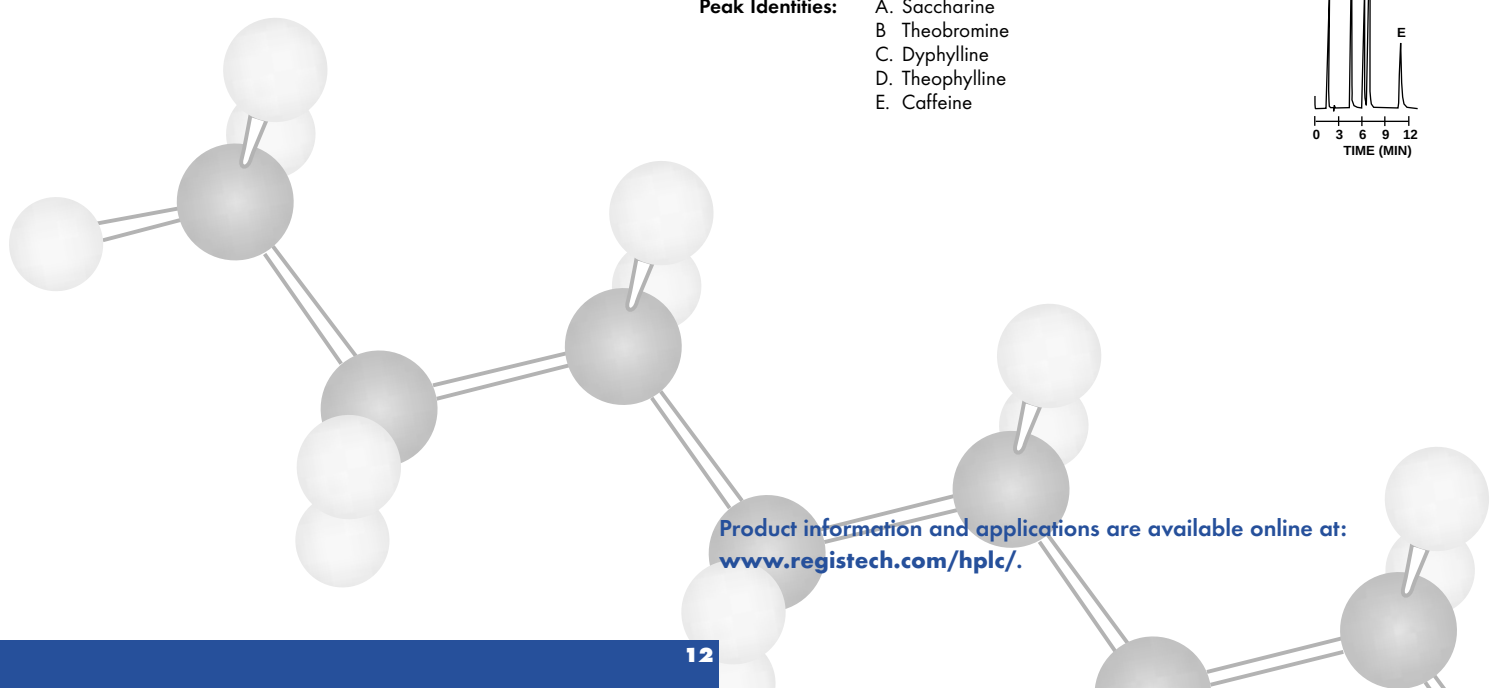
Regis offers the Val-U-Pak HP in an effort to provide a high performance and highly efficient column at the lowest possible price. This column contains spherical, 5 µm, 100Å, fully endcapped ODS silica. The Val-U-Pak HP column is batch tested, eliminating the expense of individual testing. The low cost of a Val-U-Pak HP permits the dedication of a column to a specific application.

Product	Particle Size	Column Length and i.d.	Product #	U.S. Price
Val-U-Pak HP	5 µm, 100Å	25 cm x 4.6 mm i.d.	731901	$300.00
Val-U-Pak HP	5 µm, 100Å	25 cm x 10.0 mm i.d.	731903	$825.00

Separation of Saccharine and Alkaloids

Column: REXCHROM Val-U-Pak HP (ODS), 5 µm, 100Å 25 cm x 4.6 mm i.d.
Mobile Phase: (75/25) methanol/water
Flow Rate: 1.0 mL/min
Load: 10 µL
Detection: UV 254 nm
Peak Identities:
A. Saccharine
B Theobromine
C. Dyphylline
D. Theophylline
E. Caffeine





Product information and applications are available online at: www.registech.com/hplc/.

REXCHROM Reversible Utility Column Series

Base Columns

REXCHROM Base Columns

In the past, the separation of basic compounds by HPLC has been generally unsuccessful. Base columns, developed specifically for this class of compounds, often have low efficiencies which, in turn, adversely affect both resolution and peak shape. The primary cause of this low efficiency is residual acidic sites on the silica, which interact with the basic analytes. Often the modification of mobile phase concentration and components is not a sufficient remedy.

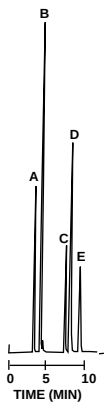
REXCHROM base columns, available in both octyl and ODS bonded phases, virtually eliminate the problem of residual acidic sites. Diligent monitoring during the base deactivation procedure results in the complete masking of these acidic sites. With this new generation of columns, separations can be performed easily with mobile phases of either aqueous methanol or acetonitrile – no buffers are necessary.

Product	Particle Size	Column Length and i.d.	Product #	U.S. Price
ODS	5 µm, 100Å	15 cm x 4.6 mm i.d.	728618	$380.00
ODS	5 µm, 100Å	25 cm x 4.6 mm i.d	728718	$400.00
Octyl	5 µm, 100Å	15 cm x 4.6 mm i.d	728608	$380.00
Octyl	5 µm, 100Å	25 cm x 4.6 mm i.d	728708	$400.00

Separation of a Well-Known Tailing Mixture

Column: REXCHROM BASE ODS, 5 µm, 100Å
25 cm x 4.6 mm i.d.
Mobile Phase: (85/15) acetonitrile/water
Flow Rate: 1.0 mL/min
Load: 10 µL
Detection: UV 254 nm
Peak Identities:
A. 5-Phenyl-1-pentanol
B. N,N-Diethylaniline
C. 1-Phenylhexane
D. 2,6-Di-*tert*-butylpyridine
E. 1-Phenylheptane

Reference: Kohler, J.; Kirkland, J. J.; *J.Chromatog.* **1987**, *385*, 125–150.

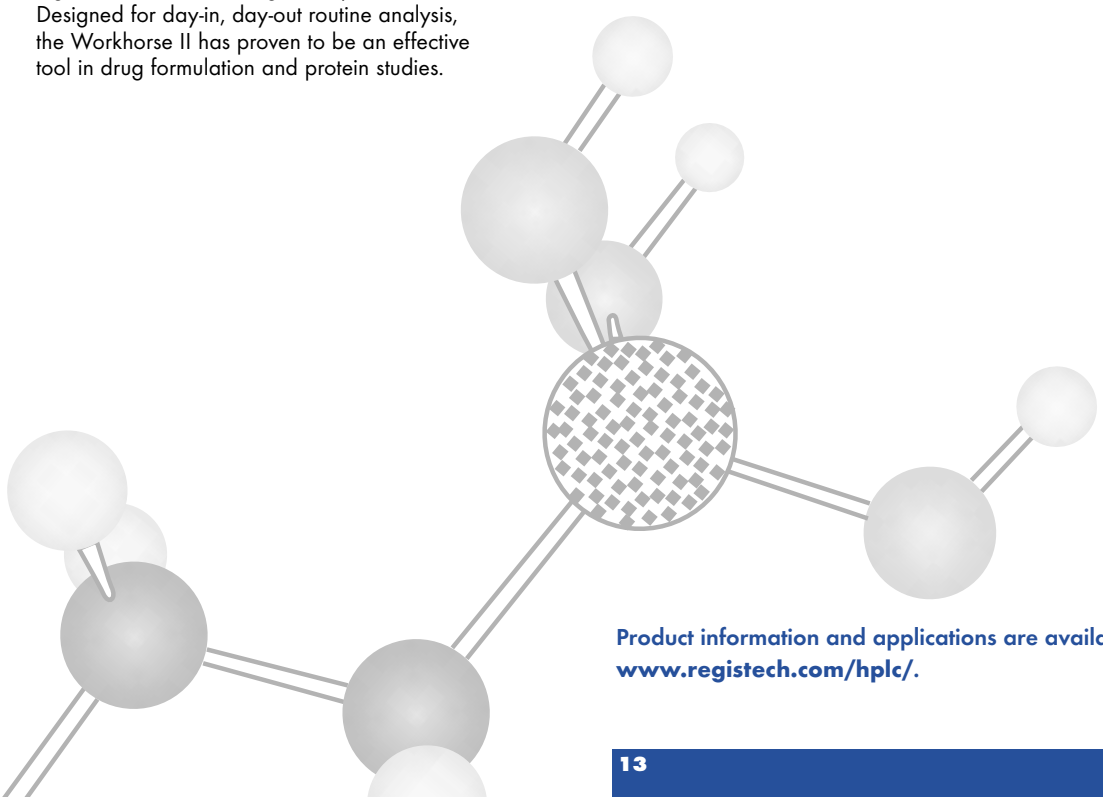


Workhorse II

Workhorse II ODS Column

For separations in which longer column length and low back pressures are essential, Regis offers the ODS Workhorse II column. This 30 cm column containing spherical 10 µm particles allows both higher flow rates and larger sample volumes. Designed for day-in, day-out routine analysis, the Workhorse II has proven to be an effective tool in drug formulation and protein studies.

Product	Particle Size	Column Length and i.d.	Product #	U.S. Price
ODS	10 µm, 100Å	30 cm x 4.6 mm i.d.	731128	$350.00



Product information and applications are available online at: www.registech.com/hplc/.

REXCHROM Guard Columns

Guard Columns

REXCHROM Guard Columns

The routine use of a guard column will significantly extend the life of any analytical column. Ideally, guard columns need to retain irreversibly adsorbed materials and be chromatographically efficient.

Regis offers a wide variety of 3 µm and 5 µm guard cartridges, conveniently packaged either in a kit or replacement set. The kit is comprised of two disposable guard cartridges, a reusable holder, and a column coupler. The replacement set contains three guard cartridges.

The guard cartridges, which contain spherical material, are packed in 1 cm x 3.0 mm i.d. columns. Proficient packing, like that of the analytical columns, allows the guard column to be used in either flow direction.

Product	Particle Size	Column Length and i.d.	Product #	U.S. Price
ODS (C18) Guard Kit*	3 µm, 100Å	1.0 cm x 3.0 mm i.d.	721184	$225.00
ODS (C18) Guard Kit replacements**			721185	$130.00
ODS (C18) Guard Kit*	5 µm, 100Å	1.0 cm x 3.0 mm i.d.	741174	$200.00
ODS (C18) Guard Kit replacements**			741175	$120.00
Octyl (C8) Guard Kit*	3 µm, 100Å	1.0 cm x 3.0 mm i.d.	721084	$225.00
Octyl (C8) Guard Kit replacements**			721085	$130.00
Octyl (C8) Guard Kit*	5 µm, 100Å	1.0 cm x 3.0 mm i.d.	741084	$200.00
Octyl (C8) Guard Kit replacements**			741085	$120.00
Phenyl Guard Kit*	3 µm, 100Å	1.0 cm x 3.0 mm i.d.	721074	$225.00
Phenyl Guard Kit replacements**			721075	$130.00
Phenyl Guard Kit*	5 µm, 100Å	1.0 cm x 3.0 mm i.d.	741074	$200.00
Phenyl Guard Kit replacements**			741075	$120.00
SAX Guard Kit*	3 µm, 100Å	1.0 cm x 3.0 mm i.d.	721304	$225.00
SAX Guard Kit replacements**			721305	$130.00
SAX Guard Kit*	5 µm, 100Å	1.0 cm x 3.0 mm i.d.	741304	$200.00
SAX Guard Kit replacements**			741305	$120.00
SCX Guard Kit*	3 µm, 100Å	1.0 cm x 3.0 mm i.d.	721334	$225.00
SCX Guard Kit replacements**			721335	$130.00
SCX Guard Kit*	5 µm, 100Å	1.0 cm x 3.0 mm i.d.	741314	$200.00
SCX Guard Kit replacements**			741315	$120.00
Nitrile Guard Kit*	3 µm, 100Å	1.0 cm x 3.0 mm i.d.	721054	$225.00
Nitrile Guard Kit replacements**			721055	$130.00
Nitrile Guard Kit*	5 µm, 100Å	1.0 cm x 3.0 mm i.d.	741054	$200.00
Nitrile Guard Kit replacements**			741055	$120.00
Amino Guard Kit*	3 µm, 100Å	1.0 cm x 3.0 mm i.d.	721034	$225.00
Amino Guard Kit replacements**			721035	$130.00
Amino Guard Kit*	5 µm, 100Å	1.0 cm x 3.0 mm i.d.	741034	$200.00
Amino Guard Kit replacements**			741035	$120.00

* Includes: 1 holder, 1 coupler, 2 guard cartridges

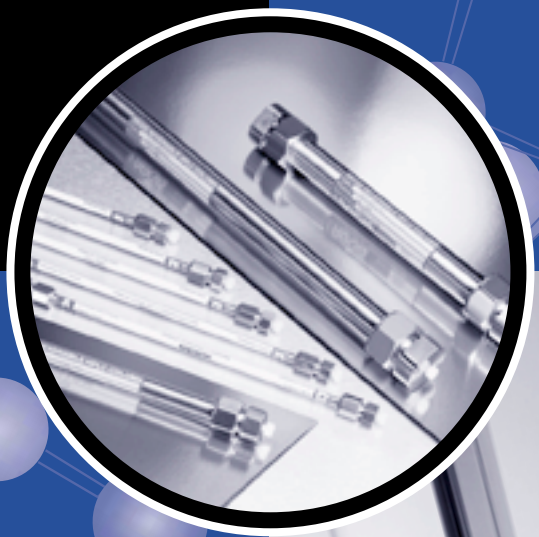
** Includes: 3 guard cartridges

Product Accessories	Product #	U.S. Price
Replacement guard cartridge holder for analytical columns	731441	$125.00
Internal fitting coupler for analytical columns	731443	$35.00

For additional information on Conventional HPLC Columns, check our Web site at www.registech.com/hplc/ or contact Regis at:

(800) 323-8144 ext. 649
(847) 967-6000 ext. 649
e-mail us at: sales@registech.com.

Chiral Stationary Phases



Chiral Stationary Phases

Chirality has become vitally important in the pharmaceutical, chemical and agricultural industries.

The differences which make compounds chiral can produce critically different pharmacological effects in biological systems. As a result, demand for stereoselective separation techniques and analytical assays to evaluate the enantiomeric purity of chiral compounds has increased.

Chiral chromatography has become a necessary tool—not only for the analytical determination of enantiomeric purity, but also for the isolation of pure enantiomers.

Chiral Chromatography

Regis Technologies is proud to be a leader in chiral separations and serve both the analytical and preparative needs of chromatographers and researchers worldwide. Regis offers three different classes of Chiral Stationary Phases (CSPs):

- Pirkle-Concept
- Davankov Ligand Exchange
- Protein-based

Regis manufactures a complete line of Pirkle Chiral Stationary Phases and Davankov Ligand Exchange columns at its pharmaceutical manufacturing facility. Columns range from analytical to preparative in size. A line of protein-based chiral stationary phases is also available. All products meet rigorous manufacturing and quality control specifications before release.

Pirkle Stationary Phases

In 1980, Regis Technologies, along with Professor William Pirkle, of the University of Illinois, introduced the Pirkle Chiral Stationary Phases. These Chiral Stationary Phases offer many advantages:

- Enantiomer separation on a wide variety of compound groups
- Column durability resulting from covalent phase bonding
- Ability to invert elution order
- Availability of analytical- to preparative-sized columns and bulk packing material
- Universal solvent compatibility

Enantiomer Separation

Regis manufactures ten Pirkle CSPs. These can separate a wide variety of enantiomers in numerous compound groups. Examples include:

- Aryl Propionic Acid Non-Sterodial Anti-Inflammatory Drugs (NSAIDs)
- Agricultural Compounds
- Natural Products
- β–Blockers
- Many Pharmaceuticals

Additional examples of enantiomer separations can be found in the Regis Chiral Application Guide IV or on our Web site at www.registech.com/chiral/. Our Web site is updated monthly with new applications and current chiral events.

Column Durability

The Pirkle Chiral Stationary Phases are covalently bonded to the silica, providing excellent column durability. Covalently bonded phases assure long-lasting columns and offer added benefits for preparative columns. Covalently bonded preparative columns are longer lasting than their coated, preparative column counterparts because with use, noncovalent coatings can leach off. Additional benefits include the columns' capacity to tolerate sample overload.

Ability to Invert Elution Order

An important advantage of the Pirkle Chiral Stationary Phases is the ability to invert elution order by using the same type of CSP, but with the opposite absolute configuration. As a result, it is possible to have the trace enantiomer elute before the major – a desirable feature for enantiomeric purity determinations. For preparative separations it is beneficial to elute the desired component first.

Analytical and Preparative-Sized Columns

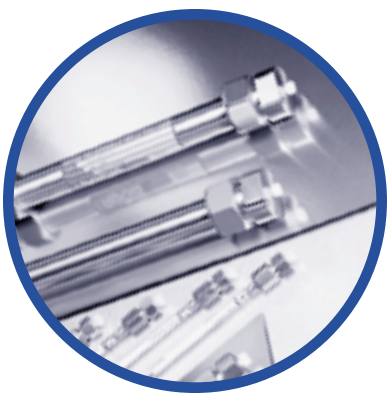
All of Regis' Pirkle HPLC columns are available in both analytical and preparative sizes. Since all chiral stationary phases are manufactured on-site, Regis can pack special or custom-sized columns quickly and easily.

Universal Solvent Compatibility

Choice of mobile phase is not a limitation with the Pirkle HPLC columns. They are compatible with most mobile phases. The pH of the mobile phase, however, must be between 2.5 and 7.5. **Both normal-phase and reversed-phase modes can be used**, although normal-phase is most common. For normal-phase separations, the classic mobile phase is a binary or ternary mixture of a hydrocarbon and a modifier, usually an aliphatic alcohol.

Typical uncharged organic modifers include ethanol, isopropanol and butanol. Under reversed-phase conditions, water-alcohol mixtures or aqueous phosphate buffers with charged organic modifiers are also employed.

Super and subcritical (SFC and SubFC) fluid chromatography, utilizing carbon dioxide, has also been introduced as a promising technique for the separation of enantiomers using Pirkle Chiral Stationary Phases.



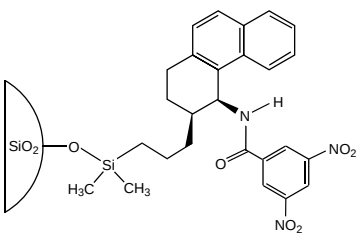
Whelk-O® 1

Analytical to Preparative Columns

The Whelk-O 1 is useful for the separation of underivatized enantiomers in a number of families including amides, epoxides, esters, ureas, carbamates, ethers, aziridines, phosphonates, aldehydes, ketones, carboxylic acids, alcohols and non-steroidal anti-inflammatory drugs (NSAIDs).

This π-electron acceptor/π-electron donor phase exhibits an extraordinary degree of generality. The broad versatility observed on the Whelk-O 1 column compares favorably with polysaccharide-derived chiral stationary phases.

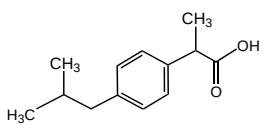
In addition, because Whelk-O 1 is covalently bonded to the support, the phase is compatible with all commonly used mobile phases, including aqueous systems – a distinct advantage over polysaccharide-derived chiral stationary phases. Other advantages include column durability, excellent efficiency, ability to invert elution order and excellent preparative capacity.

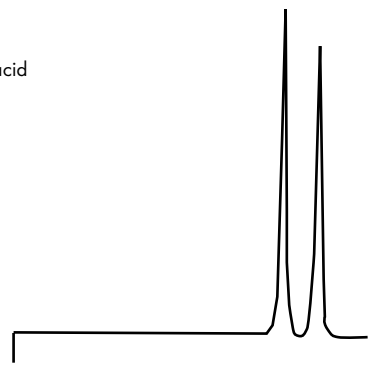


Product	Particle Size	Column Length and i.d.	Product #	U.S. Price
Spherical silica:				
(R,R)-Whelk-O 1	5 µm, 100Å	25 cm x 4.6 mm i.d.	786201	$1,500.00
(R,R)-Whelk-O 1	5 µm, 100Å	25 cm x 10.0 mm i.d.	786202	$5,000.00
(S,S)-Whelk-O 1	5 µm, 100Å	25 cm x 4.6 mm i.d.	786101	$1,500.00
(S,S)-Whelk-O 1	5 µm, 100Å	25 cm x 10.0 mm i.d.	786102	$5,000.00
Spherical Kromasil silica:				
(R,R)-Whelk-O 1	10 µm, 100Å	25 cm x 4.6 mm i.d.	786515	$1,500.00
(R,R)-Whelk-O 1	10 µm, 100Å	25 cm x 10.0 mm i.d.	786525	$5,000.00
(R,R)-Whelk-O 1	10 µm, 100Å	25 cm x 21.1 mm i.d.	786535	$11,000.00
(R,R)-Whelk-O 1	10 µm, 100Å	50 cm x 21.1 mm i.d.	786545	$18,000.00
(S,S)-Whelk-O 1	10 µm, 100Å	25 cm x 4.6 mm i.d.	786615	$1,500.00
(S,S)-Whelk-O 1	10 µm, 100Å	25 cm x 10.0 mm i.d.	786625	$5,000.00
(S,S)-Whelk-O 1	10 µm, 100Å	25 cm x 21.1 mm i.d.	786635	$11,000.00
(S,S)-Whelk-O 1	10 µm, 100Å	50 cm x 21.1 mm i.d.	786645	$18,000.00

Ibuprofen

Column: Whelk-O 1
25 cm x 4.6 mm i.d
Mobile Phase: (98/2/0.05)
hexane/isopropanol/acetic acid
Flow Rate: 0.9 mL/min
Load: 20 µL
Detection: UV 254 nm
Run Time: 8 min
Reference: 2





Whelk-O is a registered trademark of Regis Technologies, Inc.

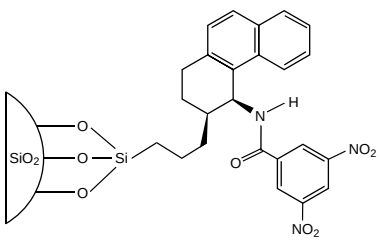
Product information and applications are available online at: www.registech.com/chiral/.

Whelk-O® 2

Analytical to Preparative Columns

Our newest addition to the Whelk-O line of chiral stationary phases is the Whelk-O 2. The Whelk-O 2 is the covalent trifunctional version of the Whelk-O 1. The Whelk-O 2 retains the same chiral selector but incorporates a trifunctional linkage to the silica support. In most cases, the enantioselectivity remains the same as that obtained with the Whelk-O 1.

Whelk-O 2 was designed to improve the resistance of the stationary phase to hydrolysis while using strong organic modifiers such as trifluoroacetic acid. The Whelk-O 2 is ideal for preparative separations since the material is bonded on 10 µm, 100Å spherical Kromasil silica. This allows the preparative chromatographer to perform method development on an analytical column and immediately scale up to larger diameter columns.

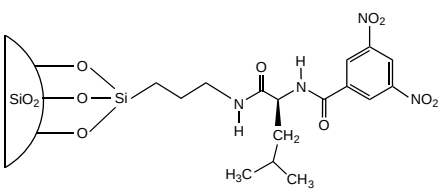


Product	Particle Size	Column Length and i.d.	Product #	U.S. Price
Spherical Kromasil silica:				
(R,R)-Whelk-O 2	10 µm, 100Å	25 cm x 4.6 mm i.d.	786315	$1,600.00
(R,R)-Whelk-O 2	10 µm, 100Å	25 cm x 10.0 mm i.d.	786325	$5,000.00
(R,R)-Whelk-O 2	10 µm, 100Å	25 cm x 21.1 mm i.d.	786335	$11,000.00
(R,R)-Whelk-O 2	10 µm, 100Å	50 cm x 21.1 mm i.d.	786345	$18,000.00
(S,S)-Whelk-O 2	10 µm, 100Å	25 cm x 4.6 mm i.d.	786415	$1,600.00
(S,S)-Whelk-O 2	10 µm, 100Å	25 cm x 10.0 mm i.d.	786425	$5,000.00
(S,S)-Whelk-O 2	10 µm, 100Å	25 cm x 21.1 mm i.d.	786435	$11,000.00
(S,S)-Whelk-O 2	10 µm, 100Å	50 cm x 21.1 mm i.d.	786445	$18,000.00

Leucine

Analytical and Semi-Preparative Columns

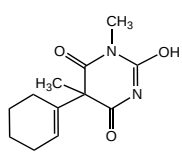
The π-acceptor leucine CSP is based on 3,5-dinitrobenzoyl leucine, covalently bonded to 5 µm aminopropyl silica. Columns derived from either L- or D-leucine are available. This phase demonstrates enhanced enantioselectivities for several classes of compounds, including benzodiazapines.



Product	Particle Size	Column Length and i.d.	Product #	U.S. Price
D-Leucine	5 µm, 100Å	25 cm x 4.6 mm i.d.	731054	$800.00
D-Leucine	5 µm, 100Å	25 cm x 10.0 mm i.d.	731254	$1,800.00
L-Leucine	5 µm, 100Å	25 cm x 4.6 mm i.d.	731041	$750.00
L-Leucine	5 µm, 100Å	25 cm x 10.0 mm i.d.	731241	$1,600.00

Hexobarbital

Column:	L-Leucine 25 cm x 4.6 mm i.d.
Mobile Phase:	(95/5) hexane/ethanol
Flow Rate:	0.7 mL/min
Load:	0.686 mg/mL
Detection:	UV 254 nm
Run Time:	16 min
k'_1:	2.89
α:	1.10



Whelk-O is a registered trademark of Regis Technologies, Inc.

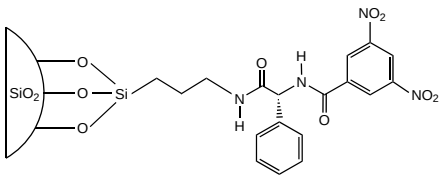
Product information and applications are available online at: www.registech.com/chiral/.

Phenylglycine

Analytical and Semi-Preparative Columns

Phenylglycine, a π-acceptor chiral phase, is based on 3,5-dinitrobenzoyl phenylglycine, covalently bonded to 5 µm aminopropyl silica. Phenylglycine columns are available in both L- and D- configurations.

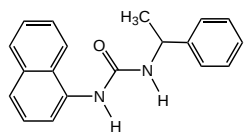
This CSP resolves a wide variety of compounds containing π-basic groups, including: aryl-substituted cyclic sulfoxides, bi-β-naphthol and its analogs, α-indanol and α-tetralol analogs, and aryl-substituted hydantoins.

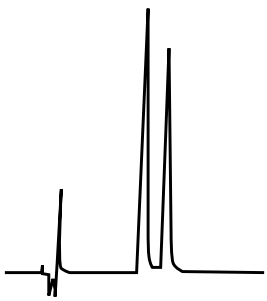


Product	Particle Size	Column Length and i.d.	Product #	U.S. Price
D-Phenylglycine	5 µm, 100Å	25 cm x 4.6 mm i.d.	731021	$700.00
D-Phenylglycine	5 µm, 100Å	25 cm x 10.0 mm i.d.	731221	$1,400.00
L-Phenylglycine	5 µm, 100Å	25 cm x 4.6 mm i.d.	731024	$700.00
L-Phenylglycine	5 µm, 100Å	25 cm x 10.0 mm i.d.	731224	$1,400.00

N-(1-Naphthyl)-N′-(1-methylbenzyl) urea

Column: D-Phenylglycine
25 cm x 4.6 mm i.d.
Mobile Phase: (70/30) hexane/ethanol
Flow Rate: 1.0 mL/min
Load: 20 µL
Detection: UV 254 nm
Run Time: 10 min
k'_1: 2.37
α: 1.22



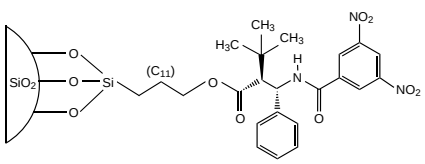


β-Gem 1

Analytical and Semi-Preparative Columns

β-Gem 1 is a π-acceptor chiral stationary phase and is prepared by covalently bonding N-3,5-dinitrobenzoyl-3-amino-3-phenyl-2-(1,1-dimethylethyl)-propanoate, to 5 µm silica through an ester linkage.

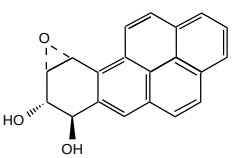
In many cases, this chiral phase considerably outperforms its widely used analog, phenylglycine. It can separate anilide derivatives of chiral carboxylic acids, including nonsteroidal anti-inflammatory agents.

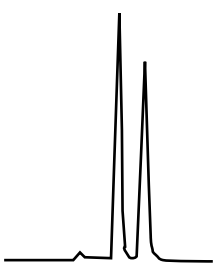


Product	Particle Size	Column Length and i.d.	Product #	U.S. Price
(R,R)-β-GEM 1	5 µm, 100Å	25 cm x 4.6 mm i.d.	731043	$1,400.00
(R,R)-β-GEM 1	5 µm, 100Å	25 cm x 10.0 mm i.d.	731243	$4,400.00
(S,S)-β-GEM 1	5 µm, 100Å	25 cm x 4.6 mm i.d.	731029	$1,400.00
(S,S)-β-GEM 1	5 µm, 100Å	25 cm x 10.0 mm i.d.	731229	$4,400.00

***trans*-(R)7,8-Dihydroxy-9,10-epoxy-7,8,9,10-tetrahydrobenzo[a]pyrene**

Column: *(R,R)*-β-Gem 1
25 cm x 4.6 mm i.d.
Mobile Phase: (60/40) hexane/ethanol
Flow Rate: 1.0 mL/min
Load: 20 µL
Detection: UV 254 nm
Run Time: 14 min
k'_1: 3.18
α: 1.25



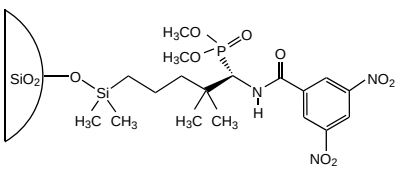


Product information and applications are available online at:
www.registech.com/chiral/.

Pirkle Chiral HPLC Columns

α-Burke 2
Analytical and Semi-Preparative Columns

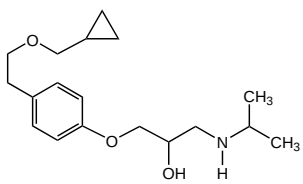
The α-Burke 2 phase is derived from dimethyl N-3,5-dinitro-benzoyl-α-amino-2,2-dimethyl-4-pentenyl phosphonate covalently bound to 5 µm silica. This π-acceptor chiral stationary phase is particularly valuable in the HPLC separation of β-blocker enantiomers, an important class of cardiovascular drugs whose enantiomers often exhibit differing pharmacological activities. The α-Burke 2 has been specifically designed to separate the enantiomers of β-blockers without chemical derivatization. In addition, it also resolves the enantiomers of many compounds separated on π-acceptor Pirkle type chiral stationary phases.

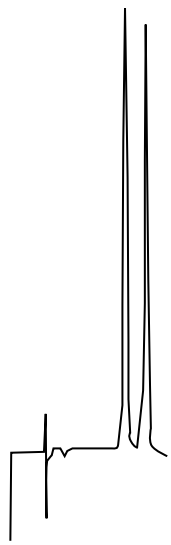


Product	Particle Size	Column Length and i.d.	Product #	U.S. Price
(R)-α-Burke 2	5 µm, 100Å	25 cm x 4.6 mm i.d.	735035	$1,400.00
(R)-α-Burke 2	5 µm, 100Å	25 cm x 10.0 mm i.d.	735235	$4,400.00
(S)-α-Burke 2	5 µm, 100Å	25 cm x 4.6 mm i.d.	735037	$1,400.00
(S)-α-Burke 2	5 µm, 100Å	25 cm x 10.0 mm i.d.	735237	$4,400.00

Betaxolol

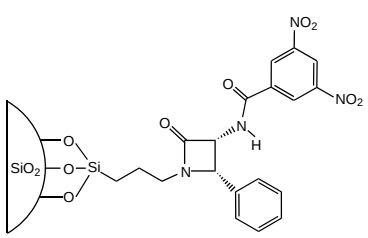
Column: α-Burke 2
25 cm x 4.6 mm i.d.
Mobile Phase: (85/10/5) CH_2C1_2/EtOH/MeOH
Flow Rate: 1 mL/min
Detection: UV 254 nm
Run Time: 11 min
k'_1: 2.36
α: 1.25
Reference: 4





Pirkle 1-J
Analytical and Semi-Preparative Columns

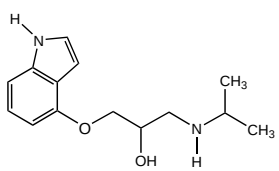
The Pirkle 1-J column is the latest in a series of CSPs from the research laboratories of Professor Pirkle. This new CSP contains an unusual β-lactam structure which significantly alters its molecular recognition properties. The Pirkle 1-J is useful for the direct separation of underivatized β-blocker enantiomers. It can also be used for the separation of the enantiomers of arylpropionic acid NSAIDs, as well as other drugs.

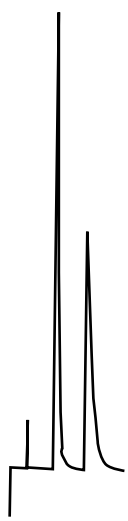


Product	Particle Size	Column Length and i.d.	Product #	U.S. Price
(3R, 4S)-Pirkle 1-J	5 µm, 100Å	25 cm x 4.6 mm i.d.	731044	$1,400.00
(3R, 4S)-Pirkle 1-J	5 µm, 100Å	25 cm x 10.0 mm i.d.	731244	$4,400.00
(3S, 4R)-Pirkle 1-J	5 µm, 100Å	25 cm x 4.6 mm i.d.	731045	$1,400.00
(3S, 4R)-Pirkle 1-J	5 µm, 100Å	25 cm x 10.0 mm i.d.	731245	$4,400.00

Pindolol

Column: Pirkle 1-J
25 cm x 4.6 mm i.d.
Mobile Phase: (80/20) methylene chloride/ethanol, +0.04M ammonium acetate
Flow Rate: 1.0 mL/min
Load: 10 µL
Detection: UV 254 nm





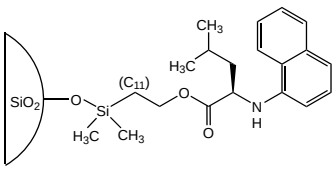
Product information and applications are available online at: www.registech.com/chiral/.

Naphthylleucine

Analytical and Semi-Preparative Columns

The naphthylleucine phase, a π-electron-donor, is based on N-(1-naphthyl) leucine, covalently bonded to 5 µm silica through an ester linkage.

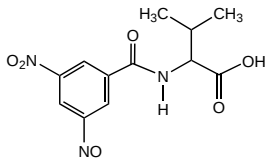
This phase resolves DNB derivatives of amino acids as the free acid when used in reversed-phase mode. In the classic normal-phase, this CSP can resolve the amides and esters of DNB amines, alcohols and amino acids.

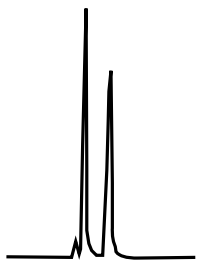


Product	Particle Size	Column Length and i.d.	Product #	U.S. Price
L-Naphthylleucine	5 µm, 100Å	25 cm x 4.6 mm i.d.	731034	$800.00
L-Naphthylleucine	5 µm, 100Å	25 cm x 10.0 mm i.d.	731234	$1,900.00

N-(3,5-Dinitrobenzoyl) valine

Column: Naphthylleucine
25 cm x 4.6 mm i.d.
Mobile Phase: (80/20) methanol/10mM KH_2PO_4, pH 6.86 + 0.5 mM Q6
Flow Rate: 1.0 mL/min
Load: 5 µL
Detection: UV 254 nm
Run Time: 4 min

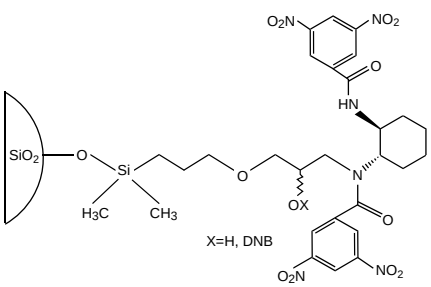




DACH-DNB

Analytical to Preparative Columns

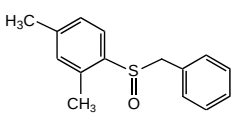
The innovative DACH-DNB CSP was designed by Italian chemists Drs. Francesco Gasparrini, Misiti and Villani at Rome University "La Sapienza." The DACH-DNB CSP, which contains the 3,5-dinitrobenzoyl derivative of 1,2-diaminocyclohexane, has been found to resolve a broad range of racemate classes including amides, alcohols, esters, ketones, acids, sulfoxides, phosphine oxides, selenoxides, phosphonates, thiophosphineoxide, phosphineselenide, phosphine-borane, beta-lactams, organometallics, atropisomers and heterocycles.

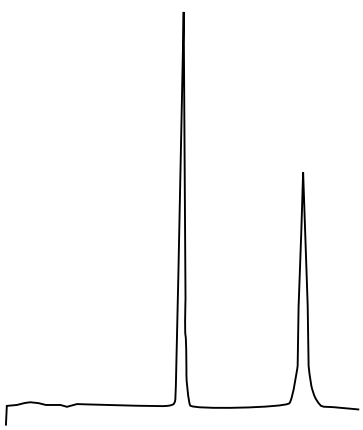


Product	Particle Size	Column Length and i.d.	Product #	U.S. Price
(R,R)-DACH-DNB	5 µm, 100Å	25 cm x 4.6 mm i.d.	788101	$1,400.00
(R,R)-DACH-DNB	5 µm, 100Å	25 cm x 10.0 mm i.d.	788102	$4,400.00
(R,R)-DACH-DNB	10 µm, 100Å	25 cm x 21.1 mm i.d.	788103	$11,000.00
(S,S)-DACH-DNB	5 µm, 100Å	25 cm x 4.6 mm i.d.	788201	$1,400.00
(S,S)-DACH-DNB	5 µm, 100Å	25 cm x 10.0 mm i.d.	788202	$4,400.00
(S,S)-DACH-DNB	10 µm, 100Å	25 cm x 21.1 mm i.d.	788203	$11,000.00

Sulfoxide

Column: (R,R)-DACH-DNB
25 cm x 4.6 mm
Mobile Phase: (95/5) CH_2Cl_2/IPA
Flow Rate: 1.0 mL/min
Detection: UV 254 nm
Run Time: 15.0 min
k'_1: 2.15
α: 2.05



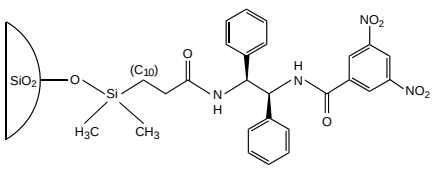


Product information and applications are available online at: www.registech.com/chiral/.

ULMO

Analytical to Preparative Columns

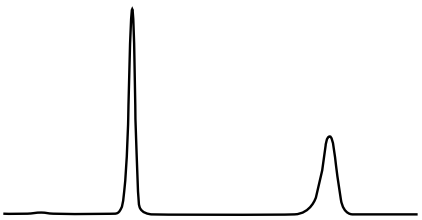
The ULMO chiral stationary phase was developed by Austrian researchers Uray, Lindner and Maier. The ULMO CSP is based on a 3,5-dintrobenzoyl derivative of diphenylethylenediamine. This CSP has a general ability to separate the enantiomers of many racemate classes and is particularly good at separating the enantiomers of aryl carbinols.

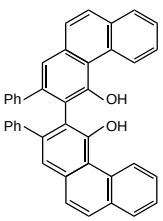


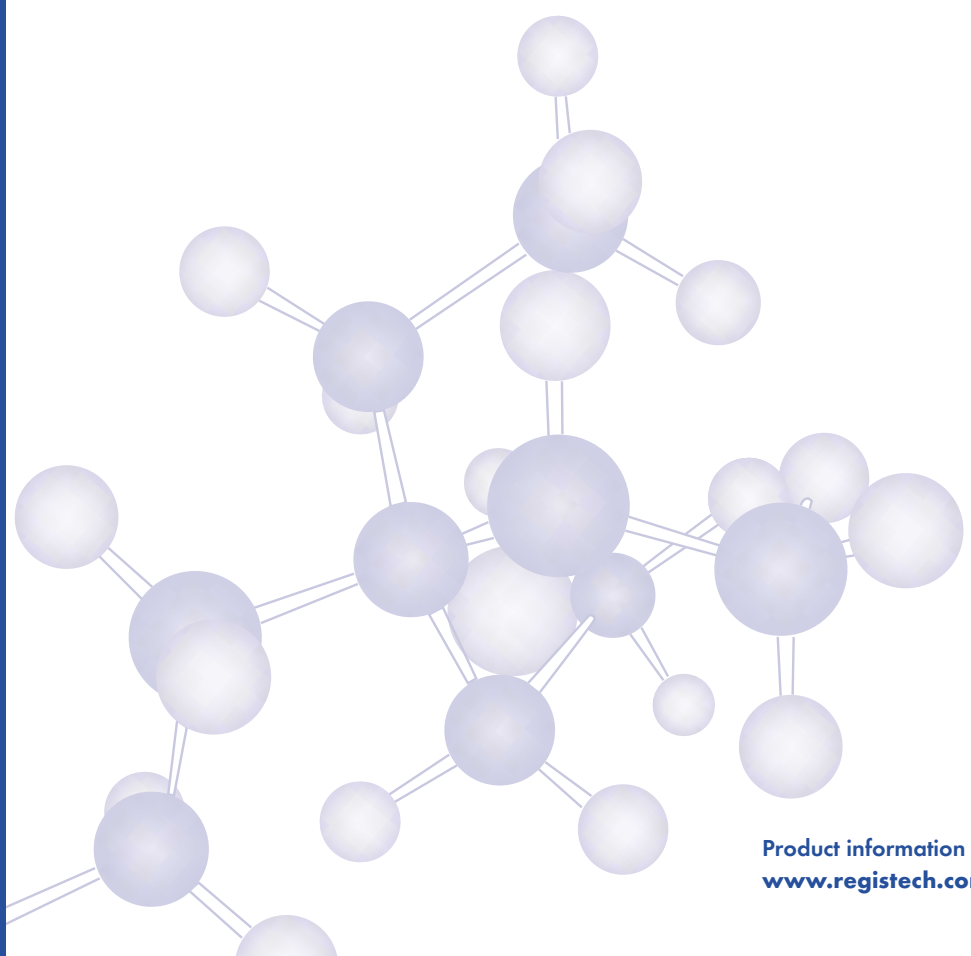
Product	Particle Size	Column Length and i.d.	Product #	U.S. Price
(S,S)-ULMO	5 µm, 100Å	25 cm x 4.6 mm i.d.	787100	$1,400.00
(S,S)-ULMO	5 µm, 100Å	25 cm x 10.0 mm i.d.	787101	$4,400.00
(S,S)-ULMO	10 µm, 100Å	25 cm x 21.1 mm i.d.	787102	$11,000.00
(R,R)-ULMO	5 µm, 100Å	25 cm x 4.6 mm i.d.	787200	$1,400.00
(R,R)-ULMO	5 µm, 100Å	25 cm x 10.0 mm i.d.	787201	$4,400.00
(R,R)-ULMO	10 µm, 100Å	25 cm x 21.1 mm i.d.	787202	$11,000.00

Vapol

Column: (R,R)-ULMO
25 cm x 4.6 mm
Mobile Phase: 100% methanol
Flow Rate: 1.5 mL/min
Detection: UV 254 nm
Run Time: 13 min
k'_1: 1.74
α: 3.37







Product information and applications are available online at:
www.registech.com/chiral/.

Davankov Ligand Exchange Chiral Stationary Phase

Davankov Ligand Exchange Chiral Stationary Phase

The Davankov chiral stationary phase is useful for the separation of underivatized amino acid enantiomers. This phase operates according to the principles of ligand-exchange chromatography (LEC), a technique pioneered by Professor V. Davankov.

The Davankov column requires a mobile phase of aqueous methanol containing copper(II) acetate. Enantioselectivity is extremely high with alphas up to 16 being reported. Regis provides either a Davankov HPLC column, or a kit which allows the user to convert a standard ODS column into a Davankov Chiral Stationary phase.

Both of these Davankov products maintain a stable coating compatible with those mobile phases generally used in amino acid separations.

Davankov Column

A pre-converted Davankov column complete with care and use guide, column test conditions and performance results is available.

Davankov Reagent A Kit

Regis provides the Davankov Reagent A kit, which contains Davankov Reagent A, a hydroxyproline derivative and copper(II) acetate (sufficient quantities to coat one 15 cm column and prepare mobile phase). The column coating procedure involves dissolving the Davankov Reagent A into methanol/water (80/20) and pumping this mixture through the column. This is followed by a wash with a concentrated solution of $Cu(OAc)_2$ in methanol/water (15/85). Detailed coating procedures are included with the kit.

Product	Particle Size	Column Length and i.d.	Product #	U.S. Price
Davankov Column	5 µm, 100Å	15 cm x 4.6 mm i.d.	731653	$700.00
Davankov Reagent A Kit			731650	$300.00
REXCHROM ODS Column	5 µm, 100Å	15 cm x 4.6 mm i.d.	728118	$300.00

DL-Leucine and DL-Norvaline

Column: REXCHROM Davankov A
15 cm x 4.6 mm i.d.

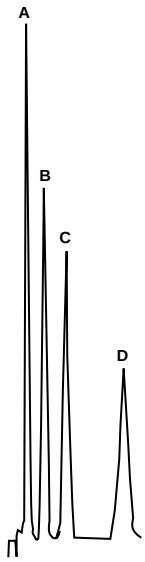
Mobile Phase: (65/35) 10^{-4} M $CuAc_2$, pH 5.0/methanol

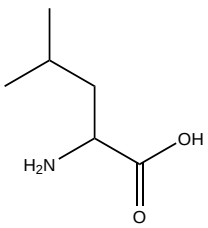
Flow rate: 2.0 mL/min

Detection: UV 254 nm

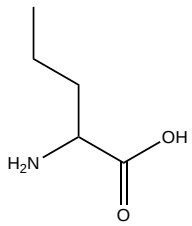
Run Time: 16 min

Peak Identities:
A. L-Norvaline
B. L-Leucine
C. D-Norvaline
D. D-Leucine

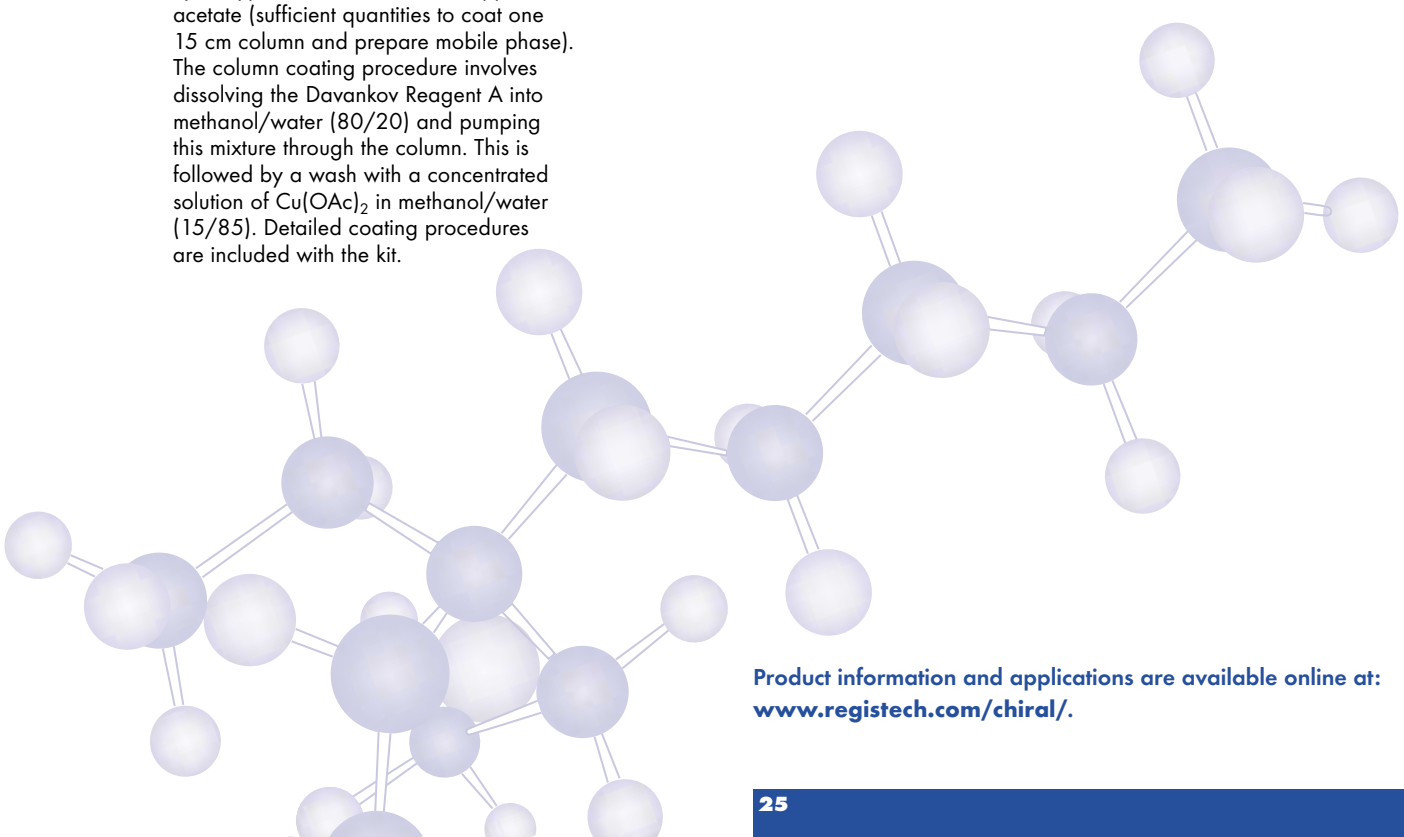




DL-Leucine



DL-Norvaline



Product information and applications are available online at: www.registech.com/chiral/.

Protein-Based Chiral Stationary Phases

Regis carries a line of protein-based chiral columns manufactured by ChromTech AB. These include:

- Chiral AGP-(α–glycoprotein)
- Chiral CBH-(cellobiohydrolase)
- Chiral HSA-(human serum albumin)

For additional product information and a Protein-Based Stationary Phase Application Guide, please contact Regis at sales@registech.com.

Chiral AGP

Micro, Analytical and Semi-Preparative Columns

Chiral AGP is the second generation chiral selector based on the α_1-acid glycoprotein (α_1-AGP) as the chiral stationary phase. The AGP has been immobilized on spherical, 5 µm particles. The Chiral AGP column is typically used in the reversed-phase mode, where it can be used for the resolution of an extremely broad range of chiral compounds, such as amines, (primary, secondary, tertiary and quaternary ammonium), acids, esters, sulphoxides, amides, and alcohols. The enantioselectivity and the retention can easily be regulated by the pH of the mobile phase, the buffer concentration and the nature and concentration of the organic modifier.

Product	Particle Size	Column Length and i.d.	Product #	U.S. Price
Chiral AGP	5 µm	15 cm x 0.18 mm i.d.	732195	$1,600.00
Chiral AGP	5 µm	10 cm x 1 mm i.d.	732194	$1,950.00
Chiral AGP	5 µm	10 cm x 2.0 mm i.d.	732196	$1,250.00
Chiral AGP	5 µm	15 cm x 2.0 mm i.d.	732197	$1,400.00
Chiral AGP	5 µm	5 cm x 4.0 mm i.d.	732198	$995.00
Chiral AGP	5 µm	10 cm x 4.0 mm i.d.	732200	$1,230.00
Chiral AGP	5 µm	15 cm x 4.0 mm i.d.	732199	$1,490.00
Chiral AGP	5 µm	10 cm x 10.0 mm i.d.	732301	$4,750.00
Chiral AGP	5 µm	15 cm x 10.0 mm i.d.	732302	$7,100.00
Chiral AGP Guard Column	5 µm	1 cm x 3.0 mm i.d.	732300	$135.00
Guard cartridge holder			731441	$125.00

Omeprazole

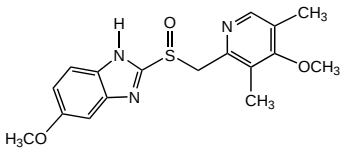
Column: Chiral-AGP
10 cm x 4.0 mm i.d.

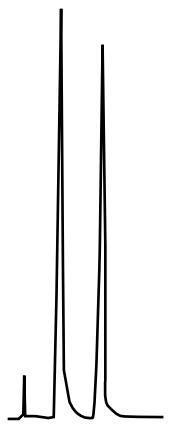
Mobile phase: 10% acetonitrile in 10 mM sodium phosphate buffer, pH 6.5

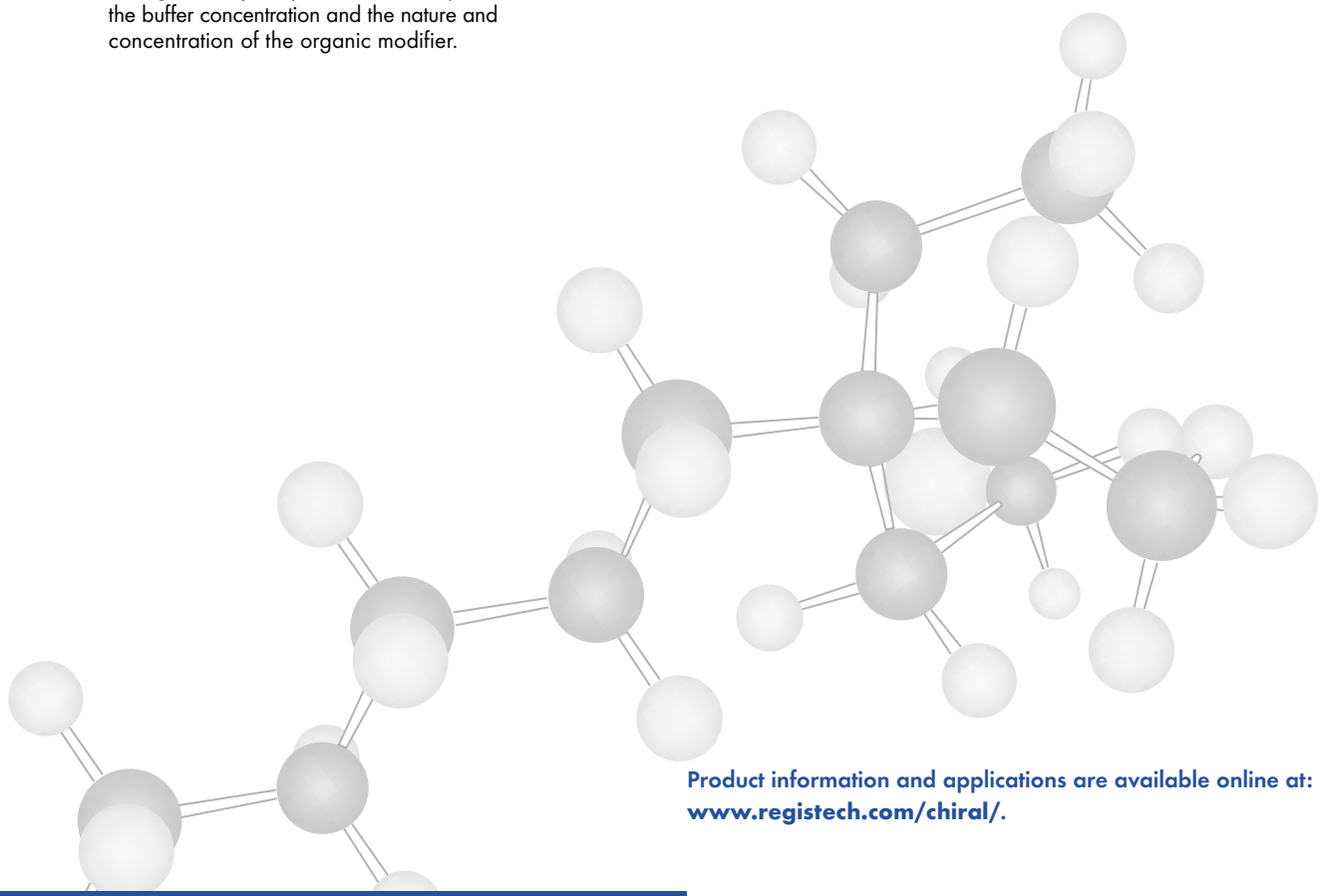
Detection: UV 210 nm

Sample Conc: 0.02 mg/mL

Run Time: 8 min







Product information and applications are available online at: **www.registech.com/chiral/.**

Chiral CBH

Micro, Analytical and Semi-Preparative Columns

Cellobiohydrolase (CBH) is a stable enzyme which has been immobilized onto 5 µm spherical silica particles. The column is used in reversed-phase mode and is effective for the separation of enantiomers of basic drugs from many compound classes. The retention and the enantioselectivity can be regulated by changes in pH, buffer concentration and the nature and concentration of organic modifer.

Product	Particle Size	Column Length and i.d.	Product #	U.S. Price
Chiral CBH	5 µm	10 cm x 0.18 mm i.d.	732357	$1,550.00
Chiral CBH	5 µm	10 cm x 2.0 mm i.d.	732353	$1,250.00
Chiral CBH	5 µm	15 cm x 2.0 mm i.d.	732354	$1,400.00
Chiral CBH	5 µm	5 cm x 4.0 mm i.d.	732352	$995.00
Chiral CBH	5 µm	10 cm x 4.0 mm i.d.	732350	$1,230.00
Chiral CBH	5 µm	15 cm x 4.0 mm i.d.	732351	$1,490.00
Chiral CBH	5 µm	10 cm x 10.0 mm i.d.	732355	$4,750.00
Chiral CBH	5 µm	15 cm x 10.0 mm i.d.	732356	$7,100.00
Chiral CBH Guard Column	5 µm	1 cm x 3.0 mm i.d.	732358	$135.00
Guard cartridge holder			731441	$125.00

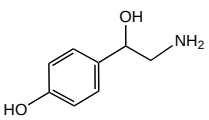
Octopamine

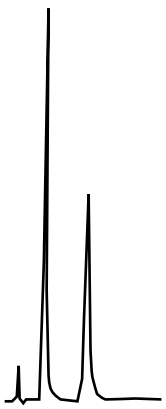
Column: Chiral-CBH
10 cm x 4.0 mm i.d.

Mobile phase: 5% 2-propanol in 10 mM sodium phosphate buffer, pH 6.0 + 50 µM disodium EDTA

Sample Conc: 0.03 mg/mL

Run Time: 9 min





Product information and applications are available online at: **www.registech.com/chiral/.**

Chiral HSA

Analytical and Semi-Preparative Columns

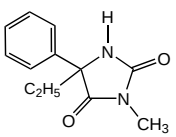
With the Chiral human serum albumin (HSA) column, the enantiomers of many carboxylic acids and amino acids can be resolved directly, without derivatization. Enantioselectivity and retention can be regulated by changing the mobile phase composition, pH, buffer concentration and/or nature of the organic modifier.

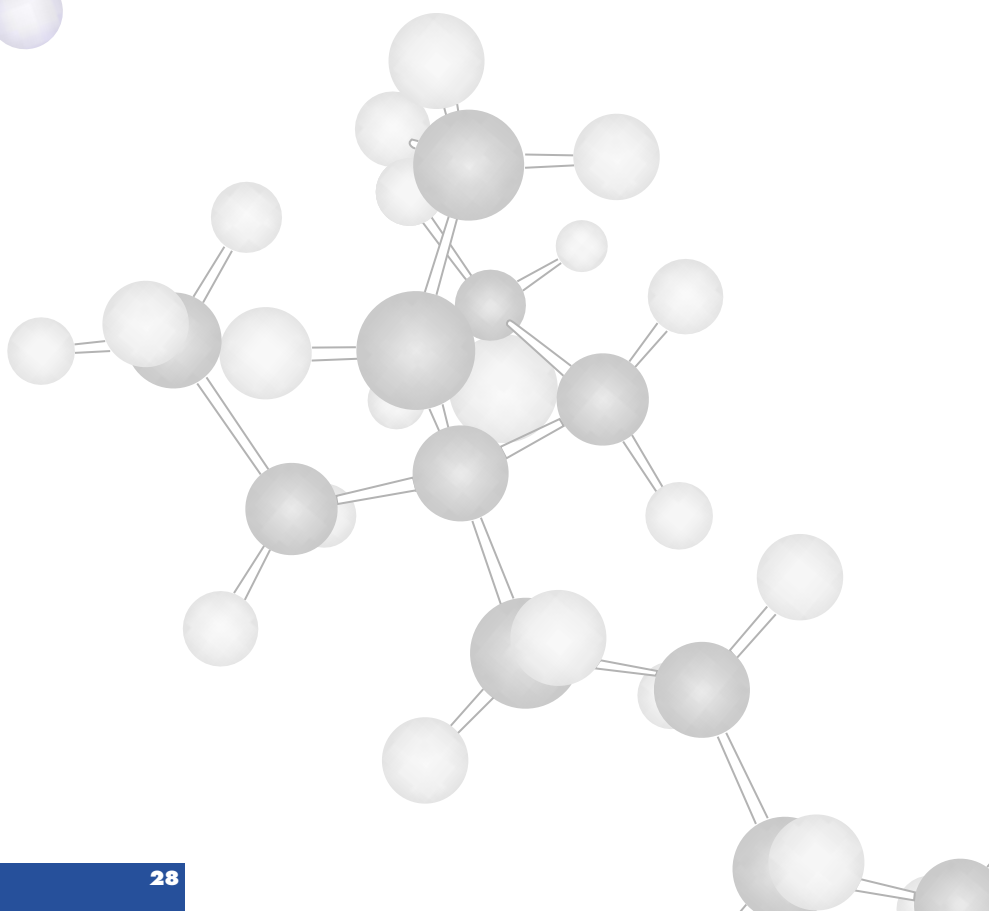
HSA has been immobilized onto 5 µm spherical silica particles. The surface chemistry of the silica and the method of immobilization provide a stable chiral separation material.

Product	Particle Size	Column Length and i.d.	Product #	U.S. Price
Chiral HSA	5 µm	10 cm x 4.0 mm i.d.	732240	$1,230.00
Chiral HSA	5 µm	15 cm x 4.0 mm i.d.	732239	$1,490.00
Chiral HSA	5 µm	10 cm x 10.0 mm i.d.	732341	$3,775.00
Chiral HSA	5 µm	15 cm x 10.0 mm i.d.	732342	$5,050.00
Chiral HSA Guard Column	5 µm	1 cm x 3.0 mm i.d.	732340	$135.00
Guard cartridge holder			731441	$125.00

Mephenytoin

Column: Chiral-HSA
10 cm x 4.0 mm i.d.
Mobile phase: 10 mM sodium phosphate buffer, pH 7.0
Detection: UV 225 nm
Sample Conc: 0.02 mg/mL
Run Time: 8 min





For additional information on Chiral Stationary Phases, check our Web site at www.registech.com/chiral/. You may also request a copy of the Chiral HPLC Application Guide containing additional Chiral Applications, by contacting Regis at:

(800) 323-8144 ext. 649
(847) 967-6000 ext. 649
e-mail us at: **sales@registech.com.**

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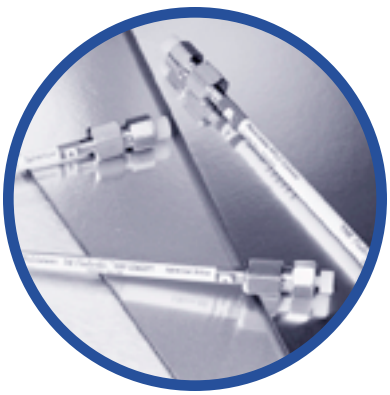
RAM Direct Injection (Restricted Access Media)

A Tool for the Separation of Small Molecules in the Presence of Large Biomolecules

HPLC analysis of small molecules contained within a protein matrix can be a difficult and time consuming task. The analysis often involves multi-step pretreatment procedures including centrifugation, extraction and filtration. RAM Direct Injection allows for the chromatographic resolution of small molecules in the presence of much larger analytes without extensive sample pretreatment (figure 1). With RAM Direct Injection HPLC columns, a variety of complex sample matrices can be injected directly, without prior sample clean-up, and drugs, drug metabolites, peptides and other analytes can be separated and detected.



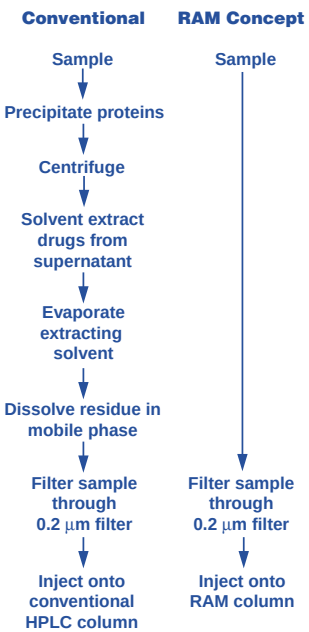


Figure 1. RAM Direct Injection eliminates the lengthy pretreatment steps needed in conventional methods.

RAM Direct Injection Advantages

RAM Direct Injection technology offers the following benefits:

- **Elimination of multiple sample pretreatment steps**

  The use of RAM Direct Injection HPLC columns eliminates the precipitation, centrifugation, solvent evaporation and residue dissolution steps (figure 1) of typical procedures. Simply filter the sample and inject directly onto the column.

- **Useful with a variety of sample matrices**

  The RAM Direct Injection HPLC columns have demonstrated efficacy in the analysis of drugs, drug metabolites, peptides and other analytes in matrices such as plasma, serum, whole blood, urine, plant and tissue extract, food and beverage, and environmental samples.

- **Compatibility with automated sample processing**

  Simplified sample preparation and use of HPLC columns allows the use of automated systems.

- **Reduction of potentially dangerous sample handling**

  With direct injection, sample handling is significantly reduced; therefore, potentially dangerous samples such as plasma, serum, urine and environmental samples do not pose as significant a threat to the worker.

- **Reduction of biohazardous waste**

  Use of SPE (solid phase extraction) disks can create biohazardous waste. RAM Direct Injection columns limit the creation of unnecessary biohazardous waste.

- **The lowest cost solution**

  Because of the benefits described above, RAM Direct Injection often offers the lowest total cost solution.

RAM Direct Injection Phases

Porous silica supports are characterized as consisting of an external, directly accessible surface and internal pores accessible only to molecules with an approximate molecular weight of less than 12,000 Daltons. Most conventional HPLC phases have a homogenous stationary phase on both silica surfaces. In contrast, the RAM phases are prepared by unique bonding processes that result in distinct inner and outer surfaces. A dual surface configuration is especially important because the majority of the silica's surface area is in the pores.

This dual phase system allows for the separation of analytes through a combination of size exclusion and conventional phase partitioning. The outer surface employs both size exclusion and hydrophilic interaction to prevent large biomolecules from accessing the inner layer. As a result, these compounds elute from the column at the void volume.

Small molecules penetrate through to the inner surface where they are retained and separated by the underlying hydrophobic support.

There are two RAM Direct Injection Technologies:

ISRP (Internal Surface Reversed Phase)

- GFF
- GFF II

SPS (Semi-Permeable Surface)

- Nitrile
- Octyl (C8)
- ODS (C18)
- Phenyl

ISRP (Internal Surface Reversed Phase)

Developed by Dr. Thomas Pinkerton, this material was created specifically for the direct analysis of drugs in serum without extensive sample preparation. The result was a new phase that allows for chromatographic separations without interference by protein adsorption.

GFF

The GFF name is derived from the glycine-L-phenylalanine-L-phenylalanine tripeptide bonded within the silica pores. GFF was chosen from many available peptides for its selectivity towards positively charged aromatic analytes and a variety of neutral molecules. The hydrophilic outer surface, created from the cleavage of the original tripeptide, is comprised of the single amino acid, glycine.

GFF II

Continuing product improvement efforts resulted in the development of the ISRP GFF II, a second generation phase with an improved bonding process–bonding the GFF peptide to the silica surface through a monofunctional glycidoxypropyl linkage rather than the original trifunctional linkage. This resulted in the following improvements:

- Increased sample retention
- Higher column efficiency
- Greater batch-to-batch reproducibility

ISRP Selectivity

Many variables can affect the selectivity of the ISRP phase, including:

Mobile Phase Composition:

The nature of ISRP analytes requires that mobile phases consist of a buffer with varying degrees of modification. Modifiers can include acetonitrile, methanol, isopropanol, and tetrahydrofuran. Caution: too much modifier can result in matrix precipitation.

pH: The pH of the mobile phase can be controlled to avoid protein denaturing and to enhance selectivity. The pH range of the column is between 2.5 and 7.5; however, within the optimal pH range of 6.0 to 7.5, both the proteins and the glycine outer surface take on a negative charge. As a result, negatively charged proteins are repulsed by the outer phase, and pass quickly through the column.

Temperature: Separations can also be optimized by varying column temperature. Lower temperatures have been shown to result in increased retention and selectivity.

Product	Particle Size	Column Length and i.d.	Product #	U.S. Price
ISRP GFF and GFF II Analytical Columns				
GFF	5 µm, 80Å	5 cm x 2.1 mm i.d.	731449	$495.00
GFF	5 µm, 80Å	5 cm x 4.6 mm i.d.	731450	$535.00
GFF	5 µm, 80Å	15 cm x 4.6 mm i.d.	731451	$795.00
GFF	5 µm, 80Å	25 cm x 4.6 mm i.d.	731452	$1,045.00
GFF II	5 µm, 80Å	5 cm x 2.1 mm i.d.	731469	$495.00
GFF II	5 µm, 80Å	5 cm x 4.6 mm i.d.	731470	$535.00
GFF II	5 µm, 80Å	15 cm x 4.6 mm i.d.	731471	$795.00
GFF II	5 µm, 80Å	25 cm x 4.6 mm i.d.	731472	$1,045.00

Product	Particle Size	Column Length and i.d.	Product #	U.S. Price
ISRP GFF and GFF II Guard Columns				
GFF Guard Kit*	5 µm, 80Å	1 cm x 3.0 mm i.d.	731440	$260.00
GFF Guard Kit replacements**			731444	$175.00
GFF II Guard Kit*	5 µm, 80Å	1 cm x 3.0 mm i.d.	731475	$260.00
GFF II Guard Kit replacements**			731474	$175.00
Guard cartridge holder			731441	$125.00
1 Coupling			731443	$35.00

*Includes 1 holder, 1 coupler, 2 guard cartridges

**Includes 3 guard cartridges

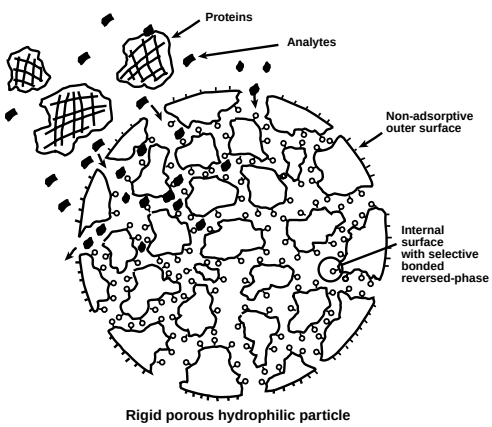
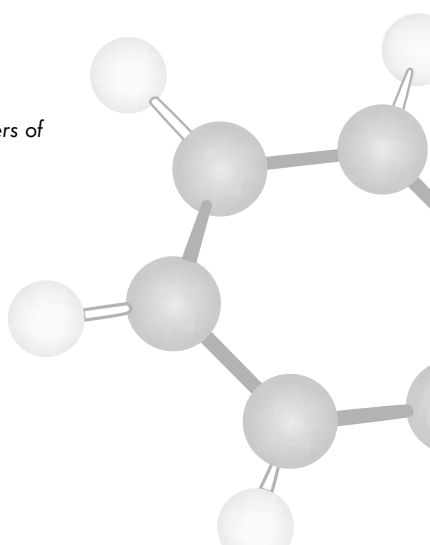


Figure 2. Demonstrates the inner and outer layers of a typical ISRP phase.



Product information and applications are available online at: www.registech.com/ram/.

SPS (Semi-Permeable Surface)

In an effort to extend the applicability of the RAM Direct Injection columns, Regis, in conjunction with Dr. Fred Regnier and Dr. Carla Desilets at Purdue University, developed the Semi-Permeable Surface (SPS) phases.

SPS Structure

Like the ISRP phase, the SPS phases consist of both hydrophilic outer and hydrophobic inner surfaces. The distinct difference is that the inner and outer surfaces of the SPS are bonded separately, allowing each to be varied independently. The SPS structure includes a hydrophobic inner phase such as ODS, and a hydrophilic outer phase of polyethylene glycol (figure 3). The outer phase provides size exclusion and hydrophilic shielding, which repels large biomolecules. The various inner phases allow for separation of small analytes.

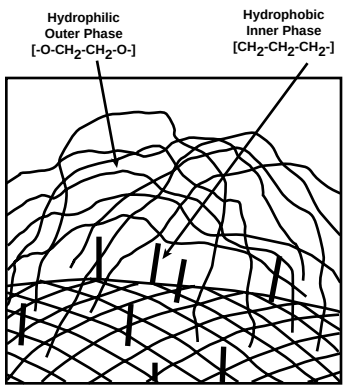


Figure 3. SPS structure highlighting the inner and outer phases.

Product	Particle Size	Column Length and i.d.	Product #	U.S. Price
SPS Analytical Columns				
Nitrile	5 µm, 100Å	15 cm x 4.6 mm i.d.	785105	$500.00
Nitrile	5 µm, 100Å	25 cm x 4.6 mm i.d.	785205	$750.00
Phenyl	5 µm, 100Å	15 cm x 4.6 mm i.d.	785107	$500.00
Phenyl	5 µm, 100Å	25 cm x 4.6 mm i.d.	785207	$750.00
Octyl	5 µm, 100Å	5 cm x 2.1 mm i.d.	785308	$330.00
Octyl	5 µm, 100Å	5 cm x 4.6 mm i.d.	785008	$385.00
Octyl	5 µm, 100Å	15 cm x 4.6 mm i.d.	785108	$500.00
Octyl	5 µm, 100Å	25 cm x 4.6 mm i.d.	785208	$750.00
ODS	5 µm, 100Å	5 cm x 2.1 mm i.d.	785318	$330.00
ODS	5 µm, 100Å	5 cm x 4.6 mm i.d.	785018	$385.00
ODS	5 µm, 100Å	15 cm x 4.6 mm i.d.	785118	$500.00
ODS	5 µm, 100Å	25 cm x 4.6 mm i.d.	785218	$750.00

Product	Particle Size	Column Length and i.d.	Product #	U.S. Price
SPS Guard Columns				
Nitrile Guard Kit*	5 µm, 100Å	1 cm x 3.0 mm i.d.	785405	$250.00
Nitrile Guard replacements**			785505	$170.00
Phenyl Guard Kit*	5 µm, 100Å	1 cm x 3.0 mm i.d.	785407	$250.00
Phenyl Guard replacements**			785507	$170.00
Octyl Guard Kit*	5 µm, 100Å	1 cm x 3.0 mm i.d.	785408	$250.00
Octyl Guard replacements**			785508	$170.00
ODS Guard Kit*	5 µm, 100Å	1 cm x 3.0 mm i.d.	785418	$250.00
ODS Guard replacements**			785518	$170.00
Guard cartridge holder			731441	$125.00
Coupling			731443	$35.00

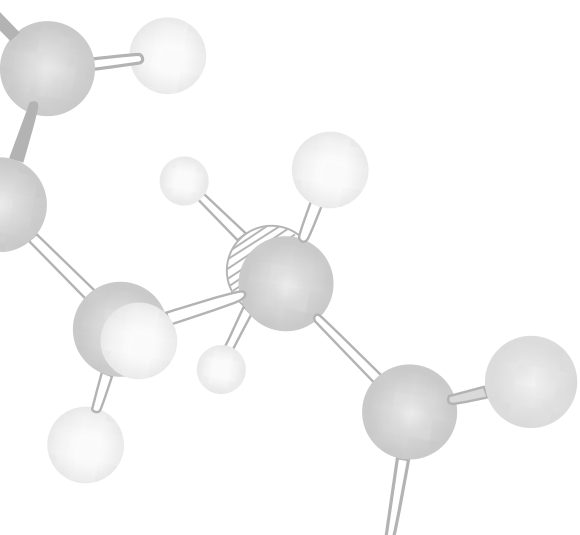
*Includes 1 cartridge holder, 1 coupling, and 2 guard cartridges

**Includes 3 guard cartridges

Product	Particle Size	Column Length and i.d.	Product #	U.S. Price
SPS 1x1 Cartridge Columns				
Octyl Cartridge Kit*	5 µm, 100Å	1 cm x 10.0 mm i.d.	785608	$400.00
Octyl Cartridge replacements**			785708	$380.00
ODS Cartridge Kit*	5 µm, 100Å	1 cm x 10.0 mm i.d.	785618	$400.00
ODS Cartridge replacements**			785718	$380.00
Guard cartridge holder			731446	$200.00

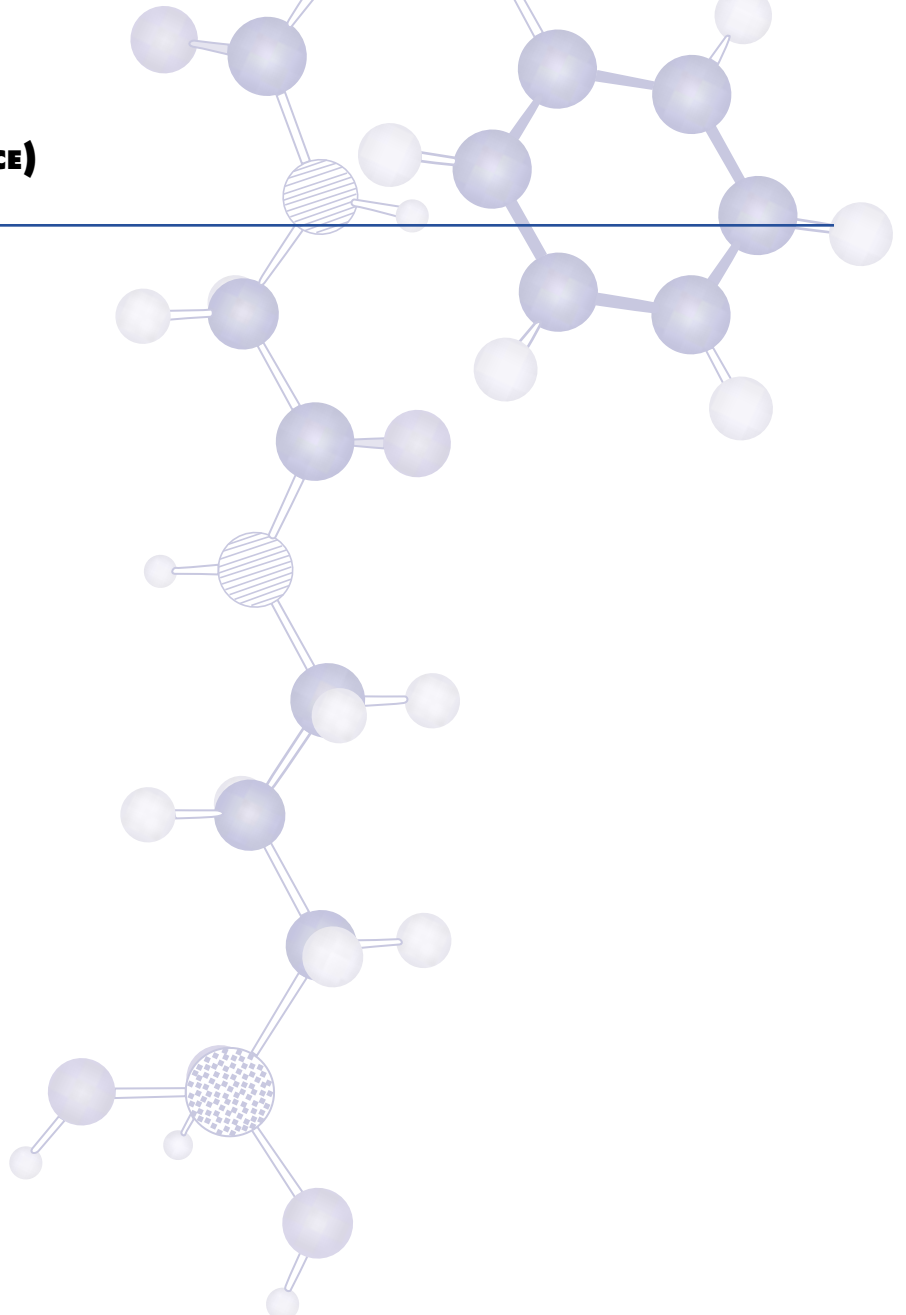
*Includes 1 cartridge holder, 1 coupling, and 2 guard cartridges

**Includes 3 guard cartridges



Product information and applications are available online at: www.registech.com/ram/.

SPS (Semi-Permeable Surface)



SPS Column Advantages

The SPS offers the following advantages:

- Increased durability
- Increased selectivity
- Allows use of buffered, normal-phase, and reversed-phase systems

SPS Selectivity

The primary advantage of SPS over ISRP GFF is that the inner surface of SPS may be varied independently of the outer, resulting in a wider scope of analysis opportunities. Available inner phases include the following:

- Nitrile
- Octyl (C8)
- ODS (C18)
- Phenyl

The retention mechanism of these SPS phases involves hydrogen bonding by the outer phase and hydrophobic interaction by the inner phase. Polar solutes interact primarily with the outer phase and show little discrimination among the various inner phases. Conversely, the nonpolar solutes interact primarily with the inner phase.

The SPS phases allow use of buffered, normal-phase, and reversed-phase eluents. The actual composition is limited only by the pH and organic modifier parameters dictated by the proteins contained within the sample.

RAM Direct Injection Applications

RAM Direct Injection has been effective in numerous applications. Adjacent is a listing of some of the compounds analyzed by RAM Direct Injection. For additional applications, please contact Regis for the RAM Direct Injection Application Guide or download from Regis Web site at www.registech.com/ram/.

Some Compounds Analyzed by RAM Methods

Acetazolamide	Cefaclor	Oxyphenbutazone	Sulfinpyrazone
Acetaminophen	Cefpiramide	Pentobarbital	Tamoxifen
Acetylsalicylic acid	3,4-Diaminopyridine	Phenelzine	Theophylline
4-Aminopyridine	Furosemide	Phenobarbital	Trazodone
Amobarbital	Heparin	Phenylalanine	Trimethoprim
Aprotinin	Hydroxyzine	Phenylbutazone	Trimipramine
Barbital	Imipramine	Phenytoin	Tryptophan
Butabarbital	Imirestat	Propranolol	Tyrosine
Caffeine	Methyl salicylate	Salicylic Acid	Verapamil
Carbamazepine	Norverapamil	Secobarbital	Warfarin

Product information and applications are available online at: www.registech.com/ram/.

RAM Direct Injection Application/ISRP

Separation of Barbiturates in Human Serum

Column: ISRP GFF II, 5 µm, 80Å
15 cm x 4.6 mm i.d.

Mobile Phase: (95/5) 0.1 M potassium phosphate buffer, pH 7.5/ methanol

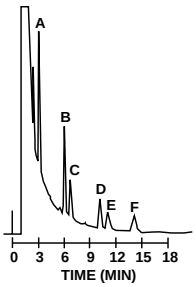
Flow Rate: 1.0 mL/min

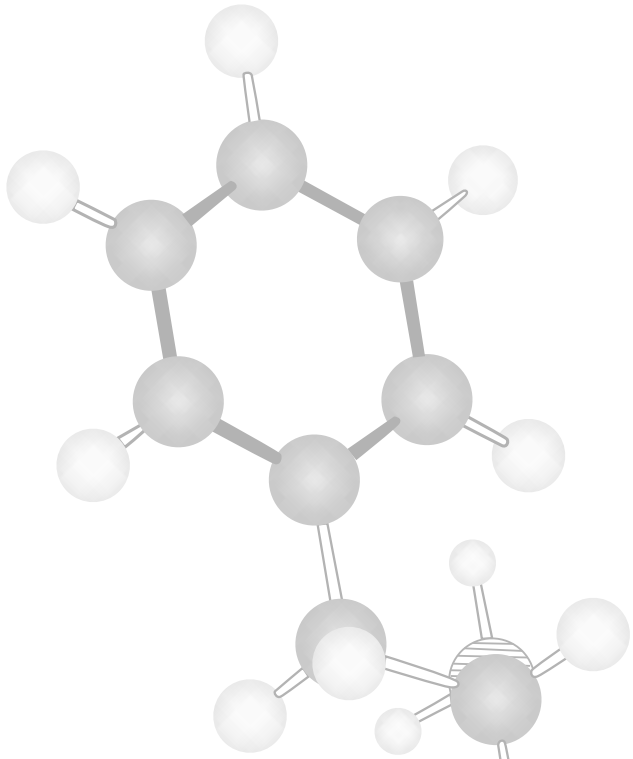
Load: 10 µL

Detection: UV 240 nm

Sample Composition in Human Serum:

A. Barbital
B. Phenobarbital
C. Butabarbital
D. Amobarbital
E. Pentobarbital
F. Secobarbital





RAM Direct Injection Application/SPS

Determination of Antipyrine and Acetaminophen

Column: SPS C8, 5 µm, 100Å
25 cm x 4.6 mm i.d.

Mobile Phase: (99/0.5/0.5) 0.1 M potassium phosphate buffer, pH 7.4/ acetonitrile/tetrahydrofuran

Flow Rate: 1.0 mL/min, 37° C

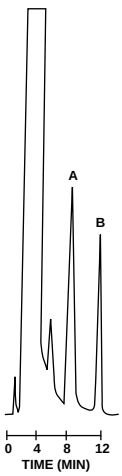
Load: 25 µL

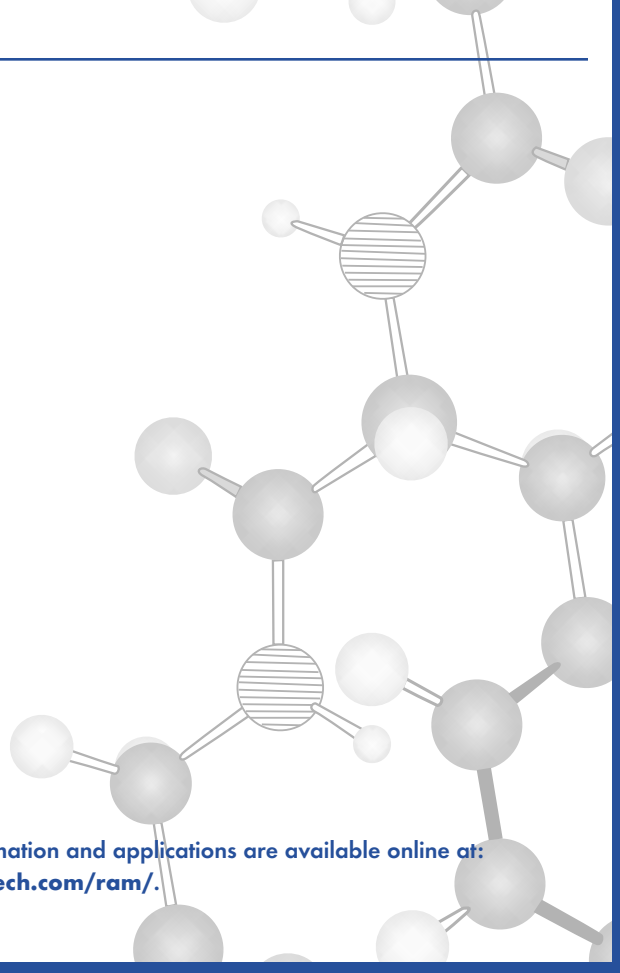
Detection: UV 244 nm

Sample Composition in Human Serum:

A. Antipyrine
B. Acetaminophen

Reference: Gurley, B.J.: et al.; Determination of Antipyrine in Human Serum by Direct Injection Restricted Access Media Liquid Chromatography; *J. Pharm. Biomed Anal.* 1994, 12 (12), 1591–1595.





Product information and applications are available online at: **www.registech.com/ram/.**

Column Switching with RAM Columns

Column Switching for Improved Sensitivity

There has been growth in the use of column switching to process a large number of samples and achieve high sensitivity. The RAM Direct Injection column can be used in a column switching application to retain the small nonpolar analytes while allowing the matrix to pass through to waste. A less polar organic mobile phase is then used to elute the accumulated analytes onto an analytical column for subsequent chromatography.

Recent column switching work involves the use of short RAM guard columns. The guard column is used to separate the analytes from the matrix before switching to an analytical column. The low cost of the guard column allows it to be discarded after 60 to100 samples. The RAM guard column is an inexpensive and simpler alternative to Solid Phase Extraction.

Figure 4 depicts a typical column switching system. In this procedure, the prefiltered but otherwise untreated sample is injected directly onto a RAM column. In the RAM column the smaller molecules are retained and concentrated, while most of the larger molecules are passed to waste. A stronger mobile phase is then used to elute the analytes onto a second column – often octadecylsilyl (ODS) – where they are separated and analyzed.

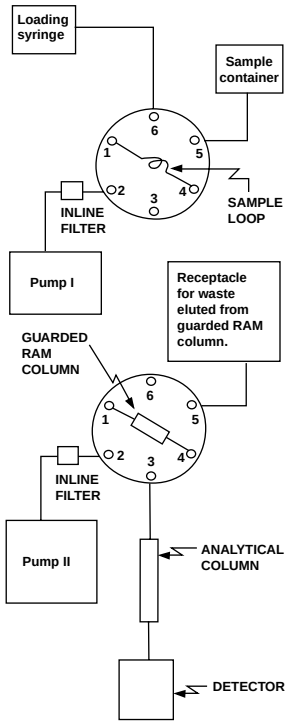


Figure 4. Column switching system.

For additional information on RAM Direct Injection, check our Web site at www.registech.com/ram/. You may also request a copy of the RAM Direct Injection Application Guide containing additional RAM applications, by contacting Regis at:

(800) 323-8144 ext. 649
(847) 967-6000 ext. 649
e-mail us at: sales@registech.com.

IAM
Chromatography

HPLC Separation Tools for Membrane Protein Purification and Drug Membrane Permeability Prediction

Immobilized Artificial Membrane (IAM) technology is an innovative approach to chromatography in which the chromatographic surface emulates the lipid environment of the cell membrane.[1,2]

Phosphatidylcholine (PC) is the major phospholipid found in cell membranes. IAM chromatography phases prepared from PC analogs closely mimic the surface of a biological cell membrane. Consequently, IAM phases display a high affinity for membrane proteins and are useful in membrane protein purification and in the study of drug-membrane interactions. The IAM surface is formed by covalently bonding the membrane-forming phospholipids to silica.

Several different types of IAM columns are used for various applications:

Membrane Protein Purification

IAM.PC

IAM.PC.MG

Drug Discovery

IAM.PC.DD2

- Drug membrane permeability prediction
- Hydrophobic in nature

IAM Fast-Screen Mini Columns

- High throughput estimation of drug permeability

IAM.PC

The IAM.PC phase, developed by Dr. Charles Pidgeon of Purdue University, was the first in a line of IAM phases to be manufactured by Regis. Use of this phase has simplified the inherent difficulties of protein isolation and purification,[3-9] allowing for rapid purification of membrane proteins while maintaining biological activity. The IAM.PC phase is an important tool for the pharmaceutical industry and academia alike.

The first IAM stationary phase was based on the prevalent membrane lipid, phosphatidylcholine (PC), and consists of monolayers of amphiphilic phospholipids covalently bonded to aminopropyl silica particles through a terminal amide linkage. As a result, the bulky phosphatidylcholine groups shield many of the amine binding sites on the silica surface, preventing amine interaction with the protein molecules.

The membrane nature of the IAM phase imparts surface characteristics which are useful in the chromatography of membrane proteins. These include: high protein loading, increased protein recovery, recovery of functional activity, and selectivity for membrane proteins.

Large membrane proteins can interact with any combination of polar headgroup, hydrophobic chain, or inner amine groups. The subsurface has been shown to interact with certain solutes, and may or may not contribute to the separation of a given biomolecule. The residual amines can be left unaltered on the subsurface or deactivated through an endcapping procedure, which results in increased stability of the bonded phase.[7] The methyl glycolate endcapping, for example, converts residual amines to neutral amides and introduces a hydroxyl group (IAM.PC.MG).

IAM PC Structure

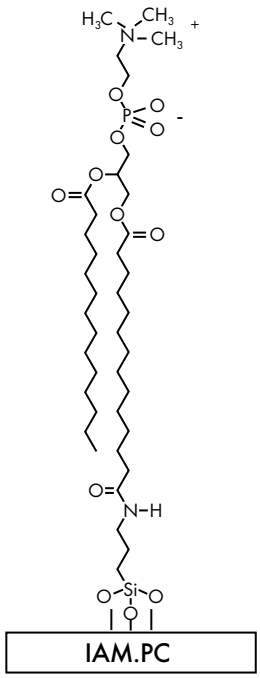


Figure 1. The Phosphatidylcholine is covalently bound to propylamine groups, which are in turn bound to silica. Because the bulky PC groups limit access to the unbonded amine groups, these may or may not affect the separation of a given protein.

IAM.PC Applications

Numerous applications have been developed using IAM.PC columns:

- Purification of Cytochrome P450
- Isolation of membrane proteins
- Prediction of solute transport across human skin
- Prediction of amino acid transport across the blood-brain barrier
- Binding of solutes to liposome membranes
- Immobilization of Trypsin and α-chymotrypsin for the determination of their inhibitor and substrate activity

For additional information on IAM.PC applications please contact Regis' technical support staff.

Product	Particle Size	Column Length and i.d.	Product #	U.S. Price
IAM.PC HPLC Columns				
IAM.PC	12 µm, 300Å	3 cm x 4.6 mm i.d.	770007	$375.00
IAM.PC.MG	12 µm, 300Å	3 cm x 4.6 mm i.d.	772007	$395.00
IAM.PC Analytical	12 µm, 300Å	15 cm x 4.6 mm i.d.	770001	$995.00
IAM.PC.MG Analytical	12 µm, 300Å	15 cm x 4.6 mm i.d.	772001	$1,250.00
IAM.PC Guard Column Kits				
IAM.PC Guard Kit*	12 µm, 300Å	1 cm x 3.0 mm i.d.	771001	$330.00
IAM.PC Guard Replacements**	12 µm, 300Å	1 cm x 3.0 mm i.d.	774001	$275.00
IAM.PC.MG Guard Kit*	12 µm, 300Å	1 cm x 3.0 mm i.d.	773001	$330.00
IAM.PC.MG Guard Replacements**	12 µm, 300Å	1 cm x 3.0 mm i.d.	775001	$275.00
Guard cartridge holder			731441	$125.00
Coupling			731443	$35.00

* Includes 1 cartridge holder, 1 coupling, 2 guard cartridges

** Includes 3 guard cartridges

IAM.PC.DD2
IAM Fast - Screen Mini Column

IAM chromatography has recently gained acceptance among drug discovery chemists for estimating the membrane permeability of small molecule drugs.

Figure 2 illustrates that the interaction between membrane bilayer and drug can be modeled by the IAM column/drug system.

K_{IAM}, the equilibrium constant describing the relative concentrations of drug in the membrane and in the external fluid, is analogous to the k'_{IAM}.

This IAM technique provides superior correlation with experimentally determined drug permeability when compared to other chromatographic methods. ODS silica, for example, retains analytes solely on the basis of hydrophobicity. IAM more closely mimics the interaction of analytes with biological membranes, where a combination of hydrophobic, ion pairing, and hydrogen bonding interactions are possible. This combination of interactions measured by the IAM column is known as phospholipophilicity.

These advances have led to the development of several new IAM phases used for predicting drug membrane permeability:

- IAM.PC.DD2
- IAM Fast-Screen Mini Column

Intestinal Drug Permeability

The retention factors measured on reversed phase C18 (ODS) columns (a commonly used model to determine drug partitioning) show extremely poor correlation with intestinal drug absorption (figure 3). For this group of compounds, hydrophobicity alone, as measured by the reversed-phase C18 column, is a poor predictor of drug absorption. Since IAM.PC Drug Discovery columns measure both hydrophilic and hydrophobic interactions between drugs and membranes, the IAM.PC Drug Discovery Column is better suited to the prediction of intestinal drug absorption.

Fluid Membrane and IAM Drug Partitioning Measurements

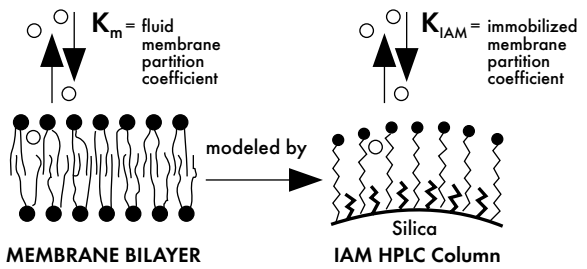
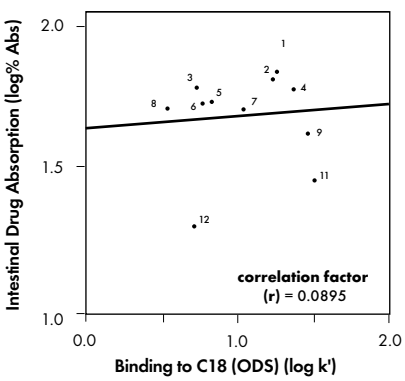


Figure 2. Fluid membrane bilayer can be modeled by IAM column.

ODS Exhibits Poor Correlation with Intestinal Drug Absorption

Column:	C18 (ODS) 3 cm x 4.6 mm i.d.
Mobile Phase:	0.01 M DPBS Buffer, pH 5.4
Flow Rate:	1.0 mL/min
Load:	10 µL
Detection:	UV 220 nm



1. *m*-Nitroaniline
2. *p*-Nitroaniline
3. Salicylic acid
4. *p*-Toluidine
5. Aniline
6. *m*-Nitrobenzoic acid
7. Phenol
8. Benzoic Acid
9. Acetanilide
10. Antipyrine
11. Theophylline
12. Acetylsalicylic acid

Figure 3. Drug partitioning into ODS does not correlate with intestinal drug absorption.

Product information and applications are available online at: www.registech.com/iam/.

IAM.PC.DD2

Like the first generation IAM.PC.DD material, the IAM.PC.DD2 is used to predict drug membrane permeability. The ester bonding of the DD2 packing offers more hydrophobicity than the first generation DD phase. This material is a diacylated or double chain ester PC ligand and is endcapped with C10/C3 alkyl chains as illustrated in figure 4.

Column Advantages

The IAM.PC.DD2 material offers the following advantages:

- Hydrophobic nature
- Greater stability
- Excellent correlation to traditional methods

Hydrophobic Nature

The IAM.PC.DD2 offers more hydrophobicity than the first generation IAM.PC.DD material. This hydrophobic nature allows for longer retention times to compounds not well retained on the IAM.PC.DD material.

Greater Stability

Another distinct advantage of the IAM.PC.DD2 material is its ability to tolerate mobile phases between pH's 7.0 to 7.5, thus resulting in longer column life under these conditions.

IAM.PC.DD2 Structure

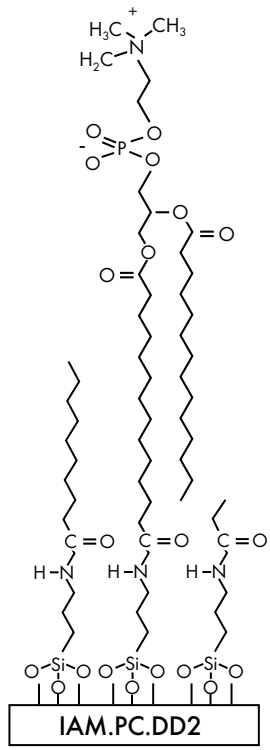


Figure 4. IAM.PC.DD2 is used to predict drug membrane permeability.

Product information and applications are available online at: www.registech.com/iam/.

IAM.PC.DD2

Excellent Correlation to Traditional Methods

The traditional means of predicting membrane permeability include the use of Caco-2 cell line cultures, intestinal tissue or liposome assays. These methods are laborious and costly to perform.

Intestinal Tissue Correlation

Measuring drug permeability in the intestinal tissue, where absorption is occurring, is physiologically more relevant than measuring drug permeability in Caco-2 cells. Figure 5 and table 1 illustrate that drug absorption in this inverted rat intestinal tissue model correlates with drug retention factors k'_{IAM} measured on the IAM.PC.DD2 column.

Sample	% Absorption of Inverted Rat Intestine	(k′) IAM.PC.DD2
m-nitroaniline	77	10.838
p-nitroaniline	68	16.086
salicylic acid	60	6.963
p-toluidine	59	4.546
aniline	54	2.069
m-nitrobenzoic acid	53	4.403
phenol	51	6.544
benzoic acid	51	2.088
acetanilide	42	5.096
antipyrine	32	3.350
theophylline	29	1.478
acetylsalcylic acid	20	0.931
r (correlation factor)*		**0.8025**

* r is calculated by plotting log k′ vs. log % absorption of inverted rat intestine.

Table 1. Correlating Drug Partitioning into IAM with rat intestinal drug absorption.

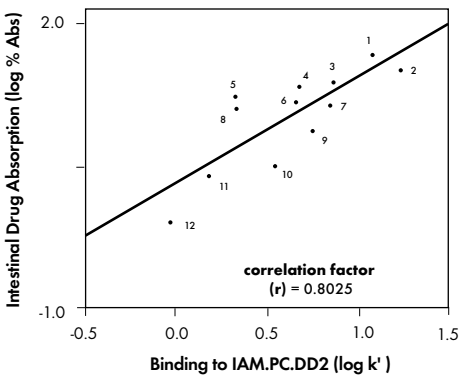
Product	Particle Size	Column Length and i.d.	Product #	U.S. Price
IAM.PC.DD2 Columns				
IAM.PC.DD2	12 µm, 300Å	3 cm x 4.6 mm i.d.	774010	$550.00
IAM.PC.DD2	12 µm, 300Å	10 cm x 4.6 mm i.d.	774011	$975.00
IAM.PC.DD2	12 µm, 300Å	15 cm x 4.6 mm i.d.	774014	$1,350.00
IAM.PC.DD2	12 µm, 300Å	Guard Kit*	774012	$330.00
IAM.PC.DD2	12 µm, 300Å	Guard Replacements**	774013	$275.00

* Includes 1 holder, 1 coupler, 2 guard cartridges

** Includes 3 guard cartridges

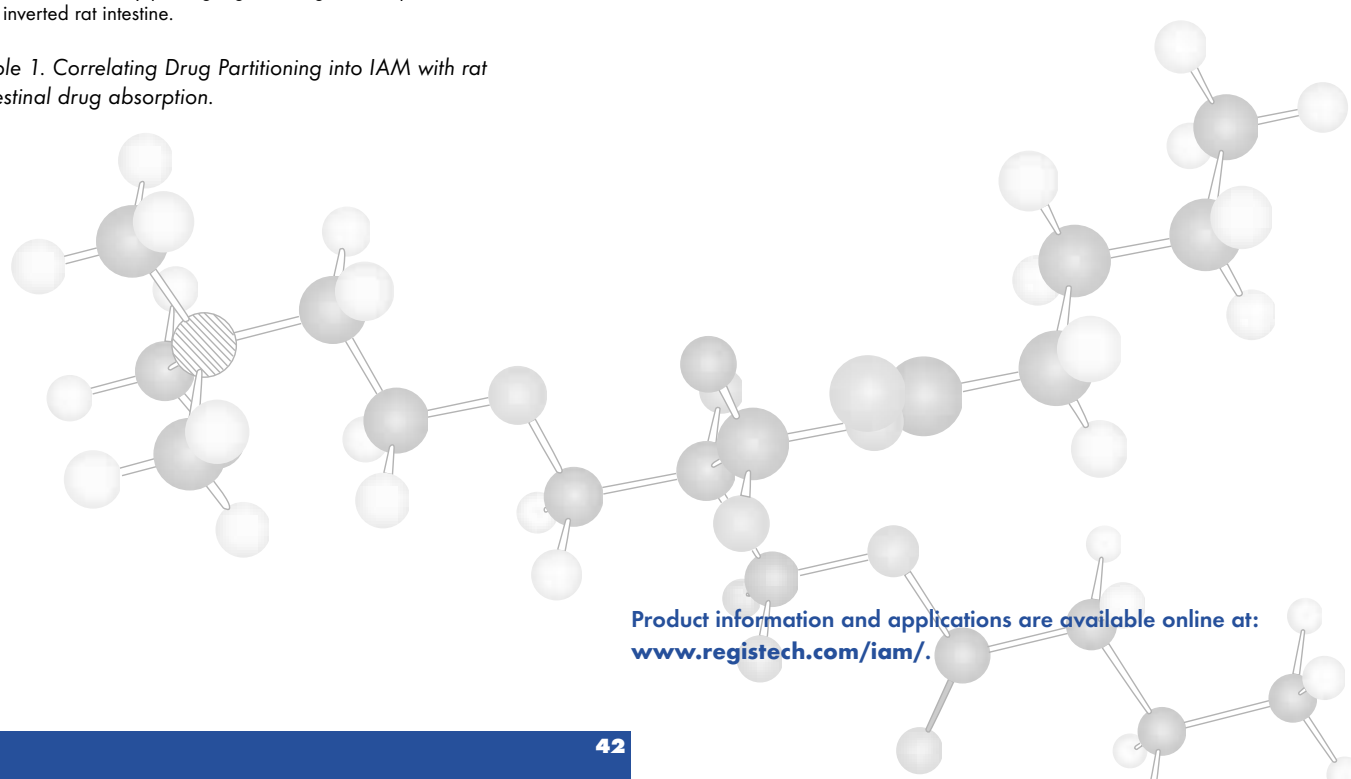
IAM Correlates with Intestinal Drug Absorption

Column: IAM.PC.DD2
10 cm x 4.6 mm i.d.
Mobile Phase: 0.01 M DPBS Buffer, pH 5.4
Flow Rate: 1.0 mL/min
Load: 10 µL
Detection: UV 220 nm



1. *m*-Nitroaniline
2. *p*-Nitroaniline
3. Salicylic acid
4. *p*-Toluidine
5. Aniline
6. *m*-Nitrobenzoic acid
7. Phenol
8. Benzoic acid
9. Acetanilide
10. Antipyrine
11. Theophylline
12. Acetylsalicylic acid

Figure 5. IAM.PC.DD2 columns measure drug absorption in inverted rat intestinal tissue.



Product information and applications are available online at: www.registech.com/iam/.

IAM Fast-Screen Mini Column

Packed with the Ester PC Ligand phase, IAM Fast-Screen Mini columns are a rapid and economically viable screening method for the high throughput estimation of drug permeability. Their benefits include excellent reproducibility, short analysis time and low cost. This can be of great use in characterizing large libraries of compounds.

The structure of the esterIAM.PC.C10/C3 packing, selected for the Fast-Screen Mini Column, is shown in figure 6. This PC analog demonstrates superiority in retention times and stability – essential features for short columns and mass drug screening.

The IAM.PC Fast-Screen Mini Column, 1 cm in length by 3.0 mm in internal diameter, was specifically designed by Regis for rapid estimation of drug permeability in high throughput screening programs. When connected to an HPLC system with an autosampler, a single column can be used in the analysis of hundreds of samples per day with highly reproducible results.

The 1cm Fast-Screen Mini Column is offered not as a separation tool, but rather as a tool for characterizing the chromatographic retention factor (k') of individual analytes. The measured k' of analytes on this column can be used to estimate a value for drug permeability.

IAM Fast-Screen Mini Column Structure

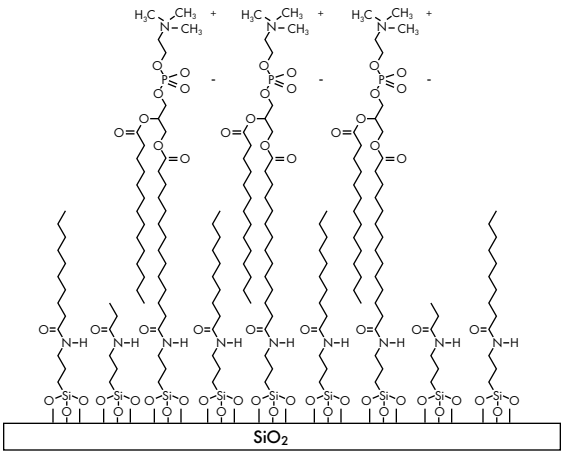


Figure 6. IAM.PC Fast-Screen Mini Column provides rapid estimation of drug permeability in high thoughput screening programs.

Column Advantages

Regis Technologies' 1 cm Fast-Screen Mini Column for Drug Discovery provides the following advantages:

- Excellent correlation to traditional methods
- Rapid indication of drug absorption
- High sample throughput
- Highly reproducible results
- Durability
- Cost effectiveness
- Ability to establish absorption zones for high throughput screening

Product information and applications are available online at: www.registech.com/iam/.

Excellent Correlation To Traditional Methods

The traditional means of predicting permeability include use of Caco-2 cell line cultures, intestinal tissue, or liposome assays. These are laborious and costly to perform.

Data obtained from the IAM Fast-Screen Mini Column correlate well to data obtained from traditional assays. This is summarized in table 2.

Method	Number of Compounds Evaluated	Correlation (r) with IAM Fast-Screen Mini Column
Partitioning into liposomes	23	0.831
Intestinal drug permeability	12	0.839
Caco-2 cell permeability	8	0.909

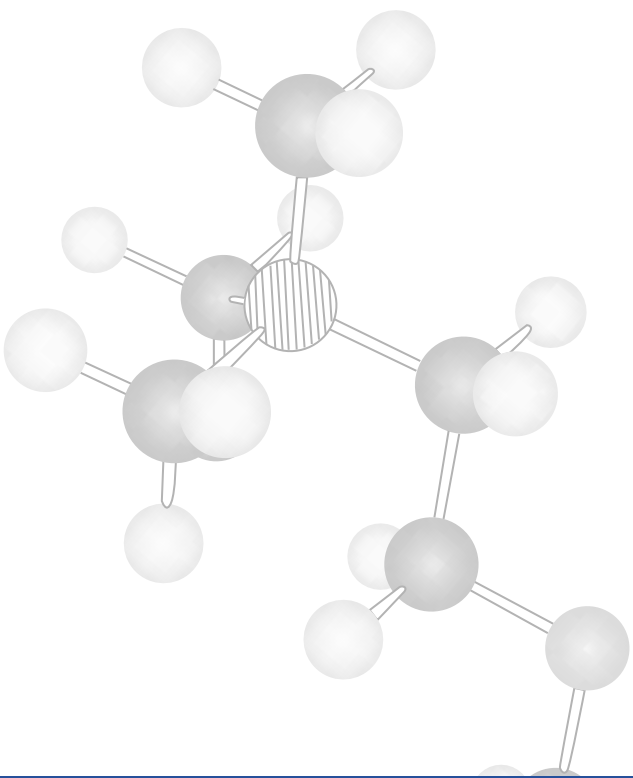
Table 2. Comparing k'_{IAM} data with other methods for estimating permeability.

Caco-2 Cell Correlation

Figure 7 illustrates that drug permeability predicted by Caco-2 cells correlates well to k'_{IAM} measured on the IAM Fast-Screen Mini Columns.

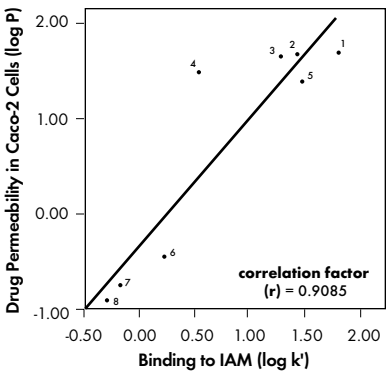
Intestinal Tissue Correlation

Table 3 shows that drug permeability predicted by Inverted Rat Intestines correlates well to drug retention factors, k'_{IAM} measured on the IAM Fast-Screen Mini Columns. Note the short retention times.



IAM Fast-Screen Correlates with Drug Permeability in Caco-2 Cells

Column: IAM Fast-Screen Mini Column 1cm x 3.0 mm i.d
Mobile Phase: 0.01 M DPBS Buffer, pH 7.4
Flow Rate: 0.5 mL/min
Load: 10 µl
Detection: UV 220 nm



1. Propranolol
2. Alprenolol
3. Warfarin
4. Metoprolol
5. Hydrocortisone
6. Terbutaline
7. Atenolol
8. (AVP) Arginine-Vasopressin

Figure 7. Correlating drug partitioning into IAM with intestinal drug permeability (log P) through Caco-2 cells.

Compound	% Absorption of Inverted Rat Intestine	IAM Fast-Screen Mini Column Retention Time (Sec)	k' (corrected)
m-nitroaniline	77	133.1	15.29
p-nitroaniline	68	177.9	21.84
salicylic acid	60	93.8	9.54
p-toluidine	59	79.7	7.48
aniline	54	52.1	3.45
m-nitrobenzoic acid	53	68.1	5.79
phenol	51	94.6	9.66
benzoic acid	51	43.7	2.22
acetanilide	42	76.2	6.97
antipyrine	32	51.8	3.40
theophylline	29	39.3	1.58
acetylsalcylic acid	20	36.1	1.11
r (correlation factor)* = 0.8385			

* r is calculated by plotting log k' vs. log % absorption of inverted rat intestine.

Chromatographic Conditions:
Column: IAM Fast-Screen Mini Column 1 cm x 3.0 mm i.d.
Mobile Phase: Dulbecco's Phosphate Buffered Saline, pH 5.4
Flow Rate: 0.3 mL/min
Load: 10 µL
Detection: UV 254 nm, 0.1 AUFS

Table 3. Correlating drug partitioning into IAM with rat intestinal drug absorption.

Product information and applications are available online at: www.registech.com/iam/.

Rapid Indication of Drug Absorption

IAM Chromatography is a more rapid alternative to other methods. In a recent study completed by Regis, k'_{IAMs} of 12 compounds were compared with absorption data obtained in situ using rat intestines. Retention times for the compounds tested were between 20 and 180 seconds, while retention factors correlated well to the intestinal absorption data.

High Sample Throughput

IAM chromatography is of increasing importance in combinatorial chemistry, where it is used to provide an initial estimate of a drug candidates' membrane permeability. Hundreds of samples can be injected into a single Fast-Screen Mini Column using an automated HPLC system. Recently a group of 12 test analytes was evaluated in 10 runs over the course of eight hours. Total run time for the 12 test analytes was only 42 minutes.

Highly Reproducible Results

The measured values for k'_{IAM} show excellent reproducibility, both from run to run and from day to day (figure 8).

Durability

IAM Fast-Screen Mini Columns are extremely durable. Correlation factors, r, for the original k', and k' after 5000 column volumes were identical.

Cost Effectiveness

Because the IAM Fast-Screen Mini Column is inexpensive, has a very short analysis time, and provides drug permeability estimates for hundreds of drug candidates in a fraction of the time of conventional methods, the IAM Fast-Screen Mini Column becomes the economical alternative for high throughput screening.

Ability to Establish Permeability Zones for High Throughput Screening

Permeability zones can be determined for different analytes when performing large-scale drug absorption screening. Thus, rapid IAM analyses can characterize a drug as having low, medium, or high membrane permeability (figure 9).

Excellent Reproducibility with IAM Fast-Screen Mini Column

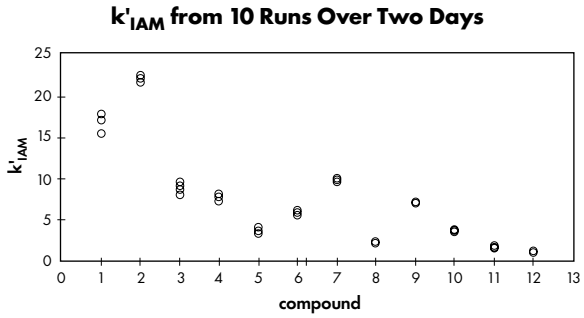


Figure 8. Highly reproducible k'_{IAM} from 10 runs over a two-day period.

k'_{IAM} Permeability Zones

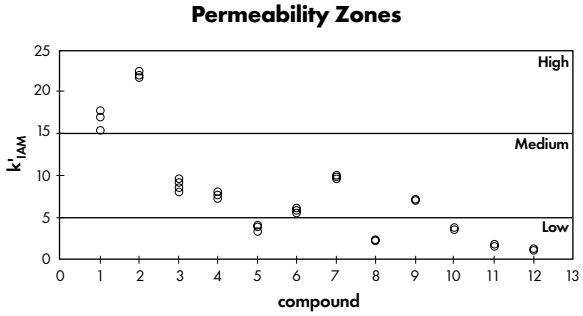
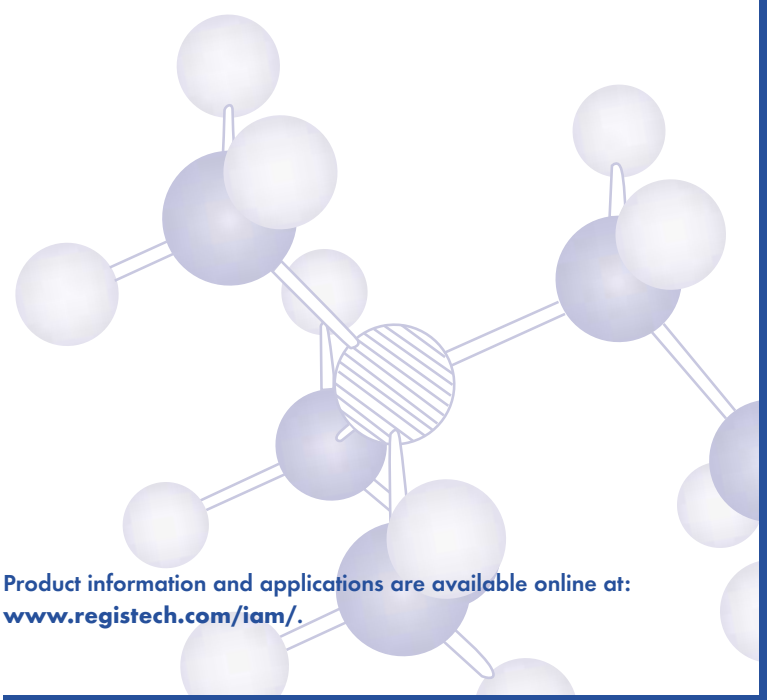


Figure 9. Permeability zones established large-scale drug absorption screening.



Product information and applications are available online at: www.registech.com/iam/.

IAM Fast-Screen Mini Column

Regis Technologies manufactures the IAM Fast-Screen Mini Column on-site in its manufacturing facility. This column, as well as all of our other products, must adhere to rigorous manufacturing and quality control specifications before release.

Regis' technical support staff, with years of chromatography experience, is available to answer any questions regarding the new IAM Fast-Screen Mini Column.

Product	Particle Size	Column Length and i.d.	Product #	U.S. Price
IAM Fast-Screen Mini Column Kit • 2 columns 1 cm x 3 mm • 1 cartridge holder • Two 1/16" nuts and ferrules • Two end plugs • Care and use booklet	12 µm, 300Å	1 cm x 3 mm i.d.	775014	$375.00
IAM Fast-Screen Mini Columns, Pkg of 6 • 6 columns, 1 cm x 3 mm • Care and use booklet	12 µm, 300Å	1 cm x 3 mm i.d.	775015	$575.00
IAM Fast-Screen Mini Columns, Pkg of 12 • 12 columns, 1 cm x 3 mm • Care and use booklet	12 µm, 300Å	1 cm x 3 mm i.d.	775016	$1,000.00

IAM References

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2. Ong, S.; et al.; Thermodynamics of Solute Partitioning into Immobilized Artificial Membranes; *Anal. Chem.* 1995, *67*, 755–762.
3. Pidgeon, C.; U.S. Patent 4 931 498, 1990.
4. Pidgeon, C.; U.S. Patent 4 927 879, 1990.
5. Pidgeon, C.; Venkatarum, U. V.; Immobilized Artificial Membrane Chromatography: Supports Composed of Membrane Lipids; *Anal. Biochem.* 1989, *176*, 36.
6. Stevens, J. M.; et al.; Characterization of Immobilized Artificial Membrane HPLC Columns Using Deoxy Nucleotides as Model Compounds; *Biochromatography*1989, *4*, 192.
7. Markovich, R. J.; et al.; Fourier Transform Infrared Assay of Membrane Lipids Immobilized to Silica: Leaching and Stability of Immobilized Artificial Membrane-Bonded Phases; *Anal. Biochem.* 1989, *182*, 237–244.
8. Pidgeon, C.; Solid Phase Membrane Mimetics: Immobilized Artificial Membranes; *Enz. Microb. Technol.* 1990, *12*, 149–150.
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10. Artursson, P.; Karlsson, J.; Correlation Between Oral Drug Adsorption in Humans and Apparent Drug Permeability Coefficients in Human Intestinal Epithelial (Caco-2) Cells; *Biochem. Biophys. Res. Commun.* 1991, *175*, 880–885.
11. Schanker, L. S.; *J. Pharmacol. Exp. Ther.* 1958, *123*, 81–88.

For additional information on IAM Chromatography, check our Web site at www.registech.com/iam/. You may also request a complete IAM publication list, by contacting Regis at:

(800) 323-8144 ext. 649
(847) 967-6000 ext. 649
e-mail us at: sales@registech.com.

Ion Pairing Reagents and Buffers

The Advantages of Ion Pair Chromatography

Ion Pair Chromatography is a method for improving the separation of charged analytes. In the resolution of organic ions with conventional HPLC methods, use of ion pair reagents can enhance peak shape and retention time when common remedies such as modifying eluent ratios or changing stationary phase fail.

In the past, chromatographic separation of charged analytes has been achieved by ion suppression (the careful adjustment of the mobile phase pH to result in a nonionized analyte). Determining the optimum mobile phase pH in ion suppression, however, often requires extensive method development. Samples containing more than one ionizable component were often unusable. The limitations of ion suppression led to the development of a new, more generally applicable approach to separation of ionized components: *ion pair chromatography.*

Developed by Dr. Gordon Schill in 1973, ion pair chromatography relies upon the addition of ionic compounds to the mobile phase to promote the formation of ion pairs with charged analytes. These reagents are comprised of an alkyl chain with an ionizable terminus (figure 1). When used with common hydrophobic HPLC phases in the reversed-phase mode, ion pair reagents can be used to selectively increase the retention of charged analytes (figure 2).

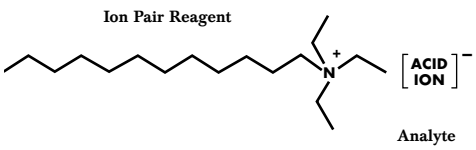


Figure 1. Quaternary Amine (Q-Series) Ion Pair Reagent.

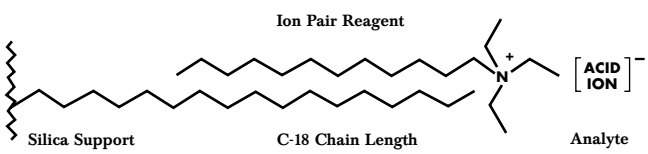


Figure 2. Quaternary Amine (Q-Series) Ion Pair Reagent interacting with C-18 Support.

Ultrapure Ion Pairing Reagents and Buffers

Although ion exchange chromatography has become a popular mode of separation, it is not useful in all situations. The advantages of ion pair chromatography over ion exchange chromatography are:

- Simple preparation of buffers
- Wide choice of carbon chain lengths for improved retention and separation
- Significantly reduced separation time
- Simultaneous separation of both ionized and nonionized solutes
- Highly reproducible results
- Improved peak shape

Regis Provides a Choice of Reagents

Regis manufactures both ultrapure anionic Sulfonate (S-Series) and cationic Quaternary Amine (Q-Series) ion pair concentrates in the following alkyl chain lengths: pentyl, hexyl, heptyl, octyl, and dodecyl. Alkyl chains are represented by cardinal numbers in the naming of our products, i.e., 5, 6, 7, 8, and 12. (See product descriptions on the following pages.)

Optical Absorbance (AUFS)			Optical Absorbance (AUFS)		
S-Series	200 nm	210 nm	Q-Series	200 nm	210 nm
S5	0.006	0.002	Q5	0.060	0.001
S6	0.048	0.018	Q6	0.059	0.006
S7	0.008	0.001	Q7	0.022	0.009
S8	0.001	0.003	Q8	0.082	0.003
S12	0.002	0.003	Q12	0.102	0.013
CH3CN	0.076	0.013			
CH3OH	0.940	0.510			

Table 1. Typical optical absorbances (AUFS) at 0.005 M.

Purity is a Key Ingredient

Purity is of key importance in the manufacture of our Ion Pair Reagents. Regis S- and Q-Series products are synthesized in accordance with the industry's highest quality standards, resulting in exceptional purity and integrity. This is demonstrated in table 1: UV transparency as low as 200 nm can be achieved for both the S- and Q-Series reagents. In most cases, these absorbances are lower than those for HPLC grade acetonitrile and methanol. Although the S- and Q-Series ion pair reagents can be used at wavelengths less than 210 nm, the crucial factors in determining what wavelength to use are the integrity of the detector optics and the purity of the organic modifiers.

Regis also supplies bulk Sulfonate and several additional bulk Ion Pair Reagents and Rivier Buffers to complement the separation capabilities of the Sulfonate S-Series and Quaternary Amine Q-Series.

How to Select a Regis Ion Pair Reagent For Method Development

To choose the proper reagent, alkyl chain lengths must be taken into consideration. The chain lengths enable selective separation of the analyte. The longer the chain, the more hydrophobic the counterion, and therefore, greater the retention. Retention may increase by a factor of almost 20 when going from pentyl (Q5) to dodecyl (Q12), as illustrated in table 2 and figure 3. Both table 2 and figure 3 demonstrate that the Q-reagent chain length governs benzoic acid retention times, but does not affect the benzyl alcohol retention times. Similar behavior can also be achieved with the S-Series.

The following are guidelines to developing a successful method using Regis' ion pair reagents:

- Select a column – endcapped ODS (octadecylsilyl) is most common.
- Use only HPLC-grade water and chromatography grade reagents in mobile phase preparation.
- Choose the mobile phase components and concentrations that give the best separation.
- If nonionic components are present in the sample, optimize the resolution prior to attempting ionic separations.
- Select the appropriate ion pair series to provide the necessary counterion. Use the Q-series for acidic compounds and the S-series for basic compounds.
- Through a process of elimination, choose the alkyl chain length which results in the best separation (figure 4).
- Once the reagent has been selected, adjust the pH of the mobile phase to maximize resolution. Because slight modification of pH can profoundly effect retention and selectivity, make all adjustments in small increments and monitor carefully (table 3).
- Ideally, the ion pair reagent concentration in the mobile phase should be 0.005 M. However, small adjustments in reagent concentration may increase retention slightly and optimize the separation (figure 5).

	Retention Times (min)		Retention Ratio
Q-Series	Benzoic Acid	Benzyl Alcohol	Acid/Alcohol
Q5	4.53	9.17	0.49
Q6	6.50	8.60	0.76
Q7	8.24	9.13	0.90
Q8	12.36	8.94	1.38
Q12	79.53	8.52	9.33

Table 2. Retention vs. chain length.

[benzoic acid/benzyl alcohol in (60/40) water/methanol]					
Q6		Q7		Q8	
pH	R	pH	R	pH	R
7.50	0.59	7.50	0.88	7.51	1.06
6.50	0.70	6.51	1.00	6.54	1.29
5.50	0.96	5.52	1.23	5.50	1.59

Table 3. Retention ratio R as a function of pH.

Effect of Q-Reagent Chain Length on Retention

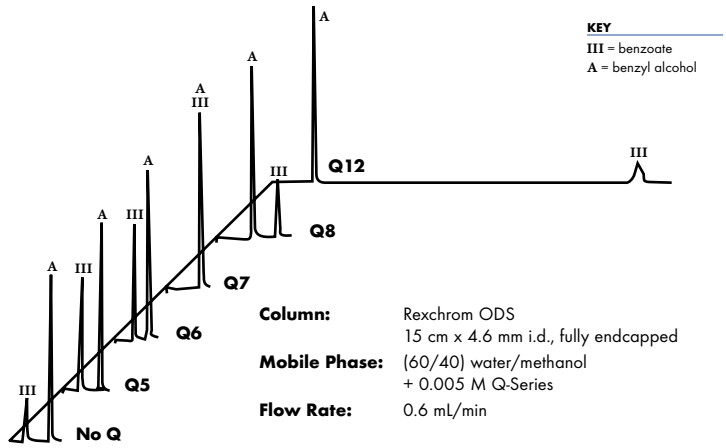


Figure 3. Retention increases with Q-Reagent chain length.

Choosing Appropriate Ion Pair Reagents

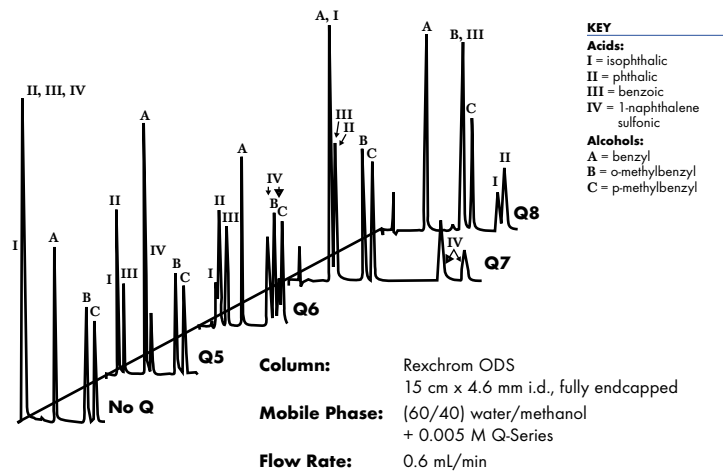


Figure 4. In a mixture of ionic and nonionic compounds, first separate the nonionic compounds from each other (See above). Then choose the ion pair reagent that retains the ionic compounds as desired. Here, Q6 seems to be the reagent of choice since all peaks are visibly separated.

Fine-Tuning a Separation

Column: Rexchrom ODS
15 cm x 4.6 mm i.d., fully endcapped

Mobile Phase: (60/40) water/methanol
+ Q-Series

Flow Rate: 0.6 mL/min

Increasing Q7 concentration from 0.005 M (left) to 0.0055 M (right) moves the benzoate peak off the benzyl alcohol peak.

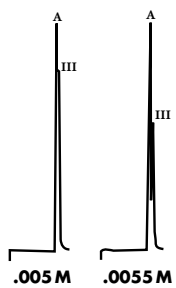


Figure 5. Increasing the Q-Reagent concentration may increase retention slightly and optimize the separation.

Regis Sulfonates (S-Series) for Basic Compounds

S-Series Ion Pair Concentrates (For Cations)

The sulfonates are sodium salts that act as an anionic counterion for the separation and resolution of positively charged analytes. The sulfonates are available as:

Ion pair concentrates – premixed 0.5 M solutions of alkyl sulfonates. When diluted to 1 L with HPLC-grade water, a 10 mL bottle forms a 0.005 M solution.

Larger quantities are available upon request. Please call Regis for pricing.

Product	Size	Product #	U.S. Price
S5 (1-pentylsodiumsulfonate)	(5) 10 mL bottles	405025	$72.00
	100 mL bottle	405035	$105.00
S6 (1-hexylsodiumsulfonate)	(5) 10 mL bottles	405026	$72.00
	100 mL bottle	405036	$105.00
S7 (1-heptylsodiumsulfonate)	(5) 10 mL bottles	405027	$72.00
	100 mL bottle	405037	$105.00
S8 (1-octylsodiumsulfonate)	(5) 10 mL bottles	405028	$72.00
	100 mL bottle	405038	$105.00
S12 (1-dodecylsodiumsulfonate)	(5) 10 mL bottles	405021	$72.00
	100 mL bottle	405031	$105.00

0.5 M solutions of Alkyl Sulfonates
(Each 10 mL bottle, diluted to 1 L, produces a 0.005 M solution)

S-Series Method Development Kit
Each kit contains a 10 mL bottle of each of the following:

S5, S6, S7, S8, S12	405020	$68.00

Bulk Ion Pair Reagents (For Cations)

Bulk powder – fine, purified crystals, for use as a buffer in large-scale mobile phase preparation.

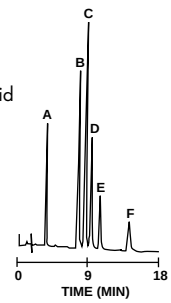
Larger quantities are available upon request. Please call Regis for pricing.

Product	Size	Product #	U.S. Price
1-Pentanesulfonate, Sodium Salt	25 gm	403025	$55.00
	100 gm	403125	$150.00
1-Hexanesulfonate, Sodium Salt	25 gm	403026	$55.00
	100 gm	403126	$150.00
1-Heptanesulfonate, Sodium Salt	25 gm	403027	$55.00
	100 gm	403127	$150.00
1-Octanesulfonate, Sodium Salt	25 gm	403028	$55.00
	100 gm	403128	$150.00
1-Dodecanesulfonate, Sodium Salt	5 gm	403021	$20.00
	25 gm	403022	$80.00

Ion Pair Applications

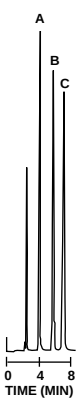
Separation of Catecholamines using Ion Pair Reagents

Column: REXCHROM ODS, 5µm, 100Å
15 cm x 4.6 mm i.d.
Mobile Phase: (89/11) 0.005 M S8 ion pair concentrate/ acetonitrile, pH 2.5
Flow Rate: 1.0 mL/min
Load: 10 µL
Detection: UV 280 nm
Peak Identities:
A. 3,4-Dihydroxyphenylacetic acid
B. Norepinephrine
C. 3,4-Dihydroxyphenylalanine
D. Epinephrine
E. 3,4-Dihydroxybenzylamine
F. Dopamine



Separation of Artificial Sweeteners

Column: REXCHROM Little Champ II (ODS), 3µm, 100Å
5 cm x 4.6 mm i.d.
Mobile Phase: (86/14) 0.005 M Q7 ion pair concentrate/ acetonitrile, pH 6.2
Flow Rate: 1.0 mL/min
Load: 10 µL
Detection: UV 210 nm
Peak Identities:
A. Aspartame
B. Acesulfame Potassium (Acesulfame-K)
C. Saccharin



Regis Quaternary Amines (Q-Series) For Acidic Compounds

Q-Series Ion Pair Concentrates (For Anions)

The Q-series is comprised of quaternary alkyltriethylamines that can be used for the resolution of negatively charged species. This unique set of cationic reagents was developed to complement the Sulfonate Series (S-Series) and is exclusively manufactured by Regis. The Quaternary Alkyltriethylamines are available as:

Ion pair concentrates — premixed 0.5 M solutions of alkyl amines. When diluted to 1 L with HPLC-grade water, a 10 mL bottle forms a 0.005 M buffered solution.

Product	Size	Product #	U.S. Price
Q5 (1-pentyltriethyl-ammonium phosphate)	(5) 10 mL bottles	404025	$72.00
	100 mL bottle	404035	$105.00
Q6 (1-hexyltriethyl-ammonium phosphate)	(5) 10 mL bottles	404026	$72.00
	100 mL bottle	404036	$105.00
Q7 (1-heptyltriethyl-ammonium phosphate)	(5) 10 mL bottles	404027	$72.00
	100 mL bottle	404037	$105.00
Q8 (1-octyltriethyl-ammonium phosphate)	(5) 10 mL bottles	404028	$72.00
	100 mL bottle	404038	$105.00
Q12 (1-dodecyltriethyl-ammonium phosphate)	(5) 10 mL bottles	404021	$72.00
	100 mL bottle	404031	$105.00

0.5 M solutions of Quaternary Alkyltriethylamines
(Each 10 mL bottle, diluted to 1 L, produces a 0.005 M solution)

Q-Series Method Development Kit

Each kit contains a 10 mL bottle of each of the following:

Q5, Q6, Q7, Q8, Q12	404020	$68.00

Other Regis Bulk Ion Pair Reagents (For Anions)

Other bulk Ion Pair reagents such as Tetrabutylammonium phosphate, Trihexylamine and Triheptylamine are complementary reagents used for the resolution of negatively charged analytes.

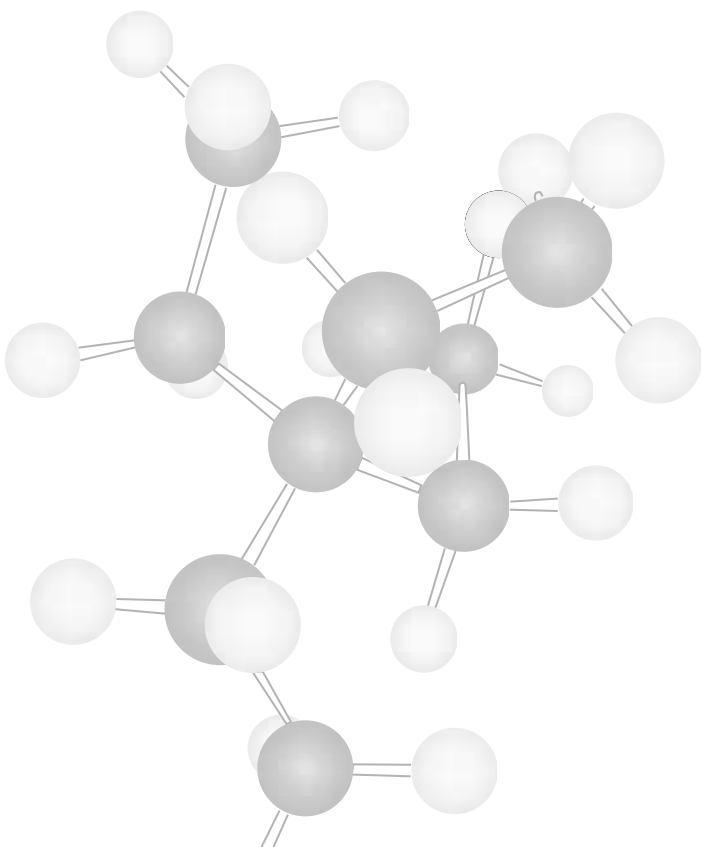
Product	Size	Product #	U.S. Price
Tetrabutylammonium phosphate 0.5 M, pH 7.5	10 mL	680502	$15.00
Tetrabutylammonium phosphate 0.5 M, pH 7.5	500 mL	680503	$270.00

Ion Pair References

1. Perry, J. A.; Glunz, L. G.; Szczerba, T. J.; Hocson, V. S.; Reagents For Ion Pair Reversed-Phase HPLC; American Laboratory 1984, 16(10), 114–119.

2. Eksborg, S.; Lagerstrom, P.; Modin, R.; Schill, G.; Ion Pair Chromatography of Organic Compounds J. Chrom. 1973, 83, 99.

3. Eksborg, S.; Schill, G.; Ion Pair Partition Chromatography of Organic Ammonium Compounds Anal. Chem. 1973, 45, 2092.



For additional information on Ion Pair Reagents, check our Web site at www.registech.com/ionpair/ or contact Regis directly at:

(800) 323-8144 ext. 649
(847) 967-6000 ext. 649
e-mail us at: sales@registech.com.

GC Derivatization Reagents

Derivatization

Derivatization is primarily performed to modify an analyte's functionality in order to enable chromatographic separations. For more than 30 years, Regis has been a leader in the manufacture of highly pure derivatization reagents for gas chromatography.

The formation of chemical derivatives to facilitate meaningful analysis has long been a common practice in gas chromatography. For the analytical chemist, judicious use of derivatization can be the key to unlocking and simplifying a great many complex and perplexing separation problems. Derivatization, accomplished through alteration of functional groups, provides:

- Increased sample volatility
- Improved selectivity and chromatographic efficiency
- Enhanced detectability

Additional procedures and references are available on our Web site at: www.registech.com.

Gas Chromotography (GC) Derivatization

Sample volatility or thermal stability is crucial in GC applications. If a sample does not possess these important characteristics, GC analysis is highly unproductive. Derivatization techniques have been developed to address these issues to insure successful separations. In GC Derivatization, replacement of active hydrogen in functional groups, such as -COOH, -OH, -NH, and -SH, is the primary area of concern and is accomplished through either silylation, acylation or alkylation.

Silylation

Silylation is the most widely used derivatization procedure for sample analysis by GC. Silylation reagents are popular because they are easy to use and readily form derivatives. In silylation, an active hydrogen is replaced by an alkylsilyl group, such |as trimethylsilyl (TMS) or *t*-butyldimethylsilyl (*t*-BDMS). Compared to their parent compounds, silyl derivatives are more volatile, less polar, and more thermally stable. As a result, GC separation is improved and detection is enhanced.

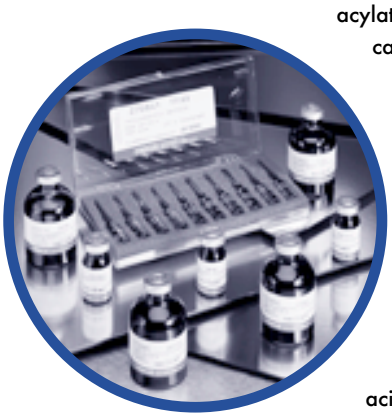
Silylation reagents are generally moisture sensitive, requiring them to be sealed under nitrogen to prevent deactivation. The derivatives of TMS reagents are also moisture sensitive. In response to this difficulty, *t*-BDMS reagents were introduced, which enabled the formation of derivatives 10,000 times more stable to hydrolysis than the TMS ethers.

Both TMS and *t*-BDMS reagents are suitable for a wide variety of compounds, offer excellent thermal stability and can be used in a variety of GC conditions and applications.

Analysis by the popular combination of gas chromatography and mass spectrometry (GS/MS) often requires special sample derivatization. Particularly effective in these applications are MTBSTFA and deutero-MTBSTFA-d.

Acylation

Acylation reagents offer the same types of advantages available from silylation reagents: creating less polar, more volatile derivatives. However, in comparison to silylating reagents, the acylating reagents more readily target highly polar, multi-functional compounds, such as carbohydrates and amino acids. In addition, acylating reagents provide the distinct advantage of introducing electron-capturing groups, thus enhancing detectability during analysis.



Generally, these reagents are available as acid anhydrides, acyl derivatives, or acyl halides. The acyl halides and acyl derivatives are highly reactive and are suitable for use where steric hindrance may be a factor. Acid anhydrides are supplied in a number of fluorinated configurations, which improve detection. These fluorinated anhydride derivatives are used primarily for Electron Capture Detection (ECD), but can also be used for Flame Ionization Detection (FID). Fluorinated anhydrides are often used in derivatizing samples to confirm drugs of abuse. Despite the special utility of these reagents, their acidic nature requires that any excess or byproducts be removed prior to analysis to prevent deterioration of the column.

Gas Chromotography (GC) Derivatization

Alkylation

As with other derivatization reagents, alkylation reagents reduce molecular polarity by replacing active hydrogens with an alkyl group. These reagents are used to modify compounds having acidic hydrogens, such as carboxylic acids and phenols. Alkylation reagents can be used alone to form esters, ethers, and amides—or they can be used in conjunction with acylation or silylation reagents. A two-step approach is commonly used in the derivatization of amino acids, where multiple functional groups on these compounds may necessitate protection during derivatization.

Due to the availability of reagents and their ease of use, esterification (the reaction of an acid with an alcohol in the presence of a catalyst to form an ester) is the most popular method of alkylation. Alkylation reagents are available in several configurations that enable the formation of a variety of esters. Alkyl esters are stable, and can be formed quickly and quantitatively. By altering the length of the substituted alkyl group, retention of the derivative can be varied. In addition to the formation of simple esters, alkylation reagents can be used in extractive procedures where biological matrices may be present.

GC Chiral Derivatization

GC analysis of enantiomeric compounds on nonracemic or achiral stationary phases requires the use of enantiopure derivatization reagents. These reagents generally target one specific functional group to produce diastereomers of each of the enantiomeric analytes. From the resulting chromatograms, calculations are conducted to determine the enantiomeric concentration of the analyte.

Guide to GC Derivatization Methods/Functional Groups

	GC Derivatization Method		
Functional Group	**Silylation**	**Acylation**	**Alkylation**
Active Hydrogens	BSA, BSTFA, BSTFA/TMCS, Deriva-Sil, Hydrox-Sil, MSTFA, MTBSTFA, TMSI	PFPOH/PFPA	DMF Dialkylacetals, TBH
Carboxylic Acids	BSTFA, Hydrox-Sil Conc., MTBSTFA, TMSI	PFPOH/PFPA	BF_3/Methanol, BF_3/*n*-Butanol, DMF Dialkylacetals, TBH
Alcohols and Phenols: unhindered and moderately hindered	BSA, BSTFA/TMCS, HMDS, MTBSTFA/*t*-BDMCS	HFBI, Fluorinated anhydrides (HFBA, PFPA, TFAA), MBTFA, MCF*	DMF Dialkylacetals, PFB-Br/TBA-H-SO_4, TBH
Alcohols and Phenols: highly hindered	BSTFA/TMCS, Deriva-Sil, Deriva-Sil Conc.	Fluorinated anhydrides (HFBA, PFPA, TFAA), HFBI, PFBCl	DMF Dialkylacetals, PFB-Br/TBA-H-SO_4, TBH
Amines: primary and secondary	BSTFA, MTBSTFA/*t*-BDMCS	Fluorinated anhydrides (HFBA, PFPA, TFAA), HFBI, MBTFA, PFBCl, TPC*	DMF Dialkylacetals, TBH
Amides	BSA, BSTFA, BSTFA/TMCS, Deriva-Sil Conc.	HFBI	DMF Dialkylacetals, TBH
Amino Acids	BSTFA, TMSI	HFBI (+ Silylation)	DMF Dialkylacetals, TBH
Catecholamines	TMSI	Fluorinated anhydrides (HFBA, PFPA, TFAA), HFBI	
Carbohydrates and Sugars	HMDS, Hydrox-Sil AQ, TMSI	MBTFA	
Inorganic Anions	BSTFA, MTBSTFA		
Nitrosamines		HFBA	
Sulfonamides	BSTFA	Fluorinated anhydrides (HFBA, PFPA, TFAA)	DMF Dialkylacetals, PFB-Br/TBA-H-SO_4

Derivatization reagents are listed in alphabetical order, not in order of preference.

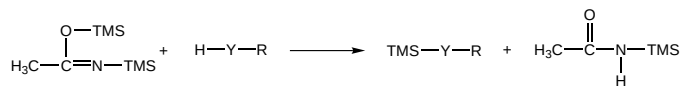
*For Chiral Analysis

Source: Knapp, D.R. *Handbook of Analytical Derivatization Reactions;* John Wiley and Sons: New York, 1979.

BSA
N,O-Bis(trimethylsilyl)acetamide

- Forms highly stable TMS derivatives with most organic functional groups under mild reaction conditions.

Product	Size	Product #	U.S. Price
BSA	10 x 1 gm	270501	$48.00
	4 x 5 gm	270502	$48.00
	25 gm	270503	$56.00
	100 gm	270504	$134.00



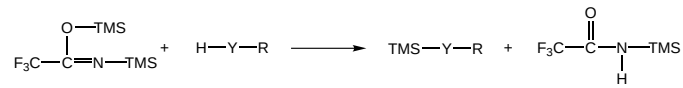
TMS = $Si(CH_3)_3$

Y = O, S, NH, NR^1, COO
R, R^1 = Alk, Ar

BSTFA-Regisil®
BSTFA +TMCS (1%, 10%)
N,O-Bis(trimethylsilyl)trifluoroacetamide

- Reacts faster and more completely than BSA, due to presence of trifluoroacetyl group.
- The high volatility of BSTFA and its byproducts results in separation of early eluting peaks.
- Highly volatile and stable products result in low detector noise and fouling.
- Excellent solubility.
- Addition of TMCS catalyzes reactions of hindered functional groups in secondary alcohols and amines.

Product	Size	Product #	U.S. Price
Regisil® RC-1 (BSTFA)	10 x 1 gm	270111	$66.00
	50 x 1 gm	270117	$225.00
	4 x 5 gm	270112	$59.00
	25 gm	270113	$66.00
	100 gm	270114	$180.00
Regisil® RC-2 (BSTFA) +1% TMCS	10 x 1 gm	270121	$66.00
	50 x 1 gm	270127	$225.00
	4 x 5 gm	270122	$59.00
	25 gm	270123	$66.00
	100 gm	270124	$180.00
Regisil® RC-3 (BSTFA) +10% TMCS	10 x 1 gm	270131	$66.00
	4 x 5 gm	270132	$59.00
	25 gm	270133	$66.00
	100 gm	270134	$180.00



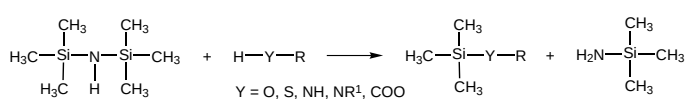
TMS = $Si(CH_3)_3$

Y = O, S, NH, NR^1, COO
R, R^1 = Alk, Ar

HMDS
Hexamethyldisilazane

- Weak TMS donor, used for silylation of carbohydrates.
- Used as mixture with pyridine and trifluoroacetic acid.

Product	Size	Product #	U.S. Price
HMDS	25 gm	270651	$27.00
	100 gm	270652	$49.00

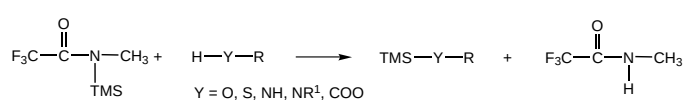


Y = O, S, NH, NR^1, COO
R, R^1 = Alk, Ar

MSTFA
N-Methyltrimethylsilyltrifluoroacetamide

- Most volatile of the TMS-acetamides.
- Useful in the analysis of volatile trace materials.

Product	Size	Product #	U.S. Price
MSTFA	10 x 1 gm	270590	$65.00
	10 gm	270589	$60.00
	25 gm	270593	$76.00
	100 gm	270594	$265.00



Y = O, S, NH, NR^1, COO
R, R^1 = Alk, Ar

TMS = $Si(CH_3)_3$

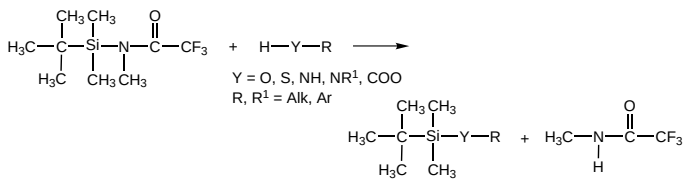
Product information and applications are available online at: www.registech.com/gc/.

Silylation Reagents

MTBSTFA
MTBSTFA + 1% *t*-BDMCS
N-Methyl-N-(*t*-butyldimethylsilyl)trifluoroacetamide

- Replaces active hydrogens to form *t*-BDMS derivatives.
- Derivatization is usually complete upon dissolution with this exceptionally strong, yet mild silylating reagent.
- MTBSTFA derivatives are 10^4 times more stable to hydrolysis than their corresponding TMS derivatives.
- Produces easily interpreted mass spectra for GC/MS.
- Addition of *t*-BDMCS catalyzes reactions of hindered alcohols and amines.

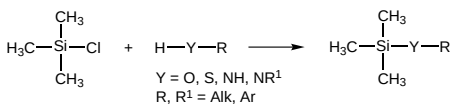
Product	Size	Product #	U.S. Price
MTBSTFA (+1% *t*-BDMCS)	5 x 1 gm	270141	$81.00
	10 x 1 gm	270144	$125.00
	2 x 5 gm	270142	$83.00
	25 gm	270143	$150.00
MTBSTFA (no *t*-BDMCS)	5 x 1 gm	270241	$81.00
	2 x 5 gm	270242	$83.00
	25 gm	270243	$150.00



TMCS
Trimethylchlorosilane

- Used as a catalyst to increase reactivity of other silylation reagents.

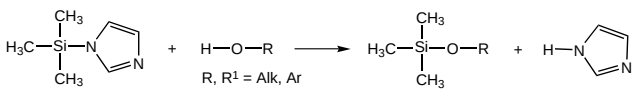
Product	Size	Product #	U.S. Price
TMCS	25 gm	270601	$27.00
	100 gm	270602	$49.00



TMSI
Trimethylsilylimidazole

- Potent, selective TMS donor that reacts with alcohols and phenols but not amines or amides.
- Derivatizes wet sugar samples, hindered hydroxyl groups in steroids, and amino acids in fluorinated acylation reagents.
- Used in the preparation of dual perfluoroacyl and TMS derivatives.

Product	Size	Product #	U.S. Price
TMSI	10 x 1 gm	270401	$47.00
	5 gm	270402	$25.00
	25 gm	270403	$62.00



Silylation Formulations

Deriva-Sil

- BSTFA:TMCS:TMSI:Pyridine (3:2:3:10) formulation.
- Derivatizes sterically-hindered compounds.
- Reacts with carbohydrates, hydroxy- and keto-steroids, fatty acids, and some amines and amides.
- Derivatizations are complete in minutes.

Product	Size	Product #	U.S. Price
Deriva-Sil – BSTFA:TMCS: TMSI:Pyridine (3:2:3:10)	10 x 1 mL	270151	$65.00
	25 mL	270152	$65.00

Deriva-Sil Concentrate

- BSTFA:TMCS:TMSI (3:2:3) concentrate formulation.
- Used for applications where pyridine is undesirable (*i.e.*, 3-ketosteroids).

Product	Size	Product #	U.S. Price
Deriva-Sil Concentrate – BSTFA:TMCS:TMSI (3:2:3)	25 mL	270150	$86.00

Product information and applications are available online at: www.registech.com/gc/.

Silylation Formulations

Hydrox-Sil

- HMDS:TMCS:Pyridine (2:1:10) formulation for one-step derivatizations.
- Fast formation of the TMS derivatives of organic acids, unhindered alcohols and phenols, and some amines.

Product	Size	Product #	U.S. Price
Hydrox-Sil – Reagent HMDS:TMCS:Pyridine (2:1:10)	10 x 1 mL	270455	$52.00
	25 mL	270457	$52.00

Hydrox-Sil AQ

- TMSI:Pyridine (21%w/v) formulation.
- Forms TMS derivatives of hydroxyl and polyhydroxyl compounds in the presence of water.

Product	Size	Product #	U.S. Price
Hydrox-Sil AQ – TMSI:Pyridine (21% w/v)	10 x 1 mL	270451	$54.00
	25 mL	270453	$50.00

Hydrox-Sil Concentrate

- HMDS:TMCS (2:1) concentrate formulation.
- Suited for applications where pyridine in Hydrox-Sil is undesirable.

Product	Size	Product #	U.S. Price
Hydrox-Sil Concentrate – HMDS:TMCS (2:1)	25 mL	270458	$76.00

Acylation Reagents

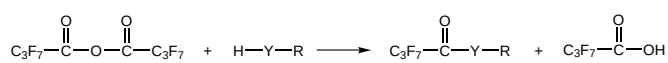
Fluorinated Anhydrides: HFBA/PFPA/TFAA

Heptafluorobutyric Anhydride/Pentafluoropropionic Anhydride/Trifluoroacetic Anhydride

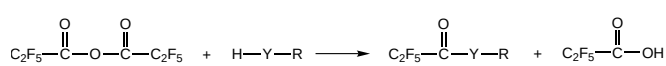
- Most commonly used for ECD.
- Reacts with alcohols, amines, and phenols.
- Bases such as triethylamine and trimethylamine can be added to promote reactivity.
- Frequently used for the confirmation of drugs of abuse.
- HFBA derivatives are the most sensitive to ECD.
- PFPA derivatives require the lowest analysis temperatures.
- TFAA is the most reactive and volatile of the anhydrides.

Product	Size	Product #	U.S. Price
HFBA	10 x 1 gm	270851	$68.00
	25 gm	270853	$91.00
PFPA	10 x 1 gm	640110	$85.00
	25 gm	640113	$90.00
	100 gm	640114	$250.00
TFAA	10 x 1 gm	270841	$56.00
	25 gm	270843	$26.00

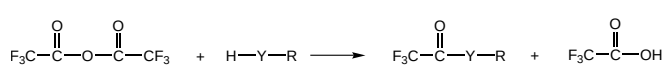
HFBA



PFPA



TFAA



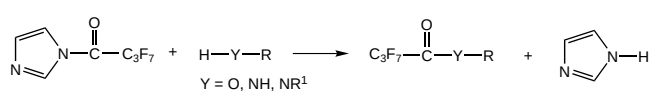
Y = O, NH, NR^1
R, R^1 = Alk, Ar

HFBI

Heptafluorobutyrylimidazole

- Readily forms derivatives with phenols, alcohols and amines suitable for ECD.
- Reactions are fast and mild.
- Imidazole is not acidic, so no decomposition or corrosion occurs on columns.

Product	Size	Product #	U.S. Price
HFBI	5 x 1 gm	270611	$96.00
	5 gm	270612	$81.00



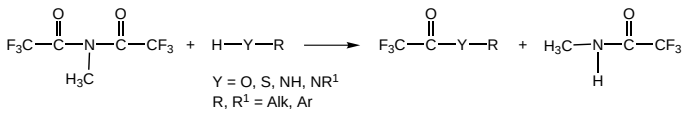
Y = O, NH, NR^1
R, R^1 = Alk, Ar

Acylation Reagents

MBTFA
N-Methyl-N-bis(trifluoroacetamide)

- Reacts rapidly under mild conditions with primary and secondary amines.
- Reacts more slowly with alcohols, phenols, and thiols.
- Works well in the analysis of sugars.

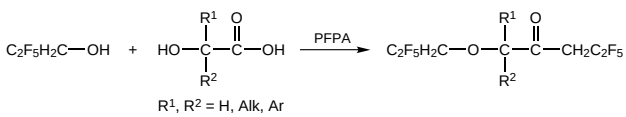
Product	Size	Product #	U.S. Price
MBTFA	10 x 1 gm	270092	$84.00
	5 gm	270091	$39.00
	25 gm	270095	$160.00
	100 gm	270093	$395.00



PFPOH
2,2,3,3,3-Pentafluoropropanol

- Used in combination with PFPA to make derivatives of the most common functional groups, especially polyfunctional bio-organic compounds.
- Formed derivatives are highly suitable for ECD.

Product	Size	Product #	U.S. Price
PFPOH	5 gm	270815	$32.00
	25 gm	270816	$100.00



Derivatization Grade Solvents

Derivatization Grade Solvents

- High purity reagents packaged under nitrogen.
- Sealed with Teflon®-coated septa, allowing easy access to sample without exposure to moisture and oxygen.

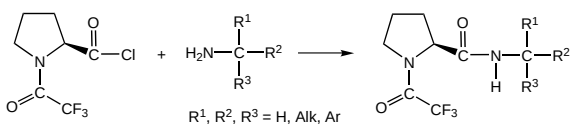
Product	Size	Product #	U.S. Price
Acetonitrile	2 x 25 mL	270010	$20.00
Dimethylformamide	2 x 25 mL	270011	$20.00
Pyridine	2 x 25 mL	270013	$20.00
Tetrahydrofuran	2 x 25 mL	270014	$20.00

GC Chiral and Specialty Derivatization Reagents

TPC
N-Trifluoroacetyl-L-Prolyl Chloride

- Couples with amines to form diastereomers which can be separated on GC columns.
- Provides sample volatility.
- Used for confirmation of drugs of abuse testing.

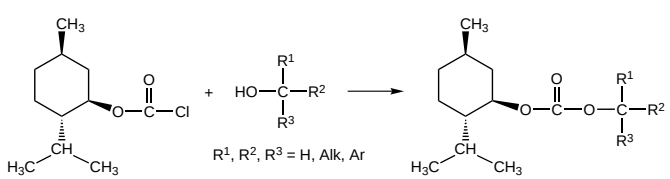
Product	Size	Product #	U.S. Price
TPC	25 mL	440001	$94.00



MCF
(1R, 2S, 5R)-(-)-Menthylchloroformate

- Resolves enantioenriched alcohols.

Product	Size	Product #	U.S. Price
MCF	25 mL	440003	$95.00



Teflon is a registered trademark of DuPont Company.

GC Chiral and Specialty Derivatization Reagents

HFIP
1,1,1,3,3,3-Hexafluoro-2-Propanol

- Esterification reagent for the determination of aromatic acids in tissue by GC and electron capture detection.

Product	Size	Product #	U.S. Price
HFIP	10 gm	270701	$22.00
	25 gm	270702	$40.00
	4 x 25 gm	270703	$120.00
	100 gm	270704	$120.00

3.0 N HCL in n-Butanol

- Most commonly used for rapid diagnosis of neonatal blood spots by Tandem Mass Spectrometry.

Product	Size	Product #	U.S. Price
3.0 N HCL in n-Butanol	4 x 25 mL	201007	$44.00
	100 mL	201009	$44.00
	500 mL	201010	$225.00

Col-Treet

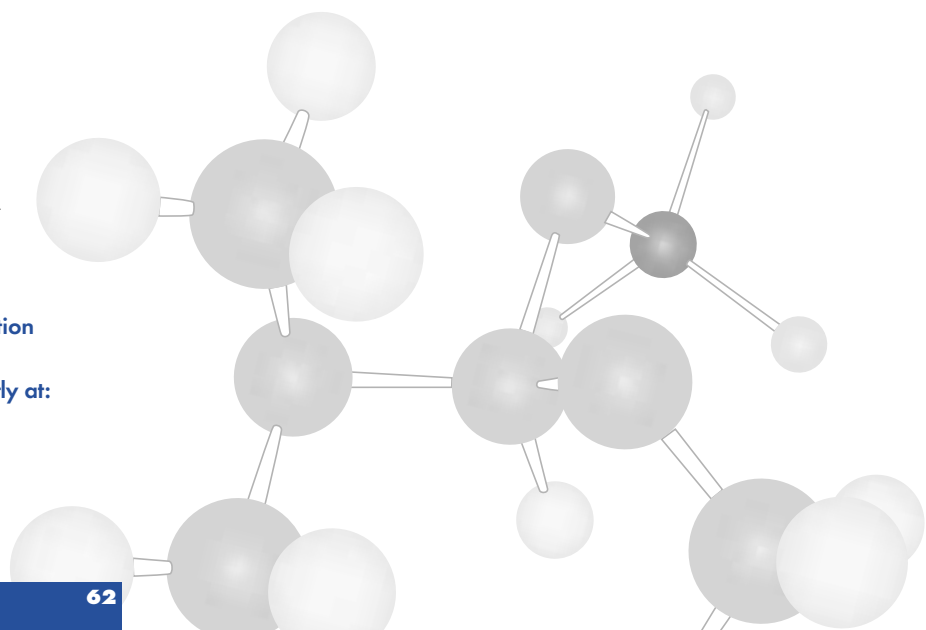
- Silylating mixture designed for conditioning gas chromatography columns.
- Eliminates peak tailing, peak broadening and residues which may reduce column efficiency.
- Not to be used with any hydrogen bonding stationary phases such as CARBOWAX® or phases with active hydrogen sites.

Product	Size	Product #	U.S. Price
Col-Treet	10 x 1 mL	970130	$40.00
	4 x 5 mL	970131	$50.00

Glas-Treet

- Used to deactivate active sites found in glassware, chromatography columns, and glass wool.
- Does not coat glass; renders it inactive chemically.

Product	Size	Product #	U.S. Price
Glas-Treet	100 mL	970068	$18.00



CARBOWAX is a registered trademark of Union Carbide Corp.

For additional information on GC Derivatization Reagents, check our Web site at www.registech.com/gc/or contact Regis directly at:

(800) 323-8144 ext. 649
(847) 967-6000 ext. 649
e-mail us at: sales@registech.com.

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Ordering Information

Placing Orders

By Phone: (800) 323-8144 ext. 649
(847) 967-6000 ext. 649

Regis Customer Service Representatives are available to take orders Monday – Friday, 8:00 a.m. – 4:30 p.m. central time.

By FAX: (847) 967-1214
(847) 967-5876

Fax orders can be placed 24 hours a day. Please include the information listed in *Ordering Details* below.

By Mail: Regis Technologies, Inc.
8210 Austin Avenue
P.O. Box 519
Morton Grove, IL 60053-0519 USA

Ordering Details

Whichever ordering method you choose, please supply the following information:

Company name

Shipping address

Billing address

Purchase order number

Product #

Quantity

Contact person

Phone number

Fax number

Payment Details

Visa/Mastercard Accepted
Bank Wire Transfers Accepted

Minimum Orders

Regis does not require a minimum order.

Order Confirmation

Confirming orders are not required. However, if it is your policy to send confirmations, please clearly indicate CONFIRMING ORDER. Regis will not accept responsibility for duplication of a shipment if CONFIRMING ORDER is not indicated.

Terms and Prices

Prices: Subject to change without prior notification.

Terms: Net 30 days.

Shipping: Prepaid and added to the invoice.

Advisement of current pricing will be made for orders placed by telephone. Unless order acknowledgment is specifically requested, orders placed via fax or mail will be shipped at current prices. If there has been a price increase of 10% or greater, Regis will advise the purchaser prior to order processing.

Quantity Discounts

10% discount: Given for orders of ten or more units of the same catalog item.

Bulk Quantities: Regis welcomes the opportunity to quote on larger quantities or bulk shipments of products listed in this catalog. Please contact Customer Service or your Sales Representative for more details.

Shipping

UPS ground: All items are shipped via UPS ground service unless otherwise requested.

UPS Red/Blue or Federal Express: Overnight or second day air service is available upon request. In order to comply with federal and international regulations, Regis reserves the right to change requested transportation in accordance with carrier guidelines.

Hazardous goods: Regulations require that hazardous goods be shipped in certified containers, bags and/or cartons. Any special packaging and/or freight charges for these items will be prepaid and added to the invoice.

F.O.B: Morton Grove, Illinois, USA; insurance charges are prepaid and added to the invoice.

International: All items bound for international destinations, via UPS or other freight carriers, are shipped freight collect.

Returns

Please inspect shipping carton and contents carefully upon arrival. Until the product has been evaluated, retain all product packaging.

If products are missing or defective, contact the Regis Customer Service Department for assistance. Items that need to be returned, whether due to defect or misorder, require a Returned Goods Authorization (RGA) number that can be obtained from Regis Customer Service. Returns will not be accepted without an RGA.

Returns made as a result of customer error are subject to a 15% or $15.00 restocking fee, whichever is greater. Except for cases of manufacturer defect, custom manufactured HPLC columns cannot be returned.

Every effort is taken to minimize product damage while in transit. However, if loss or damage should occur:

1. Save shipping cartons in their entirety.
2. Contact the carrier immediately to file a damage claim.
3. For additional assistance in filing claims, contact a Regis Customer Service Representative.

Ordering Information

Technical Service

The Regis Technical Staff is available from 8:00 a.m. to 4:00 p.m., central time, each business day to provide technical support for the products listed in this catalog.

Restrictions

All information and data presented in this catalog are believed to be accurate and reliable but are presented without guarantee, warranty or responsibility of any kind on the part of Regis Technologies, Inc., either expressed or implied. Users should use their own judgment to determine the suitability of any of the products, data or procedures presented.

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Statement concerning the possible use of a product is made without representation or warranty that any such use is free of patent infringement and is not to be considered a recommendation to infringe on any patent.

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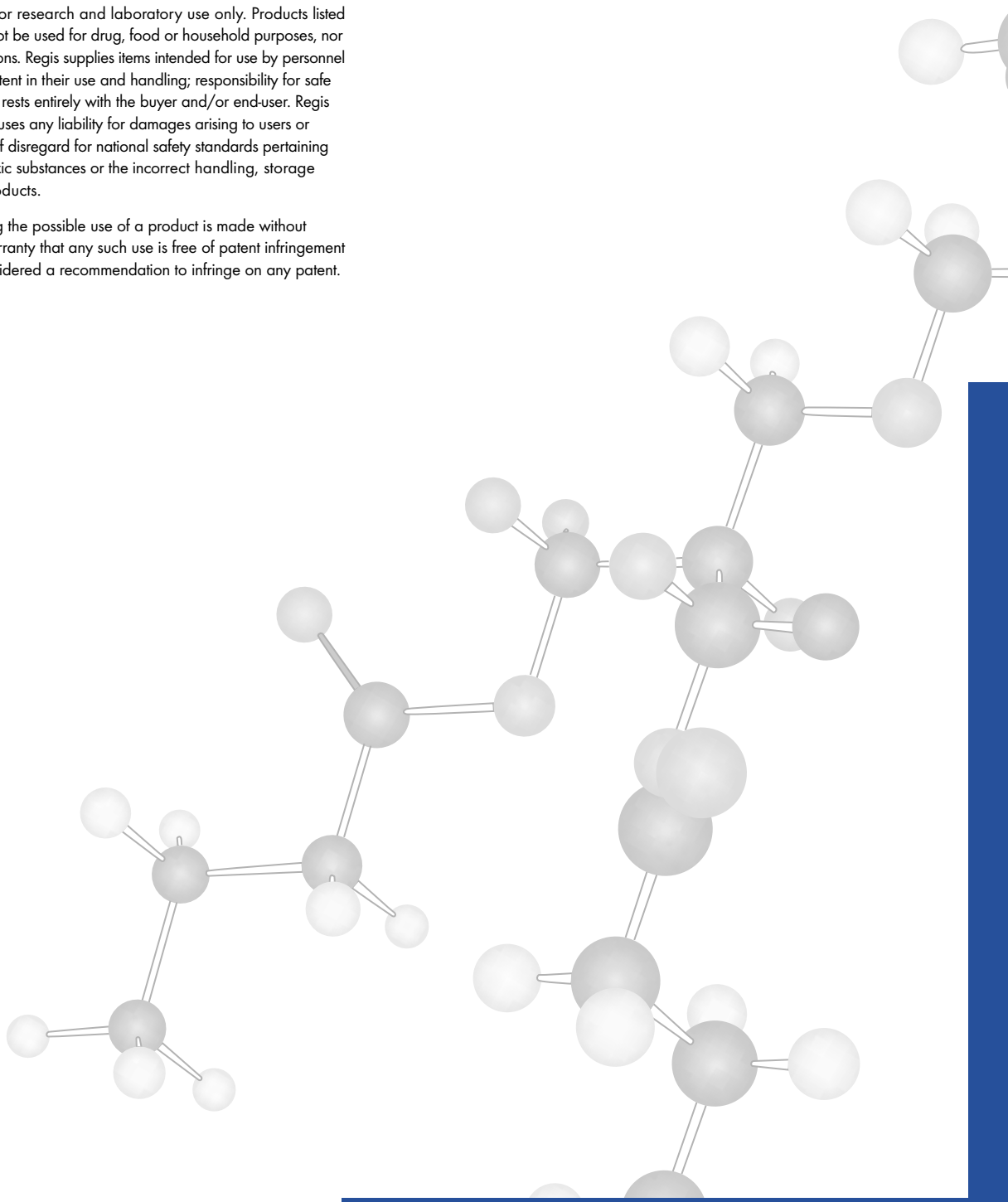

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