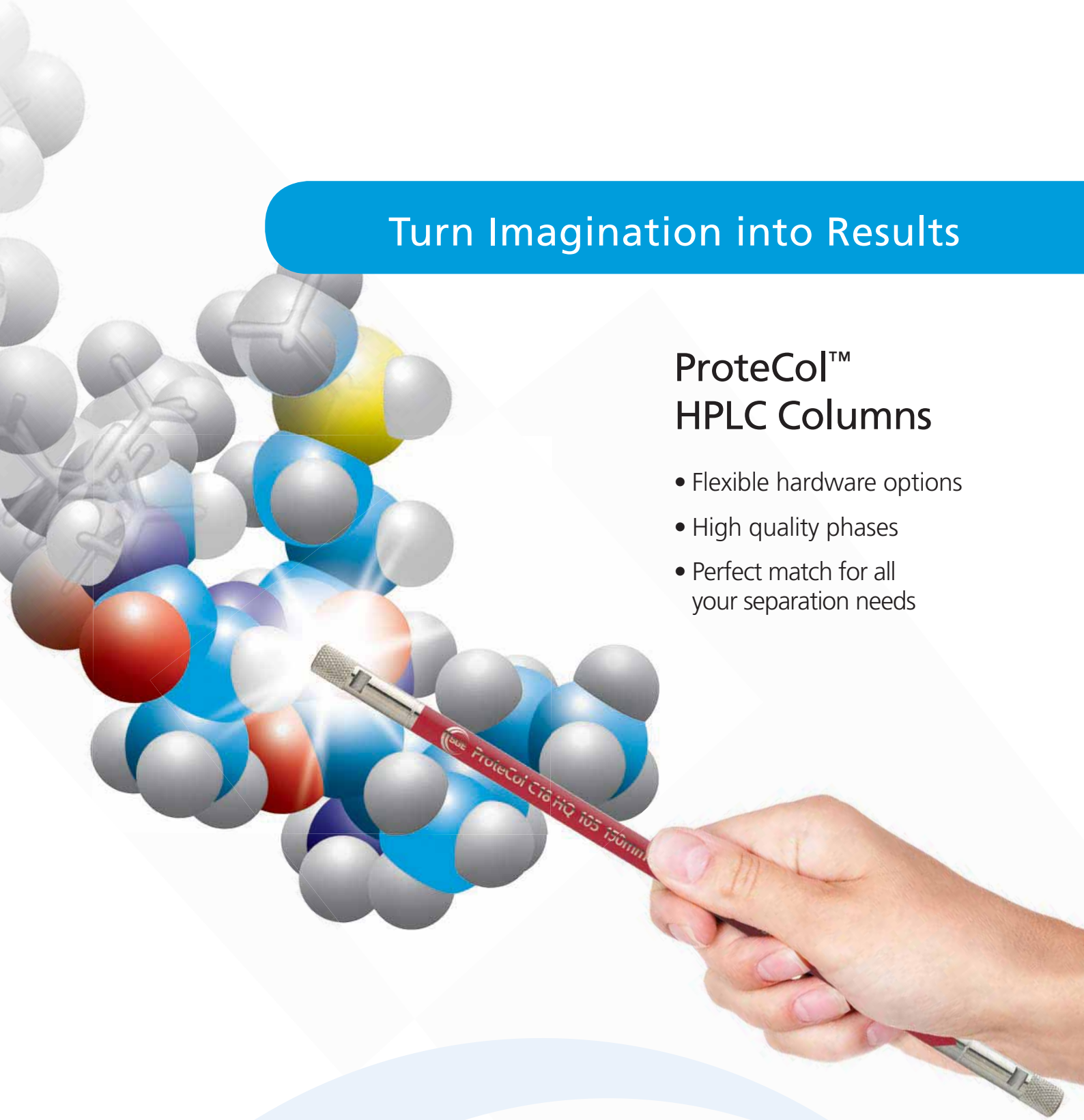
Turn Imagination into Results



ProteCol™ HPLC Columns

- Flexible hardware options
- High quality phases
- Perfect match for all your separation needs

SGE Analytical Science

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ProteCol™ Column Range Introduction

Turn imagination into results with the ProteCol™ range of HPLC columns.

With Reverse Phase, Normal Phase and Specialty Phases, ProteCol ensures you have the right phase for your separation needs. With the option of combining inert PEEK coated hardware or traditional stainless steel with each quality phase, the ProteCol HPLC solution delivers the combination you require.

ProteCol Reverse Phase

- **ProteCol C18** offers a flexible range of C18 bonded phases including pH stability and pore size options.
- **ProteCol C8** columns have pore sizes to suit your analysis.
- **ProteCol C4** columns have high durability and extended acidic and alkaline resistance.
- **ProteCol Phenyl Hexyl** columns offer unique selectivity.

ProteCol Normal Phase

- **ProteCol Amino** columns enable separation in both normal and reversed phase.
- **ProteCol Cyano and Silica** enable options for normal phase chromatography.

ProteCol Specialty Phase

- **ProteCol HILIC** range provides a polar stationary phase and highly organic mobile phase, allowing you to retain and separate polar analytes.
- **ProteCol Chiral** columns ensure the isolation and analysis of pure enantiomers.
- **ProteCol PFP** columns are useful in the separation of epimers.
- **ProteCol SCX** columns have a high loading capacity and pressure limit.

ProteCol Ultra Phase

- Range of phases for UHPLC use.

ProteCol HPLC columns are available in the following formats:
- Inert hardware: PEEK coated stainless steel or PEEKsil™ Capillary hardware
- Capillary HPLC
- Stainless steel
- UHPLC
- Semi preparative and preparative

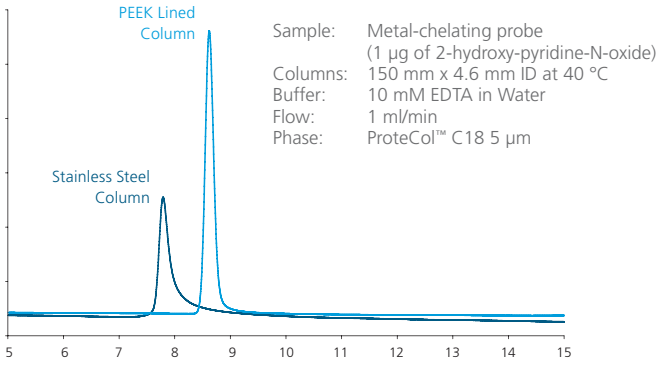
Inert Hardware

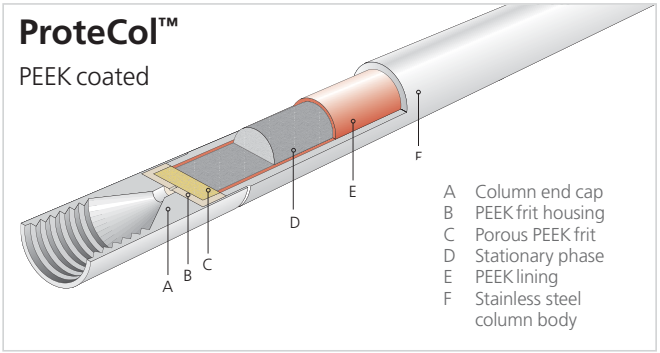
- PEEK coated stainless steel
- Capillary HPLC
- Optimized analyte recovery
- Superior peak shape and reproducibility
- Less artifacts due to reduced carryover

The Importance of Inert HPLC Column Design

Non-specific interactions between the target analyte and the silica particles in the HPLC column are now well controlled with the availability of ultrapure silicas. Today, chromatographers expect silica sourced by manufacturers to be of the highest purity. What is often not considered is the role column hardware may play in non-specific interactions – the frit and internal column hardware can both influence the behavior of analytes with known metal chelating activity.

ProteCol offers two inert hardware options PEEK coated stainless steel, or PEEKsil™ capillary hardware.





Most pharmaceutically active compounds and natural products have the potential to interact with metals. For this reason molecules like quinizarin, tetracycline or ciclopirox form tailing peaks in the presence of metal in the column or system.

Capillary HPLC

ProteCol Capillary HPLC Is Perfect For:

- Small samples - biotechnology, medical research, proteomics
- Exotic solvents - deuterated solvents for LC-NMR
- Low concentrations - highly potent pharmaceuticals, medical research
- Instrumentation - direct coupling into MS

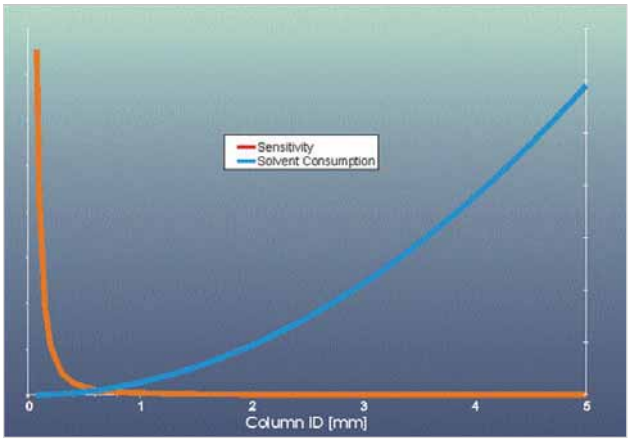
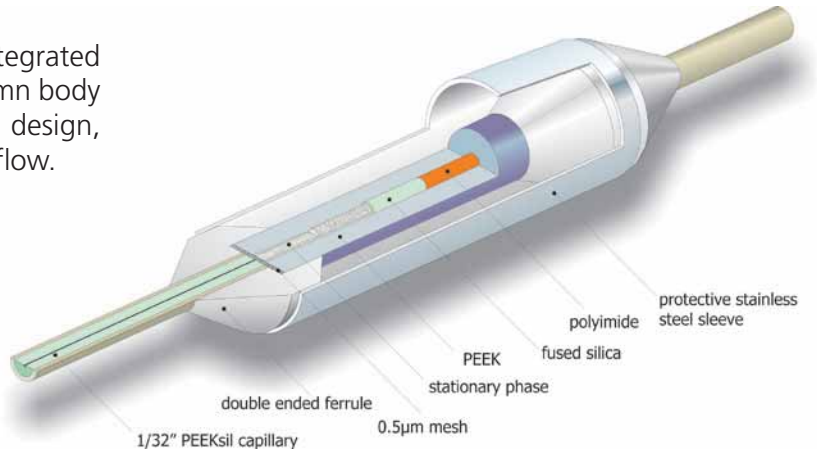


Figure demonstrating the relationship of analysis sensitivity with low volume use of solvents.

The ProteCol capillary HPLC design includes integrated connection tubing with PEEKsil™ for the column body and connection capillaries delivering robust design, zero volume connections and uninterrupted flow.



Stainless Steel Hardware

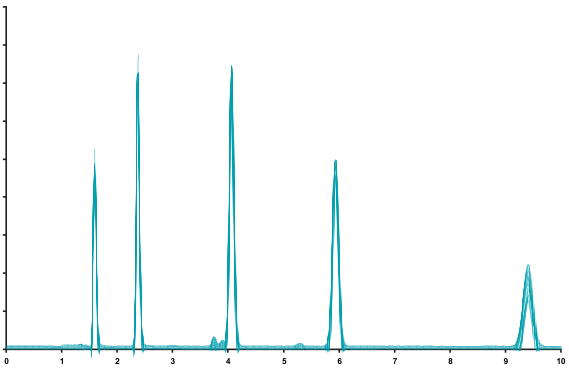
ProteCol HPLC with stainless steel hardware has both external body and end fittings manufactured from high quality 316 grade stainless steel.

UHPLC

Stainless steel hardware is designed specifically for UHPLC use, and standard with the ProteCol Ultra phases. These columns are for use at 19,000 psi.

Stability at pH 1:

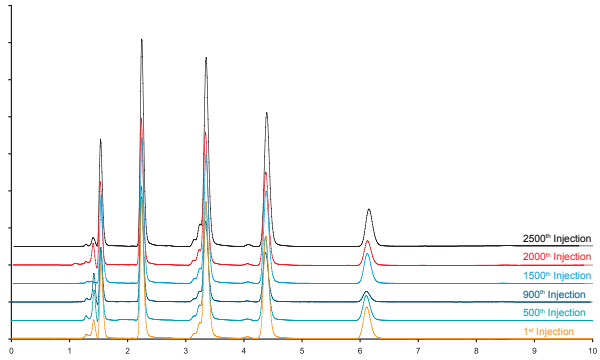
Columns in the ProteCol range show no deterioration when exposed to pH 1.0 buffers.



Overlay of 40 chromatograms run at pH 1.0 spanning 1200 column volumes.

Long-term Reproducibility

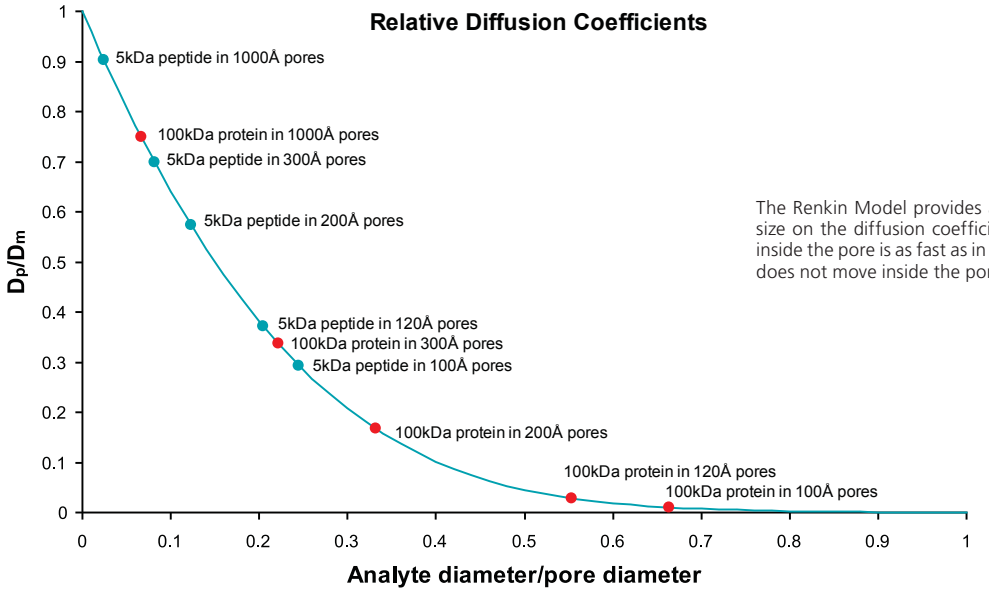
Columns in the ProteCol range show a remarkable reproducibility of thousands of injections (subject to sample purity and mobile phase conditions).



Chromatograms of a test mix over a period of 2500 injections.

Analysis of Larger Molecules

When analyzing samples containing large molecules (peptides, proteins, polymers with MW>3000) the size of the molecule and the size of the pore structure play an important role in the quality of the separation. As the analyte increases in size (relative to the pore size) the diffusion rate inside the pore becomes smaller and mass transfer in and out of the pore system becomes slow leading to band broadening. Obviously, when the analyte size is equal to or bigger than the pore size there can be no pore diffusion. A mathematical description of this relationship was published by Renkin (E.M. Renkin, J.Gen.Physio., 38 (1954) 225.) and helps to illustrate the phenomenon.



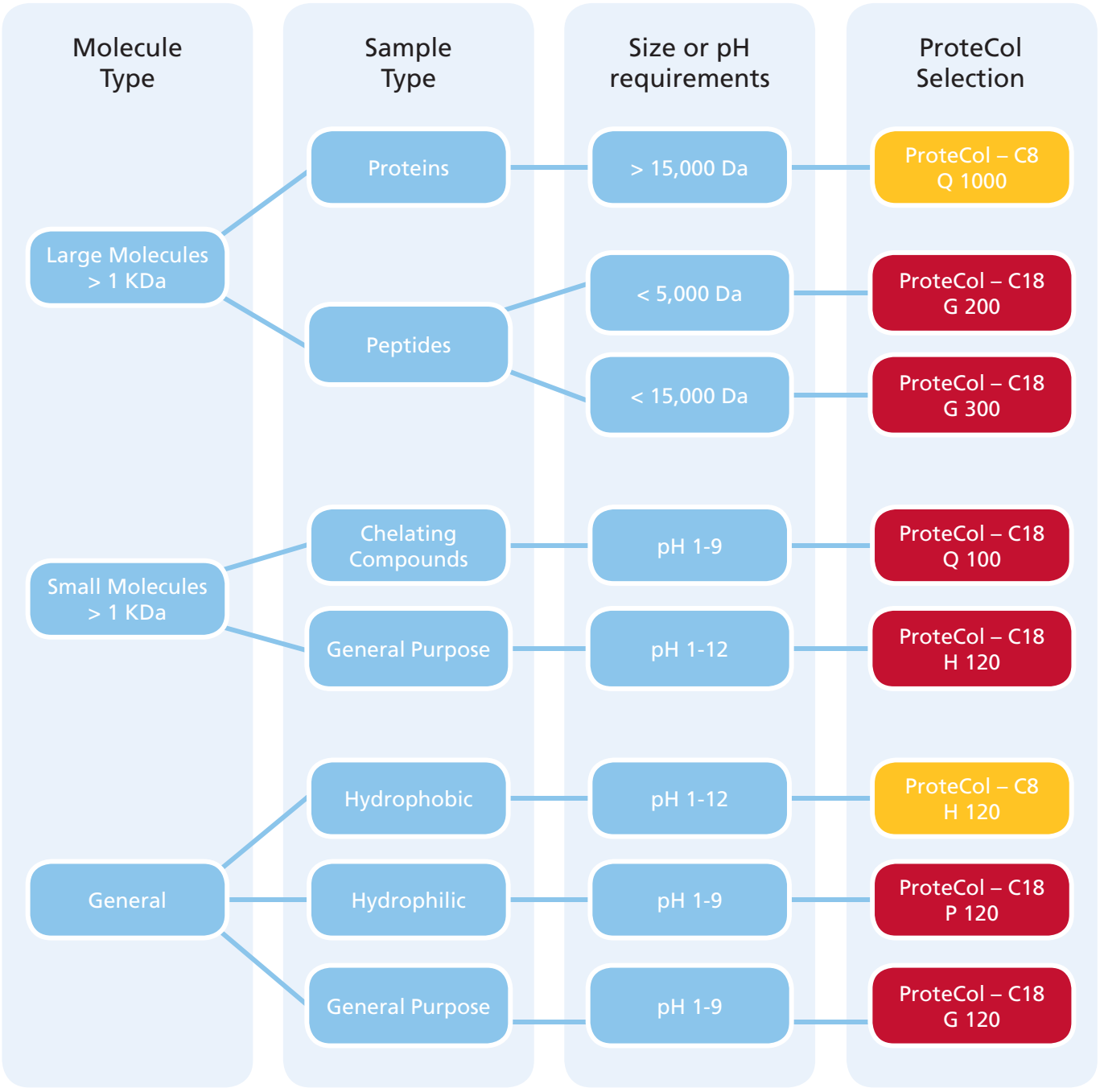
The Renkin Model provides an equation of the effect of pore and analyte size on the diffusion coefficient. A Dp/Dm value of 1 means the diffusion inside the pore is as fast as in the bulk liquid. Dp/Dm = 0 means the molecule does not move inside the pores.

An illustration of the relative diffusion rate of a 5kDa peptide and a 100kDa protein in a number of pore systems.

Reverse Phase ProteCol Range

- **ProteCol C18** offers a flexible range of C18 bonded phases including pH stability and pore size options.
- **ProteCol C8** columns have pore sizes to suit your analysis.
- **ProteCol C4** columns have high durability and extended acidic and alkaline resistance.
- **ProteCol Phenyl Hexyl** columns offer unique selectivity.

Reverse Phase Column Selection Tree



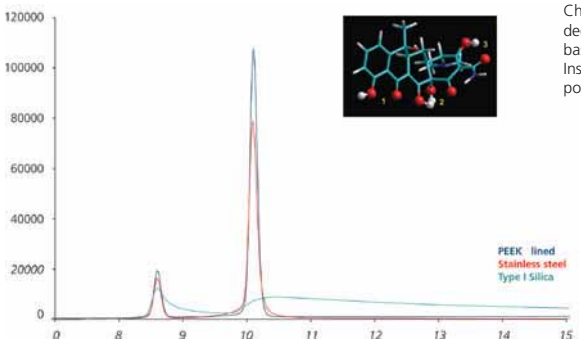
- Substantially reduced sample and column preparation time
- Improved peak shape giving you improved reproducibility and sensitivity
- Fewer artifacts due to reduced carry over
- Enables use of MS, ELSD and Corona CDA techniques

Four Chemistries

Phase	Pore Size (Å)	Particle Size (µm)	Pore Volume (ml)	Surface Area	Carbon Load %
C18 Q	100	3, 5	1.0 ± 0.1	400 ± 40	16.8
C18 G	120	2.5, 3, 5, 10	1.0 ± 0.1	300 ± 40	17.1
C18 G	200	3, 5	1.0 ± 0.1	200 ± 30	12.6
C18 G	300	3, 5	1.0 ± 0.1	100 ± 20	6.9
C18 H	120	5	1.0 ± 0.1	300 ± 40	20.9
C18 P	120	3, 5	1.0 ± 0.1	300 ± 40	14.5

C18 Q

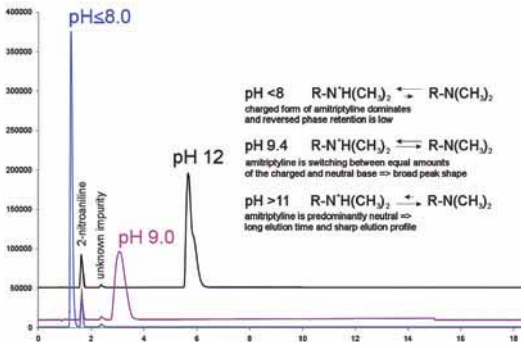
- Ultra pure silica
- Fully end capped optimized C18 phases



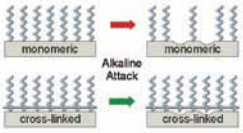
Chromatogram of tetracycline (antibiotic) and its major degradation product. Note the peak broadening on the base of the peak run through the stainless steel column. Inset: the tetracycline molecule depicting the three potential chelating groups.

C18 H

- Modified bonded phase making it easier to work from low to high pH using the same column
- Novel chemical bonding ensuring stability under extreme alkaline and acidic conditions
- pH stability 1 -11



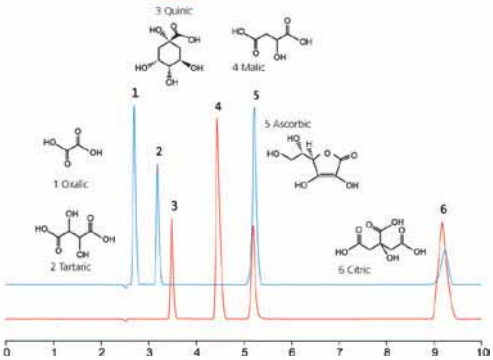
Column: 150 x 4.6 mm ID, C8 H125
Sample: Content of Vitamin Supplement Capsules (Blackmores, Australia)
Mobile Phase A: Water
Mobile Phase B: Acetonitrile
Gradient: 0 to 20 minutes 0 to 100% B
20 to 80 minutes 100% B
Flow Rate: 1 mL/min
Temperature: 20 °C
Detection: 210 nm



ProteCol™ H phase bonding

C18 G

- Stable in aqueous conditions
- Reduces non-specific analyte interactions
- Separates polar compounds
- pH stability 1 - 9



Column: 250 x 4.6 mm C18 G (5 µm)
Mobile Phase: 20 mM KH_2PO_4, pH 2.5 (H_3PO_4)
1 mL/min
Temperature: 30 °C
Detection: 210 nm
Samples: i) Test Mix (Organic Acids)
ii) Cranberry Juice

C18 P

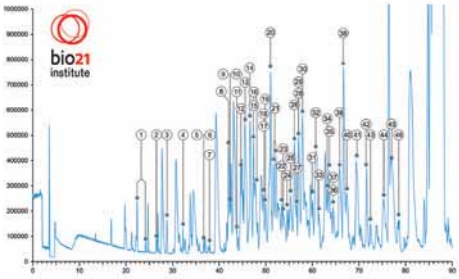
- Polar embeded C18
- 100 % compatible with water
- pH stability 1 - 9

ProteCol C8

- 1000 Å pore size
- Intermediate polarity C8 phase
- Continuity of using HPLC for all separation needs simplifies your workflow
- Facilitates the use of MS
- Eliminate SDS-PAGE from your workflow

Phase	Pore Size (Å)	Particle Size (µm)	Pore Volume (ml)	Surface Area	Carbon Load %
C8	120	5	1.0 ± 0.1	300 ± 40	11.7
C8	1000	3	0.8 ± 0.1	25 ± 5	0.7

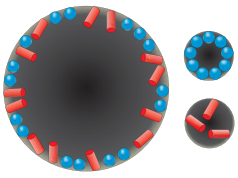
Column: ProteCol™ C8 Q1003, 300 µm ID x 100 mm
Flow rate: 5 µL/min
Mobile phase A: 0.1 % formic acid
Mobile phase B: 95 % acetonitrile, 0.1 % formic acid
Gradient: 0 min 5 % B, 30 min 55 % B, 33 min 70 % B, 38 min 70 % B, 40 min 5 % B



Base peak chromatogram of ribosomal proteins.

Why choose 1000 Å pore size?

1000 Å pore size silicas enable large irregular shaped proteins to bind to the bonded phase without restricting access to the pore - compared to 300 Å silicas whose pores are easily blocked by large proteins.



100 kDa spherical molecules in a 300 Å pore

100 kDa rod-shaped molecules in a 300 Å pore (aspect ratio 2:1)

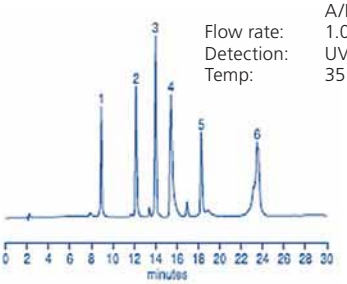
100 kDa molecules adsorbed on the wall of a 1000 Å pore

ProteCol C4

- 5 µm material
- Protein purification
- High durability
- Extended acidic and alkalic resistance
- Recommended for compounds too strongly retained on C18 and C8 phases

Phase	Pore Size (Å)	Particle Size (µm)	Particle Volume	Surface Area	% Carbon Load	pH
C4	300	5	0.9	100	3	1-11

Standard Proteins
Column: ProteCol™ C4 150 x 4.6 mm
Mobile Phase: A) CH_3CN/TFA (1000:1), B) H_2O/TFA (1000:1) A/B (20/80)
Flow rate: 1.0 mL/min
Detection: UV220 nm
Temp: 35 °C

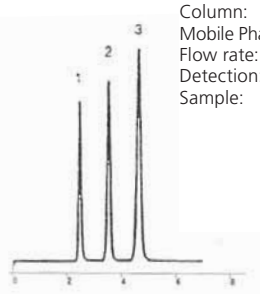


Sample:
1. Ribonuclease
2. Cytochrome
3. Lysozyme
4. BSA
5. Myoglobin
6. Ovalbumin

ProteCol Phenyl Hexyl

ProteCol Phenyl Hexyl uses a hexyl-linked phenyl phase where the hexyl alkyl chain delivers unique selectivity and increased hydrolytic stability when compared to propyl-linked chemistry. The example pictured highlights the separation of a mixture of Benzodiazapines, which is difficult to separate on a standard phenyl type column.

Phase	Pore Size (Å)	Particle Size (µm)	Surface Area	% Carbon Load	pH
Phenyl Hexyl	120	3, 5	350	10.0	1-10



Column: ProteCol™ Phenyl-Hexyl
Mobile Phase: Acetonitrile/Water (80:20)
Flow rate: 1.0 mL/min
Detection: UV235 nm
Sample:
1. Lormetazepam
2. Diazepam
3. Oxazepam

Normal Phase ProteCol™ Range

- **ProteCol Amino** column allows basic compound separation in normal phase and carbohydrate analysis.
- **ProteCol Cyano** columns provide chromatographic retention both in normal and reversed phase separation due to its moderate polarity.
- **ProteCol Silica** columns have high durability and extended acidic and alkaline resistance.

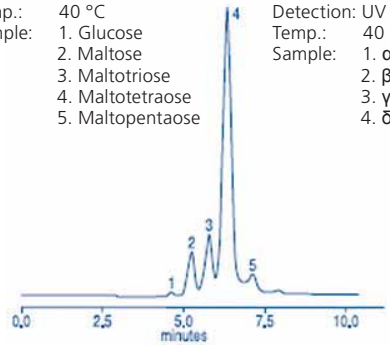
ProteCol Amino

Specifications
- Bonded with amino-propyl silane

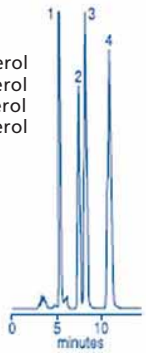
Applications
- Basic compound separation under normal phase conditions
- Saccharide separation using acetonitrile/water

Phase	Pore Size (Å)	Particle Size (µm)	Surface Area	% Carbon Load
Amino	120	3, 5	350	4.0

Malto-oligosaccharides
Column: ProteCol™ Amino 125 150 x 6 mm
Eluent: CH_3CN/H_2O-50/50
Flow rate: 1.0 mL/min
Detection: RID
Temp.: 40 °C
Sample: 1. Glucose
2. Maltose
3. Maltotriose
4. Maltotetraose
5. Maltopentaose



Tocopherol isomers
Column: ProteCol™ Amino 125 150 x 6 mm
Eluent: Hexane/Ethyl acetate (70:30)
Flow rate: 1.0 mL/min
Detection: UV 295 nm
Temp.: 40 °C
Sample: 1. α Tocopherol
2. β Tocopherol
3. γ Tocopherol
4. δ Tocopherol



ProteCol Cyano

Common applications are for the separation of flavonoids, extraction of polar compounds from non-polar samples as well as the analysis of samples containing analytes with a wide range of hydrophobicity.

Phase	Pore Size (Å)	Particle Size (µm)	Surface Area	% Carbon Load
Cyano	120	5	300	5

ProteCol Silica

High surface area and mechanical strength.

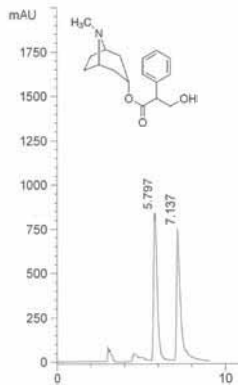
Phase	Pore Size (Å)	Particle Size (µm)	Surface Area	% Carbon Load
Silica	120	3, 5, 10	300	0

Specialty Phase ProteCol™ Range

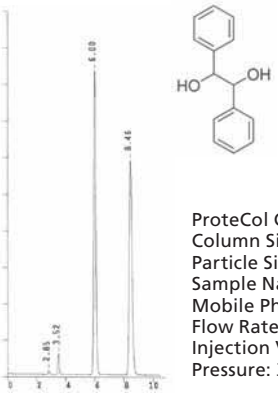
- **ProteCol Chiral** columns ensure the isolation and analysis of pure enantiomers.
- **ProteCol HILIC** range provides a polar stationary phase enabling the retention and separation of polar analytes using organic mobile phases.
- **ProteCol SCX** column has a high loading capacity and pressure limit.
- **ProteCol PFP** column is useful in the separation of epimers.

ProteCol Chiral

- **ProteCol Chiral CHM** is a modified cellulose coated on high purity, high performance spherical silica particles. The chemical modification includes the chemical bonding of 3-chloro-4 methylphenylcarbamate to cellulose. The use of cellulose modified with chlorinated phenyl groups provides for the separation for many previously unresolved or poorly resolved chiral mixtures.
- **ProteCol Chiral CHC** are polysaccharide coated chiral columns, manufactured using a unique production process of coating the proven chiral selector-tris-(3,5-dimethylphenyl) carbamoyl cellulose on high purity silica gel.
- **ProteCol Chiral CHA** polysaccharide coated chiral columns, are created using a unique production process of coating the proven chiral selector-tris-(3,5-dimethylphenyl) carbamoyl amylose on high purity silica gel.
- **ProteCol Chiral CH4** uses a modified cellulose coated on high purity, high performance spherical silica particles and consists of the chemical bonding of 4-chloro-3 methylphenylcarbamate to cellulose. The use of cellulose modified with chlorinated phenyl groups provides for the separation for many previously unresolved or poorly resolved chiral mixtures.



ProteCol™ CHC
Column Size: 250 X 4.6 mm
Particle Size: 5 micron
Sample Name: Atropine
Mobile Phase: Hexane/Ethanol 90/10
Flow Rate: 1.0 mL/min
Injection Vol: 10.0 µL
Pressure: 38.6 bar



ProteCol CHA
Column Size: 250 X 4.6mm
Particle Size: 5 micron
Sample Name: Hydrobenzoin
Mobile Phase: 15% Ethanol in Hexane
Flow Rate: 1.0 mL/min
Injection Vol: 5.0 µL
Pressure: 31 bar

Phase	Sub Phase	Chemical Structure	Particle Size (µm)
Chiral	CHC	3, 5-dimethylphenylcarbamate cellulose	5, 10
Chiral	CHA	3, 5-dimethylphenylcarbamate amylose	5, 10
Chiral	CHM	3-chloro-4-mehylphenylcarbamate cellulose	5, 10
Chiral	CH5	5-chloro-2-methylphenylcarbamate amylose	5, 10
Chiral	CH4	4-chloro-3-methylphenylcarbamate cellulose	5, 10

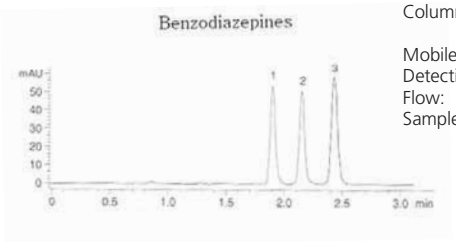
Semi-preparative and preparative formats are available.

ProteCol HILIC

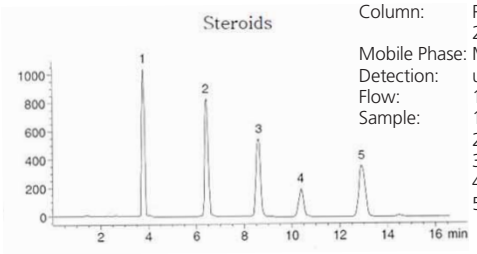
HILIC chromatography uses mobile phases containing between 5 - 20 % water for the retention of polar compounds. The ProteCol range of HILIC columns delivers you separation specific for your polar analyte analysis.

ProteCol HILIC-RP

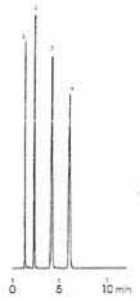
ProteCol HILIC-RP columns deliver a combination of HILIC and reversed phase chromatography – perfect for samples containing polar and hydrophobic analytes. The composition of both the polyhydroxylated polymer and ODS groups bound to silica provides hydroxyl levels that are well above conventional hydroxyl and diol type stationary phases.



Column: ProteCol™ HILIC-RP 250 x 4.6 mm 5µm
Mobile Phase: Methanol/Water (90:10)
Detection: uv @ 235 nm
Flow: 1.0 mL/min
Sample: 1. Lormetazepam
2. Diazepam
3. Oxazepan



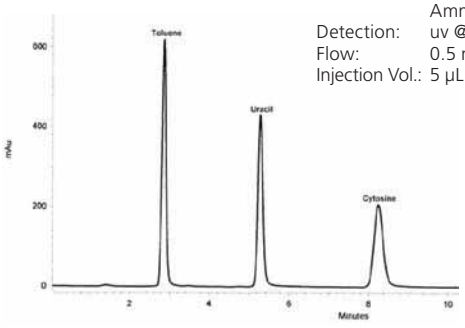
Column: ProteCol™ HILIC-RP 250 x 4.6 mm 5µm
Mobile Phase: Methanol/Water (70:30)
Detection: uv @ 254 nm
Flow: 1.0 mL/min
Sample: 1. Hydrocortisone
2. Corticosterone
3. 11 α -Hydroxyprogesterone
4. Cortisone Acetate
5. 11 - Ketoprogesterone



Column: ProteCol™ HILIC-FL 150 x 4.6 mm 5µm
Mobile Phase: 10 mM ammonium acetate in water: Acetonitrile 5:95
Flow: 1 mL/min
Detection: uv @ 21.0 nm
Sample: 1. MDA
2. Amphetamine
3. MDMA
4. Methamphetamine

ProteCol HILIC-FL

ProteCol HILIC-FL is designed for retention and separation of polar and non-polar compounds that are not retained or separated on conventional reversed phase columns. It consists of a fluorinated based stationary phase bound to silica. This composition provides for excellent retention and peak shape for polar halogenated, polar amines and polar aromatic compounds.

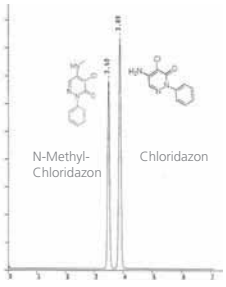


Column: ProteCol™ HILIC-HC 150 x 4.6 mm 5µm
Mobile Phase: 80 % Acetonitrile 20 % 5 mM Ammonium acetate
Detection: uv @ 254 nm
Flow: 0.5 mL/min
Injection Vol.: 5 µL

ProteCol HILIC-HC

ProteCol HILIC-HC (high capacity) is composed of a polyhydroxylated polymer coated and bound to silica, providing hydroxyl levels that are well above conventional hydroxyl and diol type stationary phases.

The chromatogram highlights the unique capability for ProteCol HILIC-HC, where toluene is less retained than uracil. Uracil has been traditionally used as an unretained marker for the determination of void volume, however with ProteCol HILIC-HC and an 80% acetonitrile mobile phase, uracil can be retained.



Column: ProteCol™ HILIC-PI 150 x 4.6 mm 5µm
Mobile Phase: Acetonitrile/Water (90:10)
Detection: uv @ 254 nm
Flow: 1.0 mL/min

ProteCol HILIC-PI

ProteCol HILIC-PI consists of an aromatic amine based stationary phase bound to silica. This composition provides for excellent retention and peak shape for polar amine compounds.

ProteCol SCX

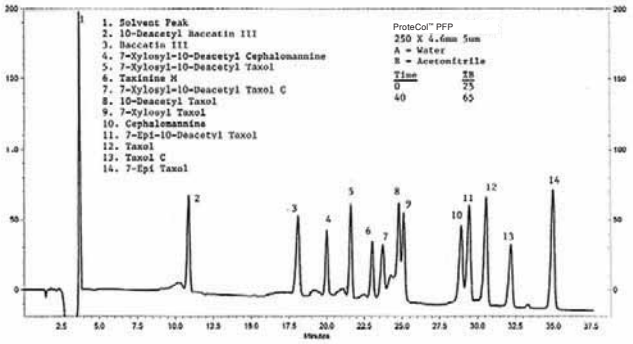
ProteCol SCX is a silica based strong cation exchanger suitable for the analysis of small organic bases. Based on a bonded aromatic sulfonic acid group and available in 5 and 3 µm particle size, ProteCol SCX will deliver superb performance:

- High loading capacity and pressure limit
- Robust bonding technology
- High density bonding
- Bonding aromatic sulfonic acid groups

Phase	Pore Size (Å)	Particle Size (µm)	Surface Area	pH
SCX	120	3, 5	350	1-10

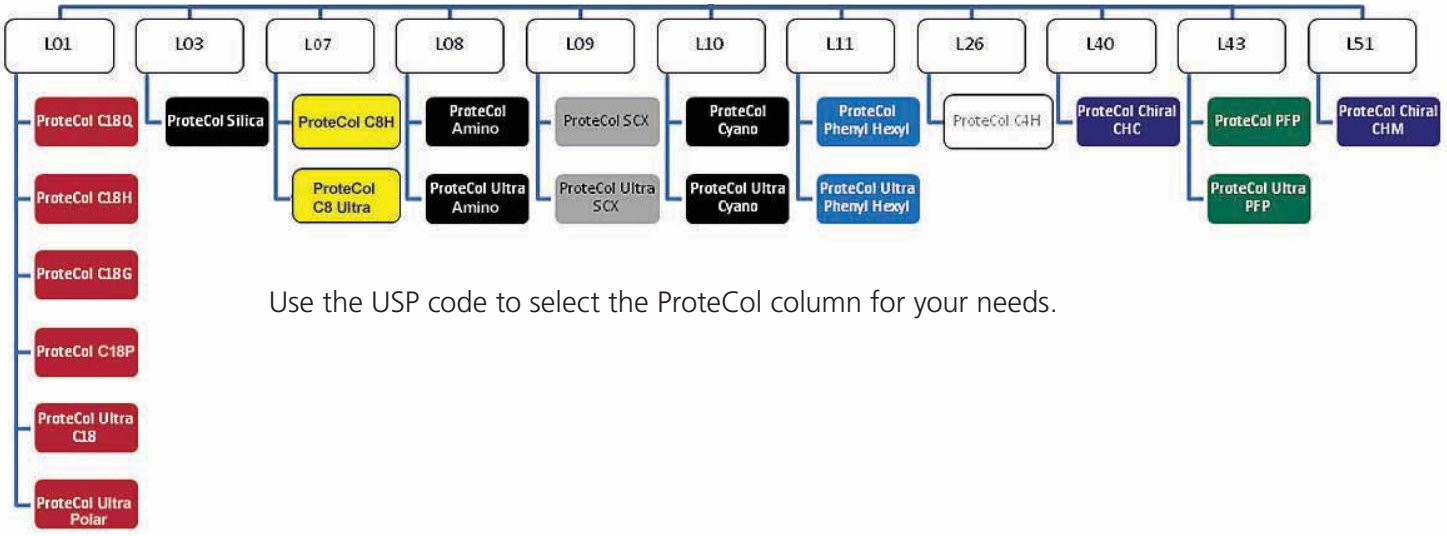
ProteCol PFP

PFP is a truly unique stationary phase with properties significantly different from ODS phases. This unique character results from bonded pentafluorophenyl groups imparting a pi-pi electron interaction, producing an enhanced retention for many compounds, particularly those that contain polarizable electrons. Many classes of compounds and naturally occurring chemicals also contain polarizable electrons and can be separated using PFP. PFP has been extremely useful in the separation of epimers. Epimers also exist in many natural mixtures such as pharmaceutically active natural paclitaxel.



Phase	Pore Size (Å)	Particle Size (µm)	Surface Area	% Carbon Load	pH
PFP	120	3, 5	350	10.0	1-10

Column Application Recommendations and USP Guide



Use the USP code to select the ProteCol column for your needs.

	Small Analyte	Large Analyte	Polar Analyte	Very Hydrophobic Analyte	Low Nonspecific Interaction	Fast Analysis	Extreme pH Conditions	Chiral Analysis	Halogenated Samples	Basic Samples	Range of Hydrophobicities in Analyte	HILIC Applications	Aromatic Samples
ProteCol C18 Q	Y	N	O	O	Y	N	N	N	Y	Y	Y	N	Y
ProteCol C18 H	Y	N	O	O	O	N	Y	N	Y	O	Y	N	Y
ProteCol C18 G	Y	N	O	O	O	N	N	N	Y	O	Y	N	Y
ProteCol C18 P	Y	N	Y	O	N/A	N	N	N	Y	O	Y	N	Y
ProteCol C8 Q	Y	N	N	Y	O	N	N	N	Y	O	Y	N	Y
ProteCol C8 H	Y	N / Y[4]	N	Y	O	N	N	N	Y	O	Y	N	Y
ProteCol C4 H	Y	N / Y[4]	N	Y	O	N	N	N	Y	O	Y	N	Y
ProteCol Phenyl Hexyl	Y	N	O	O	O	N	N	N	Y	O	Y	N	Y[2]
ProteCol Silica	Y	N	Y	N	N/A	N	N	N	Y	Y	Y	Y	Y
ProteCol Amino	Y	N	Y	N	N/A	N	N	N	Y	Y	Y	Y	Y
ProteCol Cyano	Y	N	Y	Y[3]	N/A	N	N	N	Y	O	Y	O	O
ProteCol HILIC RP	Y	N	Y	N	N/A	N	N	N	Y	Y	Y	Y	Y
ProteCol HILIC PI	Y	N	Y	N	N/A	N	N	N	Y	Y	Y	Y	Y
ProteCol HILIC FL	Y	N	Y	N	N/A	N	N	N	Y[1]	O	Y	Y	Y
ProteCol HILIC HC	Y	N	Y	N	N/A	N	N	N	Y	Y	Y	Y	Y
ProteCol Chiral CHC	Y	N	N/A	N/A	N/A	N	N	Y	N/A	N/A	N/A	N/A	N/A
ProteCol Chiral CHM	Y	N	N/A	N/A	N/A	N	N	Y	N/A	N/A	N/A	N/A	N/A
ProteCol Chiral CHA	Y	N	N/A	N/A	N/A	N	N	Y	N/A	N/A	N/A	N/A	N/A
ProteCol Chiral CH5	Y	N	N/A	N/A	N/A	N	N	Y	N/A	N/A	N/A	N/A	N/A
ProteCol Chiral CH4	Y	N	N/A	N/A	N/A	N	N	Y	N/A	N/A	N/A	N/A	N/A
ProteCol SCX	Y	N	Y	N	N/A	N	N	N	Y	Y	N	O	N
ProteCol PFP	Y	N	O	O	O	N	N	N	Y[1]	O	Y	N	Y
ProteCol Ultra C18	Y	N	O	O	N	Y	N	N	Y	O	Y	N	Y
ProteCol Ultra C8	Y	N	N	Y	N	Y	N	N	Y	O	Y	N	Y
ProteCol Ultra Amino	Y	N	Y	N	N/A	Y	N	N	Y	O	Y	Y	Y
ProteCol Ultra Cyano	Y	N	Y	Y[3]	N/A	Y	N	N	Y	O	Y	Y	O
ProteCol Ultra HILIC FL	Y	N	Y	N	N/A	Y	N	N	Y	O	Y	N	O
ProteCol Ultra HILIC PI	Y	N	Y	N	N/A	Y	N	N	Y	Y	Y	N	Y
ProteCol Ultra PFP	Y	N	O	O	N	Y	N	N	Y[1]	O	Y	N	Y
ProteCol Ultra Phenyl	Y	N	N	Y	N	Y	N	N	Y	O	Y	N	Y[2]
ProteCol Ultra Phenyl Hexyl	Y	N	O	O	N	Y	N	N	Y	O	Y	N	Y[2]
ProteCol Ultra Polar	Y	N	Y	O	N	Y	N	N	Y	O	Y	N	Y
ProteCol Ultra SCX	Y	N	Y	N	N/A	Y	N	N	Y	Y	N	O	N

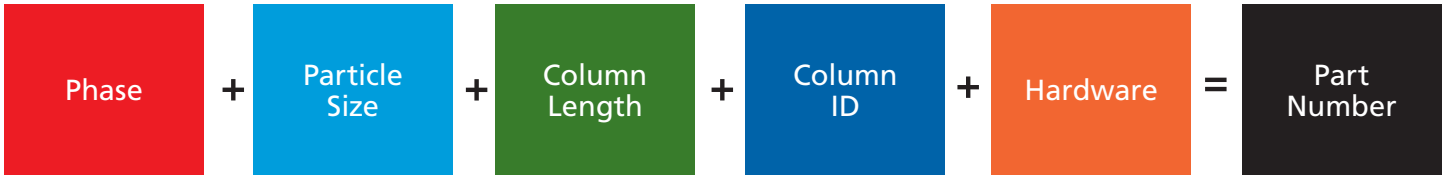
[1]) Pentafluorophenyl has a special selectivity for halogenated substances and should be used when separation on conventional RP phases is difficult.
[2]) Phenyl and Hexaphenyl have a special selectivity for aromatic substances and should be used when separation on conventional RP phases is difficult.
[3]) In reversed phase mode.
[4]) When particles with 200Å, 300Å or 1000Å are chosen.
Y = Recommended
N = Not Recommended
O = Optional

How to Order - Building your HPLC Column Part Number

The SGE ProteCol™ range of HPLC columns offers you many combinations where you can select the phase, particle size, column length and ID, as well as column hardware.

To make ordering easier, please use the following guide when building your column for your application:

- The part number starts with Phase Code, Particle Size, Length Code, ID Code, Hardware Code and whether it is a guard column.
- If you want a guard column to complement an analytical column, add "G" as a suffix.



Example:

PARTICLE SIZE	
Particle Size	Particle Size Code
1.8	18
2.5	25
3	03
5	05
10	10

LENGTH CODE	
Length	Length Code
10	G
10	T
50	L
100	M
150	N
250	R

ID CODE	
ID	ID Code
0.15	15
0.3	30
1	01
2.1	02
3	03
4.6	46
10	10

HARDWARE CODE	
Hardware	Hardware Code
Stainless Steel	S
UHPLC	U
PEEKsil™	K
PEEK Coated	P

Refer to the table on the next page

Build a column easily by downloading our HPLC Part Number Generator at www.sge.com/lc

PHASE						
Phase	Length	ID	Pore Size (Å)	Phase Code	Particle Size (µm)	Hardware Code
ProteCol™ C18 Q	LMNR	15, 30, 01, 02, 03, 46	100	2C183	3, 5	SKP
ProteCol™ C18 H	LMNR	15, 30, 01, 02, 03, 46	120	2C182	3, 5	SKP
ProteCol™ C18 G	LMNR	15, 30, 01, 02, 03, 46	120	2C185	2.5, 3, 5, 10	SKP
ProteCol™ C18 P	LMNR	15, 30, 01, 02, 03, 46	120	2POL	3, 5	SKP
ProteCol™ C8 H	LMNR	15, 30, 01, 02, 03, 46	120	2C83	3, 5	SKP
ProteCol™ C18 G	LMNR	15, 30, 01, 02, 03, 46	200	2C181	3	SKP
ProteCol™ C18 G	LMNR	15, 30, 01, 02, 03, 46	300	2C184	3, 5	SKP
ProteCol™ C8 H	LMNR	15, 30, 01, 02, 03, 46	1000	2C82	3	SKP
ProteCol™ C4 H	LMNR	15, 30, 01, 02, 03, 46	300	2C42	5	SKP
ProteCol™ Phenyl Hexyl	LMNR	02, 03, 46	120	2NH4	3, 5	SP
ProteCol™ Silica	LMNR	02, 03, 46	120	2SIL	3, 5, 10	SP
ProteCol™ Amino	LMNR	02, 03, 46	120	2AM	5	SP
ProteCol™ Cyano	LMNR	02, 03, 46	120	2CN	5	SP
ProteCol™ HILIC RP	LMNR	02, 03, 46	120	2HL6	3, 5	SP
ProteCol™ HILIC PI	LMNR	02, 03, 46	120	2HL7	5	SP
ProteCol™ HILIC FL	LMNR	02, 03, 46	120	2HL8	5	SP
ProteCol™ HILIC HC	LMNR	02, 03, 46	120	2HL9	3, 5	SP
ProteCol™ Chiral CHC	R	46	-	2CHC	5, 10	SP
ProteCol™ Chiral CHM	R	46	-	2CHM	5, 10	SP
ProteCol™ Chiral CHA	R	46	-	2CHA	5, 10	SP
ProteCol™ Chiral CH5	R	46	-	2CH5	5, 10	SP
ProteCol™ Chiral CH4	R	46	-	2CH4	5, 10	SP
ProteCol™ SCX	LMNR	02, 03, 46	120	2SCX	3, 5	SP
ProteCol™ PFP	LMNR	02, 03, 46	120	2PFP	3, 5, 10	SP
ProteCol™ Ultra C18*	LMN	02	120	2UC18	1.8	U
ProteCol™ Ultra C8*	LMN	02	120	2UC8	1.8	U
ProteCol™ Ultra Amino*	LMN	02	120	2UAM	1.8	U
ProteCol™ Ultra Cyano*	LMN	02	120	2UCN	1.8	U
ProteCol™ Ultra HILIC FL*	LMN	02	120	2UHL8	1.8	U
ProteCol™ Ultra HILIC PI*	LMN	02	120	2UHL7	1.8	U
ProteCol™ Ultra PFP*	LMN	02	120	2UPFP	1.8	U
ProteCol™ Ultra Phenyl*	LMN	02	120	2UPH	1.8	U
ProteCol™ Ultra Phenyl Hexyl*	LMN	02	120	2UNH4	1.8	U
ProteCol™ Ultra Polar*	LMN	02	120	2UPOL	1.8	U
ProteCol™ Ultra SCX*	LMN	02	120	2USCX	1.8	U

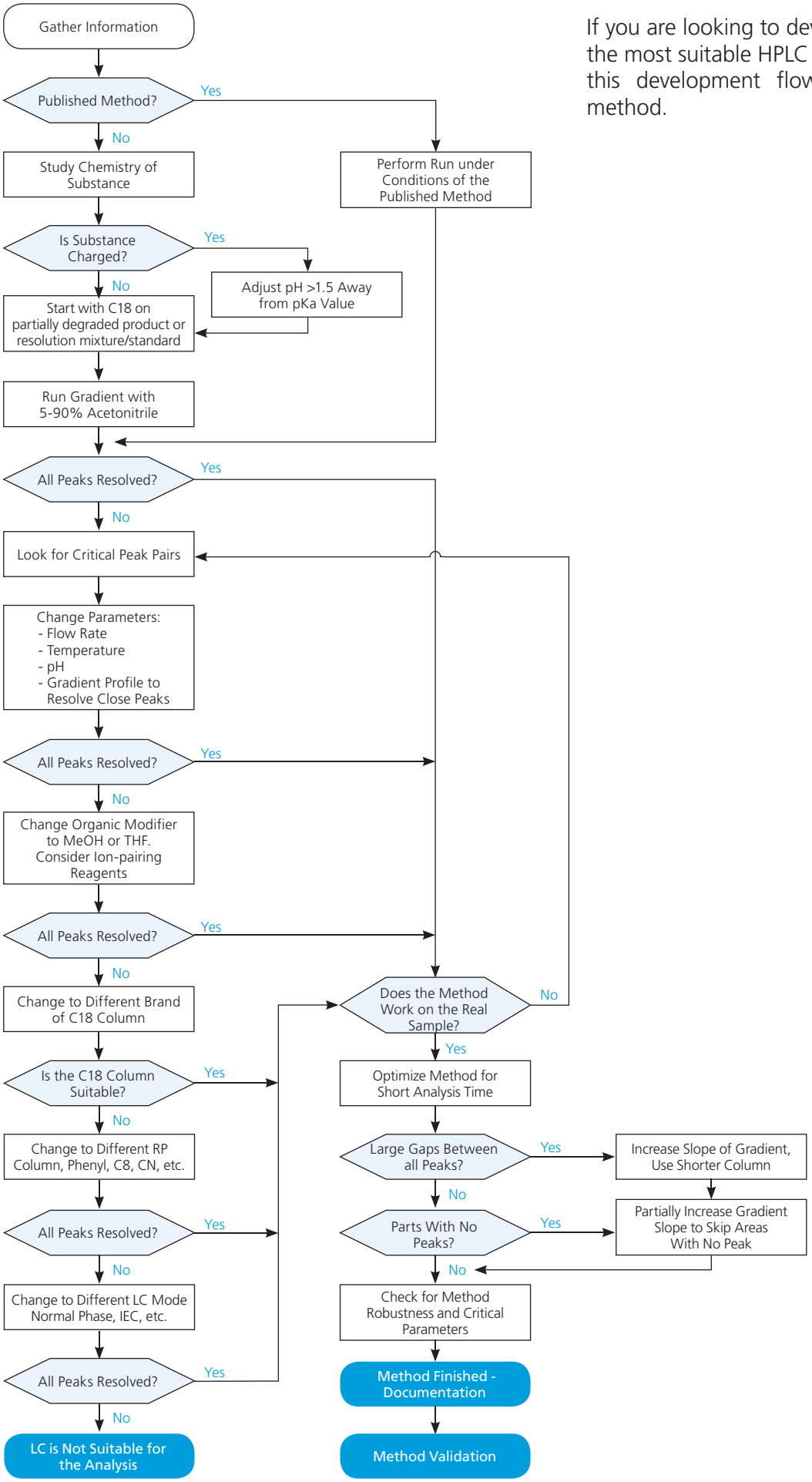
**Note no guard columns available.*

	Guard Columns (pack of three)					Trap Columns (single pack)	
ProteCol™ C18 P-120Å	4.6 mm ID	3.0 mm ID	2.1 mm ID	300 µm ID	150 µm ID	300 µm ID	150 µm ID
ProteCol™ C18 Q-100Å	4.0 mm ID	4.0 mm ID	2.1 mm ID	300 µm ID	150 µm ID	300 µm ID	150 µm ID
ProteCol™ C18 Q-200Å	4.0 mm ID	4.0 mm ID	2.1 mm ID	300 µm ID	150 µm ID	300 µm ID	150 µm ID
ProteCol™ C18 Q-300Å	4.0 mm ID	4.0 mm ID	2.1 mm ID	300 µm ID	150 µm ID	300 µm ID	150 µm ID
ProteCol™ C18 H-120Å	4.0 mm ID	4.0 mm ID	2.1 mm ID	300 µm ID	150 µm ID	300 µm ID	150 µm ID
ProteCol™ C18 G-120Å	4.0 mm ID	4.0 mm ID	2.1 mm ID	300 µm ID	150 µm ID	300 µm ID	150 µm ID
ProteCol™ C8 H-120Å	4.0 mm ID	4.0 mm ID	2.1 mm ID	300 µm ID	150 µm ID	300 µm ID	150 µm ID
ProteCol™ C8 H-1000Å	4.0 mm ID	4.0 mm ID	2.1 mm ID	300 µm ID	150 µm ID	300 µm ID	150 µm ID
ProteCol™ C4 H-300Å	4.0 mm ID	4.0 mm ID	2.1 mm ID	300 µm ID	150 µm ID	300 µm ID	150 µm ID
ProteCol™ Silica-120Å	4.0 mm ID	4.0 mm ID	2.1 mm ID	N/A	N/A	N/A	N/A
ProteCol™ Amino-120Å	4.0 mm ID	4.0 mm ID	2.1 mm ID	N/A	N/A	N/A	N/A
ProteCol™ Cyano-120Å	4.0 mm ID	4.0 mm ID	2.1 mm ID	N/A	N/A	N/A	N/A

Inner diameter of the guard columns provided. Particle size of the stationary phase is corresponding with the particle size of the main column (please specify when ordering).

HPLC Method Development

If you are looking to develop a method and determine the most suitable HPLC column for the analysis, follow this development flowchart to establish the best method.



Problem	Reason	Resolution
System Related		
Low/unsteady system pressure	Leak.	Check all connections and tighten connections, replace seals.
	Air in pump head.	Degas mobile phase and purge system.
	Dirt in check valve (check whether valve cannot close).	Firstly try purging system at high flow rate to dislodge contamination. Secondly, disassemble check valve and sonicate.
High system pressure	Blockage (contamination).	Open connections sequentially from the detector back to the pump to locate blockage. Flush capillaries, replace in-line filters or guard columns, clean injector valve, reverse column flow (without detector in-line!) depending on where the blockage was located.
	Blockage (precipitated buffer salts) can happen when the system or user suddenly changes mobile phase composition from high organic to aqueous buffer or vice versa.	Disconnect column and flush with pure water at low flow rate to dissolve buffer salts again.
	High viscosity mobile phase.	Increase temperature, change mobile phase, or decrease flow rate.
	Small stationary phase particles.	Increase temperature, reduce flow rate, use shorter column.
	Crushed particles (sudden pressure spikes can cause porous silica to fracture and generate "fines").	Replace the column
Noisy, fluctuating, drifting baseline	System contamination.	Disconnect column and rinse system with a combination of acid (10% nitric acid or 15% phosphoric acid for a short period of time followed by water and a organic wash of 75% acetonitrile/25% IPA over night) Do NOT run the acid through the column!
	Age of the UV lamp.	Replace the UV lamp.
	Temperature fluctuations.	Use column oven.
	Higher UV absorption of either mobile phase A or B causes drift in gradient elution.	Use HPLC grade solvents, check UV cut-off values for mobile phase components, change to higher wavelength.
Regular pulsing of the baseline	Air in pump head (also causes pulsing of the back pressure).	Degas mobile phase and purge system.
	Dirt in check valve (also causes pulsing of the back pressure).	First try purging system at high flow rate to dislodge contamination. Second disassemble check valve and sonicate.
	Bubble trapped in the flow cell – the detector response changes dramatically when the detector outlet is temporarily blocked with a finger.	Degas mobile phase and purge system.
The Chromatogram		
Tailing peaks	Wrong pH (some peaks are tailing while others are symmetrical).	The pH of the mobile phase should be 1.5 units or more above or below the pKa value of the analyte to have all molecules either in the charged or in the neutral state.
	Void volumes (all peaks are tailing).	Check connections, replace guard column, replace column.
	Non-specific interactions (some/all sample components can interact with active sites in the flowpath - silanol groups, metal surfaces of tubes and frits).	Replace column with an inert column, replace metal tubing with PEEKsil™ tubing. Add additives (e.g. EDTA) into mobile phase, lower pH to <2.5 in order to protonate silanol groups.
Fronting/tailing peaks	Channeling.	Channeling indicates a serious problem with the column and the column needs replacing. For the interim you can try to reverse the column flow direction.
	"Viscous fingering" – happens when there is a large difference between the viscosity of the sample and the viscosity of the mobile phase.	Try to match the viscosity of the sample with the mobile phase. Ideally, always use mobile phase as the sample diluent.
	Stationary phase degradation.	Loss of ligands when the column is exposed to extreme pH or when the column is very old can lead to peak fronting. Replace the column.
	Column over loading.	Reduce the amount of sample injected or use a column with a larger ID.

More Than Just Packaging

HPLC Packaging

SGE has developed improved packaging, enabling you to receive your column with confidence and store it securely. By designing packaging that combines shipping and storage solutions, chaotic drawers and expensive HPLC specific storage are eliminated.

Opens flat to store columns and accessories in your drawer.

Guard Column

Label to identify column

Test Report

Store up to three full sized analytical columns.

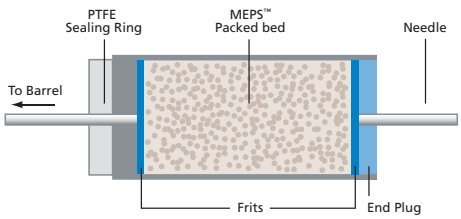
Complementary HPLC Products and Supplies

MEPS™

MEPS™ (Micro Extraction by Packed Sorbent) is a micro SPE solution that incorporates the stationary phase in a micro-cartridge integrated in a high quality SGE analytical syringe (Barrel Insert and Needle - BIN configuration).

MEPS is the miniaturization of conventional SPE packed bed devices from mL to µL bed volumes.

eVol® MEPS stationary phases available: C2, C8, C18, APS, DVB, SDVB.



Schematic of the MEPS™ stationary phase within the syringe needle – SGE's patented 'Barrel Insert and Needle' (BIN) configuration.

ProteCol™ Guard Columns and Filters

Analytical Protection

ProteCol Filter

The ProteCol filter is designed to filter the sample prior to the pre-column. Peak broadening has been eliminated due to low dead volume, inert design.

ProteCol Guard Column

We recommend the use of ProteCol Guard columns to protect the analytical column, and ensure it performs consistently. The guard column is designed to fit into the back of a PEEK fingertight fitting (provided with the guard column). No further unions are required.

Capillary Protection

- Zero dead volume filter design.
- Zero pressure drop across filter.
- Zero compromise on performance.

The ProteCol In-Line Filter is a simple and effective way to protect your capillary columns from particulates. It protects your system from blockages and increased back pressures without introducing peak tailing or loss of resolution. The filtering element is a 2 micron porosity screen, located between the square-cut and polished ends of two lengths of PEEKsil™ tubing ('tails').

Accessories

HPLC Tubing

PEEKsil™ may be used as a direct replacement for conventional stainless steel as well as a replacement for PEEK tubing used in LC systems. The PEEK polymer exterior coating and the fused silica combination makes PEEKsil very robust, making it ideal for capillary HPLC and LC-MS applications.

HPLC Connections

ProteCol Unions (stainless steel or PEEK) are combined with reusable PEEK ferrules, facilitating connecting any combination of 0.36 mm fused silica tubing, 1/32" and 1/16" PEEKsil.

- Stainless steel unions can be finger tightened or tightened with a 3/16" wrench for high-pressure applications.
- PEEK unions can be finger tightened. They are slightly larger than stainless steel unions but also lighter for less stress on your tubing.

EasyLok

EasyLok connections comprise of a knurled stainless steel nut and a double ended PEEK ferrule. The PEEK ferrule slides over any 1/16" OD tubing to its required position, while the nut is finger tightened. Unlike stainless steel, the PEEK ferrule will not crush the tubing and can be easily readjusted for quick column changes. The unique double ended ferrule design seals at two points to prevent leaks.

The fittings are compatible with any standard female HPLC fitting including Swagelok®, Parker™, Waters®, Valco® and Whatman®.

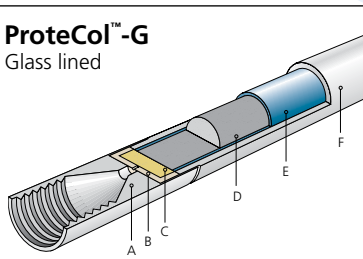
Hexnut

Ideal for applications where corrosive solvents are being used, Hexnuts have inert contact surfaces, making them biocompatible. Stainless steel 10-32 thread fittings use a non-swaging Kel-F® or PEEK replaceable ferrule.

ProteCol™ LC Columns - Exceed the limit

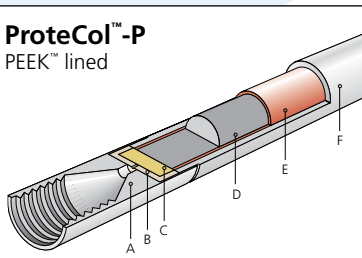
A premium inert range of LC columns delivering optimal peak shape.

ProteCol™-G
Glass lined



A Column end cap
B PEEK™ frit housing
C Porous PEEK™ frit
D Stationary phase
E Glass lining
F Stainless steel column body

ProteCol™-P
PEEK™ lined



A Column end cap
B PEEK™ frit housing
C Porous PEEK™ frit
D Stationary phase
E PEEK™ lining
F Stainless steel column body

50 SGE years
1960 - 2010

SGE Analytical Science
www.sge.com

AUSTRALIA & PACIFIC REGION CHINA EUROPE INDIA JAPAN MIDDLE EAST USA

The ProteCol™ range of LC columns

The ProteCol™ range of LC columns feature proprietary column designs, incorporating inert materials throughout the flow path and the highest quality stationary phases. The combination of these factors delivers unparalleled separation performance.

Benefits of an inert flow path are:

- Optimized analyte recovery.
- Superior peak shape and reproducibility.
- Less artifacts due to reduced carry over.

ProteCol™-P C18 HQ105 – Premium phase for optimal performance

SGE's inert LC column range enables you to focus on your application rather than the column's performance.

The NIST SRM870 method is designed to provide an even bench mark for C18 column performance. As shown in Figure 1, ProteCol™-P C18 HQ105 approaches the 'ideal' performance of a column with no non-specific interactions.

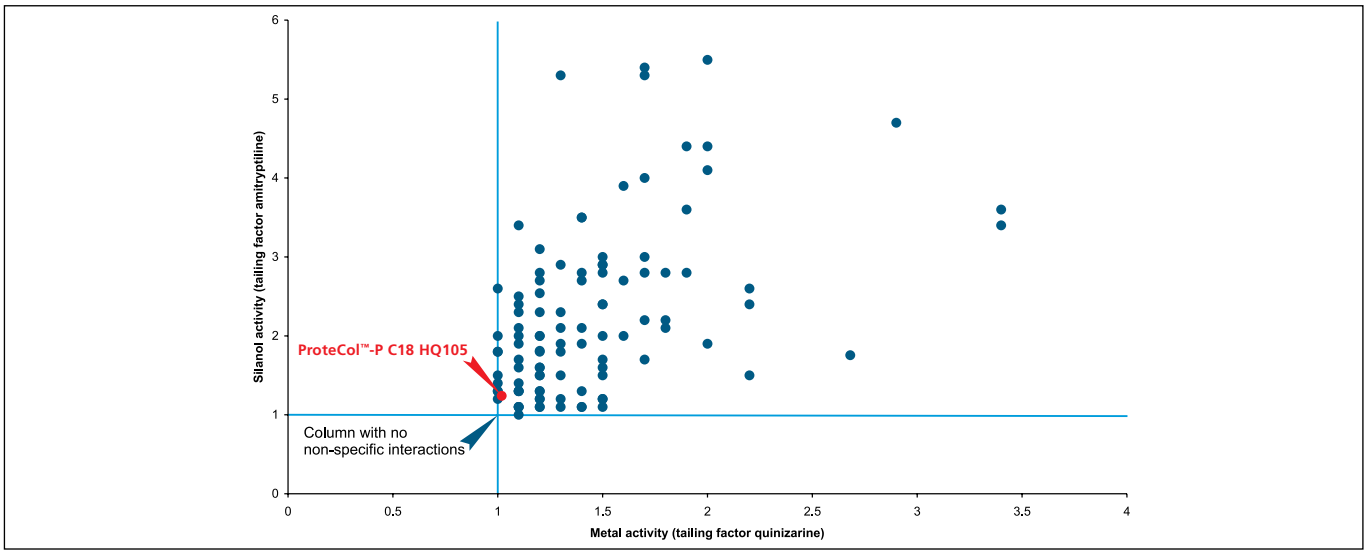


Figure 1: Non-specific interactions of the NIST SRM870 probe molecules on commercially available C18 columns. (Comparison data available at: www.usp.org/USPNF/columns.html)

Ideally, you have symmetrical peaks of the NIST SRM870 test mix – deviations indicate non-specific binding.

In Figure 2 the overlay of chromatograms illustrates clearly the superior peak performance of the ProteCol™-P C18 HQ105 phase compared to a Type I silica and an average C18 competitor's product.

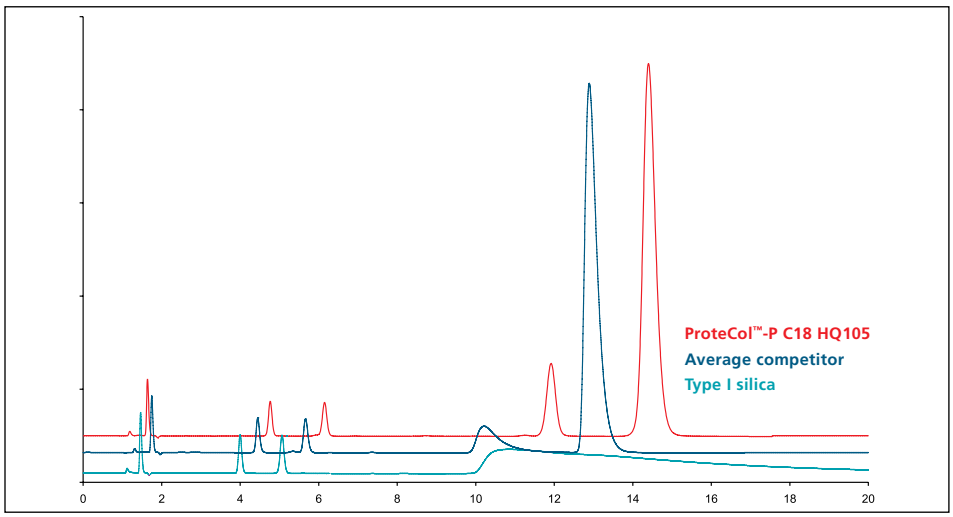


Figure 2. Chromatograms of the NIST SRM870 mix on different types of columns

Why metal-free chromatography?

Many pharmaceutical active substances are rich in oxygen and can therefore interact with metal (Fe). Our tests have shown the N-hydroxypyridine-2-on – the chelating part of the anti-fungal cyclopirox molecule – is a powerful probe for metal activity. In one experiment, a PEEK™ lined ProteCol™-P C18 HQ105 coated column was compared to a stainless steel ProteCol™ C18 HQ105 column where the connection tubing also varied between stainless steel and PEEKsil™ (PEEK™ coated fused silica tubing). As demonstrated in Figure 3, peak tailing was minimized with the reduction of metal in the flow path resulting in increased peak height – hence, sensitivity.

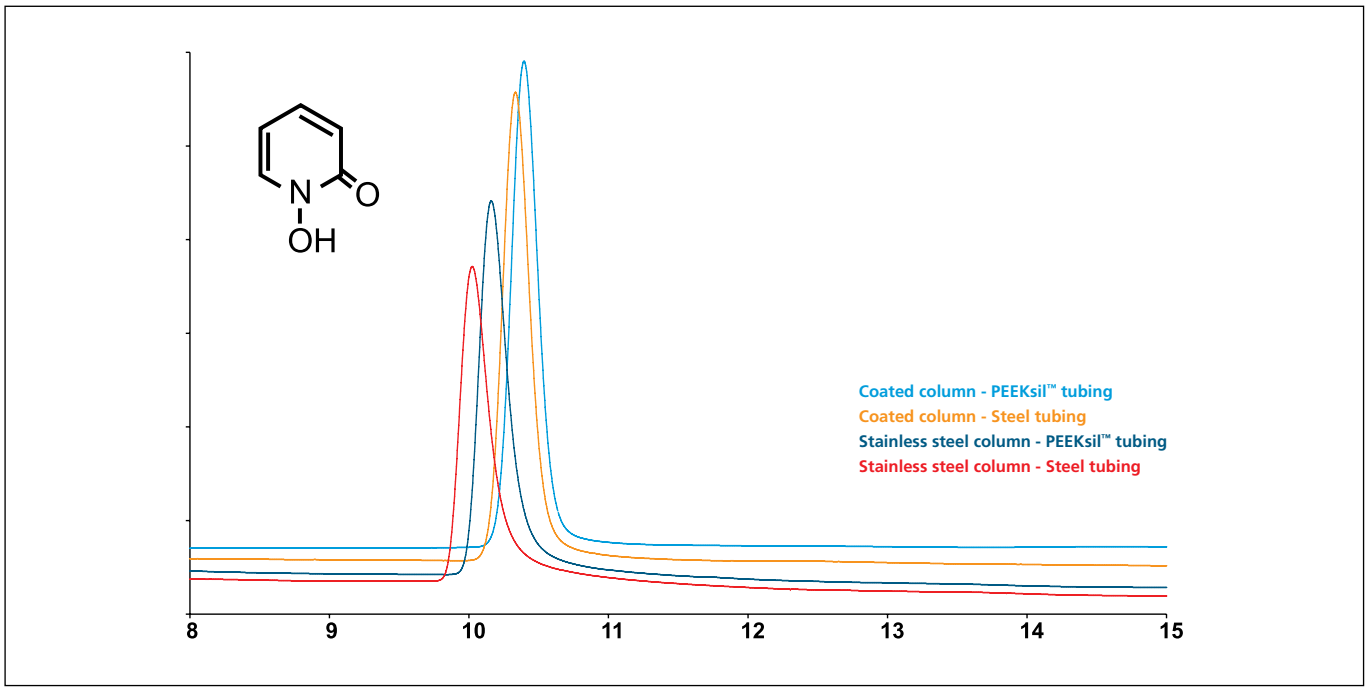


Figure 3: N-hydroxypyridine-2-on peak with various amounts of metal surfaces present in the flow path.

A second experiment was conducted with tetracycline antibiotics. Tetracycline and related drugs have a number of potential chelating groups aligned on one side of the molecule and are known to form metal complexes (dietary calcium and iron render the antibiotic ineffective). Figure 4 demonstrates the improved peak sensitivity using the PEEK™ lined ProteCol™-P C18 HQ105 column format.

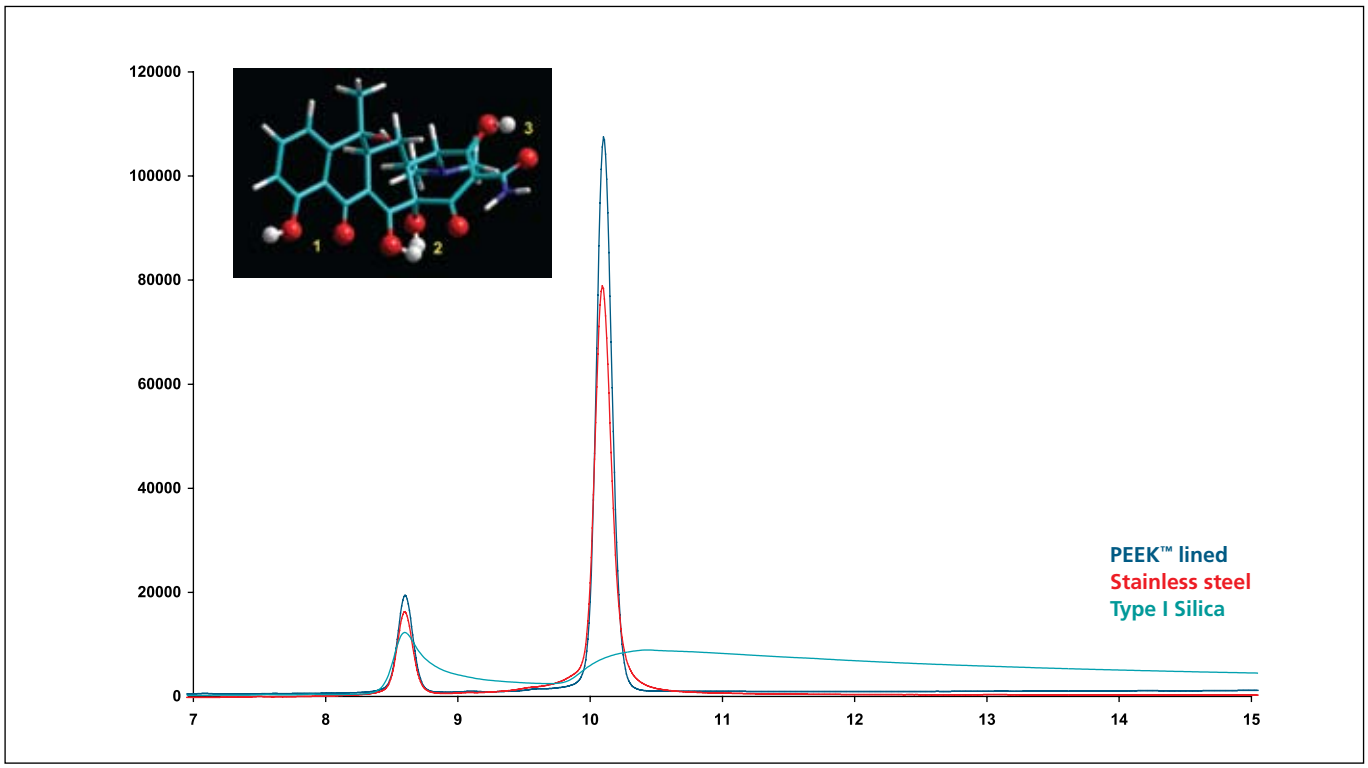


Figure 4: Chromatogram of tetracycline and its major degradation product. Note the peak broadening on the base of the peak run through the stainless steel column. Inset: the tetracycline molecule depicting the three potential chelating groups.

ProteCol™-P C18 HPH125 – Special phase for enhanced durability

The ProteCol™-P C18 HPH125 column has a specially modified stationary phase which allows it to be used outside commonly recommended pH ranges. While the silica matrix material of any silica based LC column has a stability limit of ~pH8, the special C18 modification of the support in combination with the PEEK™ lined column hardware, enables the column to be run at pH9 and above without deterioration of performance.

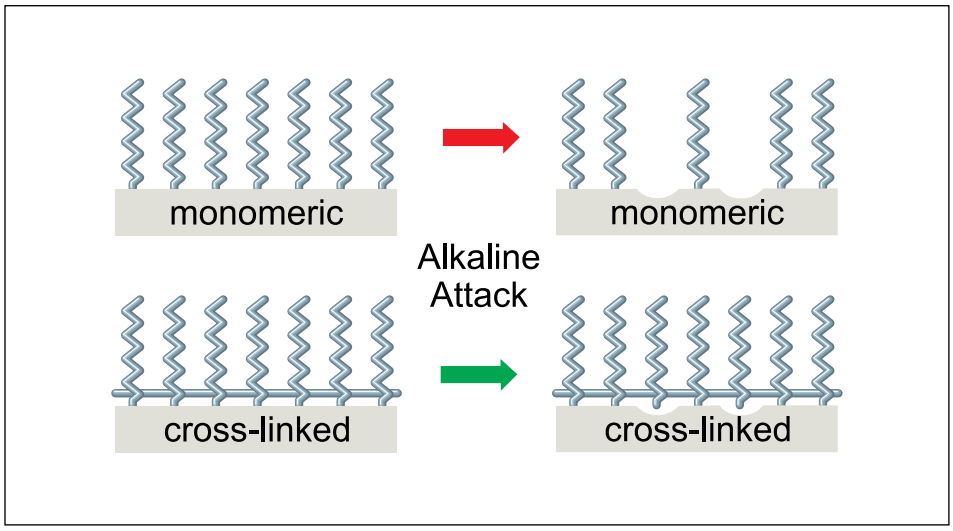


Figure 5: Difference between the pH stability of monomeric modified stationary phases and crosslinked stationary phases.

In our tests on the effects of elevated pH on ProteCol™-P C18 HPH125 chromatographic performance, we have observed that peak symmetry is the most sensitive parameter to measure column performance compared to the often quoted retention time or the k'-value. Figure 6 illustrates that peak symmetry on the ProteCol™-P C18 HPH125 column remains unchanged at pH 9.15 and over 3000 column volumes at 40°C. When compared to monomeric silica, peak symmetry deteriorated at less than 1000 column volumes whereas the retention time remained unchanged (see inset).

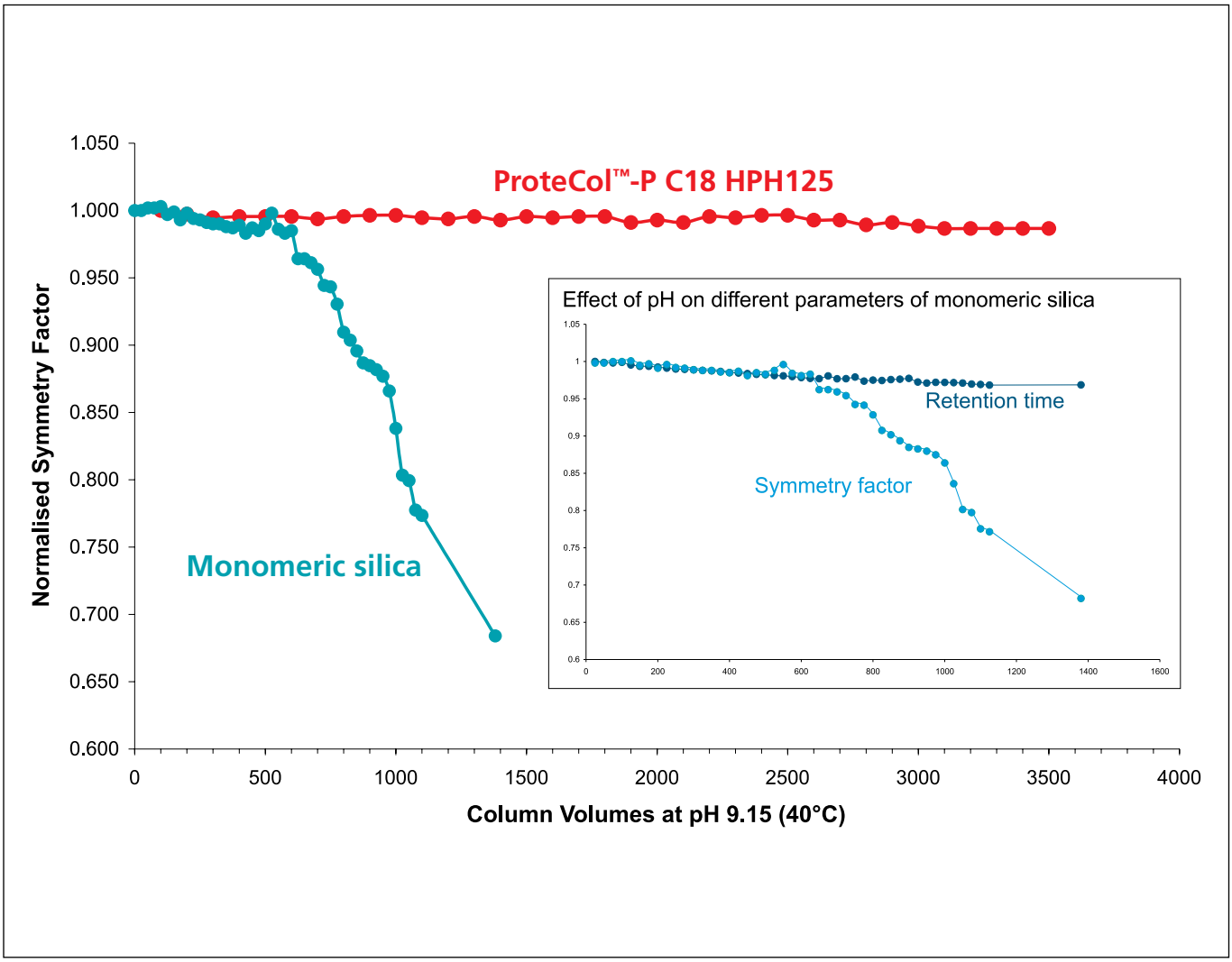


Figure 6: Effect of pH 9.15 on the performance of conventional monomeric silica and ProteCol™-P C18 HPH125.

Chemical properties of the ProteCol™ range

Stability at pH 1:

All columns in the ProteCol™ range show no deterioration when exposed to pH 1.0 buffers.

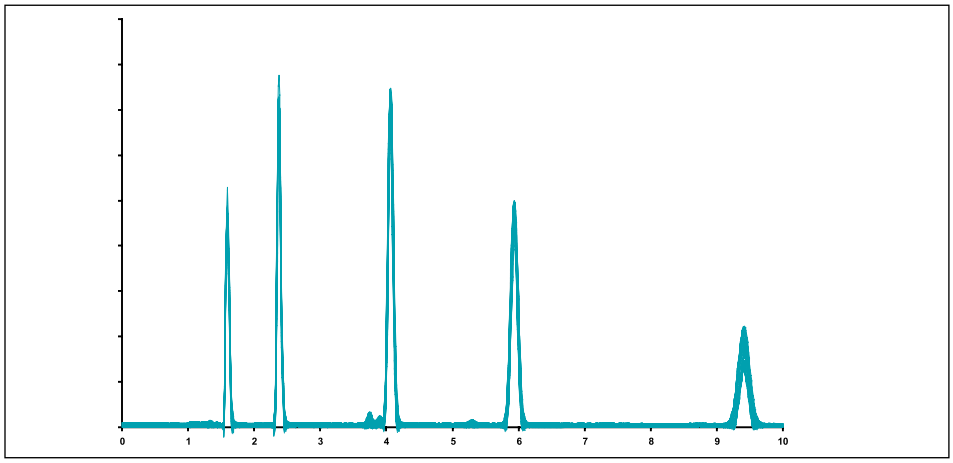


Figure 7: Overlay of 40 chromatograms run at pH 1.0 spanning 1200 column volumes

Long-term reproducibility

All columns in the ProteCol™ range show a remarkable reproducibility of thousands of injections (subject to sample purity and mobile phase conditions).

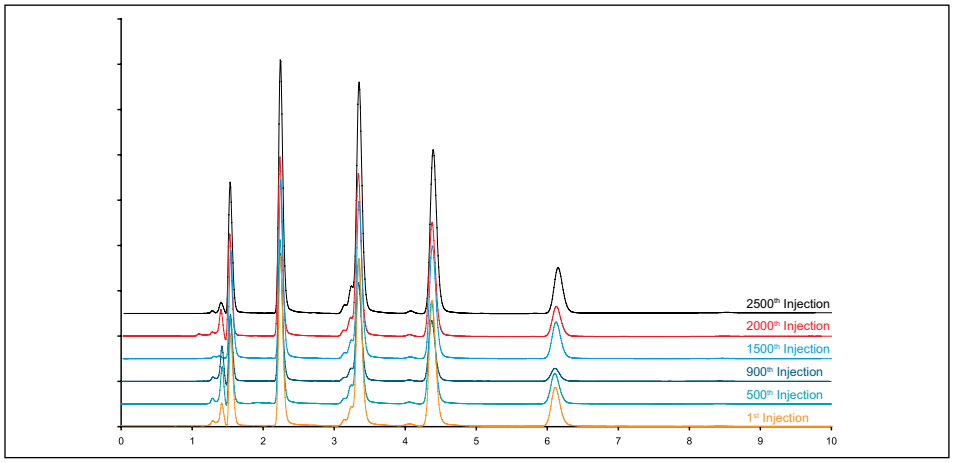


Figure 8: Chromatograms of a test mix over a period of 2500 injections

Analysis of larger molecules

When analyzing samples containing large molecules (peptides, proteins, polymers with MW>3000) the size of the molecule and the size of the pore structure play an important role in the quality of the separation. As the analyte increases in size (relative to the pore size) the diffusion rate inside the pore becomes smaller and mass transfer in and out of the pore system becomes slow leading to band broadening. Obviously, when the analyte size is equal to or bigger than the pore size there can be no pore diffusion. A mathematical description of this relationship was published by Renkin (E.M. Renkin, J.Gen.Physio., 38 (1954) 225.) and helps to illustrate the phenomenon.

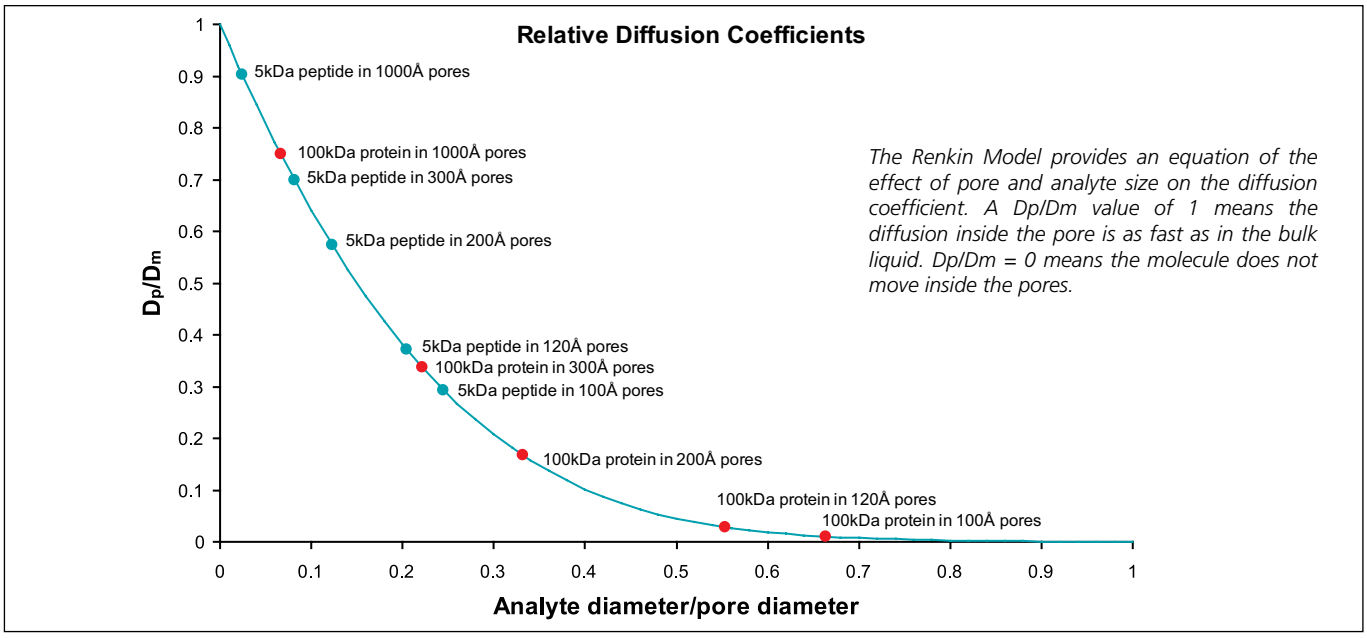


Figure 9: An illustration of the relative diffusion rate of a 5kDa peptide and a 100kDa protein in a number of pore systems

ProteCol™-G C18 HQ203 and HQ303 – Columns for peptides

ProteCol™-G C18 HQ203 and HQ 303 are columns packed with stationary phases of 200Å and 300Å pores, respectively. They both show reasonable fast diffusion rates for a typical peptide (MW~5000) or any other molecule of a similar size.

The difference between them is the specific surface area (surface area are per unit of weight) which in case of the 200Å pore size material is twice as high as for the 300Å pore size particles (200 and 100 m²/g respectively). The surface area is directly linked to the column capacity. Figure 10 shows that in terms of resolution and peak capacity both columns provide very similar results.

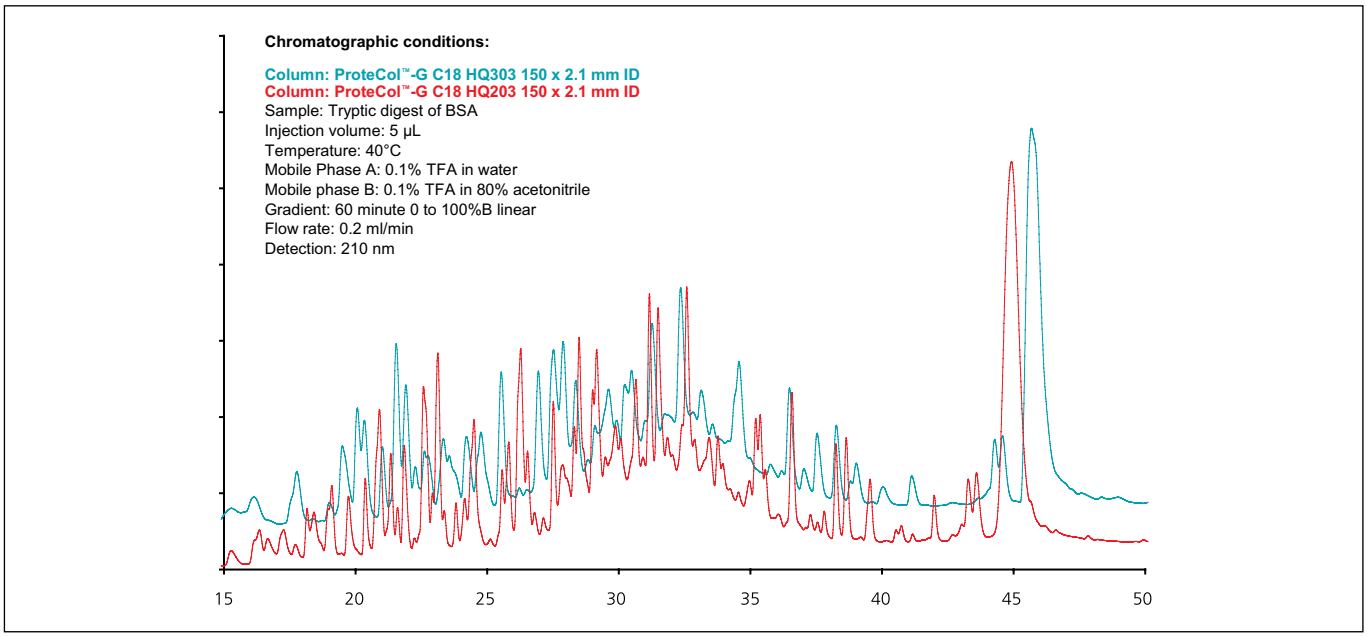


Figure 10: Separation of a BSA digest on a ProteCol™-G C18 HQ203 and ProteCol™-G C18 HQ303 column

ProteCol™-G C8 HQ1003 – The protein separation column

Figure 9 shows clearly that a 300Å pore size is not ideal for separating larger proteins. Our ProteCol™-G C8 HQ1003 column therefore uses a 1000Å pore size packing material.

Most proteins have a very hydrophobic core and they tend to unfold when coming in contact with a reversed phase surface. This can lead to very strong binding and sample loss. A C8 stationary phase gives much higher recoveries. The following example is the separation of the AOHUPO Membrane Protein Initiative mouse liver membrane proteins standard.

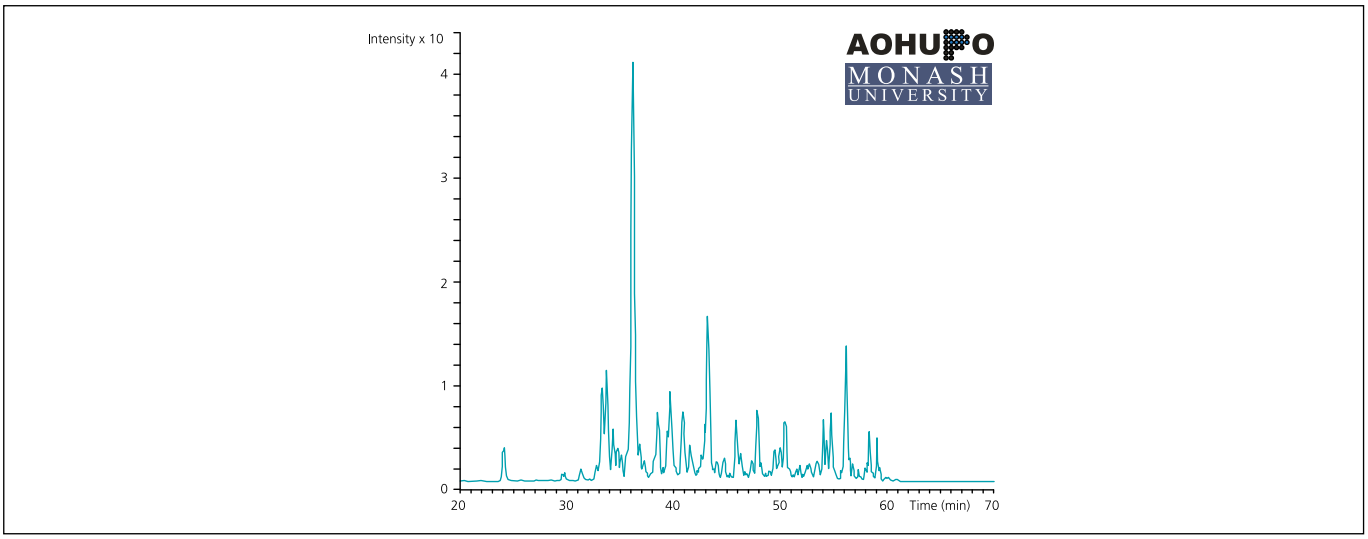


Figure 11: Base peak chromatogram of mouse liver membrane proteins separated on a ProteCol™-G C8 HQ1003 300 µm x 100mm column.

ProteCol™ – Product range and part numbers

Naming convention: **SGE ProteCol™-P C18 HQ105**

Lining
Stationary phase
Pore size with particle number
Phase description: HQ = High Quality, GP = General Purpose, HPH = High PH

Description	Stationary Phase	Pore Size	Particle Size	Lining	I.D.	Length	Pack Size	Part no.
Analytical Columns								
ProteCol™-P C18 HQ105	C18 HQ	100 Å	5 µm	PEEK™ lined	4.6 mm	250 mm	1	250100
ProteCol™-P C18 HQ105	C18 HQ	100 Å	5 µm	PEEK™ lined	4.6 mm	150 mm	1	250102
ProteCol™-P C18 HQ105	C18 HQ	100 Å	5 µm	PEEK™ lined	2.1 mm	250 mm	1	250105
ProteCol™-P C18 HQ105	C18 HQ	100 Å	5 µm	PEEK™ lined	2.1 mm	150 mm	1	250107
ProteCol™-P C18 HQ103	C18 HQ	100 Å	3 µm	PEEK™ lined	2.1 mm	150 mm	1	250200
ProteCol™-P C18 HQ103	C18 HQ	100 Å	3 µm	PEEK™ lined	2.1 mm	100 mm	1	250202
ProteCol™-P C18 HPH125	C18 HPH	120 Å	5 µm	PEEK™ lined	4.6 mm	250 mm	1	250110
ProteCol™-P C18 HPH125	C18 HPH	120 Å	5 µm	PEEK™ lined	4.6 mm	150 mm	1	250112
ProteCol™-P C18 HPH125	C18 HPH	120 Å	5 µm	PEEK™ lined	2.1 mm	250 mm	1	250115
ProteCol™-P C18 HPH125	C18 HPH	120 Å	5 µm	PEEK™ lined	2.1 mm	150 mm	1	250117
ProteCol™ C18 GP125	C18 GP	120 Å	5 µm	SS (PEEK™ frit)	4.6 mm	250 mm	1	250210
ProteCol™ C18 GP125	C18 GP	120 Å	5 µm	SS (PEEK™ frit)	4.6 mm	150 mm	1	250212
ProteCol™ C18 GP125	C18 GP	120 Å	5 µm	SS (PEEK™ frit)	2.1 mm	250 mm	1	250215
ProteCol™ C18 GP125	C18 GP	120 Å	5 µm	SS (PEEK™ frit)	2.1 mm	150 mm	1	250217
ProteCol™-G C18 HQ305	C18 HQ	300 Å	5 µm	GLT™	4.6 mm	250 mm	1	250120
ProteCol™-G C18 HQ305	C18 HQ	300 Å	5 µm	GLT™	4.6 mm	150 mm	1	250122
ProteCol™-G C18 HQ305	C18 HQ	300 Å	5 µm	GLT™	2.1 mm	250 mm	1	250125
ProteCol™-G C18 HQ305	C18 HQ	300 Å	5 µm	GLT™	2.1 mm	150 mm	1	250127
ProteCol™-G C18 HQ303	C18 HQ	300 Å	3 µm	GLT™	2.1 mm	150 mm	1	250130
ProteCol™-G C18 HQ303	C18 HQ	300 Å	3 µm	GLT™	2.1 mm	100 mm	1	250132
ProteCol™-G C18 HQ303	C18 HQ	300 Å	3 µm	PEEKsil™	300 µm	150 mm	1	250135
ProteCol™-G C18 HQ303	C18 HQ	300 Å	3 µm	PEEKsil™	300 µm	100 mm	1	250137
ProteCol™-G C18 HQ303	C18 HQ	300 Å	3 µm	PEEKsil™	150 µm	150 mm	1	250140
ProteCol™-G C18 HQ303	C18 HQ	300 Å	3 µm	PEEKsil™	150 µm	100 mm	1	250142
ProteCol™-G C18 HQ203	C18 HQ	200 Å	3 µm	GLT™	2.1mm	150 mm	1	250150
ProteCol™-G C18 HQ203	C18 HQ	200 Å	3 µm	GLT™	2.1mm	100 mm	1	250152
ProteCol™-G C18 HQ203	C18 HQ	200 Å	3 µm	PEEKsil™	300 µm	150 mm	1	250155
ProteCol™-G C18 HQ203	C18 HQ	200 Å	3 µm	PEEKsil™	300 µm	100 mm	1	250157
ProteCol™-G C18 HQ203	C18 HQ	200 Å	3 µm	PEEKsil™	150 µm	150 mm	1	250160
ProteCol™-G C18 HQ203	C18 HQ	200 Å	3 µm	PEEKsil™	150 µm	100 mm	1	250162
ProteCol™-G C8 HQ125	C8 HQ	120 Å	5 µm	GLT™	4.6 mm	250 mm	1	250190
ProteCol™-G C8 HQ125	C8 HQ	120 Å	5 µm	GLT™	4.6 mm	150 mm	1	250192
ProteCol™-G C8 HQ125	C8 HQ	120 Å	5 µm	GLT™	2.1 mm	250 mm	1	250195
ProteCol™-G C8 HQ125	C8 HQ	120 Å	5 µm	GLT™	2.1 mm	150 mm	1	250197
ProteCol™-G C8 HQ1003	C8 HQ	1000 Å	3 µm	GLT™	2.1mm	150 mm	1	250170
ProteCol™-G C8 HQ1003	C8 HQ	1000 Å	3 µm	GLT™	2.1mm	100mm	1	250172
ProteCol™-G C8 HQ1003	C8 HQ	1000 Å	3 µm	PEEKsil™	300 µm	150 mm	1	250175
ProteCol™-G C8 HQ1003	C8 HQ	1000 Å	3 µm	PEEKsil™	300 µm	100mm	1	250177
ProteCol™-G C8 HQ1003	C8 HQ	1000 Å	3 µm	PEEKsil™	150 µm	150 mm	1	250180
ProteCol™-G C8 HQ1003	C8 HQ	1000 Å	3 µm	PEEKsil™	150 µm	100mm	1	250182

Description	Stationary Phase	Pore Size	Particle Size	Frit	I.D.	Length	Pack Size	Part no.
Guard Columns								
ProteCol™ C18 GP125	C18 GP	120 Å	5 µm	PEEK™	2.1 mm	10 mm	3	250032
ProteCol™ C18 GP125	C18 GP	120 Å	5 µm	PEEK™	4 mm	10 mm	3	250033
ProteCol™ C8 HQ125	C8 HQ	120 Å	5 µm	PEEK™	2.1 mm	10 mm	3	250003
ProteCol™ C8 HQ125	C8 HQ	120 Å	5 µm	PEEK™	4 mm	10 mm	3	250005
ProteCol™ C18 HQ105	C18 HQ	100 Å	5 µm	PEEK™	2.1 mm	10 mm	3	250007
ProteCol™ C18 HQ105	C18 HQ	100 Å	5 µm	PEEK™	4 mm	10 mm	3	250009
ProteCol™ C18 HPH125	C18 HPH	120 Å	5 µm	PEEK™	2.1 mm	10 mm	3	250013
ProteCol™ C18 HPH125	C18 HPH	120 Å	5 µm	PEEK™	4 mm	10 mm	3	250015
ProteCol™ C8 HQ1003	C8 HQ	1000 Å	3 µm	PEEK™	2.1 mm	10 mm	3	250019
ProteCol™ C8 HQ1003	C8 HQ	1000 Å	3 µm	PEEK™	4 mm	10 mm	3	250017
ProteCol™ C18 HQ203	C18 HQ	200 Å	3 µm	PEEK™	2.1 mm	10 mm	3	250021
ProteCol™ C18 HQ203	C18 HQ	200 Å	3 µm	PEEK™	4 mm	10 mm	3	250023
ProteCol™ C18 HQ305	C18 HQ	300 Å	5 µm	PEEK™	2.1 mm	10 mm	3	250025
ProteCol™ C18 HQ305	C18 HQ	300 Å	5 µm	PEEK™	4 mm	10 mm	3	250027
ProteCol™ C18 HQ303	C18 HQ	300 Å	3 µm	PEEK™	2.1 mm	10 mm	3	250029
ProteCol™ C18 HQ303	C18 HQ	300 Å	3 µm	PEEK™	4 mm	10 mm	3	250031