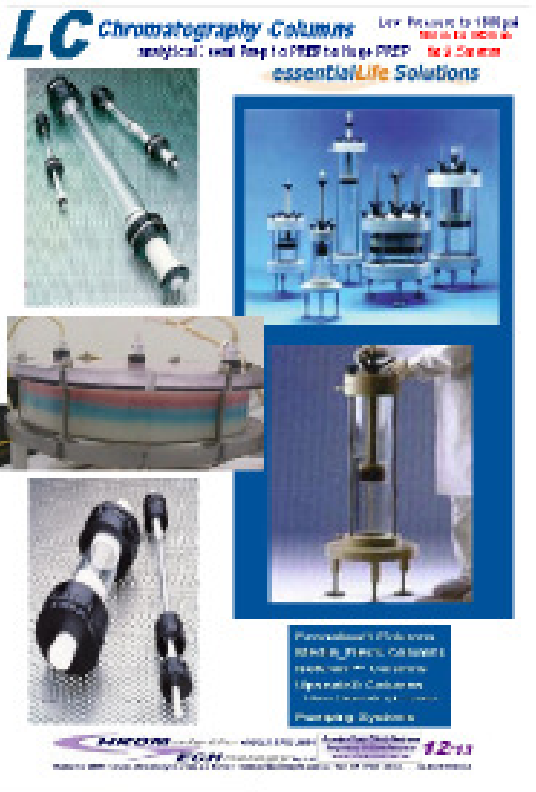
Chromatography COLUMNS

Guard Columns for GC and HPLC

also
Unpacked Columns
Stainless steel
PEEK



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Selecting a GC Column

Strategic column choices can improve lab productivity by assuring that speed and resolution are optimized. While the number of choices available can be daunting, consideration of the resolution equation variables—selectivity, retention (capacity), and efficiency—simplifies the decision. Selectivity determines which stationary phase is most appropriate, and it can be approximated using retention indices or existing applications. Once the phase has been chosen, physical dimensions (internal diameter, film thickness, length) can be selected based on retention and efficiency. Understanding how selectivity, retention, and efficiency influence separations allows analysts to make effective, informed choices and quickly select the best column for specific separations.

$$R = \frac{1}{4}\sqrt{\frac{L}{H}} \times \frac{k}{k+1} \times \frac{\alpha-1}{\alpha}$$

Efficiency | Retention | Selectivity

R = resolution
L = column length
H = HETP
k = capacity factor
α = selectivity

Selectivity, α

The selectivity of the capillary column is directly related to how the analyte molecule interacts with the stationary phase being considered. If the analyte strongly interacts with the stationary phase, it can be said that strong intermolecular forces exist. These intermolecular forces of attraction between the analyte and the stationary phase are a function of the structure of both the analyte molecule and the stationary phase. If these two structures are similar, then the attractive forces are strong. If they are dissimilar, then analyte to stationary phase attraction is weak, and less retention is observed. Therefore, when selecting a stationary phase, knowledge of the structure of the analytes of interest and the stationary phase is crucial. The reference table on page 27 provides the chemical structure of Restek's most common stationary phases.

An example of selectivity can be shown using benzene and butanol (both have nearly the same boiling point) eluting through the 20% diphenyl/80% dimethyl polysiloxane stationary phase (Rtx®-20). The benzene molecule will dissolve into the stationary phase more readily than the butanol based on the concept that "likes dissolve likes". Since benzene solvates more readily with the stationary phase, it has more interactions with the stationary phase as it elutes through the column. Therefore, the elution order of these two compounds on the Rtx®-20 stationary phase will be butanol first and benzene second.

As methyl groups are replaced by different functionalities such as phenyl or cyanopropyl pendant groups, the selectivity of the column shifts towards compounds that will have a better solubility in the stationary phase. For example the Rtx®-200 stationary phase provides high selectivity for analytes containing lone pair electrons, such as halogens, nitrogen, or carbonyl groups. Polyethylene glycol columns, such as the Stabilwax® and Rtx®-Wax columns are highly selective towards polar compounds such as alcohols. Again using the example above, the butanol more readily solvates into the polyethylene glycol stationary phase; therefore, the butanol will have more interaction with the phase and elute after benzene.

Pro *ez*GC software will save you time and money by greatly enhancing your productivity and increasing sample throughput.

For Fast GC, Windows® NT, 2000, XP, Vista, or Windows® 7 (compatibility mode).

Pro *ez*GC Methods Development Software

- Optimize temperature and flow programs with a single analysis.
- Reduce analysis time and improve sample resolution.
- Model retention gap and guard column applications, including Restek Integra-Guard® columns.
- Optimize dual-column run conditions, columns in parallel or in series.

Take the guesswork out of selecting the best column and conditions for your GC analysis. Pro *ez*GC software accurately predicts separations on any capillary column, and is useful for selecting a column and conditions from a single GC run. Using your retention data, or the extensive library, you can automatically evaluate thousands of combinations of column dimensions, oven temperature programs, and carrier gas pressure programs to determine the best separation with the fastest analysis time.

Pro *ez*GC includes a master set of retention index libraries at no extra charge! These libraries contain more than 3,000 compounds analyzed on the most commonly used stationary phases, in ten application areas, including pesticides, PCBs, dioxins/furans, flavor and fragrance compounds, drugs of abuse, FAMEs, semivolatile and volatile pollutants, petroleum hydrocarbons, and solvents and chemicals. The libraries permit computer simulation without entering actual laboratory data.

Description	qty.	cat.#	price
Pro *ez*GC Method Development Software CD-ROM	ea.	21487	$201

Table I lists the Kovats retention indices for the more common stationary phases. Assigning a retention index to each probe listed provides a basis for comparing several stationary phases and their relative retention to one another for a set of molecular probes. For example, when Kovats indices are identical on two column phases, then the resulting separations will be identical. If, however, a Kovats value of one probe varies significantly from the value on another phase for the same probe, then the resulting compound elution order will differ. Thus, the Kovats indices are useful for comparing column selectivity for different types of compounds among different phases.

Table I Retention indices for Restek phases

Phase	Benzene	Butanol	Pentanone	Nitropropane
Rtx-1	651	651	667	705
Rtx-5/Rtx-5MS	667	667	689	743
Rtx-20	711	704	740	820
Rtx-1301/Rtx-624	689	729	739	816
Rtx-35	746	733	773	867
Rtx-200	738	758	884	980
Rtx-50	778	769	813	921
Rtx-1701	721	778	784	881
Rtx-65TG	794	779	825	938
Rtx-225	847	937	958	958
Stabilwax	963	1158	998	1230

Retention, k

The capacity of the column relates to how much material can be injected onto a column without adversely affecting peak shape. If the amount of a compound (mass) exceeds the capacity of a column (WCOT), the peak will front, which sometimes can look like a "shark fin". The goal is to select a column with sufficient capacity such that peak shape will not suffer. Peak symmetry is typically used to calculate the degree of sample overload. There are two primary column-related dimensions that affect capacity, assuming the proper column phase was selected: column internal diameter (ID) and phase film thickness (µ).

When selecting column ID, consideration should include the type of injection, the detector being used, and the concentration of sample (amount on-column). The injection technique is an important consideration because the ID of the column may need to be selected based on whether a split, splitless, cool on-column injection, or other sample transfer to the column is being used. The second consideration is the detector and how much flow it can optimally work under. For example, some MS detectors can only handle column flow rates of up to 1.5 mL/min.; therefore, a 0.53 mm ID column, which requires higher flows for proper chromatography, is not an option for this detector. The third consideration is sample capacity of the column. If the concentration of the sample exceeds the column capacity, loss of resolution, poor reproducibility, and peak distortion will result. Table II shows several typical column characteristics for various column IDs.

Table II Typical characteristics for columns with the same phase ratio, such as 0.10 mm ID x 0.10 µm and 0.18 mm ID x 0.18 µm, etc.

	Column ID					
Characteristic	0.10mm	0.15mm	0.18mm	0.25mm	0.32mm	0.53mm
Helium Flow (@ 20cm/sec.)	0.16mL/min.	0.3mL/min.	0.3mL/min.	0.7mL/min.	1.2mL/min.	2.6mL/min.
Hydrogen Flow (@ 40cm/sec.)	0.32mL/min.	0.6mL/min.	0.6mL/min.	1.4mL/min.	2.4mL/min.	5.2mL/min.
Sample Capacity (max load per component)	<10ng	<40ng	<50ng	50–100ng	400–500ng	1000–2000ng
Theoretical Plates/Meter	8000	4000	3500	3200	2500	1800

Film thickness (μ) has a direct effect on the retention and elution temperature for each sample component. Extremely volatile compounds should be analyzed on thick-film columns to increase the time the compounds spend in the stationary phase, allowing them to separate. High molecular weight compounds must be analyzed on thinner film columns. This reduces the length of time the analytes stay in the column, and minimizes bleed at required higher elution temperatures. Film thickness also affects the amount of material that can be injected onto the column without overloading. A thicker film column can be used for higher concentration samples, such as purity analysis.

Film thickness directly affects phase ratio (β), which is an important consideration when changing internal diameter. When internal diameter increases, film thickness (df) must increase in order to provide similar resolution and retention. Table III shows values for common dimensions of columns. Similar values indicate similar elution for different IDs.

Table III Phase ratio (β) values for common column dimensions.*

	Film Thickness (df) / β Value						
Column ID	0.10μm	0.25μm	0.50μm	1.0μm	1.5μm	3.0μm	5.0μm
0.18mm	450	180	90	45	30	15	9
0.25mm	625	250	125	63	42	21	13
0.32mm	800	320	160	80	53	27	16
0.53mm	1325	530	265	128	88	43	27

*β = r/2df (r=internal radius of tubing; df = phase film thickness)

Efficiency, N

Column efficiency (N) is the column length divided by the height equivalent to a theoretical plate (HETP). The effective theoretical plates are affected by how well the phase has been coated onto the column walls and is measured by how narrow the peaks are when they are eluted at the end of the column. Therefore, the higher the column efficiency (N), the better resolution power the column will have.

Capillary columns are made in various lengths, typically in standard lengths of 10, 15, 30, 60, and 105 meters. Longer columns provide more resolving power, but increase analysis time. Doubling the column length increases resolution by approximately 41% (note: the column length is under the square root function). However, under isothermal conditions, it will double analysis time. In temperature-programmed analyses, retention times are more dependent on temperature than column length, with a marginal increase (approx. 10-20%) in analysis time upon doubling the column length.

Conclusion

A basic understanding of the resolution equation allows analysts to make more effective column choices. Phase choice is influenced primarily by selectivity, which can be approximated by considering phase and analyte structures, as well as by referencing retention indices or existing applications. Column retention (capacity) and efficiency also affect separations and should influence decisions on column internal diameter, film thickness, and length. By considering these factors, analysts can simplify the column selection process and increase lab productivity by optimizing separations.

Selection of Capillary Column Summary

Selecting a capillary column for an analysis can be done by following these basic steps:

1) Choose the proper phase for the compounds being chromatographed

a. Review the application section of this catalog or www.restek.com/chromatograms for similar compound list.
b. Call Restek's experienced technical support team (800-356-1688, ext. 4) or e-mail us at:
   - support@restek.com (in the USA)
   - intltechsupp@restek.com (international)
   - or contact your Restek representative.

2) Select column ID, film thickness, and length

a. Base choice on:
   - Injection technique (split, splitless, cool on-column, etc.)
   - Detector type (is low flow required?)
   - Amount of analyte being injected onto column (sample capacity)

3) Set optimum parameters for your analysis

a. Optimize column flow (mL/min.)
b. Choose appropriate carrier gas (hydrogen, helium, or nitrogen)
c. Optimize oven temperature program

What Are the Operating Temperatures for My Column?

All Restek columns have published minimum and maximum operating temperatures that establish the working range for the stationary phase. Note that these ranges vary with the thickness of the coating.

Rtx®-VMS (fused silica)

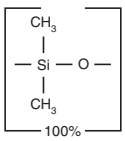
ID	df (µm)	temp. limits
0.25mm	1.40	-40 to 240/260°C
0.32mm	1.80	-40 to 240/260°C
0.45mm	2.55	-40 to 240/260°C
0.53mm	3.00	-40 to 240/260°C

The minimum operating temperature defines the lowest usable temperature before the stationary phase solidifies. Operating the column below the minimum temperature will not harm the phase, but poor peak shape and other chromatography problems may occur.

Many phases list 2 maximum operating temperatures. The first temperature is the maximum isothermal operating temperature. This is the temperature to which the columns are guaranteed to meet the minimum bleed specification (i.e., lowest bleed level). The second temperature is the maximum temperature-programmed operating temperature, the temperature to which the column can be heated for short periods of time (i.e., during a temperature-programmed analysis). If only one temperature is listed, it is both the isothermal and the maximum temperature.

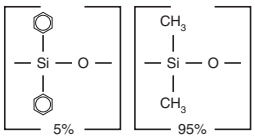
Structures, polarities, properties, and uses for Restek capillary column phases, in order of increasing polarity

Rxi®-1ms, Rxi®-1HT, Rtx®-1
100% dimethyl polysiloxane



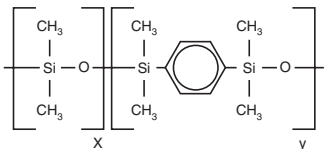
Polarity: nonpolar
Uses: solvents, petroleum products, pharmaceutical samples, waxes
[G1]

Rxi®-5ms, , Rxi®-5HT, Rtx®-5, Rtx®-5MS
5% diphenyl/95% dimethyl polysiloxane



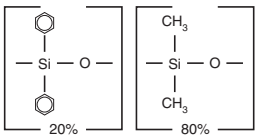
Polarity: slightly polar
Uses: flavors, environmental, aromatic hydrocarbons
[G27]

Rxi®-5Sil MS
5% phenyl
95% dimethyl arylene polysiloxane



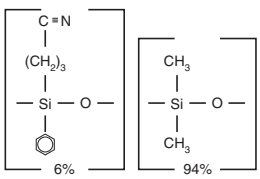
Polarity: slightly polar
Uses: flavors, environmental, pesticides, PCBs, aromatic hydrocarbons

Rtx®-20
20% diphenyl
80% dimethyl polysiloxane



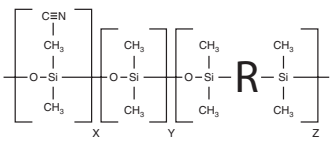
Polarity: slightly polar
Uses: volatile compounds, alcohols
[G32]

Rtx®-1301, Rtx®-624, Rtx®-G43
6% cyanopropylphenyl
94% dimethyl polysiloxane



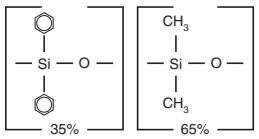
Polarity: slightly polar
Uses: volatile compounds, insecticides, residue solvents in pharmaceutical products
[G43]

Rxi®-624Sil MS
6% cyanopropylphenyl
94% dimethyl arylene polysiloxane



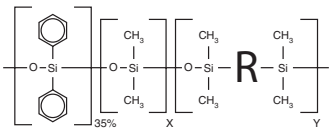
Polarity: intermediately polar
Uses: volatile compounds, insecticides, residue solvents in pharmaceutical products

Rtx®-35
35% diphenyl
65% dimethyl polysiloxane



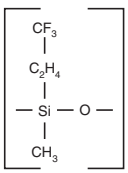
Polarity: intermediately polar
Uses: pesticides, Aroclor PCBs, amines, nitrogen-containing herbicides
[G42]

Rxi®-35Sil MS
35% phenyl
65% dimethyl arylene polysiloxane



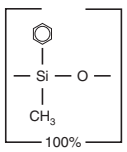
Polarity: intermediately polar
Uses: pesticides, Aroclor PCBs, amines, nitrogen-containing herbicides

Rtx®-200
trifluoropropylmethyl polysiloxane



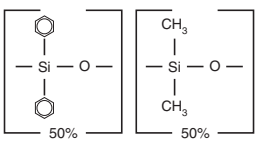
Polarity: selective for lone pair electrons
Uses: environmental, solvents, Freon® gases, drugs, ketones, alcohols
[G6]

Rtx®-50
50% phenyl
50% methyl polysiloxane



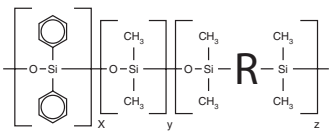
Polarity: intermediately polar
Uses: FAMEs, carbohydrates
[G3]

Rxi®-17
50% diphenyl
50% dimethyl polysiloxane



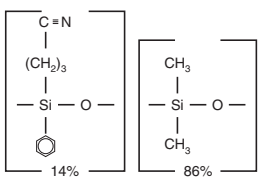
Polarity: intermediately polar
Uses: triglycerides, phthalate esters, steroids, phenols
[G3]

Rxi®-17Sil MS
50% phenyl
50% dimethyl arylene polysiloxane



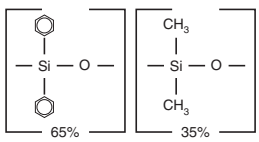
Polarity: intermediately polar
Uses: triglycerides, phthalate esters, steroids, phenols

Rtx®-1701
14% cyanopropylphenyl
86% dimethyl polysiloxane



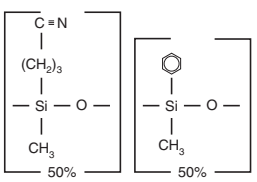
Polarity: intermediately polar
Uses: pesticides, Aroclor PCBs, alcohols, oxygenates
[G46]

Rtx®-65, Rtx®-65TG
65% diphenyl
35% dimethyl polysiloxane



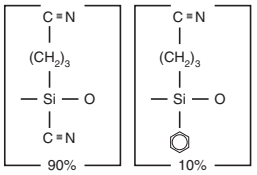
Polarity: intermediately polar
Uses: triglycerides, rosin acids, free fatty acids

Rtx®-225
50% cyanopropylmethyl
50% phenylmethyl polysiloxane



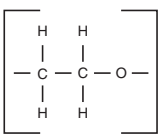
Polarity: polar
Uses: FAMEs, carbohydrates
[G7]

Rt®-2330
90% biscyanopropyl
10% cyanopropylphenyl polysiloxane



Polarity: polar
Uses: cis/trans FAMEs, dioxin isomers, rosin acids
[G48]

Stabilwax®, Rtx®-Wax
Carbowax® PEG



Polarity: polar
Uses: FAMEs, flavors, acids, amines, solvents, xylene isomers
[G16]

note

Structures, polarities, and properties also apply to metal MXT® stationary phases.

Columns by Phase

Restek	Phase Composition	USP Nomenclature*	Agilent	Varian-Chrompack	SGE	Phenomenex	Macherey-Nagel	Supelco	Alltech	Quadrex
Rtx-1 (p. 49)	100% dimethyl polysiloxane	G1, G2, G38	HP-1 / DB-1	CP Sil 5 CB	BP-1	ZB-1	Optima-1	SPB-1	AT-1	007-1
Rxi-1HT (p. 47)	100% dimethyl polysiloxane		DB-1HT	VF-1HT		ZB-1HT			EC-1, AT-1HT	
Rxi-1ms (p. 41)	100% dimethyl polysiloxane (low bleed)		HP-1/ HP-1ms DB-1/ DB-1ms Ultra-1	VF-1ms / CP-Sil 5 CB Low Bleed/MS	BP-1	ZB-1, ZB-1ms	Optima-1ms, Optima-1ms Accent	SPB-1, Equity-1	AT-1	007-1
Rtx-5 (p. 50)	5% diphenyl 95% dimethyl polysiloxane	G27, G36	HP-5/ DB-5	CP Sil 8 CB	BP-5	ZB-5	Optima-5	SPB-5	EC-5, AT-5	007-5
Rxi-5HT (p. 47)	5% diphenyl 95% dimethyl polysiloxane		DB-5HT	VF-5HT		ZB-5HT				
Rxi-5ms (p. 41)	5% diphenyl 95% dimethyl polysiloxane (low bleed)	G27, G36	HP-5/ HP-5ms DB-5, Ultra-2	CP-Sil 8 CB	BP-5	ZB-5, ZB-5ms	Optima-5, Optima-5ms	SPB-5, Equity-5	AT-5ms	007-5
Rxi-5Sil MS (p. 42, 87, 95, 97)	5% phenyl/95% dimethyl arylene polysiloxane		DB-5ms, DB-5ms UI	VF-5ms / CP-Sil 8 CB Low Bleed/MS	BPX-5	ZB-5ms	Optima-5ms Accent	SLB-5ms		007-5MS
Rxi-XLB (p. 44, 94)	Arylene/methyl modified polysiloxane		DB-XLB	VF-XMS		MR1	Optima-XLB			
Rtx-20 (p. 51)	20% diphenyl 80% dimethyl polysiloxane	G28, G32						SPB-20	EC-20, AT-20	007-20
Rtx-35 (p. 51)	35% diphenyl 65% dimethyl polysiloxane	G42	HP-35, DB-35		BPX-35, BPX-608	ZB-35		SPB-35, SPB-608	AT-35	007-35
Rxi-35Sil MS (p. 44)	35% phenyl/65% dimethyl arylene polysiloxane		DB-35ms	VF-35ms	BP-35	MR2	Optima-35ms			
Rtx-50 (p. 52)	50% phenyl 50% methyl polysiloxane	G3	HP-50		AT-50		Optima-17	SPB-50	AT-50	007-17
Rxi-17 (p. 44)	50% diphenyl 50% dimethyl polysiloxane		HP-50+, HP-17, DB-17, DB-608	CP-Sil 24 CB		ZB-50	Optima-17			
Rxi-17Sil MS (p. 45, 73, 98)	50% phenyl/50% dimethyl arylene polysiloxane		HP-17, DB-17, DB-17ms	CP-Sil 24 CB, VF-17ms	BPX-50	ZB-50	Optima-17ms			
Rtx-65 (p. 52)	65% diphenyl 35% dimethyl polysiloxane	G17								007-65HT
Rxi-624Sil MS (p. 46, 83, 103)	6% cyanopropyl phenyl/94% dimethyl arylene polysiloxane	G43	HP-624, DB-624	VF-624ms	BP-624	ZB-624	Optima-624			
Rtx-1301 (p. 55) Rtx-624 (p. 55)	6% cyanopropyl phenyl 94%dimethyl polysiloxane	G43	HP-1301, HP-624, DB-1301, DB-624	CP-1301, VF-1301ms, VF-624ms	BP-624	ZB-624	Optima-1301, Optima-624	SPB-1301	AT-624, AT-1301	007-1301
Rtx-1701 (p. 56)	14% cyanopropyl phenyl 86%dimethyl polysiloxane	G46	HP-1701, PAS-1701, DB-1701	CP Sil 19 CB, VF-1701ms	BP-10	ZB-1701, ZB-1701P	Optima-1701	SPB-1701	AT-1701	007-1701
Rtx-200 (p. 54)	trifluoropropyl methyl polysiloxane	G6	DB-210, DB-200	VF-200ms			Optima-210		AT-210	007-210
Rtx-200ms (p. 54)	trifluoropropyl methyl polysiloxane (low bleed)			VF-200ms						
Rtx-225 (p. 56)	50% cyanopropyl 50% phenylmethyl polysiloxane	G7, G19	HP-225, DB-225	CP Sil 43 CB	BP-225		Optima-225	SPB-225	AT-225	007-225
Rtx-440 (p. 53)	modified polysiloxane (unique phase)		unique column							
Rt-2330 (p. 57)	90% biscyanopropyl 10% cyanopropyl phenyl polysiloxane	G48			BPX-70			SP-2330, SP-2331, SP-2380	AT-Silar	
Rt-2560 (p. 57, 69)	bicyanopropyl polysiloxane		HP-88	CP Sil 88				SP-2560		
Rtx-Wax (p. 58)	polyethylene glycol	G14, G15, G16, G20, G39	HP-Wax, DB-Wax	CP Wax 52 CB	BP-20	ZB-Wax	Optima Wax		AT-Wax	
Stabilwax (p. 59, 84)	polyethylene glycol	G14, G15, G16, G20, G39	Innowax	CP Wax 52 CB, VF-WAX MS		ZB-WAX Plus		Supelcowax-10		
Restek PLOT Columns	**Phase Composition**	**USP Nomenclature**	**Agilent**	**Varian**	**SGE**	**Phenomenex**	**Macherey-Nagel**	**Supelco**	**Alltech**	**Quadrex**
Rt-Alumina BOND/Na_2SO_4 (p. 108) MXT-Alumina BOND/Na_2SO_4	Na_2SO_4 deactivation		GS-Alumina, HP PLOT S	CP-AL_2O_3 / Na_2SO_4				AluminaSulfate-PLOT	AT-Alumina	
Rt-Alumina BOND/KCl (p. 108, 76)	KCl deactivation		GS-Alumina/KCl, HP-PLOT Al_2O_3/KCl	CP-Al_2O_3/KCl				AluminaChloride -PLOT		
Rt-Alumina BOND/CFC (p. 108, 74)			unique column							
Rt-Msieve 5A (p. 109) MXT-Msieve 5A			GS-Msieve, HP PLOT Molsieve	CP-Molsieve 5A				Molsieve 5A	AT-Molsieve	PLT-5A
Rt-Q-BOND (p. 110) MXT-Q-BOND	100% divinylbenzene			CP-PoraPLOT Q, CP-PoraBond Q				Supel-Q-PLOT	AT-Q	
Rt-QS-BOND (p. 110)	porous divinyl benzene homopolymer		GS-Q							
Rt-S-BOND (p. 110) MXT-S-BOND	divinylbenzene 4-vinylpyridine			CP-PoraPLOT S						
Rt-U-BOND (p. 110)	divinylbenzene ethylene glycol/dimethylacrylate		HP-PLOT U	CP-PoraPLOT U, CP-PoraBond U						

*See page 139 for our USP Liquid P

Columns by Application/Industry

Restek	Applications	Agilent	Supelco	Macherey-Nagel	SGE	Varian-Chrompack	Phenomenex
Specially deactivated phases							
Rtx-Volatile Amine (p. 63)	Volatile amines					CP-VolAmine	
Rtx-5Amine (p. 64)	Amines					CP-Sil 8 CB	
Rtx-35Amine (p. 65)	Amines	unique column					
Stabilwax-DB (p. 66)	Amines	CAM	Carbowax Amine			CP WAX 51	
Stabilwax-DA (p. 67)	Free fatty acids	HP-FFAP, DB-FFAP	Nukol	Permabond FFAP, Optima FFAP	BP-21	VF-DA, CP WAX 58 CB	ZB-FFAP
Chiral Columns							
Rt-βDEXm, Rt-βDEXsm, Rt-βDEXse, Rt-βDEXsp, Rt-βDEXsa, Rt-βDEXcst, Rt-γDEXsa (p. 68)	Chiral compounds						
Foods, Flavors, & Fragrances							
Rt-2560 (p. 69)	*cis/trans* FAMEs	HP-88	SPB-2560				
FAMEWAX (p. 70)	Marine oils		Omegawax				
Rt-CW20M F&F (p. 71)	Flavors & fragrance	HP-20m, CarboWax 20			BP-20M		
Rtx-1 F&F (p. 71)	Flavors & fragrance						
Rtx-65 TG (p. 72)	Triglycerides	unique column					
Petroleum & Petrochemical							
Rt-Alumina BOND/CFC (p. 74)	Chlorinated fluorocarbons (CFCs)						
Rtx-DHA (p. 75)	Detailed hydrocarbon analysis	HP-PONA, DB-Petro	Petrocol DH		BP1-PONA	CP Sil PONA CB	
Rtx-2887 (p. 77)	Hydrocarbons - ASTM 2887	DB-2887	Petrocol 2887, Petrocol EX2887				
MXT-2887 (p. 77)	Hydrocarbons - ASTM 2887						
D3606 (p. 128)	Ethanol - ASTM 3606	unique column					
Rt-TCEP (p. 80)			TCEP			CP-TCEP	
MXT-1HT SimDist (p. 77)	Simulated distillation	DBHT-SimDist				CP-SIMDIST	ZB-1T SimDist
MXT-1 SimDist (p. 79)	Simulated distillation	DBHT-SMD				CP-SIMDIST	Ultimetal
MXT-500 SimDist (p. 79)	Simulated distillation	unique column					
Rtx-Biodiesel TG (p. 81) MXT-Biodiesel TG (p. 81)	Triglycerides in biodiesel	unique column					
Clinical/Forensic - Blood Alcohol Testing							
Rtx-BAC1 (p. 82)	Blood alcohol testing	DB-ALC1					ZB-BAC1
Rtx-BAC2 (p. 82)	Blood alcohol testing	DB-ALC2					ZB-BAC2
Pharmaceutical							
Rtx-G27 w/IntegraGuard (p. 86)	Organic volatile impurities (OVI) - USP 467						
Rtx-G43 w/IntegraGuard (p. 86)	Organic volatile impurities (OVI) - USP 467		OVI-G43				
Rxi-624Sil MS (p. 83)	Organic volatile impurities (OVI) - USP 467	HP-624, DB-624			BP-624	VF-624	ZB-624
Rtx-5 (G27) (p. 85)	Organic volatile impurities (OVI) - USP 467	HP-5/ DB-5	SPB-5, Equity-5	Optima-1301, Optima-624	BP-5	CP-Sil 8, CP Sil 8 CB	ZB-5
Stabilwax (G16) (p. 84)	Organic volatile impurities (OVI) - USP 467	Innowax	Supelcowax-10		BP-624	CP Wax 52 CB	ZB-WaxPlus
Environmental							
Rxi-5Sil MS (p. 87, 95, 97)	Semivolatiles - EPA Methods 8270, 625, 525	DB-5ms	SLB-5	Optima-5ms		VF-5ms	ZB-5ms
Rtx-VMS (p. 100)	Volatiles - EPA Methods 8260, 624, 524	unique column					
Rxi-624Sil MS (p. 103)	Volatiles - EPA Method 624	DB-624				VF-624ms	ZB-624
Rtx-502.2 (p. 102)	Volatiles - EPA Methods 8010, 8020, 502.2, 601, 602	DB-502.2	VOCOL				
Rtx-Volatiles (p. 102)	Volatiles - EPA Methods 8010, 8020, 502.2, 601, 602		VOCOL				
Rtx-VRX (p. 101)	Volatiles - EPA Methods 8010, 8020, 502.2, 601, 602	DB-VRX					
Rtx-CLPesticides (p. 88)	Organochlorine pesticides - EPA Methods 8081, 8082, 608, 505, 508	unique column					
Rtx-CLPesticides2 (p. 88)	Organochlorine pesticides - EPA Methods 8081, 8082, 608, 505, 508	unique column					
Stx-CLPesticides (p. 90)	Organochlorine pesticides - EPA Methods 8081, 8082, 608, 505, 508	unique column					
Stx-CLPesticides2 (p. 90)	Organochlorine pesticides - EPA Methods 8081, 8082, 608, 505, 508	unique column					
Rtx-1614 (p. 92)	Brominated flame retardants	unique column					
Rtx-PCB (p. 93)	Polychlorinated biphenyl - EPA Methods 8082, 608, PCB congeners	unique column					
Rxi-XLB (p. 94)	Polychlorinated biphenyl - EPA Methods 8082, 608, PCB congeners	DB-XLB				VF-XMS	MR1
Rtx-OPPesticides (p. 91)	Organophosphorus pesticides - EPA Method 8141	unique column					
Rtx-OPPesticides2 (p. 91)	Organophosphorus pesticides - EPA Method 8141	unique column					
Rtx-Dioxin2 (p. 96)	Dioxin & Furans - EPA Methods	unique column					
Rxi-17Sil MS (p. 98)	Polycyclic aromatic hydrocarbons	HP-17, DB-17, DB-17ms		Optima-17ms	BPX-50	CP-Sil 24 CB, VF-17ms	ZB-50
Rtx-Mineral Oil (p. 99)	DIN ENISO 9377-2					Select Mineral Oil	

GC Column Installation Checklist

The Restek Innovations and Technical Services specialists have found this to be a reliable sequence for avoiding problems when installing a capillary GC column.

Instrument Preparation & Column Installation

1. Cool all heated zones.
2. Visually inspect indicating oxygen and moisture traps. Replace saturated traps.
3. Examine the inlet and the detector. Clean or replace all dirty or corroded parts.
4. Replace the inlet liner and septum, and the injector seals (O-rings, inlet seals, ferrules, etc.).
5. Mount the column in the oven with a support that protects it from scratches. Center the column in the oven. This ensures uniform heat exposure generating consistent retention times.
   - Restek has two types of cages for fused silica columns, an 11-pin cage and the original cage that uses high temperature string to hold the column in place. **If you have the cage with high temperature string, do not remove the string that holds the column in the cage!**
6. Uncoil the ends to make sure the ends are long enough to reach the injector and detector. Cut a few centimeters from each end of the column.
   - To cut a fused silica column, use the smooth edge of a ceramic scoring wafer (cat.# 20116).
7. While pointing the inlet end of the column downward (to prevent shards from falling into the column), slide the nut and appropriate size ferrule onto the inlet end of the column. Cut an additional 2 cm from the end of the column to remove any material scraped from the ferrule onto the edge of the column.
8. Install the column the appropriate distance in the injector, as indicated in your instrument manual.
9. Set the carrier gas to the flow rate or inlet pressure recommended for the column or to your method flow rate/pressure. Confirm presence of column flow by immersing the column outlet in a vial of solvent.
10. Flush the column at ambient temperature with carrier gas: at least 5 minutes for a 25-30 m column and 10 minutes for a 50-60 m column.
11. Set the injector temperatures. Do not exceed the column's maximum operating temperature (listed on the column tag). Check inlet for leaks.
12. Install the column into the detector as described in the instrument manual. Set the detector gases and temperatures to proper settings.
13. Check the detector connections for leaks, using a Restek Electronic Leak Detector (cat.# 22839).
14. Verify the carrier gas flow is at the rate you intend to use for your analysis. (Use the Restek ProFlow 6000 flowmeter, cat.# 22656, to ensure accurate flow measurement.) Set the split vent, septum purge, and any other applicable gas rates as appropriate.
15. Inject an unretained compound, to verify the column is installed correctly and to determine the dead volume time for checking column flow. The type of detector and column type will determine which compound to inject. A symmetric peak indicates the column is installed correctly. Adjust the carrier gas flow as necessary.
16. Condition the column 20 °C above the final analysis temperature of your method. Do not exceed the column's maximum operating temperature. For most applications, 1 hour of conditioning is sufficient. For sensitive detectors or low level analysis, longer conditioning times or conditioning the column at the maximum temperature may be beneficial. Extended time at high temperatures will not adversely affect column performance as long as precautions are taken to make sure the carrier gas is clean and is filtered for oxygen and water.
17. To check instrument performance, analyze a column test mix for a new method, or a known standard to confirm proper column and system performance.
18. Your GC system is now ready to be calibrated and acquire samples.

Scott Grossman, Applications Chemist
Checking for leaks, using a thermal conductivity leak detector (step 13).

Note 1: For some types of sensitive detection systems, like MS, PID and PDD, it is recommended to condition the column as listed in Step 16 without making the connection to the detector. In this case, plug off the detector during conditioning. After conditioning, continue with Step 12.

Note 2: Also, when you intend to condition thick-film coated columns (film thickness $> 1\,\mu m$) at temperatures near the maximum operation temperature, it is recommended to do the initial 1-2 hrs conditioning without a connection to the detector and repeat procedure above, starting at Step 12.

Standby Conditions

Short-Term: leave the column in the GC with carrier gas flowing at an oven temperature of 100-150°C.

Long-Term: remove the column from the GC and seal the ends by gently and carefully pushing each end into the curved edge of a septum. Store the column in the original box away from strong lighting.

If you have any questions or problems installing a Restek column, visit **www.restek.com/gcinstall** or call Technical Service at 800-356-1688 or 814-353-1300, ext. 4, or contact your Restek representative.

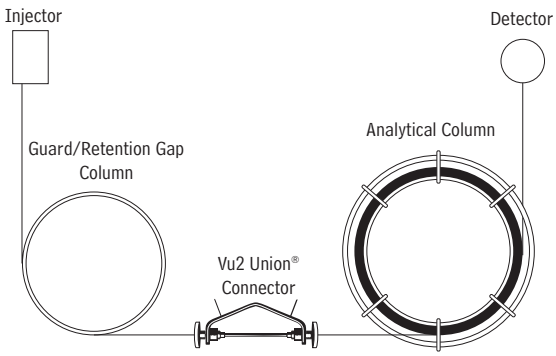
Guard Columns and Retention Gaps

Guard columns and retention gaps are widely used in gas chromatography. The concept of the guard column is to trap nonvolatile material at the head of the column, not allowing the material to reach the analytical column. The concept of the retention gap is to help focus the compounds transferred from the inlet to a small band at the head of the analytical column in order to reduce chromatographic peak broadening. Both concepts (trapping nonvolatile material and refocusing the target analytes) may take place when a piece of deactivated tubing is connected to an analytical column as in Figure 1.

did you know?

We test our guard columns/ transfer lines with a comprehensive test mix to ensure high inertness.

Figure 1 A guard/retention gap column connected to an analytical column



please note

For superior inertness, try our Siltek® guard columns!
See page 33 for details.

Having trouble making a leak-free connection? Try our "built in" Integra-Guard® columns!
See page 35 for details.

Analyte Focusing

There are two injection techniques where the retention gap is used to help focus target analytes at the beginning of the analytical column, cool on-column injection and splitless injection.

For cool on-column injection, the purpose of a retention gap is to help focus the sample components when introducing a liquid sample directly into the retention gap. The cool on-column injection is performed by inserting the syringe needle into the retention gap (this can be accomplished with a 0.53mm ID retention gap and a 26s gauge syringe) and transferring the liquid sample directly into the retention gap. The injection is made with the injector and column oven set below the boiling point of the solvent. As the solvent is evaporated, the volatile target analytes migrate in the solvent towards the analytical column, and the heavier analytes will be distributed over the retention gap. As the oven temperature increases, the target analytes vaporize and move unretained down the retention gap column until the compounds reach the liquid stationary phase of the analytical column. At this juncture, the target analytes are trapped/focused by the liquid phase forming a narrow injection band.

The retention gap may also be useful in hot vaporization injections when the transfer of the compounds from the inlet to the column does not form a focused band. Typical applications include water injections or injections using small ID columns, where split or tailing peaks would indicate an unfocused band. In these applications, the target analytes are trapped in a nonuniform or longitudinally diffuse band at the head of the retention gap (Figure 2a). As the oven temperature is increased, the solvent and target compounds are vaporized and move unretained through the retention gap (Figure 2b). When the target compounds come in contact with the stationary phase, they are refocused in a narrow band (Figure 2c), improving the chromatography.

Figure 2 Retention gaps are used to focus components in a tight band at the beginning of the analytical column.

a) Sample introduction: a liquid film of solvent and sample is deposited in the first length of capillary.

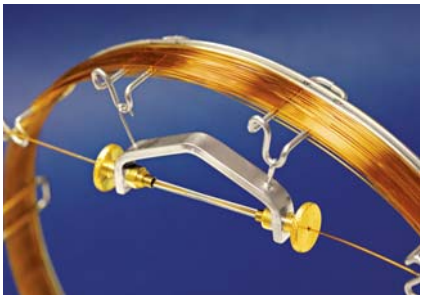
b) As oven temperature increases, the solvent evaporates and the target compounds elute unretained through the retention gap until they contact the analytical column.

c) When target compounds come in contact with the stationary phase, they are refocused on the analytical column, resulting in a narrow initial band width.

it's a **fact**

To eliminate connections that may leak and to ensure longer column lifetime, use our unique Integra-Guard® Column. See **page 35**.

Connectors for Fused Silica Columns



Vu2 Union® Connector
(See page 289.)

Press-Tight® Connectors
(See pages 287-288.)

MXT® Union Connector Kit
for Fused Silica
(See page 292.)

Protecting the Analytical Column

The concept of a guard column is to protect the analytical column from becoming contaminated with nonvolatile compounds. The guard column is used to retain nonvolatile material, usually in the first 10-20 cm, not allowing this material to elute onto the liquid phase of the analytical column. As the oven temperature increases, the more volatile target compounds vaporize, elute down the guard column, and refocus at the head of the analytical column without interference from the nonvolatile material left behind.

Using guard columns is advantageous, because they prevent contamination that can cause active sites as well as change the conditions of the focusing zone of the analytical column. Another advantage is that the resolution of closely eluting compounds will not be affected when the column is trimmed during maintenance, because the guard column does not contribute to the resolving power of the analytical column. Using guard columns is a simple, cost-effective way to extend analytical column lifetime.

In summary, the retention gap and guard column are essentially the same products, but are used for different purposes. The deactivated tubing helps focus target analytes at the head of the analytical column for on-column and splitless injections, and also prevents nonvolatile material from contaminating the head of the analytical column.

What type of guard column should be used?

When using a guard column, it is important to match the polarity of the solvent and the polarity of the surface deactivation. Rxi® Guard tubing is good for a wide variety of applications and allows most common solvents (methylene chloride, hexane, isooctane, toluene) to easily wet and create a uniform film on the tubing surface.

If more polar solvents such as methanol or water are used, a polar-deactivated guard column is recommended to allow the solvent to wet the tubing surface. However, polar-deactivated guard columns are not resistant to harsh "water vaporization", which occurs when water in the liquid state is injected into the tubing and rapidly vaporizes (such as in steam cleaning). Hydroguard® deactivation is an alternative for direct aqueous injections. However, a Hydroguard®-deactivated guard column will not allow polar solvents to wet the tubing surface, and may cause solvent beading if the oven temperature is 20°C below the solvent boiling point. Siltek® deactivation creates a highly inert surface for very active compounds such as chlorinated and organophosphorus pesticides. Base-deactivated guard columns reduce adsorption and tailing for amines and other basic compounds.

How is a guard column connected to the analytical column?

To connect the guard column to the analytical column, Vu2-Union®, Press-Tight®, and other connectors are available. MXT® unions, typically used for connecting metal columns together, are now available for fused silica columns. See pages 287 to 292 for information about these connectors.

Fused Silica Guard/Retention Gap Columns

Rxi® Guard/Retention Gap Columns (fused silica)

- Extend column lifetime.
- Excellent inertness—obtain lower detection limits for active compounds.
- Sharper chromatographic peaks by utilizing retention gap technology.
- Maximum temperature: 360 °C.

Nominal ID	Nominal OD	5-Meter	5-Meter/6-pk.	10-Meter	10-Meter/6-pk.
0.25mm	0.37 ± 0.04mm	10029	10029-600	10059	10059-600
0.32mm	0.45 ± 0.04mm	10039	10039-600	10064	10064-600
0.53mm	0.69 ± 0.05mm	10054	10054-600	10073	10073-600

Intermediate-Polarity Deactivated Guard/Retention Gap Columns/Transfer Lines (fused silica)

- Tested with a comprehensive test mix, to ensure high inertness.
- Useful for a wide range of applications.
- Use with most common solvents.
- Maximum temperature: 325 °C

Nominal ID	Nominal OD	1-Meter	5-Meter	5-Meter/6-pk.
0.025mm	0.363 ± 0.012mm	10097		
0.05mm	0.363 ± 0.012mm	10098	10040	10040-600
0.075mm	0.363 ± 0.012mm	10099		
0.10mm	0.363 ± 0.012mm	10100	10041	
0.15mm	0.363 ± 0.012mm	10101	10042	
0.18mm	0.37 ± 0.04mm	10102	10046	
0.25mm	0.37 ± 0.04mm		10043	10043-600
0.28mm	0.37 ± 0.04mm		10003	10003-600
0.32mm	0.45 ± 0.04mm		10044	10044-600
0.45mm	0.69 ± 0.04mm		10005	10005-600
0.53mm	0.69 ± 0.05mm		10045	10045-600

Nominal ID	Nominal OD	10-Meter	10-Meter/6-pk.	30-Meter*	60-Meter*†
0.25mm	0.37 ± 0.04mm	10049	10049-600	10012	10013
0.32mm	0.45 ± 0.04mm	10048	10048-600	10022	10023
0.53mm	0.69 ± 0.05mm	10047		10032	10033

Siltek®-Deactivated Guard/Retention Gap Columns/Transfer Lines (fused silica)

- Tested with a comprehensive test mix, to ensure high inertness.
- Revolutionary deactivation process for superior inertness.
- Analyze active samples accurately; ideal for chlorinated pesticide analysis (reduces endrin breakdown to less than 1%).
- Maximum temperature: 380 °C.

Nominal ID	Nominal OD	5-Meter	10-Meter
0.25mm	0.37 ± 0.04mm	10026	10036
0.32mm	0.45 ± 0.04mm	10027	10037

Polar-Deactivated Guard/Retention Gap Columns (fused silica)

- Tested with a comprehensive test mix, to ensure high inertness.
- Polyethylene glycol deactivation layer provides optimum wettability for polar compounds.
- Minimize peak splitting when using polar solvents such as methanol or water.
- Compatible with Stabilwax®, Rtx®-225, and Rt®-2330 capillary columns.
- Maximum temperature: 280 °C.

Nominal ID	Nominal OD	5-Meter	10-Meter	30-Meter*	60-Meter*†
0.25mm	0.37 ± 0.04mm	10065	10068	10014	10015
0.32mm	0.45 ± 0.04mm	10066	10069	10024	10025
0.53mm	0.69 ± 0.05mm	10067	10070	10034	10035

*30- and 60-meter lengths are banded in 5-meter sections.
†Recommendation: Cut 60m guard columns into shorter lengths. Using full length may cause peak distortion.

it's a **fact**

To eliminate connections, use an Integra-Guard® Column. See **page 35**.

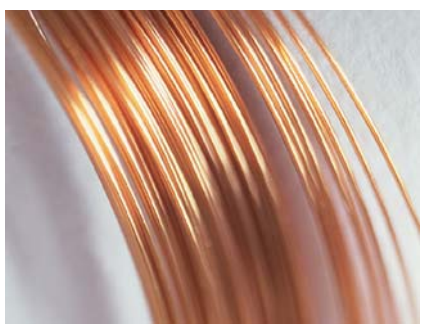
also **available**

Metal MXT® Guard/Retention Gap Columns
Rugged, flexible, Siltek® treated stainless steel tubing; inertness comparable to fused silica tubing. See **page 114**.

it's a **fact**

Use guard columns to:

- Reduce effects of dirty samples on column performance.
- Reduce downtime and maintenance.



did you **know**?

Siltek®-deactived guard columns minimize breakdown and improve recovery of analytes!

best **choice**

Siltek® treated tubing (cat.# 22505, **page 320**) is recommended for purge and trap transfer lines.

Base-Deactivated Guard/Retention Gap Columns (fused silica)

- Tested with a basic amine test mix.
- Excellent inertness for basic compounds.
- Recommended for use with Rtx®-5 Amine, Rtx®-35 Amine, Rtx®-Volatile Amine, and Stabilwax®-DB capillary columns.
- Batch test chromatogram included.
- Maximum temperature: 315 °C.

Chemists using guard columns in the analyses of basic compounds frequently observe peak tailing and low recovery. This happens because conventionally deactivated tubing surfaces can be adsorptive to basic compounds. Restek offers base-deactivated guard columns, as well as base-deactivated inlet liners, for completely inert sample pathways.

Nominal ID	Nominal OD	5-Meter	5-Meter/6-pk.
0.25mm	0.37 ± 0.04mm	10000	10000-600
0.32mm	0.45 ± 0.04mm	10001	10001-600
0.53mm	0.69 ± 0.05mm	10002	10002-600

also **available**

Base-deactivated inlet liners
See page 213.

did you **know**?

We test our guard columns/transfer lines with a comprehensive test mix to ensure high inertness.

Hydroguard® Water-Resistant Guard/Retention Gap Columns/Transfer Lines (fused silica)

- Extend analytical column lifetime by preventing degradation from harsh "steam-cleaning" water injections.
- Tested with a comprehensive test mix, to ensure high inertness.
- Maximum temperature: 325 °C.

When transfer lines from purge & trap systems, air monitoring equipment, or other instruments carry condensed water vapor, deactivated column tubing quickly becomes active because of the creation of free silanol groups. These silanol groups adsorb active oxygenated compounds, such as alcohols and diols.

Restek chemists have addressed this concern and found a solution—the Hydroguard® deactivation process. A unique deactivation chemistry creates a high-density surface that is not readily attacked by aggressive hydrolysis. The high-density surface coverage of the Hydroguard® deactivation layer effectively prevents water vapor from reaching the fused silica surface beneath. Use Hydroguard® tubing for connecting GCs to:

- Headspace analyzers.
- Air analysis equipment and concentrator units.

also **available**

Metal MXT® Guard Columns
Rugged, flexible, Siltek® treated stainless steel tubing; inertness comparable to fused silica tubing. See **page 114**.

Nominal ID	Nominal OD	5-Meter	5-Meter/6-pk.	10-Meter	30-Meter*	60-Meter*†
0.05mm	0.363 ± 0.012mm	10075				
0.10mm	0.363 ± 0.012mm	10076				
0.15mm	0.363 ± 0.012mm	10077				
0.18mm	0.37 ± 0.04mm	10078				
0.25mm	0.37 ± 0.04mm	10079	10079-600	10082	10085	10088
0.32mm	0.45 ± 0.04mm	10080	10080-600	10083	10086	10089
0.53mm	0.69 ± 0.05mm	10081	10081-600	10084	10087	10090

*30- and 60-meter lengths are banded in 5-meter sections.
†Recommendation: Cut 60m guard columns into shorter lengths. Using full length may cause peak distortion.

Fused Silica Guard/Retention Gap Columns

Innovative Integra-Guard® Columns

- No leaks for a more robust method.
- No column connections for easier, faster maintenance.
- No peak distortions due to connector dead volume and thermal capacity.

For analysts who find it inconvenient to make a leak-free connection between the guard column and the analytical column, we offer Integra-Guard® columns. These innovative columns incorporate both guard column and analytical column in a continuous length of tubing, eliminating the connection and all connection-associated problems! The guard column section is marked separately from the analytical column, using high-temperature string.

A wide variety of our Integra-Guard® capillary columns are listed below. The Integra-Guard® column is so economical that we challenge you to compare our price against that of a conventional connection, even if you assemble it yourself. If you are currently using a guard column, or are considering using one, call today and ask about Integra-Guard® columns.

Description	qty.	cat.#	price
Rtx-1			
30m, 0.25mm ID, 0.25µm Rtx-1 w/5m Integra-Guard Column	ea.	10123-124	
30m, 0.53mm ID, 1.00µm Rtx-1 w/5m Integra-Guard Column	ea.	10155-126	
30m, 0.53mm ID, 5.00µm Rtx-1 w/5m Integra-Guard Column	ea.	10179-126	
Rtx-5			
30m, 0.25mm ID, 0.25µm Rtx-5 w/5m Integra-Guard Column	ea.	10223-124	
30m, 0.25mm ID, 0.25µm Rtx-5 w/10m Integra-Guard Column	ea.	10223-127	
30m, 0.25mm ID, 1.00µm Rtx-5 w/5m Integra-Guard Column	ea.	10253-124	
30m, 0.32mm ID, 0.25µm Rtx-5 w/5m Integra-Guard Column	ea.	10224-125	
30m, 0.32mm ID, 1.00µm Rtx-5 w/5m Integra-Guard Column	ea.	10254-125	
30m, 0.53mm ID, 5.00µm Rtx-5 w/5m Integra-Guard Column	ea.	10279-126	
60m, 0.32mm ID, 0.25µm Rtx-5 w/5m Integra-Guard Column	ea.	10227-125	
Rtx-5MS			
15m, 0.25mm ID, 0.25µm Rtx-5MS w/5m Integra-Guard Column	ea.	12620-124	
15m, 0.25mm ID, 0.50µm Rtx-5MS w/10m Integra-Guard Column	ea.	12635-127	
30m, 0.25mm ID, 0.10µm Rtx-5MS w/5m Integra-Guard Column	ea.	12608-124	
30m, 0.25mm ID, 0.25µm Rtx-5MS w/5m Integra-Guard Column	ea.	12623-124	
30m, 0.25mm ID, 0.25µm Rtx-5MS w/10m Integra-Guard Column	ea.	12623-127	
30m, 0.25mm ID, 0.50µm Rtx-5MS w/5m Integra-Guard Column	ea.	12638-124	
30m, 0.25mm ID, 0.50µm Rtx-5MS w/10m Integra-Guard Column	ea.	12638-127	
30m, 0.32mm ID, 0.25µm Rtx-5MS w/5m Integra-Guard Column	ea.	12624-125	
30m, 0.32mm ID, 1.00µm Rtx-5MS w/5m Integra-Guard Column	ea.	12654-125	
Rxi-5Sil MS			
15m, 0.25mm ID, 0.25µm Rxi-5Sil MS w/10m Integra-Guard Column	ea.	13620-127	
30m, 0.25mm ID, 0.25µm Rxi-5Sil MS w/5m Integra-Guard Column	ea.	13623-124	
30m, 0.25mm ID, 0.25µm Rxi-5Sil MS w/10m Integra-Guard Column	ea.	13623-127	
15m, 0.25mm ID, 0.50µm Rxi-5Sil MS w/5m Integra-Guard Column	ea.	13635-124	
30m, 0.25mm ID, 0.50µm Rxi-5Sil MS w/5m Integra-Guard Column	ea.	13638-124	
30m, 0.25mm ID, 0.50µm Rxi-5Sil MS w/10m Integra-Guard Column	ea.	13638-127	
30m, 0.32mm ID, 0.50µm Rxi-5Sil MS w/5m Integra-Guard Column	ea.	13639-125	
30m, 0.32mm ID, 1.00µm Rxi-5Sil MS w/5m Integra-Guard Column	ea.	13654-125	
Rtx-624			
30m, 0.25mm ID, 1.40µm Rtx-624 w/5m Integra-Guard Column	ea.	10968-124	
30m, 0.32mm ID, 1.80µm Rtx-624 w/5m Integra-Guard Column	ea.	10970-125	
30m, 0.53mm ID, 3.00µm Rtx-624 w/5m Integra-Guard Column	ea.	10971-126	
Rtx-1301			
30m, 0.53mm ID, 3.00µm Rtx-1301 w/5m Integra-Guard Column	ea.	16085-126	
Rtx-1701			
30m, 0.25mm ID, 0.25µm Rtx-1701 w/5m Integra-Guard Column	ea.	12023-124	
Stabilwax			
30m, 0.25mm ID, 0.25µm Stabilwax w/5m Integra-Guard Column	ea.	10623-124	
30m, 0.32mm ID, 1.00µm Stabilwax w/5m Integra-Guard Column	ea.	10654-125	
30m, 0.53mm ID, 1.00µm Stabilwax w/5m Integra-Guard Column	ea.	10655-126	

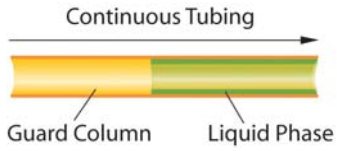
restek **innovation**!

Integra-Guard® Columns: guard columns WITHOUT connections—protecting your analytical column has never been this easy!

similar **products**

DuraGuard, EZ-Guard, Guardian

Integra-Guard® built-in guard column



String indicates where the analytical column begins.

Tag indicates guard column end.

Integra-Guard® columns are available for all phases listed, for columns with 0.25, 0.32 or 0.53mm ID. If you don't see what you need here, contact us.

Rxi® GCColumns

3-IN-1 TECHNOLOGY

Highest Inertness • Lowest Bleed • Exceptional Reproducibility

Lower Detection Limits with Ground-Breaking Column Technology

Rxi® technology unifies outstanding inertness, low bleed, and high reproducibility into a single high performance column line. Take variation out of the equation and get the most consistent results for trace level analysis with Rxi® columns.

Visit us at **www.restek.com/rxi**

phases available

- Rxi®-1ms (p. 41)
- Rxi®-1HT (p. 47)
- Rxi®-5ms (p. 41)
- Rxi®-5Sil MS (p. 42)
- Rxi®-5HT (p. 47)
- Rxi®-XLB (p. 44)
- Rxi®-624Sil MS (p. 46)
- Rxi®-35Sil MS (p. 44)
- Rxi®-17 (p. 44)
- Rxi®-17Sil MS (p. 45)
- Rxi® guard/retention gap columns (p. 40)

Make the Switch to Rxi® columns!

Experience what Rxi® did for many others

- Lower detection limits
- Better peak shape
- Accurate results

Rxi 3-IN-1 TECHNOLOGY

Highest Inertness • Lowest Bleed • Exceptional Reproducibility

Lower Detection Limits with Ground-Breaking Column Technology

Rxi® columns deliver more accurate, reliable trace-level results than any other fused silica column on the market. To ensure the highest level of performance, all Rxi® capillary columns are manufactured and individually tested to meet stringent requirements for exceptional inertness, low bleed, and unsurpassed column-to-column reproducibility.

Highest Inertness

Inertness is one of the most difficult attributes to achieve in an analytical column, but it is one of the most critical as it improves peak shape, response, and retention time stability. Rxi® technology produces the most inert columns available, providing:

- Increased signal-to-noise ratios to improve low-level detection.
- Reproducible retention times for positive identifications.
- Improved response for polar, acidic, and basic compounds.

Increased Signal and Reproducible Retention Times

When capillaries are not sufficiently deactivated, peaks become asymmetric, resulting in reduced signal and unpredictable retention times. As column activity increases, peak tailing becomes more pronounced, reducing peak height and causing retention time to drift (Figure 1). In practice, this means that sensitivity is lost and trace-level analytes cannot be reliably determined. In addition, even compounds at higher concentrations may be misidentified, due to retention time shifting.

A more significant problem for sample analysis is that retention time can vary with analyte concentration if the column is not highly inert. Since the amount of target analyte in samples is unknown, retention times on a poorly deactivated column can easily vary enough to move compounds outside of the retention time window (Figure 2). This can result in inaccurate identifications and the need for manual integration and additional review or analysis before results can be reported. Using inert Rxi® columns ensures that compounds elute with good signal-to-noise ratios at expected retention times, regardless of analyte concentration.

Figure 1 As column activity increases, signal decreases and retention time shifts.

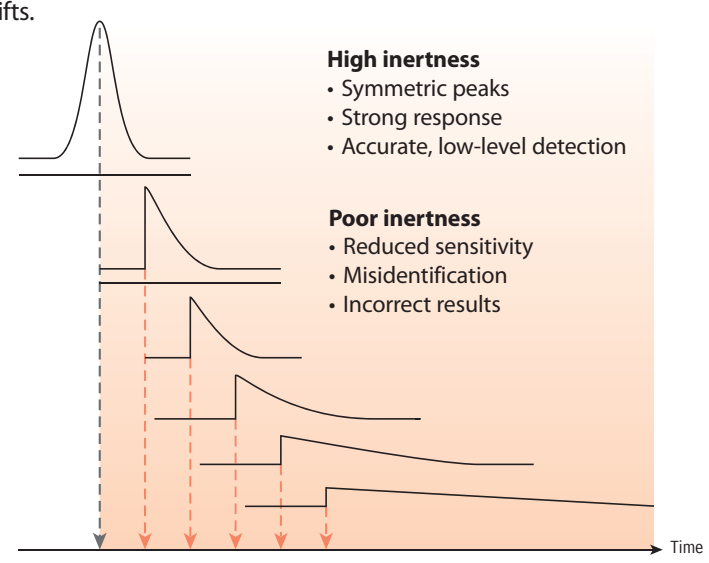
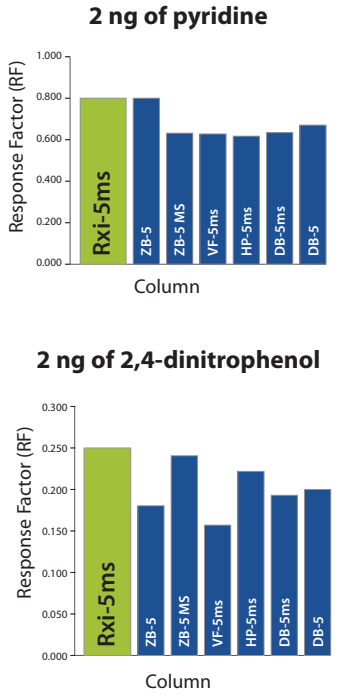
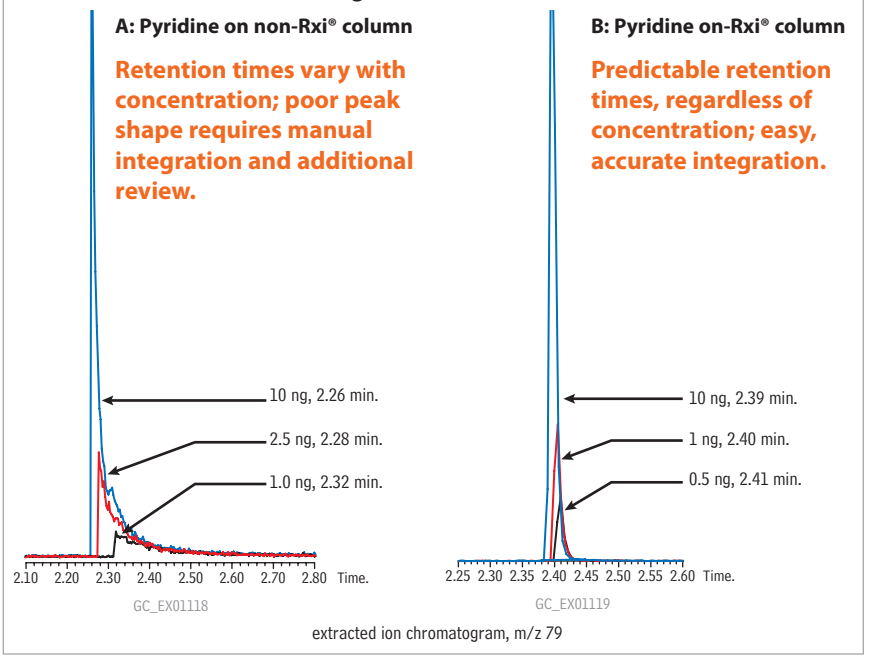


Figure 3 An Rxi®-5ms column gives the highest response for both basic and acidic compounds.



Comparison of 30m x 0.25mm ID, 0.25µm columns.

Figure 2 Analyte levels in samples are unknown; only inert columns, which prevent concentration from affecting retention time, can assure accurate results.



extracted ion chromatogram, m/z 79

Improved Response for Difficult Compounds

Another reason column inertness is important for trace-level analysis is that many acidic, basic, and polar compounds will tail significantly and become difficult to analyze if the column contains active sites. The remarkable neutrality of Rxi® columns solves this problem and allows a wide range of compounds to be analyzed with high sensitivity, often on a single column. All Rxi® columns are exceptionally inert as demonstrated in Figure 3 by high response factors for both pyridine (basic) and 2,4-dinitrophenol (acidic). Rxi® columns reliably produce highly symmetric peaks and improved responses for difficult compounds, indicating greater inertness than columns produced by other manufacturers (Figure 4).

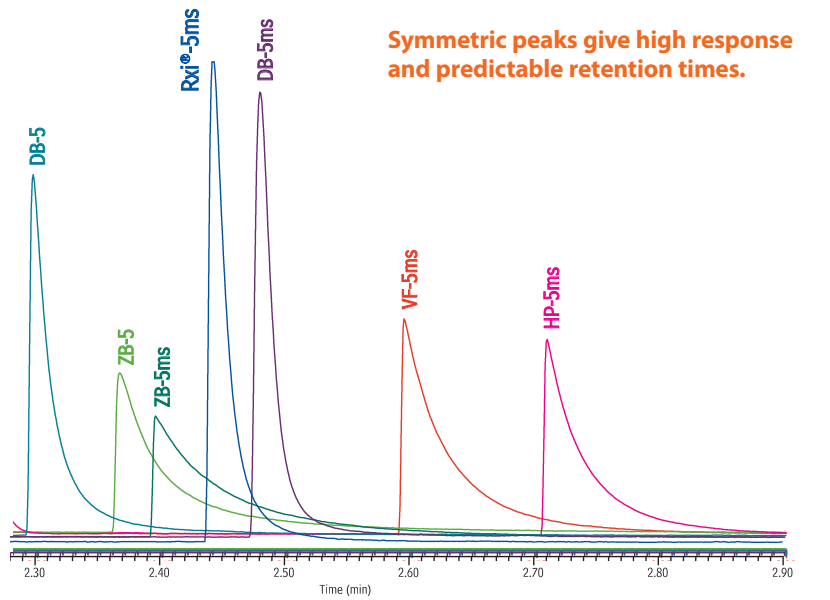
Innovation & Service

"When my research group needed a GC column for a chiral separation, Restek was the only company that offered to provide us with test columns to evaluate. The willingness of Restek to work with us to find a solution to our separation problem is exceptional."

Joe Dinnocenzo,
Professor of Chemistry
Director, Center for
Photoinduced Charge Transfer
University of Rochester

How can we help you today?
Contact support@restek.com or your local Restek representative for helpful, knowledgeable technical support.

Figure 4 Rxi® columns are the most inert columns on the market providing the most symmetric peak shape for basic compounds, such as pyridine.



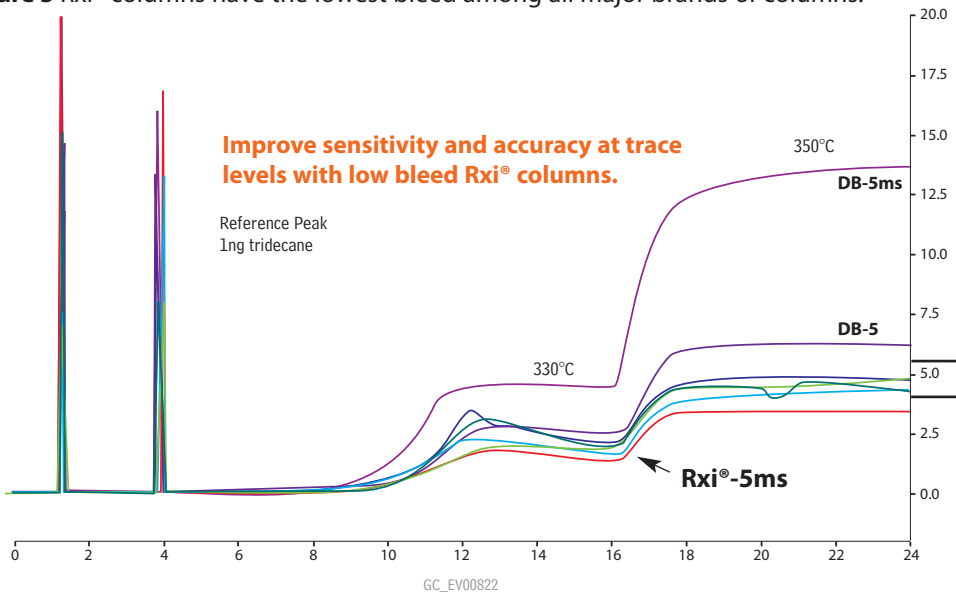
Comparison of 30m x 0.25mm ID, 0.25µm 5% diphenyl columns, 2ng pyridine on-column, helium carrier gas, Oven temp.: 50°C (3 min.) to 180°C @ 35°C/min. (5 min.), Det.: FID @ 250°C

Lowest Bleed

Rxi® columns are more stable at high temperatures than any other manufacturer's column (Figure 5), resulting in higher system sensitivity. This low-bleed characteristic is the result of superior stabilization achieved by optimizing polymer cross-linking and surface deactivation technologies. Benefits of using ultra-low bleed Rxi® columns include:

- Increased sensitivity, for lower detection limits and better matches to mass spectral libraries.
- Faster system stabilization.
- Reduced detector contamination and less downtime for maintenance.

Figure 5 Rxi® columns have the lowest bleed among all major brands of columns.

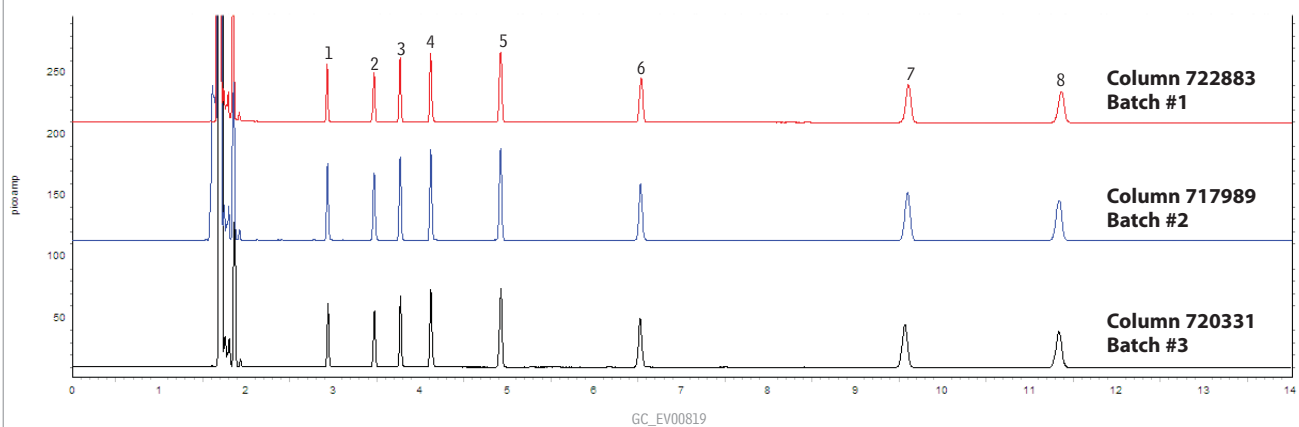


Comparison of 30m x 0.25mm ID, 0.25µm 5%-diphenyl columns at 330°C through 350°C; hydrogen carrier gas; flame ionization detection.

Exceptional Reproducibility

Chromatographers today need to know that every column they receive is going to perform the same way as the column it replaces. Unmatched manufacturing precision and stringent quality control mean Rxi® columns exceed industry standards, resulting in the best column-to-column reproducibility available as measured by efficiency, retention, bleed, and inertness (Figure 6).

Figure 6 Rxi® columns are engineered to assure column-to-column and lot-to-lot reproducibility.



Column:	Rxi®-5ms, 30m, 0.25mm ID, 0.25µm (cat.# 13423)
Sample:	500µg/mL Isothermal Column Test Mix in toluene
Inj.:	1.0µL, split injection (split ratio 1:100), 4mm single gooseneck inlet liner with wool (cat.# 22405)
Inj. temp.:	250°C
Carrier gas:	hydrogen, constant flow
Linear velocity:	38cm/sec. @ 135°C
Oven temp.:	135°C
Det.:	FID @ 330°C

1. 1,6-hexanediol
2. 4-chlorophenol
3. methyl nonanoate
4. 1-decylamine
5. tridecane
6. 1-undecanol
7. acenaphthylene
8. pentadecane

Rxi® Columns Overview

Column Cross-Reference Table

Rxi® columns produce the same selectivity as competitor columns, but are much more inert, exhibit lower bleed, and offer exceptional reproducibility. For more accurate, reliable trace-level results, choose Rxi® columns.

POLARITY: non-polar → + polar

Restek	Phase Composition	Agilent	Varian/ Chrompack	SGE	Phenomenex	Machery-Nagel	Supelco
Rxi-1ms	100% dimethyl polysiloxane	HP-1ms UI, DB-1ms UI, HP-1, HP-1ms, DB-1 DB-1ms, Ultra-1	VF-1ms CP-Sil 5 CP Sil 5 CB Low Bleed/MS	BP-1	ZB-1 ZB-1ms	Optima-1 Optima-1ms Optima-1ms Accent	SPB-1 Equity-1
Rxi-1HT	100% dimethyl polysiloxane	DB-1HT	VF-1HT		ZB-1HT		
Rxi-5ms	5% diphenyl/ 95% dimethyl polysiloxane	HP-5ms UI, HP-5, HP-5ms, DB-5, Ultra-2	CP-Sil 8 CP Sil 8 CB	BP-5	ZB-5 ZB-5ms	Optima-5 Optima-5ms	SPB-5 Equity-5
Rxi-5Sil MS	5% phenyl, 95% dimethyl arylene polysiloxane	DB-5ms UI, DB-5ms	VF-5ms CP-Sil 8 CB Low Bleed/MS	BPX-5	ZB-5ms	Optima-5ms Accent	SLB-5ms
Rxi-5HT	5% diphenyl/95% dimethyl polysiloxane	DB-5HT	VF-5HT		ZB-5HT		
Rxi-XLB	arylene/methyl modified polysiloxane	DB-XLB	VF-Xms		MR1	Optima-XLB	
Rxi-624Sil MS	6% cyanopropylphenyl, 94% dimethyl arylene polysiloxane	DB-624, HP-624	VF-624ms	BP-624	ZB-624	Optima-624	
Rxi-35Sil MS	35% phenyl, 65% dimethyl arylene polysiloxane	DB-35ms	VF-35ms	BP-35	MR2	Optima-35ms	
Rxi-17	50% diphenyl/50% dimethyl polysiloxane	HP-17, DB-17, DB-608, HP-50+	CP-Sil 24 CB		ZB-50	Optima-17	
Rxi-17Sil MS	50% phenyl, 50% dimethyl arylene polysiloxane	DB-17ms, HP-17, DB-17	VF-17ms CP-Sil 24 CB	BPX-50	ZB-50	Optima-17ms	

Visit **www.restek.com/rxi** for detailed comparisons and to learn how exceptional Rxi® inertness, bleed, and reproducibility can improve your data.

Use **Rxi® Guard/Retention Gap Columns** to protect your analytical column and help focus analytes.

Rxi® Guard/Retention Gap Columns (fused silica)

- Extend column lifetime.
- Excellent inertness—obtain lower detection limits for active compounds.
- Sharper chromatographic peaks by utilizing retention gap technology.
- Maximum temperature: 360°C.

Nominal ID	Nominal OD	5-Meter	5-Meter/6-pk.	10-Meter	10-Meter/6-pk.
0.25mm	0.37 ± 0.04mm	10029	10029-600	10059	10059-600
0.32mm	0.45 ± 0.04mm	10039	10039-600	10064	10064-600
0.53mm	0.69 ± 0.05mm	10054	10054-600	10073	10073-600

Rxi®-1ms Columns (fused silica)

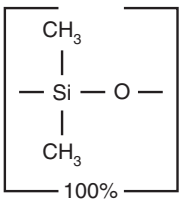
(nonpolar phase, Crossbond® 100% dimethyl polysiloxane)

- General purpose columns for drugs of abuse, essential oils, hydrocarbons, pesticides, PCB congeners (e.g. Aroclor mixes), sulfur compounds, amines, solvent impurities, simulated distillation, oxygenates, gasoline range organics (GRO), refinery gases.
- Tested and guaranteed for ultra-low bleed—improved signal-to-noise ratio, for better sensitivity and mass spectral integrity.
- Temperature range: -60 °C to 330/350 °C (bleed tested temperature/maximum operating temperature).
- Equivalent to USP G2 phase.

ID	df	temp. limits	15-Meter	30-Meter	60-Meter
0.25mm	0.25µm	-60 to 330/350°C	13320	13323	13326
	0.50µm	-60 to 330/350°C	13335	13338	13341
	1.00µm	-60 to 330/350°C	13350	13353	13356
0.32mm	0.25µm	-60 to 330/350°C	13321	13324	13327
	0.50µm	-60 to 330/350°C	13336	13339	13342
	1.00µm	-60 to 330/350°C	13351	13354	13357
	4.00µm	-60 to 330/350°C		13396	
0.53mm	0.50µm	-60 to 330/350°C	13337	13340	
	1.00µm	-60 to 330/350°C	13352	13355	
	1.50µm	-60 to 330/350°C	13367	13370	13373

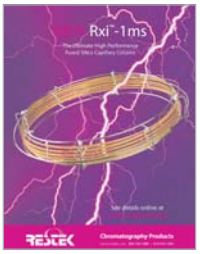
ID	df	temp. limits	10-Meter	12-Meter	20-Meter	25-Meter	50-Meter
0.10mm	0.10µm	-60 to 330/350°C	13301				
0.18mm	0.18µm	-60 to 330/350°C			13302		
	0.36µm	-60 to 330/350°C			13311		
0.20mm	0.33µm	-60 to 330/350°C		13397		13398	13399

Rxi®-1ms Structure



similar phases

DB-1, DB-1ms, HP-1, HP-1ms, Ultra-1, SPB-1, Equity-1, VF-1ms, CP-Sil 5 CB Low Bleed/MS



free literature

Rxi®-1ms: The Ultimate High Performance Fused Silica Capillary Column

Download your free copy from **www.restek.com**

lit. cat.# 580075B

Rxi®-5ms Columns (fused silica)

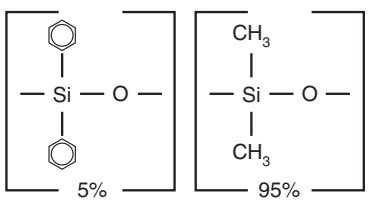
(low polarity phase, Crossbond® 5% diphenyl/95% dimethyl polysiloxane)

- General purpose columns for semivolatiles, phenols, amines, residual solvents, drugs of abuse, pesticides, PCB congeners (e.g. Aroclor mixes), solvent impurities.
- Most inert column on the market.
- Tested and guaranteed for ultra-low bleed—improved signal-to-noise ratio, for better sensitivity and mass spectral integrity.
- Temperature range: -60 °C to 330/350 °C (bleed tested temperature/maximum operating temperature).
- Equivalent to USP G27 phase.

ID	df	temp. limits	15-Meter	30-Meter	60-Meter
0.25mm	0.25µm	-60 to 330/350°C	13420	13423	13426
	0.40µm	-60 to 330/350°C		13481	
	0.50µm	-60 to 330/350°C	13435	13438	13441
	1.00µm	-60 to 330/350°C	13450	13453	13456
0.32mm	0.25µm	-60 to 330/350°C	13421	13424	13427
	0.50µm	-60 to 330/350°C	13436	13439	13442
	1.00µm	-60 to 330/350°C	13451	13454	13457
0.53mm	0.25µm	-60 to 330/350°C	13422	13425	
	0.50µm	-60 to 330/350°C	13437	13440	
	1.00µm	-60 to 330/350°C	13452	13455	
	1.50µm	-60 to 330/350°C	13467	13470	

ID	df	temp. limits	10-Meter	12-Meter	20-Meter	25-Meter	50-Meter
0.10mm	0.10µm	-60 to 330/350°C	13401				
0.18mm	0.18µm	-60 to 330/350°C			13402		
	0.30µm	-60 to 330/350°C			13409		
	0.36µm	-60 to 330/350°C			13411		
0.20mm	0.33µm	-60 to 330/350°C		13497		13498	13499

Rxi®-5ms Structure



similar phases

DB-5, HP-5, HP-5ms, Ultra-2, SPB-5, Equity-5, CP-Sil 8

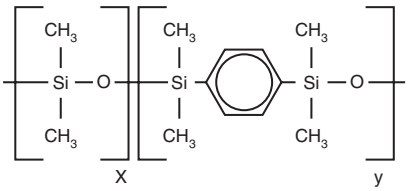
free literature

Rxi®-5ms Columns

Download your free copy from **www.restek.com**

lit. cat.# 580046A

Rxi®-5Sil MS Structure



similar **phases**

DB-5ms, VF-5ms, CP-Sil 8 Low-Bleed/MS, DB-5ms UI, Rtx-5Sil MS

Rxi®-5Sil MS Columns (fused silica)

(low polarity Crossbond® silarylene phase; selectivity close to 5% phenyl/ 95% dimethyl arylene polysiloxane)

- Engineered to be a low bleed GC/MS column.
- Excellent inertness for active compounds.
- General purpose columns—ideal for GC/MS analysis of polycyclic aromatic compounds, chlorinated hydrocarbons, phthalates, phenols, amines, organochlorine pesticides, organophosphorus pesticides, drugs, solvent impurities, and hydrocarbons.
- Temperature range: -60 °C to 350 °C.

The Rxi®-5Sil MS stationary phase incorporates phenyl groups in the polymer backbone. This improves thermal stability, reduces bleed, and makes the phase less prone to oxidation. Rxi®-5Sil MS columns are ideal for GC/MS applications requiring high sensitivity, including use in ion trap systems.

ID	df	temp. limits	15-Meter	30-Meter	60-Meter
0.25mm	0.10µm	-60 to 330/350°C	13605	13608	
	0.25µm	-60 to 330/350°C	13620	13623	13626
	0.50µm	-60 to 330/350°C	13635	13638	
	1.00µm	-60 to 325/350°C	13650	13653	13697
0.32mm	0.25µm	-60 to 330/350°C	13621	13624	
	0.50µm	-60 to 330/350°C		13639	
	1.00µm	-60 to 325/350°C		13654	
0.53mm	1.50µm	-60 to 310/330°C		13670	

ID	df	temp. limits	10-Meter	20-Meter	40-Meter
0.10mm	0.10µm	-60 to 330/350°C	43601		
0.18mm	0.10µm	-60 to 320/350°C			
	0.18µm	-60 to 330/350°C		43602	43605
	0.36µm	-60 to 330/350°C		43604	

Rxi®-5Sil MS with Integra-Guard®

Get the protection without the connection!

- Extend column lifetime.
- Eliminate leaks with a built-in retention gap.
- Inertness verified by isothermal testing.

Description	qty.	cat.#	price
15m, 0.25mm ID, 0.25µm Rxi-5Sil MS w/10m Integra-Guard Column	ea.	13620-127	
30m, 0.25mm ID, 0.25µm Rxi-5Sil MS w/5m Integra-Guard Column	ea.	13623-124	
30m, 0.25mm ID, 0.25µm Rxi-5Sil MS w/10m Integra-Guard Column	ea.	13623-127	
15m, 0.25mm ID, 0.50µm Rxi-5Sil MS w/5m Integra-Guard Column	ea.	13635-124	
30m, 0.25mm ID, 0.50µm Rxi-5Sil MS w/5m Integra-Guard Column	ea.	13638-124	
30m, 0.25mm ID, 0.50µm Rxi-5Sil MS w/10m Integra-Guard Column	ea.	13638-127	
30m, 0.32mm ID, 0.50µm Rxi-5Sil MS w/5m Integra-Guard Column	ea.	13639-125	
30m, 0.32mm ID, 1.00µm Rxi-5Sil MS w/5m Integra-Guard Column	ea.	13654-125	

free literature

Rxi®-5Sil MS: Exceptionally Inert Columns for GC/MS and Trace Level Analyses

lit. cat.# GNFL1061

Developing New Methods for Pesticides in Dietary Supplements

lit. cat.# PHAN1242

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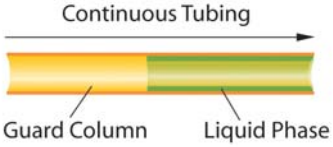
Integra-Guard® built-in guard column



Phases currently available as Integra-Guard® columns

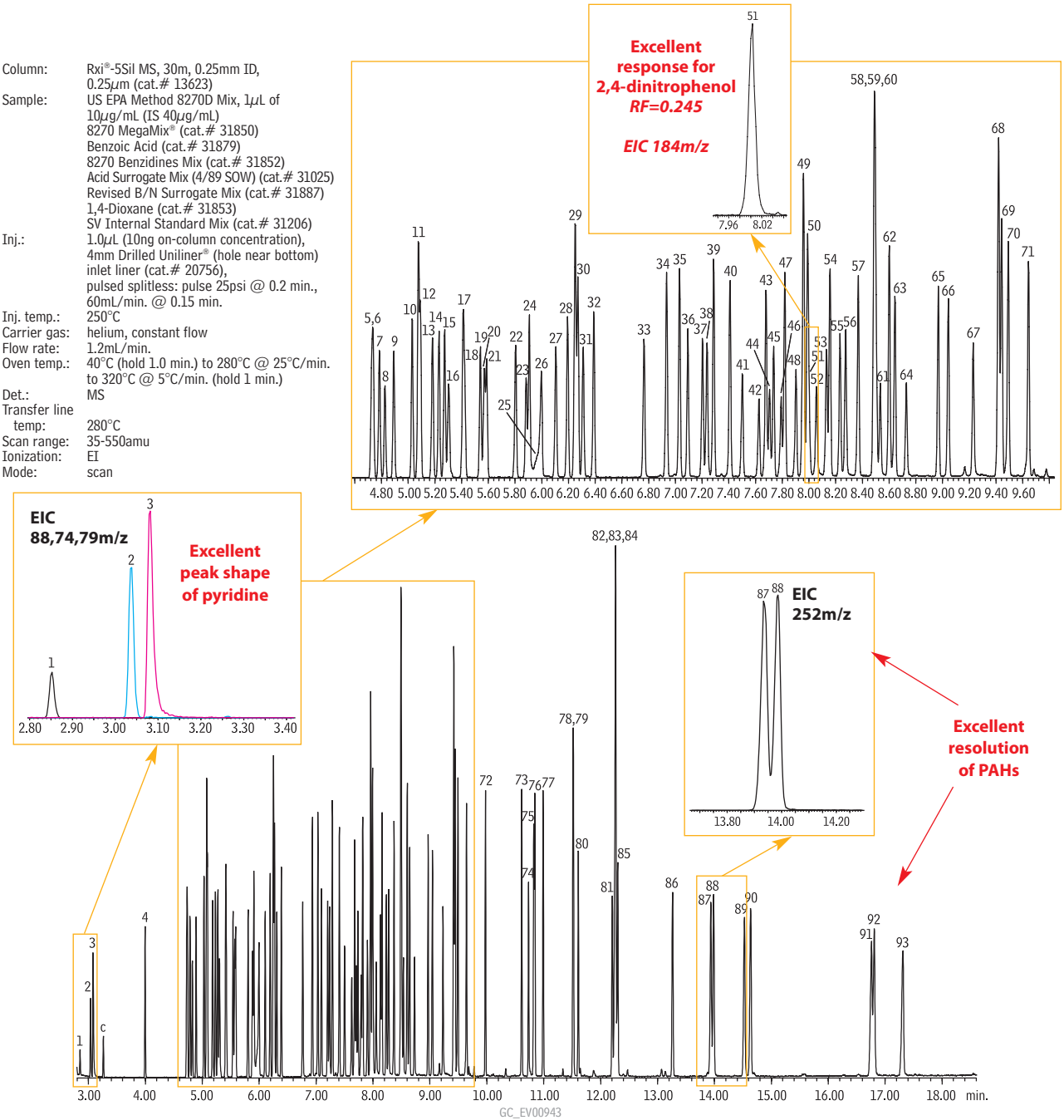
Rtx®-1
Rtx®-5
Rtx®-5MS
Rxi®-5Sil MS
Rtx®-624
Rtx®-1301
Rtx®-1701
Stabilwax®

See page 35 for more information.

Integra-Guard® columns are available for all phases listed, for columns with 0.25, 0.32 or 0.53mm ID. If you don't see what you need here, contact us.

Semivolatile organics for US EPA Method 8270 on an Rxi®-5Sil MS column.

Column:	Rxi®-5Sil MS, 30m, 0.25mm ID, 0.25µm (cat.# 13623)
Sample:	US EPA Method 8270D Mix, 1µL of 10µg/mL (IS 40µg/mL) 8270 MegaMix® (cat.# 31850) Benzoic Acid (cat.# 31879) 8270 Benzidines Mix (cat.# 31852) Acid Surrogate Mix (4/89 SOW) (cat.# 31025) Revised B/N Surrogate Mix (cat.# 31887) 1,4-Dioxane (cat.# 31853) SV Internal Standard Mix (cat.# 31206)
Inj.:	1.0µL (10ng on-column concentration), 4mm Drilled Uniliner® (hole near bottom) inlet liner (cat.# 20756), pulsed splitless: pulse 25psi @ 0.2 min., 60mL/min. @ 0.15 min.
Inj. temp.:	250°C
Carrier gas:	helium, constant flow
Flow rate:	1.2mL/min.
Oven temp.:	40°C (hold 1.0 min.) to 280°C @ 25°C/min. to 320°C @ 5°C/min. (hold 1 min.)
Det.:	MS
Transfer line temp:	280°C
Scan range:	35-550amu
Ionization:	EI
Mode:	scan



1. 1,4-dioxane
2. *n*-nitrosodimethylamine
3. pyridine
c. toluene
4. 2-fluorophenol (SS)
5. phenol-d6 (SS)
6. phenol
7. aniline
8. bis(2-chloroethyl) ether
9. 2-chlorophenol
10. 1,3-dichlorobenzene
11. 1,4-dichlorobenzene-d4 (IS)
12. 1,4-dichlorobenzene
13. benzyl alcohol
14. 1,2-dichlorobenzene
15. 2-methylphenol
16. bis(2-chloroisopropyl) ether
17. 4-methylphenol/3-methylphenol
18. *n*-nitroso-di-*n*-propylamine
19. hexachloroethane
20. nitrobenzene-d5 (SS)
21. nitrobenzene
22. isophorone
23. 2-nitrophenol
24. 2,4-dimethylphenol
25. benzoic acid
26. bis(2-chloroethoxy)methane
27. 2,4-dichlorophenol
28. 1,2,4-trichlorobenzene
29. naphthalene-d8 (IS)
30. naphthalene
31. 4-chloroaniline
32. hexachlorobutadiene
33. 4-chloro-3-methylphenol
34. 2-methylnaphthalene
35. 1-methylnaphthalene
36. hexachlorocyclopentadiene
37. 2,4,6-trichlorophenol
38. 2,4,5-trichlorophenol
39. 2-fluorobiphenyl (SS)
40. 2-chloronaphthalene
41. 2-nitroaniline
42. 1,4-dinitrobenzene
43. dimethyl phthalate
44. 1,3-dinitrobenzene
45. 2,6-dinitrotoluene
46. 1,2-dinitrobenzene
47. acenaphthylene
48. 3-nitroaniline
49. acenaphthene-d10 (IS)
50. acenaphthene
51. 2,4-dinitrophenol
52. 4-nitrophenol
53. 2,4-dinitrotoluene
54. dibenzofuran
55. 2,3,5,6-tetrachlorophenol
56. 2,3,4,6-tetrachlorophenol
57. diethyl phthalate
58. 4-chlorophenyl phenyl ether
59. fluorene
60. 4-nitroanaline
61. 4,6-dinitro-2-methylphenol
62. *n*-nitrosodiphenylamine (diphenylamine)
63. 1,2-diphenylhydrazine (as azobenzene)
64. 2,4,6-tribromophenol (SS)
65. 4-bromophenyl phenyl ether
66. hexachlorobenzene
67. pentachlorophenol
68. phenanthrene-d10 (IS)
69. phenanthrene
70. anthracene
71. carbazole
72. di-*n*-butyl phthalate
73. fluoranthene
74. benzidine
75. pyrene-d10 (SS)
76. pyrene
77. *p*-terphenyl-d14 (SS)
78. 3,3'-dimethylbenzidine
79. butyl benzyl phthalate
80. bis(2-ethylhexyl) adipate
81. 3,3'-dichlorobenzidine
82. benzo(a)anthracene
83. bis(2-ethylhexyl) phthalate
84. chrysene-d12 (IS)
85. chrysene
86. di-*n*-octyl phthalate
87. benzo(b)fluoranthene
88. benzo(k)fluoranthene
89. benzo(a)pyrene
90. perylene-d12 (IS)
91. indeno(1,2,3-cd)pyrene
92. dibenzo(a,h)anthracene
93. benzo(ghi)perylene

c = contaminant

similar phases

DB-XLB, VF-Xms

tech tip

In combination with an Rxi®-XLB column, simple adjustments to the injection conditions can greatly improve sensitivity for active and high molecular weight Method 525.2 target compounds.

By eliminating contact between the sample and the hot metal surfaces in the injection port, a Drilled Uniliner® inlet liner prevents analytes from degrading in the injection port.

Rxi®-XLB Columns (fused silica)

(low polarity proprietary phase)

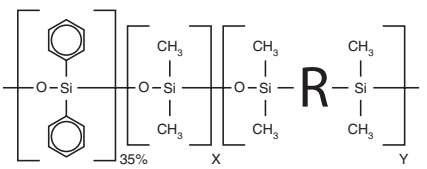
- General purpose columns exhibiting extremely low bleed. Ideal for many GC/MS applications, including pesticides, PCB congeners (e.g. Aroclor mixes), PAHs.
- Unique selectivity.
- Temperature range: 30 °C to 360 °C.

ID	df	temp. limits*	15-Meter	30-Meter	60-Meter
0.25mm	0.10µm	30 to 340/360°C	13705	13708	
	0.25µm	30 to 340/360°C	13720	13723	13726
	0.50µm	30 to 340/360°C		13738	
	1.00µm	30 to 340/360°C	13750	13753	
0.32mm	0.10µm	30 to 340/360°C		13709	
	0.25µm	30 to 340/360°C	13721	13724	13727
	0.50µm	30 to 340/360°C		13739	
	1.00µm	30 to 340/360°C		13754	
0.53mm	0.50µm	30 to 340/360°C		13740	
	1.50µm	30 to 320/340°C	13767	13770	

ID	df	temp. limits	10-Meter	20-Meter
0.10mm	0.10µm	30 to 340/360°C	43701	
0.18mm	0.18µm	30 to 340/360°C		43702

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

Rxi®-35Sil MS Structure



similar phases

DB-35ms, MR2, VF-35ms

Rxi®-35Sil MS Columns (fused silica)

(midpolarity phase; equivalent to 35% phenyl/65% dimethyl arylene polysiloxane)

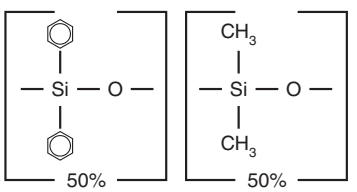
- Special selectivity and excellent inertness for substituted polar compounds, such as drugs, pesticides, herbicides, PCBs, phenols, etc.
- Very low bleed phase for GC/MS analysis.
- Extended temperature range: 50 °C to 340/360 °C.

ID	df	temp. limits	15-Meter	30-Meter
0.25mm	0.25µm	50 to 340/360°C	13820	13823
	0.50µm	50 to 340/360°C	13835	13838
	1µm	50 to 320/340°C	13850	13853
0.32mm	0.25µm	50 to 340/360°C	13821	13824
	0.50µm	50 to 340/360°C	13836	13839
	1µm	50 to 320/340°C	13851	13854
0.53mm	0.50µm	50 to 320/340°C	13837	13840
	1µm	50 to 320/340°C	13852	13855

NEW!

More dimensions are now available!

Rxi®-17 Structure



similar phases

DB-17, DB-608, CP-Sil 24 CB, HP-50+

Rxi®-17 Columns (fused silica)

(midpolarity phase; Crossbond® 50% diphenyl/50% dimethyl polysiloxane)

- General purpose columns for pesticides, herbicides, rosin acids, phthalate esters, triglycerides, sterols.
- Temperature range: 40 °C to 320 °C.

ID	df	temp. limits	15-Meter	30-Meter
0.25mm	0.25µm	40 to 280/320°C	13520	13523
	0.50µm	40 to 280/320°C	13535	13538
	1.00µm	40 to 280/320°C	13550	13553
0.32mm	0.25µm	40 to 280/320°C	13521	13524
	0.50µm	40 to 280/320°C	13536	13539
	1.00µm	40 to 280/320°C	13551	13554
0.53mm	0.25µm	40 to 280/320°C	13522	13525
	0.50µm	40 to 280/320°C	13537	13540
	0.83µm	40 to 280/320°C		13569
	1.00µm	40 to 280/320°C	13552	13555
	1.50µm	40 to 280/320°C	13567	13570

ID	df	temp. limits	10-Meter	20-Meter
0.10mm	0.10µm	40 to 280/320°C	13501	
0.18mm	0.18µm	40 to 280/320°C		13502

Rxi®-17Sil MS Columns (fused silica)

(midpolarity Crossbond® silarylene phase; equivalent to 50% phenyl/50% dimethyl arylene polysiloxane)

NEW!

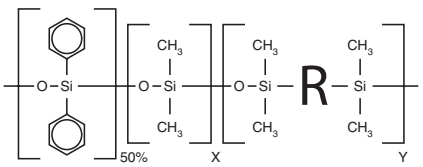
- 340/360 °C upper temperature limits.
- Excellent inertness and selectivity for active environmental compounds, such as PAHs.
- Equivalent to USP phase G3.
- Low-bleed for use with sensitive detectors, such as MS.
- Excellent separation of EU-PAHs, including fluoranthenes.

ID	df	temp. limits*	15-Meter	30-Meter	60-Meter
0.25mm	0.25µm	40 to 340/360°C	14120	14123	14126
0.32mm	0.25µm	40 to 340/360°C	14121	14124	

ID	df	temp. limits	10-Meter	20-Meter
0.10mm	0.10µm	40 to 340/360°C	14101	
0.18mm	0.18µm	40 to 340/360°C		14102
	0.36µm	40 to 340/360°C		14111

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

Rxi®-17Sil MS Structure

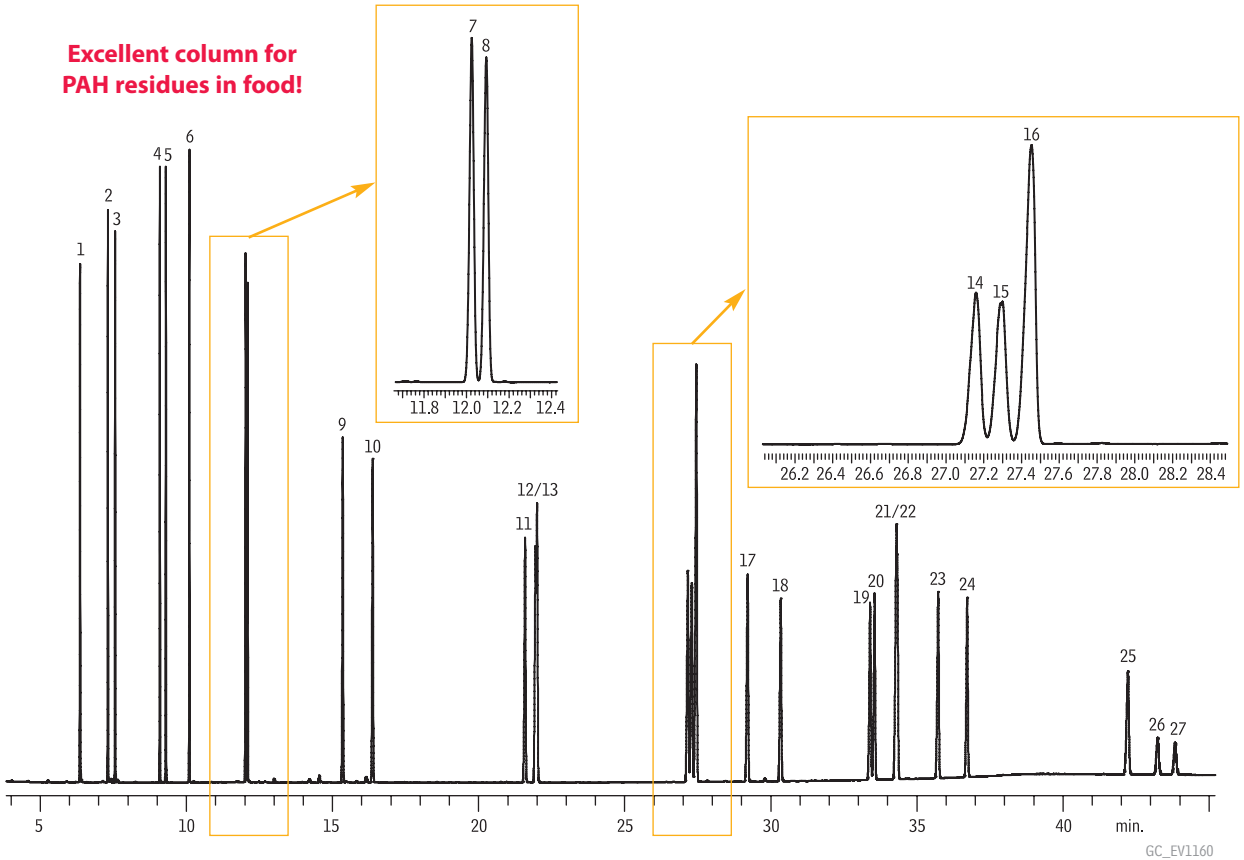


similar phases

DB-17ms, VF-17ms, BPX-50

Polycyclic Aromatic Hydrocarbons on Rxi®-17Sil MS

Excellent column for PAH residues in food!



GC_EV1160

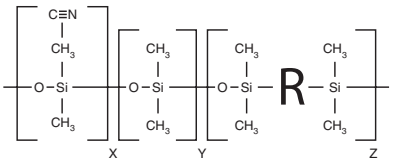
1. Naphthalene
2. 2-Methylnaphthalene
3. 1-Methylnaphthalene
4. Acenaphthylene
5. Acenaphthene
6. Fluorene
7. Phenanthrene
8. Anthracene
9. Fluoranthene
10. Pyrene
11. Benz[a]anthracene
12. Chrysene
13. Triphenylene
14. Benzo[b]fluoranthene
15. Benzo[k]fluoranthene
16. Benzo(j)fluoranthene
17. Benzo[a]pyrene
18. 3-Methylcholanthrene
19. Dibenz(a,h)acridine
20. Dibenz[a,j]acridine
21. Indeno[1,2,3-cd]pyrene
22. Dibenz[a,h]anthracene
23. Benzo[ghi]perylene
24. 7H-Dibenzo[c,g]carbazole
25. Dibenzo[a,e]pyrene
26. Dibenzo(a,i)pyrene
27. Dibenzo(a,h)pyrene

Column	Rxi®-17Sil MS, 30 m, 0.25 mm ID, 0.25 µm (cat.# 14123)
Sample	SV Calibration Mix #5 / 610 PAH Mix (cat.# 31011) EPA Method 8310 PAH Mixture (cat.# 31841)
Diluent:	dichloromethane
Conc.:	10 ppm
Injection	
Inj. Vol.:	0.5 µL splitless (hold 1.75 min.)
Liner:	Auto SYS XL PSS Split/Splitless w/Wool (cat.# 21718)
Inj. Temp.:	320 °C
Purge Flow:	75 mL/min.
Oven	
Oven Temp:	65 °C (hold 0.5 min.) to 220 °C at 15 °C/min. to 330 °C at 4 °C/min. (hold 15 min.)
Carrier Gas	He, constant flow
Flow Rate:	2.0 mL/min.
Detector	FID @ 320 °C
Instrument	PE Clarus 600 GC
Acknowledgement	Instrument provided by PerkinElmer

Rxi®-624Sil MS

Rxi®-624Sil MS Structure

NEW!



similar **phases**

DB-624, HP-624, VF-624, BP-624, ZB-624, AT-624, 007-1301, G43R

Rxi®-624Sil MS Columns (fused silica)

(midpolarity Crossbond® silarylene phase; equivalent to 6% cyanopropylphenyl/ 94% dimethyl arylene polysiloxane)

- Low bleed, high thermal stability column—maximum temperatures up to 320 °C.
- Inert—excellent peak shape for a wide range of compounds, including acidic and basic compounds.
- Selective—highly selective for residual solvents, great choice for USP<467>.
- Manufactured for column-to-column reproducibility—well-suited for validated methods.

ID	df	temp. limits	20-Meter	30-Meter	60-Meter
0.18mm	1.00µm	-20 to 300/320°C	13865		
0.25mm	1.40µm	-20 to 300/320°C		13868	
0.32mm	1.80µm	-20 to 300/320°C		13870	13872
0.53mm	3.00µm	-20 to 280/300°C		13871	

free literature

Rxi®-624Sil MS: The "Go To" GC Column for Fast, Effective Volatile Impurities Method Development

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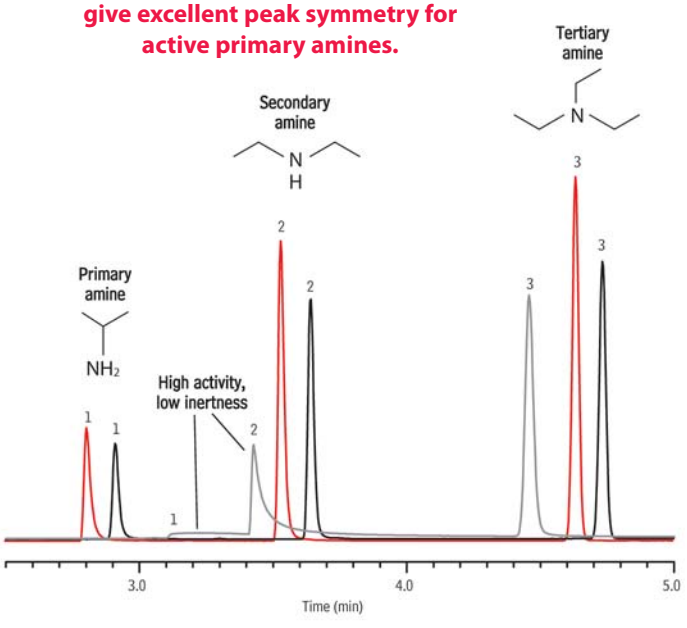
lit. cat.# PHFL1245

Inertness comparison (basic compounds): primary, secondary, and tertiary amines on an Rxi®-624Sil MS column.

Highly inert Rxi®-624Sil MS columns give excellent peak symmetry for active primary amines.



GC_PH1162

Peaks	Conc. (µg/mL)
1. Isopropylamine	100
2. Diethylamine	100
3. Triethylamine	100

Column	Rxi®-624SilMS, 30 m, 0.32 mm ID, 1.8 µm (cat.# 13870)
Sample	
Diluent:	DMSO
Conc.:	100 µg/mL
Injection	
Inj. Vol.:	1 µL split (split ratio 20:1)
Liner:	5mm Single Gooseneck with Wool (cat.# 22973-200.1)
Inj. Temp.:	250 °C
Oven	
Oven Temp:	50 °C (hold 1 min.) to 200 °C at 20 °C/min. (hold 5 min.)
Carrier Gas	He, constant flow
Linear Velocity:	37 cm/sec.
Detector	FID @ 250 °C
Instrument	Agilent/HP6890 GC

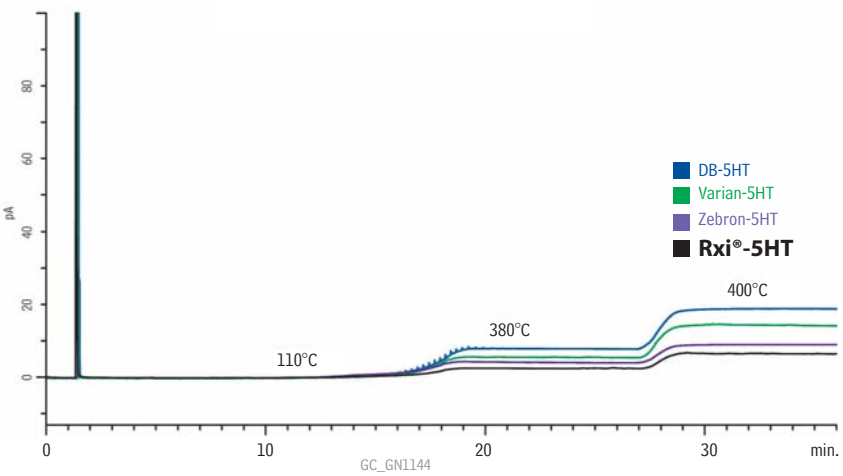
NEW!

Looking for an **Inert** and **Low Bleed** High Temp Column?

Rxi GCColumns

High temperature columns have thin films so they need to be thoroughly deactivated. Restek's Rxi® process offers better inertness and lower bleed than any other manufacturer.

Bleed Profiles of 5HT Columns



Column: Rxi®-5HT (see notes for competitors), 30 m, 0.25 mm ID, 0.10 µm (cat.# 13908)
For analytical conditions, visit www.restek.com and search for chromatogram GC_GN1144

Replace DB-5ht, ZB-5HT, and VF-5ht and benefit from better data and lower bleed!

Rxi®-5HT Columns (fused silica)

(low polarity phase; 5% diphenyl/95% dimethyl polysiloxane)

- 40% longer lifetime from specially designed fused silica tubing.
- Columns processed for high temperature applications.
- Temperature range: -60 to 400 °C*.

ID	df	temp. limits	15-Meter	30-Meter
0.25mm	0.10µm	-60 to 400°C	13905	13908
	0.25µm	-60 to 400°C		13923
0.32mm	0.10µm	-60 to 400°C	13906	13909
	0.25µm	-60 to 400°C		13924
0.53mm	0.15µm	-60 to 400°C		13910

*Column is capable of going to 430°C, but column lifetime will be reduced.

Rxi®-1HT Columns (fused silica)

(100% dimethyl polysiloxane)

NEW!

- Columns processed for high temperature applications.
- Temperature range: -60 to 400 °C*.

ID	df	temp. limits	15-Meter	30-Meter
0.25mm	0.10µm	-60 to 400°C	13950	13951
	0.25µm	-60 to 400°C		13952
0.32mm	0.10µm	-60 to 400°C	13953	13954
	0.25µm	-60 to 400°C		13955
0.53mm	0.15µm	-60 to 400°C		13956

*Column is capable of going to 430°C, but column lifetime will be reduced.

General Purpose Columns

Chemically bonded capillary columns

- Allow for direct solvent injection onto column.
- Columns can be solvent rinsed.

Extensive GC column selection

- Available in many dimensions, including variations in length, internal diameter, and film thickness.
- Internal diameters include 0.10mm and 0.18mm for faster analysis time and greater resolution.

Broad range of stationary phases

- Columns based on polysiloxane backbone; functional groups added to the polymers to vary selectivity:

Rtx® GC Columns

Rtx®-1, Rtx®-5, Rtx®-5MS, Rtx®-20, Rtx®-35, Rtx®-50, Rtx®-65, Rtx®-440, Rtx®-200, Rtx®-200MS, Rtx®-1301, Rtx®-624, Rtx®-1701, Rtx®-225, Rtx®-2330, Rtx®-Wax, Stabilwax®

visit **www.restek.com** for complete product listings

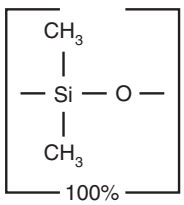
Rtx®-1 Columns (fused silica)

(nonpolar phase; Crossbond® 100% dimethyl polysiloxane)

- General purpose columns for solvent impurities, PCB congeners (e.g. Aroclor mixes), simulated distillation, drugs of abuse, gases, natural gas odorants, sulfur compounds, essential oils, hydrocarbons, semivolatiles, pesticides, oxygenates.
- Temperature range: -60 °C to 350 °C.
- Equivalent to USP G1, G2, G38 phases.

Rtx®-1 columns exhibit long lifetime and very low bleed at high operating temperatures. A proprietary synthesis process eliminates residual catalysts that could cause degradation and increase bleed.

Rtx®-1 Structure



ID	df	temp. limits*	15-Meter	30-Meter	60-Meter	105-Meter
0.25mm	0.10µm	-60 to 330/350°C	10105	10108	10111	
	0.25µm	-60 to 330/350°C	10120	10123	10126	10129
	0.50µm	-60 to 330/350°C	10135	10138	10141	10144
	1.00µm	-60 to 320/340°C	10150	10153	10156	10159
0.32mm	0.10µm	-60 to 330/350°C	10106	10109	10112	
	0.25µm	-60 to 330/350°C	10121	10124	10127	10130
	0.50µm	-60 to 330/350°C	10136	10139	10142	
	1.00µm	-60 to 320/340°C	10151	10154	10157	10160
	1.50µm	-60 to 310/330°C	10166	10169	10172	10175
	3.00µm	-60 to 280/300°C	10181	10184	10187	10190
	4.00µm	-60 to 280/300°C		10198		
	5.00µm	-60 to 260/280°C	10176	10178	10180	
0.53mm	0.10µm	-60 to 320/340°C	10107	10110		
	0.25µm	-60 to 320/340°C	10122	10125	10128	
	0.50µm	-60 to 310/330°C	10137	10140	10143	
	1.00µm	-60 to 310/330°C	10152	10155	10158	
	1.50µm	-60 to 310/330°C	10167	10170	10173	
	3.00µm	-60 to 270/290°C	10182	10185	10188	10189
	5.00µm	-60 to 270/290°C	10177	10179	10183	10194
	7.00µm	-60 to 240/260°C	10191	10192	10193	

ID	df	temp. limits	10-Meter	20-Meter	40-Meter
0.10mm	0.10µm	-60 to 330/350°C	41101	41102	
	0.40µm	-60 to 320/340°C	41103	41104	
0.18mm	0.20µm	-60 to 330/350°C	40101	40102	40103
	0.40µm	-60 to 320/340°C	40110	40111	40112

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

Rtx®-1 with Integra-Guard® Column

Get the protection without the connection!

- Extend column lifetime.
- Eliminate leaks with a built-in retention gap.
- Inertness verified by isothermal testing.

Description	qty.	cat.#	price
30m, 0.25mm ID, 0.25µm Rtx-1 w/5m Integra-Guard Column	ea.	10123-124	
30m, 0.53mm ID, 1.00µm Rtx-1 w/5m Integra-Guard Column	ea.	10155-126	
30m, 0.53mm ID, 5.00µm Rtx-1 w/5m Integra-Guard Column	ea.	10179-126	

similar phases

DB-1, DB-1MS, HP-1, HP-1MS, Ultra-1, SPB-1, Equity-1, MDN-1, VF-1ms, CP-Sil 5 CB

also available

Metal MXT® Columns
Rugged, flexible, Siltek® treated stainless steel tubing; inertness comparable to fused silica tubing. See **page 115** for our MXT®-1 columns.

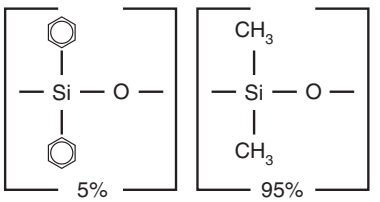
it's a fact

For exceptional inertness, ultra-low bleed, and unsurpassed performance, choose Rxi®-1ms columns! See **pages 36-41**.

crossbond® technology

reduces bleed, prolongs column lifetime, and allows rejuvenation through solvent rinsing.

Rtx®-5/Rtx®-5MS Structure

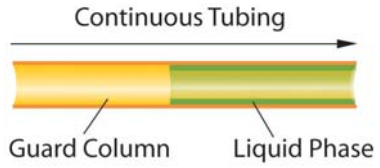


similar **phases**

DB-5, HP-5, HP-5MS, Ultra-2, SPB-5, Equity-5, MDN-5, CP-Sil 8 CB

NOTE: DB-5MS is a silarylene based polymer, similar to Rxi-5Sil MS.

Integra-Guard® built-in guard column



Get the protection without the connection!
For Rtx®-5 and Rtx®-5MS columns with built-in Integra-Guard® guard columns, see **page 35**.

also **available**

Metal MXT® Columns
Rugged, flexible, Siltek® treated stainless steel tubing; inertness comparable to fused silica tubing. See **page 116** for our MXT®-5 columns.

Rtx®-5 Amine Columns
See **page 64**.

it's a **fact**

For exceptional inertness, ultra-low bleed, and unsurpassed performance, choose Rxi®-5ms columns! See **pages 36-41**.

Rtx®-5/Rtx®-5MS (fused silica)

- General purpose columns for drugs, solvent impurities, pesticides, hydrocarbons, PCB congeners (e.g. Aroclor mixes), essential oils, semivolatiles.
- Temperature range: -60 °C to 350 °C.
- Equivalent to USP G27 and G36 phases.

The 5% diphenyl/95% dimethyl polysiloxane stationary phase is the most popular GC stationary phase and is used in a wide variety of applications. All residual catalysts and low molecular weight fragments are removed from the Rtx®-5 polymer, providing a tight mono-modal distribution and extremely low bleed.

Rtx®-5 Columns (fused silica)

(low polarity phase; Crossbond® 5% diphenyl/95% dimethyl polysiloxane)

ID	df	temp. limits*	15-Meter	30-Meter	60-Meter	105-Meter
0.25mm	0.10µm	-60 to 330/350°C	10205	10208	10211	10214
	0.25µm	-60 to 330/350°C	10220	10223	10226	10229
	0.50µm	-60 to 330/350°C	10235	10238	10241	10244
	1.00µm	-60 to 320/340°C	10250	10253	10256	10259
0.32mm	0.10µm	-60 to 330/350°C	10206	10209	10212	10215
	0.25µm	-60 to 330/350°C	10221	10224	10227	10230
	0.50µm	-60 to 330/350°C	10236	10239	10242	10245
	1.00µm	-60 to 330/350°C	10251	10254	10257	10260
	1.50µm	-60 to 310/330°C	10266	10269	10272	10275
	3.00µm	-60 to 280/300°C	10281	10284	10287	10290
0.53mm	0.10µm	-60 to 320/340°C	10207	10210	10213	
	0.25µm	-60 to 320/340°C	10222	10225	10228	
	0.50µm	-60 to 310/330°C	10237	10240	10243	
	1.00µm	-60 to 310/330°C	10252	10255	10258	
	1.50µm	-60 to 310/330°C	10267	10270	10273	
	3.00µm	-60 to 270/290°C	10282	10285	10288	
	5.00µm	-60 to 270/290°C	10277	10279	10283	

ID	df	temp. limits	10-Meter	20-Meter	40-Meter
0.10mm	0.10µm	-60 to 330/350°C	41201	41202	
	0.40µm	-60 to 320/340°C	41203	41204	
0.18mm	0.20µm	-60 to 325/340°C	40201	40202	40203
	0.40µm	-60 to 315/330°C	40210	40211	40212

30-meter	6-pack cat.#	6-pack price	price if bought separately	savings of
0.25mm ID, 0.25µm	10223-600			
0.25mm ID, 0.50µm	10238-600			
0.32mm ID, 1.00µm	10254-600			
0.53mm ID, 1.50µm	10270-600			

Six columns for the price of five!
Other phases and configurations available on request.

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

Rtx®-5MS—Low-bleed GC/MS Columns (fused silica)

(low-polarity phase; Crossbond® 5% diphenyl/95% dimethyl polysiloxane)

Column specifically tested for low bleed performance.

ID	df	temp. limits	15-Meter	30-Meter	60-Meter
0.25mm	0.10µm	-60 to 330/350°C	12605	12608	12611
	0.25µm	-60 to 330/350°C	12620	12623	12626
	0.50µm	-60 to 330/350°C	12635	12638	12641
	1.00µm	-60 to 325/350°C	12650	12653	
0.32mm	0.10µm	-60 to 330/350°C	12606	12609	12612
	0.25µm	-60 to 330/350°C	12621	12624	12627
	0.50µm	-60 to 330/350°C	12636	12639	12642
	1.00µm	-60 to 325/350°C	12651	12654	
0.53mm	0.50µm	-60 to 320/340°C	12637	12640	
	1.00µm	-60 to 320/340°C	12652	12655	
	1.50µm	-60 to 310/330°C	12667	12670	

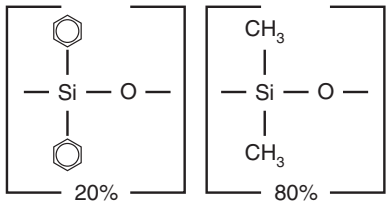
Rtx®-20 Columns (fused silica)

(low to midpolarity phase; Crossbond® 20% diphenyl/80% dimethyl polysiloxane)

- General purpose columns for volatile compounds, flavor compounds, alcoholic beverages.
- Temperature range: -20 °C to 320 °C.
- Equivalent to USP G28, G32 phases.

Rtx®-20 polymer is synthesized to exacting standards. All residual catalysts and low molecular weight fragments are removed from the polymer, providing a tight monomodal distribution and extremely low bleed.

Rtx®-20 Structure



ID	df	temp. limits	15-Meter	30-Meter
0.25mm	0.25µm	-20 to 300/320°C	10320	10323
	0.50µm	-20 to 290/310°C	10335	10338
	1.00µm	-20 to 280/300°C	10350	10353
0.32mm	0.25µm	-20 to 300/320°C	10321	10324
	0.50µm	-20 to 290/310°C	10336	10339
	1.00µm	-20 to 280/300°C	10351	10354
0.53mm	0.25µm	-20 to 260/280°C	10322	10325
	1.00µm	-20 to 260/280°C	10352	10355

similar **phase**

SPB-20, AT-20, 007-7

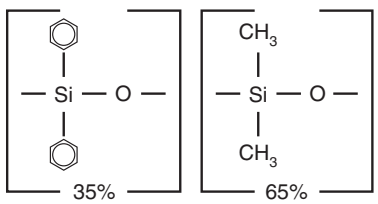
Rtx®-35 Columns (fused silica)

(midpolarity phase; Crossbond® 35% diphenyl/65% dimethyl polysiloxane)

- General purpose columns for organochlorine pesticides, PCB congeners (e.g. Aroclor mixes), herbicides, pharmaceuticals, sterols, rosin acids, phthalate esters.
- Temperature range: 40 °C to 320 °C.
- Equivalent to USP G42 phase.

An Rtx®-35 column is a popular confirmation column for pesticides and herbicides, in conjunction with an Rtx®-5 or Rtx®-1701 column. The higher phenyl content causes useful elution order and retention time changes.

Rtx®-35 Structure



ID	df	temp. limits	15-Meter	30-Meter
0.25mm	0.25µm	40 to 320°C	10420	10423
	0.50µm	40 to 310°C	10435	10438
	1.00µm	40 to 290°C	10450	10453
0.32mm	0.25µm	40 to 320°C	10421	10424
	0.50µm	40 to 310°C	10436	10439
	1.00µm	40 to 290°C	10451	10454
0.53mm	0.25µm	40 to 260/280°C	10422	10425
	0.50µm	40 to 300°C	10437	10440
	1.00µm	40 to 290°C	10452	10455
	1.50µm	40 to 280°C	10467	10470
	3.00µm	40 to 240/260°C	10482	10485

ID	df	temp. limits	10-Meter	20-Meter
0.18mm	0.20µm	40 to 300/320°C	40401	40402
	0.40µm	40 to 290/310°C	40410	40411

similar **phases**

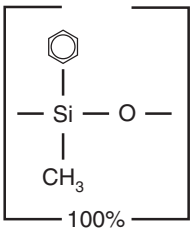
DB-35, HP-35, SPB-35, SPB-608

also **available**

Metal MXT® Columns
Rugged, flexible, Siltek® treated stainless steel tubing; inertness comparable to fused silica tubing. See **page 116** for our MXT®-20 columns and **page 117** for our MXT®-35 columns.

Rtx®-35 Amine Columns
See **page 65.**

Rtx®-50 Structure



similar **phases**

HP-50, SPB-50, SP-2250

also **available**

Metal MXT® Columns
Rugged, flexible, Siltek® treated stainless steel tubing; inertness comparable to fused silica tubing. See **page 117** for our MXT®-50 columns.

Rtx®-50 Columns (fused silica)

(midpolarity phase; Crossbond® 50% phenyl/50% methyl polysiloxane)

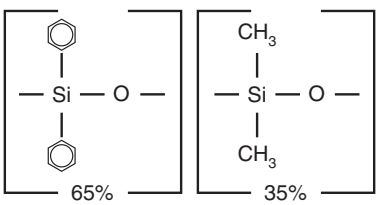
- General purpose columns for pesticides, herbicides, rosin acids, phthalate esters, triglycerides, sterols.
- Temperature range: 40 °C to 320 °C.
- Equivalent to USP G3 phase.

The high thermal stability of Rtx®-50 columns makes possible dual-column analysis with common phases such as Rtx®-1MS or Rtx®-5MS. Between analyses, high temperatures can be used to drive less volatile contaminants off of the column.

ID	df	temp. limits	15-Meter	30-Meter
0.25mm	0.25µm	40 to 300/320°C	10520	10523
	0.50µm	40 to 290/310°C	10535	10538
	1.00µm	40 to 280/300°C	10550	10553
0.32mm	0.25µm	40 to 300/320°C	10521	10524
	0.50µm	40 to 290/310°C	10536	10539
	1.00µm	40 to 280/300°C	10551	10554
0.53mm	0.25µm	40 to 280/300°C	10522	
	0.50µm	40 to 270/290°C	10537	10540
	0.83µm	40 to 270/290°C		10569
	1.00µm	40 to 260/280°C	10552	10555
	1.50µm	40 to 250/270°C	10567	10570

ID	df	temp. limits	10-Meter	20-Meter
0.18mm	0.20µm	40 to 310/330°C	40501	40502
	0.40µm	40 to 300/320°C	40510	40511

Rtx®-65 Structure



similar **phases**

TAP-CB, 400-65HT, 007-65HT

also **available**

Metal MXT® Columns
Rugged, flexible, Siltek® treated stainless steel tubing; inertness comparable to fused silica tubing. See **page 117** for our MXT®-65 columns.

Rtx®-65 Columns (fused silica)

(mid to high polarity phase; Crossbond® 65% diphenyl/35% dimethyl polysiloxane)

- General purpose columns for phenols, fatty acids.
- Temperature range: 50 °C to 300 °C.
- Equivalent to USP G17 phase.

The Rtx®-65 phase contains the highest phenyl content of any bonded stationary phase available, to improve separation of aromatic compounds through increased phase-analyte interaction. A unique polarity makes these columns ideal for a variety of analyses, from phenols to FAMEs. As a confirmation column for EPA Method 604 phenols, an Rtx®-65 column produces a different elution order, compared to the primary Rtx®-5 column. Rtx®-65 columns elute FAMEs according to equivalent chain length, similar to bonded Carbowax® columns, but the Rtx®-65 phase does not suffer the thermal stability limitations of other polar stationary phases.

ID	df	temp. limits	30-Meter
0.25mm	0.25µm	50 to 300°C	17023
	0.50µm	50 to 280/300°C	17038
	1.00µm	50 to 260/280°C	17053
0.32mm	0.25µm	50 to 300°C	17024
	0.50µm	50 to 280/300°C	17039
	1.00µm	50 to 260/280°C	17054
0.53mm	0.25µm	50 to 290/300°C	17025
	0.50µm	50 to 270/290°C	17040
	1.00µm	50 to 250/270°C	17055

also **available**

Rtx®-65TG Columns
Tested specifically for triglycerides.
See **page 72.**

crossbond® **technology**

reduces bleed, prolongs column lifetime, and allows rejuvenation through solvent rinsing.

restek **innovation**!

Rtx®-440 Columns (fused silica)

(midpolarity proprietary Crossbond® phase)

- General purpose columns with unique selectivity for pesticides, PAHs, or other semivolatiles. Ideal for low/trace level analyses.
- Low bleed, high-resolution columns with unique selectivity.
- Wide temperature range: 20 °C to 340 °C.

ID	df	temp. limits	30-Meter
0.25mm	0.25µm	20°C to 320/340°C	12923
	0.50µm	20°C to 320/340°C	12938
0.32mm	0.25µm	20°C to 320/340°C	12924
	0.50µm	20°C to 320/340°C	12939
0.53mm	0.50µm	20°C to 320/340°C	12940
	1.00µm	20°C to 320/340°C	12955

ID	df	temp. limits	20-Meter	40-Meter
0.18mm	0.18µm	20°C to 320/340°C	42902	42903

Organochlorine Pesticides (US EPA Method 8081A) on an Rtx®-440 column.

Column: Rtx®-440 30m, 0.32mm ID, 0.50µm (cat.# 12939)

Sample: Organochlorine Pesticides Mix AB #2 (cat.# 32292),
8-80µg/mL each component in ethyl acetate
Chlorobenzilate (cat.# 32211) 1,000µg/mL in methanol
Diallate (cis & trans) (custom) 1,000µg/mL in hexane
Hexachlorobenzene (cat.# 32231) 1,000µg/mL in acetone
Hexachlorocyclopentadiene (cat.# 32232) 1,000µg/mL in methanol
Isodrin (custom) 1,000µg/mL in hexane
Kepone (custom) 1,000µg/mL in hexane
Mirex (custom) 1,000µg/mL in hexane
2,4'-DDD (cat.# 32098) 1,000µg/mL in methanol
2,4'-DDE (cat.# 32099) 1,000µg/mL in methanol
2,4'-DDT (cat.#32200) 1,000µg/mL in methanol
TCMX (cat.# 32027) 200µg/mL in acetone
DCB (cat.# 32029) 200µg/mL in acetone

Inj.: 1.0µL splitless (hold 0.75 min.), 2mm Siltek® treated single gooseneck inlet liner (cat.# 20961-214.1)

Inj. temp.: 275°C

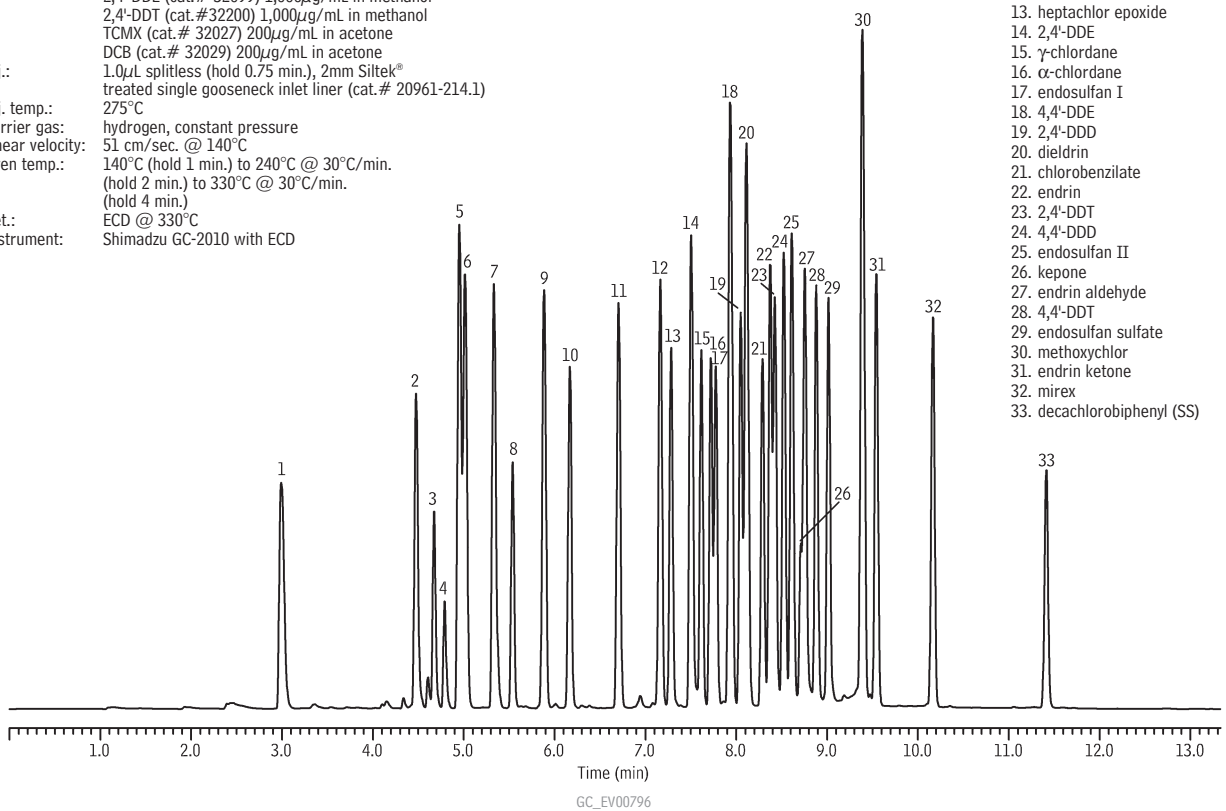
Carrier gas: hydrogen, constant pressure

Linear velocity: 51 cm/sec. @ 140°C

Oven temp.: 140°C (hold 1 min.) to 240°C @ 30°C/min. (hold 2 min.) to 330°C @ 30°C/min. (hold 4 min.)

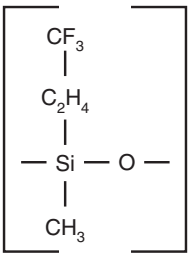
Det.: ECD @ 330°C

Instrument: Shimadzu GC-2010 with ECD



1. hexachlorocyclopentadiene
2. 2,4,5,6-tetrachloro-m-xylene (SS)
3. *cis*-diallate
4. *trans*-diallate
5. α-BHC
6. hexachlorobenzene
7. γ-BHC
8. β-BHC
9. δ-BHC
10. heptachlor
11. aldrin
12. isodrin
13. heptachlor epoxide
14. 2,4'-DDE
15. γ-chlordane
16. α-chlordane
17. endosulfan I
18. 4,4'-DDE
19. 2,4'-DDD
20. dieldrin
21. chlorobenzilate
22. endrin
23. 2,4'-DDT
24. 4,4'-DDD
25. endosulfan II
26. kepone
27. endrin aldehyde
28. 4,4'-DDT
29. endosulfan sulfate
30. methoxychlor
31. endrin ketone
32. mirex
33. decachlorobiphenyl (SS)

Rtx®-200 Structure



similar **phases**

DB-200, DB-210, VF-200ms

Rtx®-200/Rtx®-200MS (fused silica)

- General purpose columns for solvents, Freon® fluorocarbons, alcohols, ketones, silanes, glycols. Excellent confirmation column, with an Rtx®-5 column, for phenols, nitrosamines, organochlorine pesticides, chlorinated hydrocarbons, and chlorophenoxy herbicides.
- Temperature range: -20 °C to 340 °C.
- Equivalent to USP G6 phase.

Rtx®-200 columns have accomplished many difficult separations not possible on any other bonded stationary phase. Many analysts consider these the best, most inert mid-polarity columns available. The trifluoropropyl stationary phase has a unique selectivity that changes elution orders and resolves compounds that phenyl, cyano, or Carbowax® phases can not. The Rtx®-200 column offers exceptional thermal stability, low bleed, and superior inertness—even for active compounds such as phenols, and with sensitive detectors such as ECDs, NPDs, and MSDs.

Rtx®-200 Columns (fused silica)

(midpolarity phase; Crossbond® trifluoropropylmethyl polysiloxane)

ID	df	temp. limits*	15-Meter	30-Meter	60-Meter	105-Meter
0.25mm	0.25µm	-20 to 320/340°C	15020	15023	15026	15029
	0.50µm	-20 to 310/330°C	15035	15038	15041	15044
	1.00µm	-20 to 290/310°C	15050	15053	15056	15059
0.32mm	0.25µm	-20 to 320/340°C	15021	15024	15027	15030
	0.50µm	-20 to 310/330°C	15036	15039	15042	15045
	1.00µm	-20 to 290/310°C	15051	15054	15057	15060
	1.50µm	-20 to 280/300°C	15066	15069	15072	15075
0.53mm	0.25µm	-20 to 310/330°C	15022	15025	15028	
	0.50µm	-20 to 300/320°C	15037	15040	15043	
	1.00µm	-20 to 290/310°C	15052	15055	15058	
	1.50µm	-20 to 280/300°C	15067	15070	15073	
	3.00µm	-20 to 260/280°C	15082	15085	15088	15091

ID	df	temp. limits	10-Meter	20-Meter	40-Meter
0.18mm	0.20µm	-20 to 310/330°C	45001	45002	45003
	0.40µm	-20 to 310/330°C	45010	45011	45012

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

also **available**

Metal MXT® Columns
Rugged, flexible, Siltek® treated stainless steel tubing; inertness comparable to fused silica tubing. See **page 118** for our MXT®-200 columns.

Rtx®-200MS—Low-bleed GC/MS Columns (fused silica)

(midpolarity phase; Crossbond® trifluoropropylmethyl polysiloxane)

Column specifically tested for low bleed performance.

ID	df	temp. limits	30-Meter
0.25mm	0.10µm	-20 to 320/340°C	15608
	0.25µm	-20 to 320/340°C	15623
	0.50µm	-20 to 310/330°C	15638
	1.00µm	-20 to 290/310°C	15653
0.32mm	0.10µm	-20 to 320/340°C	15609
	0.25µm	-20 to 320/340°C	15624
	0.50µm	-20 to 310/330°C	15639
	1.00µm	-20 to 290/310°C	15654

Rtx®-1301 (G43) Columns (fused silica)

(low to midpolarity phase; Crossbond® 6% cyanopropylphenyl/94% dimethyl polysiloxane)

- General purpose columns for residual solvents, alcohols, oxygenates, and volatile organic compounds.
- Temperature range: -20 °C to 280 °C.
- Equivalent to USP G43 phase.

Many analysts feel the Rtx®-1301 column has the best cyanosiloxane bonded stationary phase available, with no other column manufacturer providing lower bleed, longer lifetime, or better inertness. Our polymer is fully characterized to ensure long-term reproducibility, column-to-column consistency, and low bleed—even with sensitive detectors such as ECDs and MSDs.

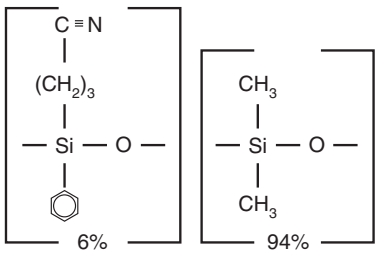
ID	df	temp. limits*	15-Meter	30-Meter		60-Meter	75-Meter	105-Meter
0.25mm	0.25µm	-20 to 280°C	16020	16023	$450	16026		
	0.50µm	-20 to 270°C	16035	16038	$450	16041		
	1.00µm	-20 to 260°C	16050	16053	$450	16056		
	1.40µm	-20 to 240°C				16016		
0.32mm	0.25µm	-20 to 280°C	16021	16024	$480	16027		
	0.50µm	-20 to 270°C	16036	16039	$480	16042		
	1.00µm	-20 to 260°C	16051	16054	$480	16057		
	1.50µm	-20 to 250°C	16066	16069	$480	16072		
	1.80µm	-20 to 240°C		16092	$480	16093		
0.53mm	0.25µm	-20 to 280°C	16022	16025	$540	16028		
	0.50µm	-20 to 270°C	16037	16040	$540	16043		
	1.00µm	-20 to 260°C	16052	16055	$540	16058		
	1.50µm	-20 to 250°C	16067	16070	$540	16073		
	3.00µm	-20 to 240°C	16082	16085	$540	16088	16076	16091

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

please note

Rtx®-1301 columns and Rtx®-624 columns are exactly the same columns.

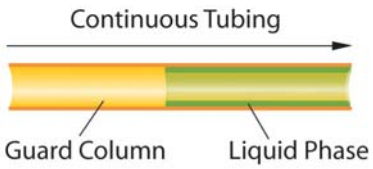
Rtx®-1301 Structure



similar phases

DB-1301, DB-624, HP-1301, HP-624, SPB-1301, SPB-624, VF-1301, VF-624ms, CP-1301, CP-Select 624 CB

Integra-Guard® built-in guard column



Get the protection without the connection!
For Rtx®-1301 and Rtx®-624 columns with built-in Integra-Guard® guard columns, see **page 35**.

Rtx®-624 Columns (fused silica)

(low to midpolarity phase; Crossbond® 6% cyanopropylphenyl/94% dimethyl polysiloxane)

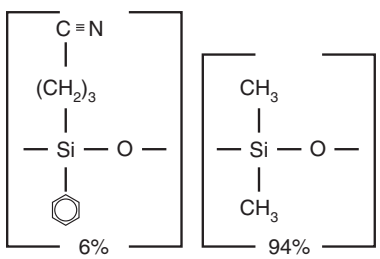
- Application-specific columns for volatile organic pollutants. Recommended in US EPA methods for volatile organic pollutants.
- Temperature range: -20 °C to 240 °C.
- Equivalent to USP G43 phase.

The unique polarity of the Rtx®-624 column makes it ideal for analyzing volatile organic pollutants. Although the Rtx®-502.2 column is recommended in many methods, the Rtx®-624 column offers better resolution of early eluting compounds. The Rtx®-624 phase produces greater than 90% resolution of the first six gases in EPA Methods 8260 and 524.2. This stationary phase is especially well-suited for EPA Method 524.2 revision IV since it resolves 2-nitropropane from 1,1-dichloropropanone, which share quantification ion m/z 43 and must be separated chromatographically.

ID	df	temp. limits	30-Meter	60-Meter	75-Meter	105-Meter
0.25mm	1.40µm	-20 to 240°C	10968	10969		
0.32mm	1.80µm	-20 to 240°C	10970	10972		
0.45mm	2.55µm	-20 to 240°C			10982	
0.53mm	3.00µm	-20 to 240°C	10971	10973	10974	10975

ID	df	temp. limits	20-Meter	40-Meter
0.18mm	1.00µm	-20 to 240°C	40924	40925

Rtx®-624 Structure



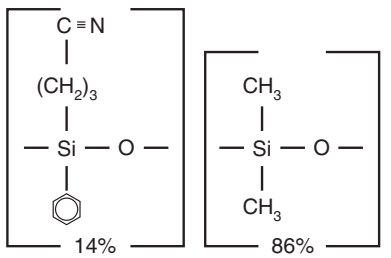
similar phases

DB-1301, DB-624, HP-1301, HP-624, SPB-1301, SPB-624, VF-1301, VF-624ms, CP-1301, CP-Select 624 CB

also available

Metal MXT® Columns
Rugged, flexible, Siltek® treated stainless steel tubing; inertness comparable to fused silica tubing. See **page 117** for our MXT®-1301 columns and **page 121** for our MXT®-624 columns.

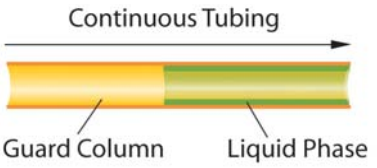
Rtx®-1701 Structure



similar **phases**

DB-1701, HP-1701, SPB-1701, VF-1701, CP-Sil 19 CB

Integra-Guard® built-in guard column

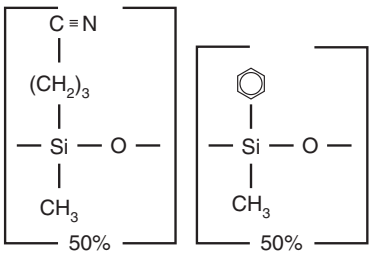


Get the protection without the connection!
For Rtx®-1701 columns with built-in Integra-Guard® guard columns, see **page 35**.

also **available**

Metal MXT® Columns
Rugged, flexible, Siltek® treated stainless steel tubing; inertness comparable to fused silica tubing. See **page 118** for our MXT®-1701 columns.

Rtx®-225 Structure



similar **phases**

DB-225, HP-225, SPB-225, CP-Sil 43 CB

Rtx®-1701 Columns (fused silica)

(midpolarity phase; Crossbond® 14% cyanopropylphenyl/86% dimethyl polysiloxane)

- General purpose columns for alcohols, oxygenates, PCB congeners (e.g. Aroclor mixes), pesticides.
- Temperature range: -20 °C to 280 °C.
- Equivalent to USP G46 phase.

Rtx®-1701 is one of the more popular stationary phases used in capillary GC. The mix of cyano and phenyl functional groups increases the polarity and offers a different elution order relative to less polar Rtx®-1 or Rtx®-5 columns. An Rtx®-1701 column is ideal for confirmation analysis, in combination with an Rtx®-35 or Rtx®-5 column. The polymer is fully characterized to ensure long-term reproducibility, column-to-column consistency, and low bleed, even with sensitive detectors such as ECDs and MSDs.

ID	df	temp. limits*	15-Meter	30-Meter	60-Meter
0.25mm	0.10µm	-20 to 280°C			12011
	0.25µm	-20 to 280°C	12020	12023	12026
	0.50µm	-20 to 270/280°C	12035	12038	12041
	1.00µm	-20 to 260/280°C	12050	12053	12056
0.32mm	0.10µm	-20 to 280°C		12009	
	0.25µm	-20 to 280°C	12021	12024	12027
	0.50µm	-20 to 270/280°C	12036	12039	12042
	1.00µm	-20 to 260/280°C	12051	12054	12057
	1.50µm	-20 to 240/260°C	12066	12069	12072
0.53mm	0.10µm	-20 to 270/280°C	12007		
	0.25µm	-20 to 270/280°C	12022	12025	12028
	0.50µm	-20 to 260/270°C	12037	12040	12043
	1.00µm	-20 to 250/270°C	12052	12055	12058
	1.50µm	-20 to 240/260°C	12067	12070	12073
	3.00µm	-20 to 230/250°C	12082	12085	12088

ID	df	temp. limits	10-Meter	20-Meter
0.10mm	0.10µm	-20 to 280°C	42201	42202
0.18mm	0.20µm	-20 to 280°C	42001	42002
	0.40µm	-20 to 270/280°C	42010	42011

Rtx®-225 Columns (fused silica)

(polar phase; Crossbond® 50% cyanopropylmethyl/50% phenylmethyl polysiloxane)

- General purpose columns for FAMEs, carbohydrates, sterols, flavor compounds.
- Temperature range: 40 °C to 240 °C.
- Equivalent to USP G7, G19 phases.

The cyanopropyl-containing Rtx®-225 phase is slightly less polar than bonded polyethylene glycol (PEG) phases, but it can be used for many of the same applications.

Improvements to the Rtx®-225 polymer have increased thermal stability, reduced bleed, and improved inertness. The Rtx®-225 column provides a 20°C thermal stability advantage over other "225" columns because of our unique polymer synthesis technology and proprietary siloxane deactivation. In most similar columns, the Carbowax® deactivation layer is not fully compatible with the cyanopropyl siloxane polymer, which can cause adsorption, tailing of active compounds, and lower efficiency.

ID	df	temp. limits*	15-Meter	30-Meter	60-Meter
0.25mm	0.10µm	40 to 220/240°C	14005	14008	
	0.25µm	40 to 220/240°C	14020	14023	14026
	0.50µm	40 to 220/240°C	14035	14038	14041
0.32mm	0.10µm	40 to 220/240°C	14006	14009	
	0.25µm	40 to 220/240°C	14021	14024	14027
	0.50µm	40 to 220/240°C	14036	14039	14042
	1.00µm	40 to 200/220°C	14051	14054	14057
0.53mm	0.10µm	40 to 200/220°C	14007	14010	
	0.25µm	40 to 200/220°C	14022	14025	
	0.50µm	40 to 200/220°C	14037	14040	14043
	1.00µm	40 to 200/220°C	14052	14055	14058

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

Rt®-2330 Columns (fused silica)

(highly polar phase; 90% biscyanopropyl/10% phenylcyanopropyl polysiloxane—not bonded)

- General purpose columns for *cis*/*trans* FAMEs, dioxin isomers.
- Temperature range: 0 °C to 275 °C.
- Equivalent to USP G8 and G48 phase.

Rt®-2330 is one of the most polar capillary column stationary phases. Cyano groups on both sides of the polymer backbone give the phase a strong dipole moment and high selectivity for *cis*/*trans* compounds or compounds with conjugated double bonds. Highly polar columns typically exhibit poor column efficiencies, high bleed, and short column lifetimes when thermally cycled. To overcome some of these problems, we developed a surface treatment that is more compatible with the Rt®-2330 phase. In addition, our improved polymer produces columns with improved column efficiency and lower bleed.

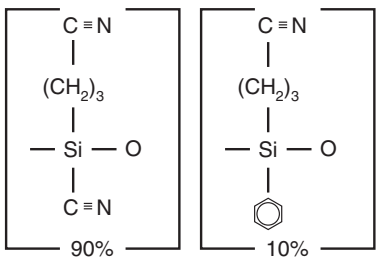
Because the Rt®-2330 stationary phase is not bonded, it should not be solvent rinsed.

ID	df	temp. limits*	30-Meter	60-Meter	105-Meter
0.25mm	0.10µm	0 to 260/275°C	10708	10711	10714
	0.20µm	0 to 260/275°C	10723	10726	10729
0.32mm	0.20µm	0 to 260/275°C	10724	10727	10730
0.53mm	0.10µm	0 to 260/275°C	10710	10713	
	0.20µm	0 to 260/275°C	10725	10728	

ID	df	temp. limits	10-Meter	20-Meter	40-Meter
0.18mm	0.10µm	0 to 260/275°C	40701	40702	40703

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

Rt®-2330 Structure



similar phases

DB-23, HP-23, SP-2330, SP-2380

Doing Dioxin Analysis?
Rtx®-Dioxin2 columns provide better resolution and higher maximum temperatures than conventional columns. See **page 96**.

Rt®-2560 Column (fused silica)

(highly polar phase; biscyanopropyl polysiloxane—not bonded)

- Application-specific column for *cis*/*trans* FAMEs.
- Stable to 250 °C.

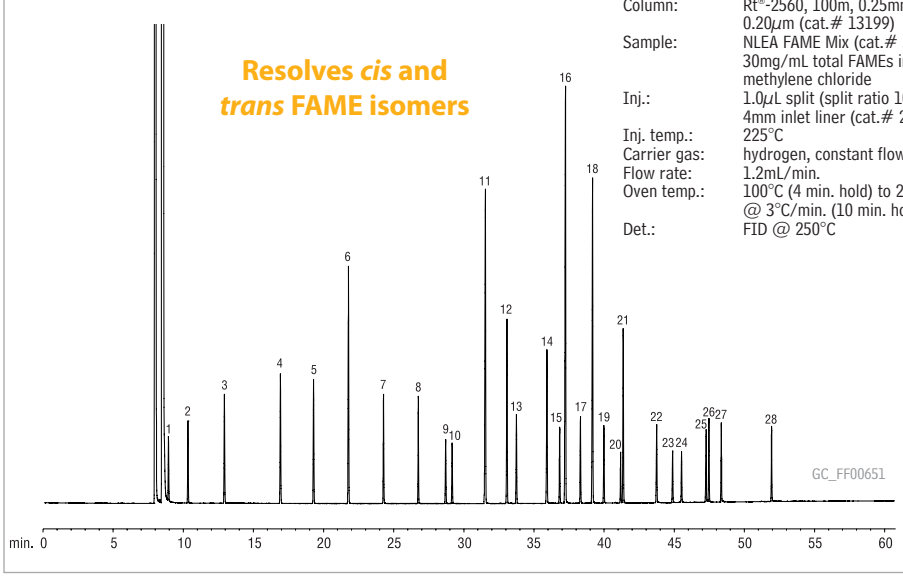
Because the Rt®-2560 stationary phase is not bonded, it should not be solvent rinsed.

ID	df	temp. limits	100-Meter
0.25mm	0.20µm	20 to 250°C	13199

similar phases

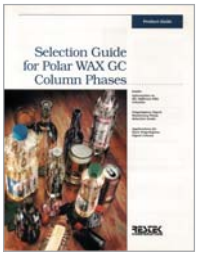
SPB-2560, HP-88, Silar 10C, CP-Sil 88 FAME, CP-Sil 88

NLEA FAMEs resolved on an Rt®-2560 column.



Column: Rt®-2560, 100m, 0.25mm ID, 0.20µm (cat.# 13199)
Sample: NLEA FAME Mix (cat.# 35078), 30mg/mL total FAMEs in methylene chloride
Inj.: 1.0µL split (split ratio 100:1), 4mm inlet liner (cat.# 20814)
Inj. temp.: 225°C
Carrier gas: hydrogen, constant flow
Flow rate: 1.2mL/min.
Oven temp.: 100°C (4 min. hold) to 240°C @ 3°C/min. (10 min. hold)
Det.: FID @ 250°C

1. C4:0 methyl butyrate
2. C6:0 methyl hexanoate
3. C8:0 methyl octanoate
4. C10:0 methyl decanoate
5. C11:0 methyl undecanoate
6. C12:0 methyl laurate
7. C13:0 methyl tridecanoate
8. C14:0 methyl myristate
9. C14:1 methyl myristoleate (*cis*-9)
10. C15:0 methyl pentadecanoate
11. C16:0 methyl palmitate
12. C16:1 methyl palmitoleate (*cis*-9)
13. C17:0 methyl heptadecanoate
14. C18:0 methyl stearate
15. C18:1 methyl elaidate (*trans*-9)
16. C18:1 methyl oleate (*cis*-9)
17. C18:2 methyl linoelaidate (*trans*-9,12)
18. C18:2 methyl linoleate (*cis*-9,12)
19. C20:0 methyl arachidate
20. C20:1 methyl eicosenoate (*cis*-11)
21. C18:3 methyl linolenate (*cis*-9,12,15)
22. C22:0 methyl behenate
23. C22:1 methyl erucate (*cis*-13)
24. C23:0 methyl tricosanoate
25. C24:0 methyl lignocerate
26. C20:5 methyl eicosapentaenoate (*cis*-5,8,11,14,17)
27. C24:1 methyl nervonate (*cis*-15)
28. C22:6 methyl docosahexaenoate (*cis*-4,7,10,13,16,19)



free literature

Selection Guide for Polar Wax GC Column Phases

Download your free copy from **www.restek.com**

lit. cat.# 59890

similar phases

DB-WAX, HP-Wax

Rtx®-Wax Columns (fused silica)

(polar phase; Crossbond® Carbowax® polyethylene glycol)

- Best polyethylene glycol (PEG) phase for alkenols, glycols, and aldehydes.
- Temperature range: 20 °C to 250 °C.
- Equivalent to USP G14, G15, G16, G20, G39 phases.

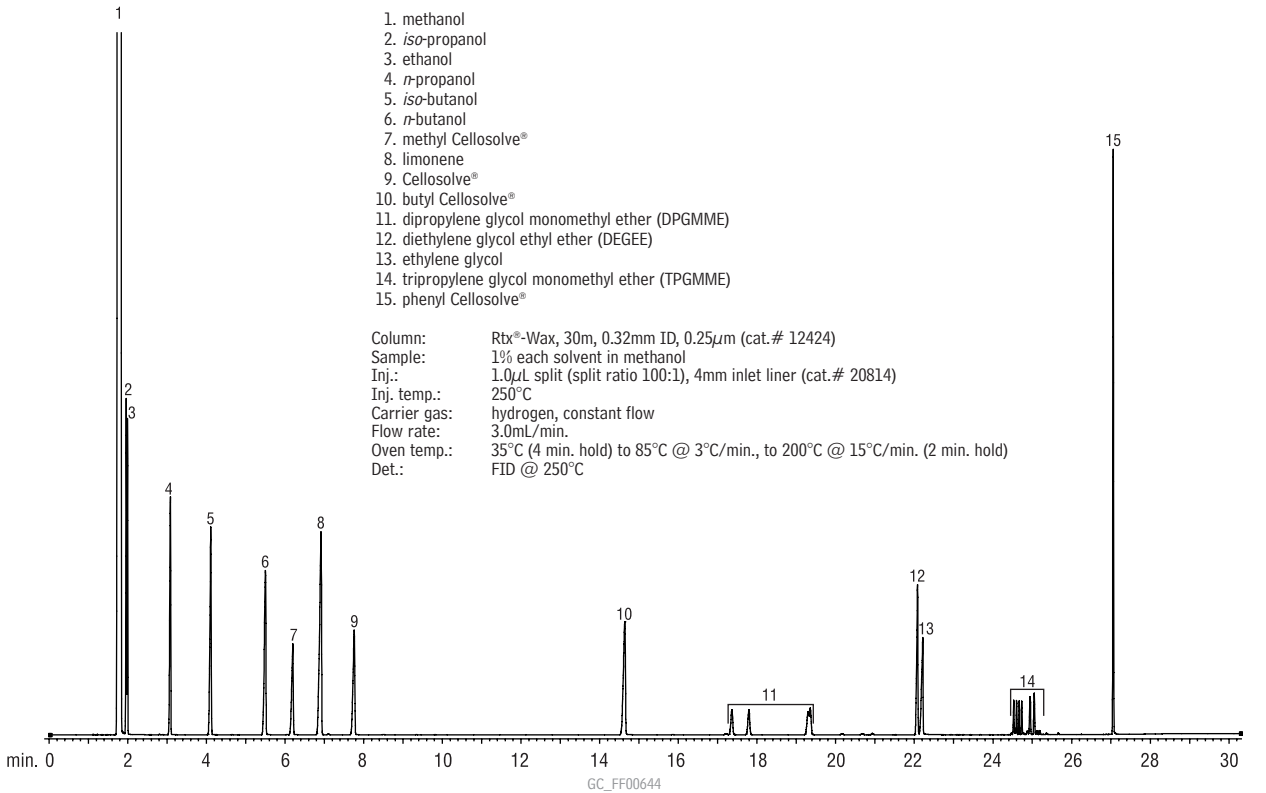
Rtx®-Wax columns are the most inert and efficient PEG columns currently available. The extended operating temperature range allows analysis of compounds having a wide volatility range, and ensures low bleed at temperatures as high as 250 °C. Selectivity is comparable to other Carbowax® columns, for compounds of intermediate to high polarity. Selectivity data available on request.

ID	df	temp. limits*	15-Meter	30-Meter	60-Meter
0.25mm	0.25µm	20 to 250°C	12420	12423	12426
	0.50µm	20 to 250°C	12435	12438	12441
0.32mm	0.25µm	20 to 250°C	12421	12424	12427
	0.50µm	20 to 250°C	12436	12439	12442
	1.00µm	20 to 240/250°C	12451	12454	12457
0.53mm	0.25µm	20 to 250°C	12422	12425	
	0.50µm	20 to 250°C	12437	12440	12443
	1.00µm	20 to 240/250°C	12452	12455	12458

ID	df	temp. limits	10-Meter	20-Meter
0.10mm	0.10µm	20 to 250°C	41601	41602
	0.20µm	20 to 240/250°C	41603	41604

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

Cleaning solvents on an Rtx®-Wax column.



Stabilwax® Columns (fused silica)

(polar phase; Crossbond® Carbowax® polyethylene glycol)

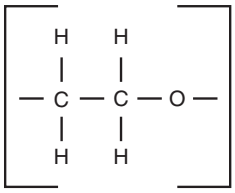
- Most stable polyethylene glycol (PEG) column available.
- Rugged enough to withstand repeated water injections.
- Lowest bleed PEG column on the market; long column lifetimes are assured
- Temperature range: 40 °C to 260 °C.
- Equivalent to USP G14, G15, G16, G20, and G39 phases.

Restek's polar-deactivated surface tightly binds the Carbowax® polymer and increases thermal stability, relative to competitive columns. Because of the increased stability produced by the bonding process, Stabilwax® columns exhibit long column lifetimes, even when programming repeatedly up to 260 °C. The bonding mechanism of the column also produces polar compound retention times that do not shift as is often observed on other wax-type columns. In addition, this bonding mechanism produces a column that can be rejuvenated by solvent washing. Stabilwax® columns are used for a wide range of compounds and matrices including: FAMEs, flavor compounds, essential oils, solvents, aromatics including xylene isomers, acrolein/acrylonitrile (EPA 603), and oxygenated compounds. Also used for purity testing of chemicals and analyzing impurities in water matrices and alcoholic beverages.

ID	df	temp. limits	15-Meter	30-Meter	60-Meter
0.25mm	0.10µm	40 to 250/260°C	10605	10608	10611
	0.25µm	40 to 250/260°C	10620	10623	10626
	0.50µm	40 to 250/260°C	10635	10638	10641
0.32mm	0.25µm	40 to 250/260°C	10621	10624	10627
	0.50µm	40 to 250/260°C	10636	10639	10642
	1.00µm	40 to 240/260°C	10651	10654	10657
0.53mm	0.25µm	40 to 250/260°C	10622	10625	10628
	0.50µm	40 to 250/260°C	10637	10640	10643
	1.00µm	40 to 240/260°C	10652	10655	10658
	1.50µm	40 to 230/240°C	10666	10669	10672
	2.00µm	40 to 220/230°C	10667	10670	

ID	df	temp. limits	10-Meter	20-Meter
0.10mm	0.10µm	40 to 250/260°C	42601	
0.18mm	0.18µm	40 to 250/260°C		40602

Stabilwax® Structure



NEW! manufacturing procedure

Better column-to-column reproducibility

similar phases

DB-WAX, DB-WAXetr, HP-Wax, HP-Innowax, Supelcowax 10, CP-Wax 52 CB

Six columns for the price of five!

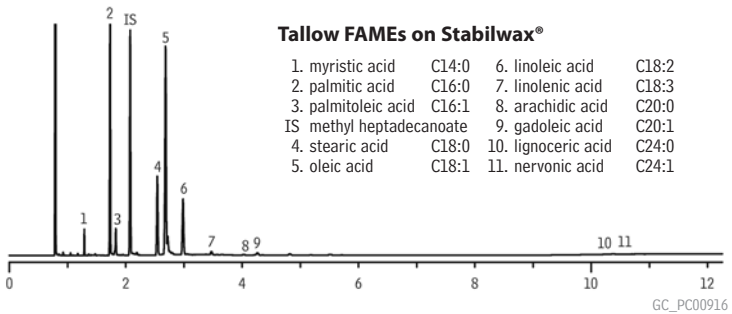
Call 800-356-1688, ext. 4, or your Restek representative for details!

also available

Metal MXT® Columns

Rugged, flexible, Silcosteel® treated stainless steel tubing; inertness comparable to fused silica tubing. See **page 118** for our MXT®-WAX columns.

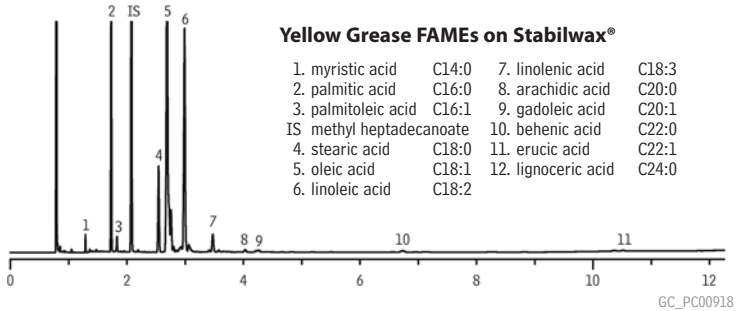
FAMEs in biodiesel oils on a Stabilwax® column.



GC_PC00916

Tallow FAMEs on Stabilwax®

1.	myristic acid	C14:0	6.	linoleic acid	C18:2
2.	palmitic acid	C16:0	7.	linolenic acid	C18:3
3.	palmitoleic acid	C16:1	8.	arachidic acid	C20:0
IS	methyl heptadecanoate		9.	gadoleic acid	C20:1
4.	stearic acid	C18:0	10.	lignoceric acid	C24:0
5.	oleic acid	C18:1	11.	nervonic acid	C24:1



GC_PC00918

Yellow Grease FAMEs on Stabilwax®

1.	myristic acid	C14:0	7.	linolenic acid	C18:3
2.	palmitic acid	C16:0	8.	arachidic acid	C20:0
3.	palmitoleic acid	C16:1	9.	gadoleic acid	C20:1
IS	methyl heptadecanoate		10.	behenic acid	C22:0
4.	stearic acid	C18:0	11.	erucic acid	C22:1
5.	oleic acid	C18:1	12.	lignoceric acid	C24:0
6.	linoleic acid	C18:2			

Column:	Stabilwax®, 30m, 0.32mm ID, 0.25µm (cat.# 10624)
Sample:	various sources of biodiesel (B100), prepared according to European Method EN 14103
Inj.:	1.0µL split (split ratio 100:1), Cyclosplitter® inlet liner (cat.# 20706)
Inj. temp.:	250°C
Carrier gas:	hydrogen, constant flow, 3mL/min.
Linear velocity:	60cm/sec.
Oven temp.:	210°C (hold 5 min.) to 230°C @ 20°C/min. (hold 5 min.)
Det.:	FID @ 250°C

See page 646 for Soy FAMEs and Rapeseed FAMEs analysis.

Fast GC

Fast GC Using 0.10 mm and 0.15 mm ID Capillary Columns

- Significantly reduces analysis time without sacrificing resolution.
- Higher column efficiencies speed up separations.
- Ideal for GC/MS.
- Excellent for comprehensive GC (GCxGC) as second dimension column.

Narrow bore (less than or equal to 0.15 mm ID) columns are attractive alternatives to conventional-diameter capillary columns because they provide faster analysis times and higher resolving power. As column ID decreases, column efficiency (plates/meter) greatly increases. Therefore, resolution can be achieved with a shorter column, which decreases analysis time. In addition, narrow bore columns are more compatible with GC/MS since typical flow rates are 1.0 mL/min. or less, eliminating the need to split the column flow at the MS interface. Conventional methods are easily converted to narrow bore columns, but some research may be necessary due to lower column capacities and higher back pressures.

Rxi®-1ms Columns for Fast GC (fused silica)

(nonpolar phase, Crossbond® 100% dimethyl polysiloxane)

ID	df	temp. limits	10-Meter	20-Meter
0.10mm	0.10µm	-60 to 330/350°C	13301	
0.15mm	0.15µm	-60 to 330/350°C	43800	43801
	2.0µm	-60 to 330/350°C		43802

Rxi®-5ms Columns for Fast GC (fused silica)

(low polarity phase, Crossbond® 5% diphenyl/95% dimethyl polysiloxane)

ID	df	temp. limits	10-Meter
0.10mm	0.10µm	-60 to 330/350°C	13401

Rxi®-5Sil MS Columns for Fast GC (fused silica)

(low polarity Crossbond® silarylene phase; selectivity close to 5% diphenyl/95% dimethyl polysiloxane)

ID	df	temp. limits	10-Meter		20-Meter
0.10mm	0.10µm	-60 to 330/350°C	43601		
0.15mm	0.15µm	-60 to 330/350°C	43815	$295	43816
	2.0µm	-60 to 330/350°C			43817

Rxi®-17 Columns for Fast GC (fused silica)

(midpolarity phase; Crossbond® 50% diphenyl/50% dimethyl polysiloxane)

ID	df	temp. limits	10-Meter
0.10mm	0.10µm	40 to 280/320°C	13501

Rxi®-17Sil MS Columns for Fast GC (fused silica)

(midpolarity Crossbond® silarylene phase; equivalent to 50% phenyl methyl polysiloxane)

ID	df	temp. limits	10-Meter	20-Meter
0.15mm	0.15µm	40 to 340/360°C	43820	43821

Rtx®-200 Columns for Fast GC (fused silica)

(midpolarity phase; Crossbond® trifluoropropylmethyl polysiloxane)

ID	df	temp. limits	10-Meter	20-Meter
0.15mm	0.15µm	-20 to 320/340°C	43835	43836

Stabilwax® Columns for Fast GC (fused silica)

(polar phase; Crossbond® Carbowax® polyethylene glycol)

ID	df	temp. limits	10-Meter	20-Meter
0.10mm	0.10µm	40 to 250/260°C	42601	
0.15mm	0.15µm	40 to 250/260°C	43830	43831

Rt®-LC50 Columns for Fast GC (fused silica)

(polar, dimethyl [50% liquid crystal] polysiloxane)

ID	df	temp. limits	10-Meter
0.10mm	0.10µm	100°C to 270°C	19736

Rtx®-CLPesticides for Fast GC (fused silica)

(proprietary Crossbond® phase)

ID	df	temp. limits	10-Meter
0.10mm	0.10µm	-60 to 310/330°C	43101

Rtx®-CLPesticides2 for Fast GC (fused silica)

(proprietary Crossbond® phase)

ID	df	temp. limits	10-Meter	20-Meter
0.10mm	0.10µm	-60 to 310/330°C	43301	43302

tech tip

Operating considerations for 0.10 mm ID columns

The small degree of extra care involved in using 0.10 mm ID columns will be more than repaid by faster analyses and higher column efficiencies. 0.10 mm ID columns require higher operating pressures (>40 psig), which can result in more ferrule leaks, septum leaks, and sample flashback through leaking syringe plungers. Connections must be monitored and leak-checked more often. Operating a 0.10 mm ID column below optimum pressure will cause poor resolution and other poor performance. Sample capacity also is reduced, relative to wider-bore columns. Take care to not overload the column, and make sure you inject quickly when using split injection.

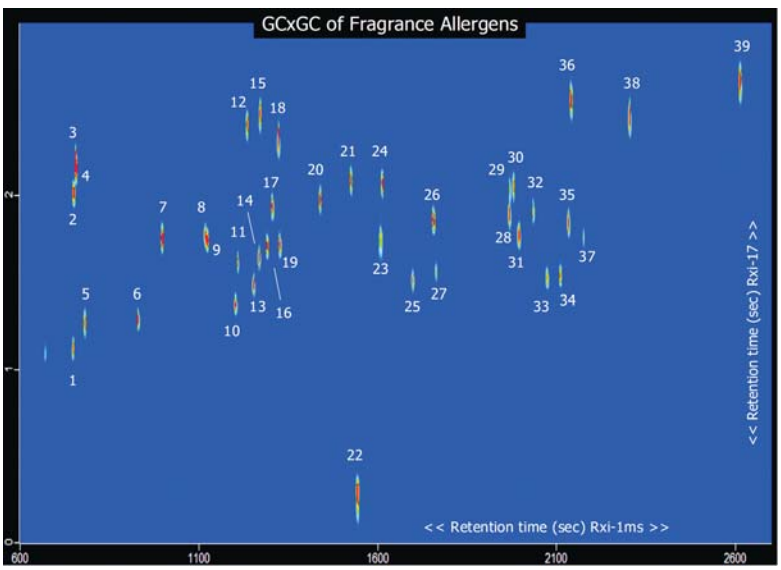
GCxGC Second Dimension Selectivity Kit

The selectivity kit contains four columns of different selectivity for method development.
Includes one each of the following:

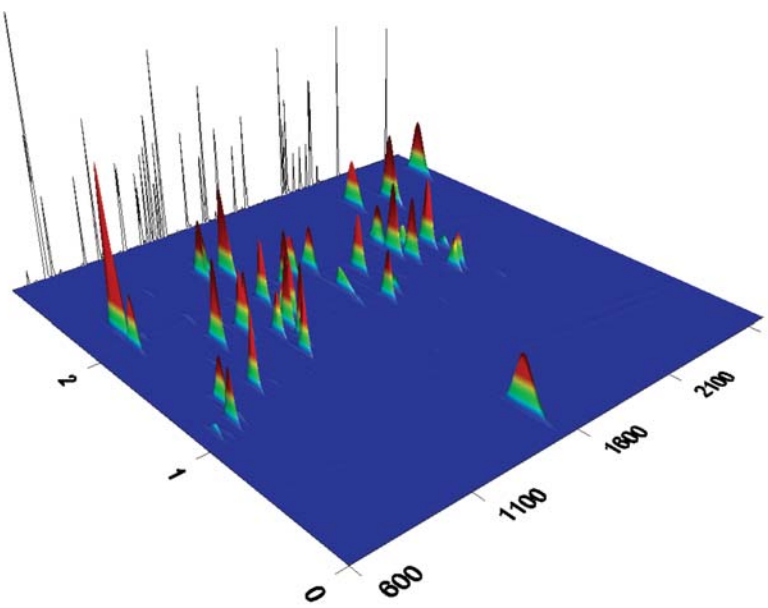
- Rxi®-17, 50% diphenyl dimethylpolysiloxane
- Rtx®-CLPesticides, trifluoropropyl containing polymer
- Stabilwax®, polar polyethylene glycol
- Rt®-LC350, liquid crystalline phase selective for aromatic compounds

Description	qty.	cat.#	price
GCxGC Second Dimension Selectivity Kit	kit	15105	
Columns can also be purchased individually.			
Rxi-17, 1.1m (±3cm), 0.10mm ID, 0.10µm	ea.	15104	
Rtx-CLPesticides, 1.1m (±3cm), 0.10mm ID, 0.10µm	ea.	15103	
Stabilwax, 1.1m (±3cm), 0.10mm ID, 0.10µm	ea.	15102	
Rt-LC350, 1.1m (±3cm), 0.15mm ID, 0.10µm	ea.	15101	

Fragrance Allergens on Rxi®-1ms & Rxi®-17 (GC x GC)



GC_FF01010



GC_FF01011

1. limonene
2. 1-fluoronaphthalene
3. benzyl alcohol
4. phenyl acetaldehyde
5. eucalyptol
6. linalool
7. camphor
8. methyl-2-octynoate
9. estragole
10. citronellol
11. citral 1
12. *trans*-cinnamaldehyde
13. geraniol
14. citral 2
15. anise alcohol
16. hydroxycitronellol
17. safrole
18. cinnamyl alcohol
19. methyl-2-nonynoate
20. eugenol
21. methyl eugenol
22. coumarin
23. hydroxycitronellol contaminant
24. isoeugenol
25. α-isomethyl ionone 1
26. lilial
27. α-isomethyl ionone 2
28. amyl cinnamal
29. lyral 1
30. lyral 2
31. amylcinnamyl alcohol 1
32. amylcinnamyl alcohol 2
33. farnesol 1
34. farnesol 2
35. hexyl cinnamal 1
36. benzyl benzoate
37. hexyl cinnamal 2
38. benzyl salicylate
39. benzyl cinnamate

Columns:	Rxi®-1ms, 30m, 0.25mm ID, 0.25µm (cat.# 13323) Rxi®-17, 1m, 0.10mm ID, 0.10µm (10m, cat.# 13501)
Sample:	fragrance allergens in MTBE
Instrument:	LECO Corporation GCxGC/FID with quad-jet, dual-stage modulator and secondary oven
Inj.:	0.2µL split (split ratio 1:200), 4mm laminar cup splitter (cat.# 20801)
Inj. temp.:	250°C
Carrier gas:	helium, corrected constant flow via pressure ramps
Flow rate:	2mL/min.
Oven temp.:	Rxi®-1ms: 40°C (hold 1 min.) to 240°C @ 4°C/min. Rxi®-17: 45°C (hold 1 min.) to 245°C @ 4°C/min.
Modulation:	modulator temperature offset: 20°C second dimension separation time: 3 sec. hot pulse time: 0.8 sec. cool time between stages: 0.7 sec.
Det.:	FID @ 300°C makeup flow + column flow: 50mL/min. hydrogen: 40mL/min. air: 450mL/min. data collection rate: 200 Hz

Application-Specific Columns

Application-specific columns

- Designed for specific classes of compounds and methods.
- Includes specially deactivated columns.

Many chromatography markets and applications represented

- Foods, Flavors & Fragrances
- Petroleum & Petrochemical
- Clinical, Forensic & Toxicology
- Pharmaceutical
- Environmental

Unique stationary phases and applications

- Designed to help solve chromatographic challenges.
- Optimized stationary phases for best separations, accurate quantification, and best choice for shorter analysis times.

Basic Compounds Analysis

Rtx®-Volatile Amine Columns (fused silica)

- Unique selectivity for baseline resolution of all volatile amines.
- Excellent inertness assures accuracy and sensitivity for volatile amines, including free ammonia.
- Highly robust phase withstands repeated water injections, resulting in longer column lifetime.
- High temperature stability (290 °C) ensures elution of amines up to C16 and allows contaminants to be removed by "baking out" the column.

NEW!

The Rtx®-Volatile Amine column was designed specifically for analyzing volatile amines in difficult matrices, such as water. The unique base deactivation creates an exceptionally inert surface for these sensitive compounds, resulting in highly symmetric peaks which allow low detection limits. The stable bonded phase yields a column that is not only retentive and highly selective for these compounds, but is also very robust and able to withstand repeated water injections. Comparisons made by customers performing routine volatile amine applications have shown the Rtx®-Volatile Amine column outperforms other amine-specific columns, especially for peak shape and lifetime. Each Rtx®-Volatile Amine column is held to stringent quality specifications and tested with a specially designed test mix that includes basic compounds to ensure exceptional inertness, reliability, and reproducibility. These qualities assure consistent performance and make the Rtx®-Volatile Amine column the best choice for volatile amines analysis.

ID	temp. limits	15-Meter	30-Meter	60-Meter
0.32mm	-60 to 290°C	18076	18077	18078

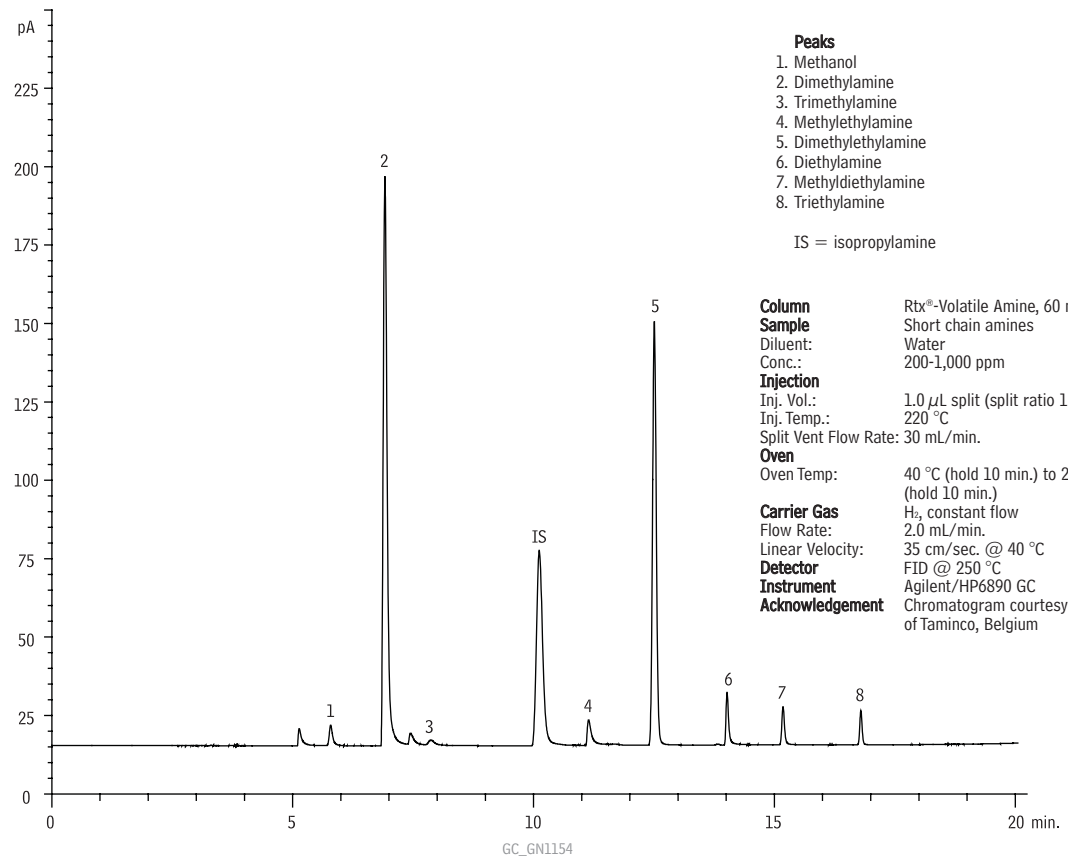
similar **phases**

Direct replacement for CP-Volamine, thick-film CP-Sil 8 for amines, and other amine-deactivated columns coated with low polarity polysiloxane phases.

please **note**

We recommend using base-deactivated fused silica guard columns **(page 34)** and base-deactivated liners (**page 213**) with Rtx®-Volatile Amine columns.

Short chain amines in water on an Rtx®-Volatile Amine column.



Peaks
1. Methanol
2. Dimethylamine
3. Trimethylamine
4. Methylethylamine
5. Dimethylethylamine
6. Diethylamine
7. Methyldiethylamine
8. Triethylamine

IS = isopropylamine

Column	Rtx®-Volatile Amine, 60 m, 0.32 mm ID (cat.# 18078)
Sample	Short chain amines
Diluent:	Water
Conc.:	200-1,000 ppm
Injection	
Inj. Vol.:	1.0 µL split (split ratio 15:1)
Inj. Temp.:	220 °C
Split Vent Flow Rate:	30 mL/min.
Oven	
Oven Temp:	40 °C (hold 10 min.) to 250 °C at 20 °C/min. (hold 10 min.)
Carrier Gas	H_2, constant flow
Flow Rate:	2.0 mL/min.
Linear Velocity:	35 cm/sec. @ 40 °C
Detector	FID @ 250 °C
Instrument	Agilent/HP6890 GC
Acknowledgement	Chromatogram courtesy of Mr. Gilbert Baele of Taminco, Belgium

restek
innovation!

Basic Compounds Analysis

Rtx®-5 Amine Columns (fused silica)
(low polarity phase; Crossbond® 5% diphenyl/95% dimethyl polysiloxane)

- Application-specific columns for amines and other basic compounds, including alkylamines, diamines, triamines, ethanolamines, and nitrogen-containing heterocyclics.
- Stable to 315 °C.

Active basic compounds that otherwise require derivatization, or an alternative analytical technique, can be analyzed on an Rtx®-5 Amine column. The tubing surface is chemically altered to reduce tailing of basic compounds, eliminating the need for column priming. An Rtx®-5 Amine column is ideal for analyzing a wide variety of basic compounds, but breakthrough technology also allows the analysis of neutral compounds, adsorptive compounds with oxygen groups susceptible to hydrogen bonding, or even weakly acidic compounds such as phenols. Every Rtx®-5 Amine column is tested to ensure that it exceeds the requirements for analyzing ppm levels of amines, without priming, and to ensure low bleed at maximum operating temperature.

ID	df	temp. limits	15-Meter	30-Meter
0.25mm	0.25µm	-60 to 300/315°C	12320	12323
	0.50µm	-60 to 300/315°C	12335	12338
	1.00µm	-60 to 300/315°C	12350	12353
0.32mm	1.00µm	-60 to 300/315°C	12351	12354
	1.50µm	-60 to 290/305°C	12366	12369
0.53mm	1.00µm	-60 to 290/305°C	12352	12355
	3.00µm	-60 to 280/295°C	12382	12385

similar **phase**

PTA-5, CP-Sil CB

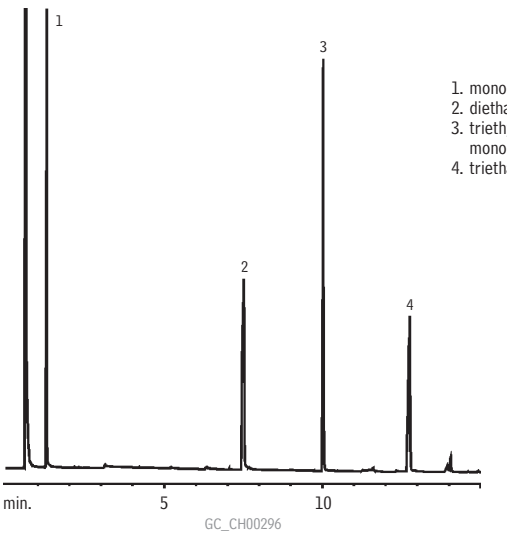
also **available**

See **page 65** for Rtx®-35 Amine columns.

please **note**

We recommend using base-deactivated fused silica guard columns **(page 34)** and base-deactivated liners (**page 213**) with Rtx®-5 Amine columns.

Ethanolamines on an Rtx®-5 Amine column.



1. monoethanolamine
2. diethanolamine
3. triethylene glycol monomethylether (IS)
4. triethanolamine

Column:	Rtx®-5 Amine, 15m, 0.25mm ID, 0.50µm (cat.# 12335)
Sample:	1.0µL split injection of ethanolamine mix in methanol
On-column conc.:	34ng
Oven temp.:	50°C (hold 2 min.) to 180°C @ 10°C/min. (hold 2 min.)
Inj./det. temp.:	280°C/300°C
Carrier gas:	hydrogen
Linear velocity:	43cm/sec. set @ 50°C
FID sensitivity:	6.4 x 10^{-11} AFS
Split ratio:	58:1

Basic Compounds Analysis

Rtx®-35 Amine Columns (fused silica)
(midpolarity phase; Crossbond® 35% diphenyl/65% dimethyl polysiloxane)

- Application-specific columns for amines and other basic compounds, including alkylamines, diamines, triamines, ethanolamines, and nitrogen-containing heterocyclics.
- Stable to 220 °C.

Active basic compounds that otherwise require derivatization, or an alternative analytical technique, can be analyzed on an Rtx®-35 Amine column. The tubing surface is chemically altered to reduce tailing of basic compounds, eliminating the need for column priming. An Rtx®-35 Amine column is ideal for analyzing a wide variety of basic compounds, but breakthrough technology also allows the analysis of neutral compounds, adsorptive compounds with oxygen groups susceptible to hydrogen bonding. Every Rtx®-35 Amine column is tested to ensure that it meets the requirements for analyzing ppm levels of amines, without priming, and to ensure low bleed at maximum operating temperature.

ID	df	temp. limits	15-Meter	30-Meter
0.25mm	0.50µm	0 to 220°C	11335	11338
	1.00µm	0 to 220°C	11350	11353
0.32mm	1.00µm	0 to 220°C	11351	11354
	1.50µm	0 to 220°C	11366	11369
0.53mm	1.00µm	0 to 220°C	11352	11355
	3.00µm	0 to 220°C	11382	11385

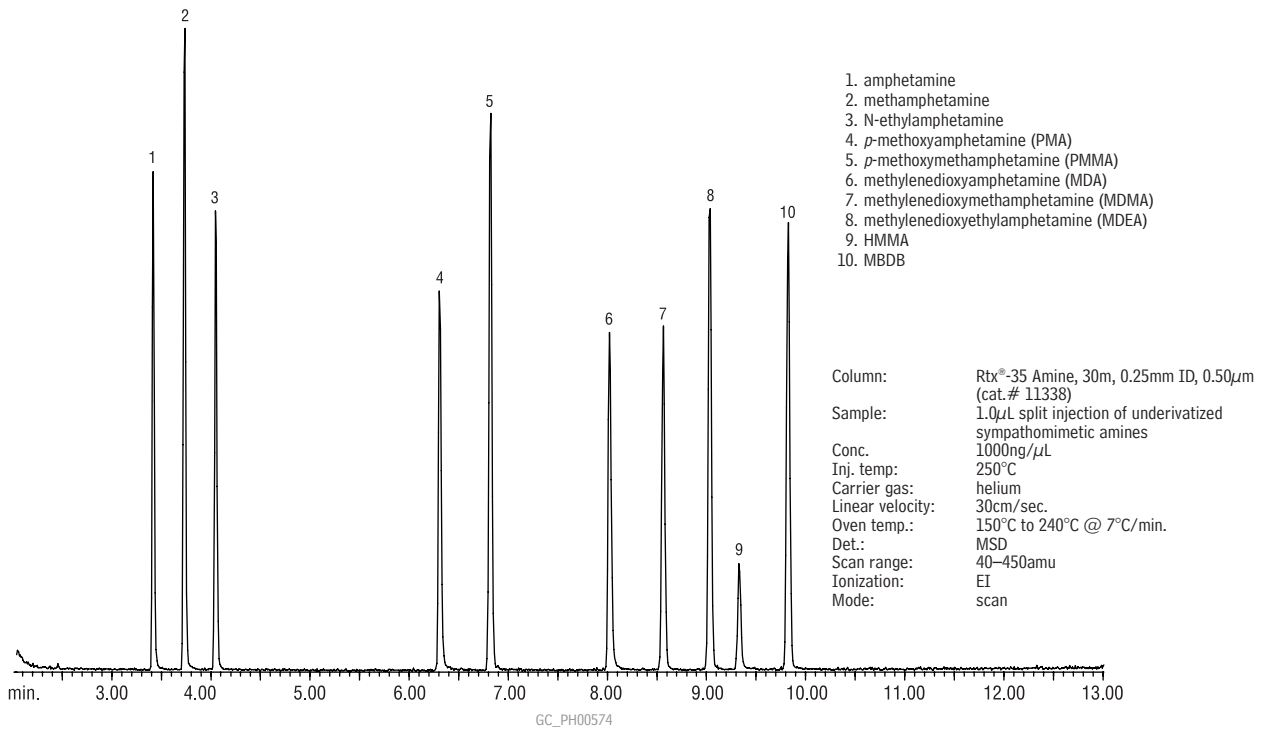
restek **innovation!**

please **note**

We recommend using base-deactivated fused silica guard columns **(page 34)** and base-deactivated liners (**page 213**) with Rtx®-35 Amine columns.

Table of Contents for
GC Chromatograms
see **page 542**

Sympathomimetic amines (basic drugs) (underivatized) on an Rtx®-35 Amine column.



1. amphetamine
2. methamphetamine
3. N-ethylamphetamine
4. *p*-methoxyamphetamine (PMA)
5. *p*-methoxymethamphetamine (PMMA)
6. methylenedioxyamphetamine (MDA)
7. methylenedioxymethamphetamine (MDMA)
8. methylenedioxyethylamphetamine (MDEA)
9. HMMA
10. MBDB

Column:	Rtx®-35 Amine, 30m, 0.25mm ID, 0.50µm (cat.# 11338)
Sample:	1.0µL split injection of underivatized sympathomimetic amines
Conc.	1000ng/µL
Inj. temp:	250°C
Carrier gas:	helium
Linear velocity:	30cm/sec.
Oven temp.:	150°C to 240°C @ 7°C/min.
Det.:	MSD
Scan range:	40–450amu
Ionization:	EI
Mode:	scan

Basic Compounds Analysis

free literature

GC Analysis of Non-Purgeable Solvents in Pharmaceutical Discharges

Download your free copy from **www.restek.com**

lit. cat.# 580027

similar phases

DB-CAM, Carbowax® Amine, CP Wax 51 for amines

Stabilwax®-DB Columns (fused silica)

(polar phase; Crossbond® base-deactivated Carbowax® polyethylene glycol—for amines and basic compounds)

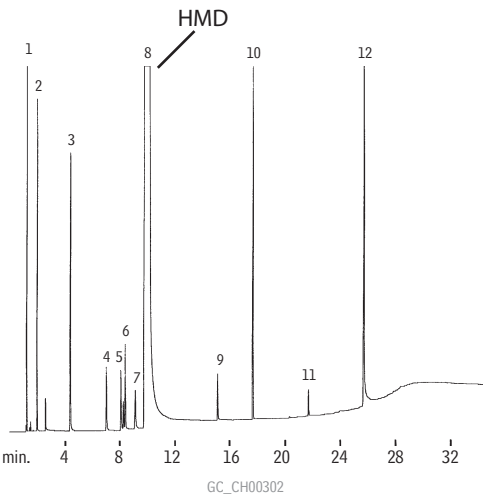
- Application-specific columns for underivatized amines and other basic compounds, including alkylamines, diamines, triamines, nitrogen-containing heterocyclics. No need for column priming.
- Temperature range: 40 °C to 220 °C.

Stabilwax®-DB columns reduce adsorption and improve responses for many basic compounds, without analyte derivatization or column priming. For different selectivity of basic compounds, or higher oven temperatures, use an Rtx®-5 Amine column.

Stabilwax®-DB is a bonded stationary phase, but avoid rinsing these columns with water or alcohols.

ID	df	temp. limits	15-Meter	30-Meter	60-Meter
0.25mm	0.25µm	40 to 210/220°C	10820	10823	
	0.50µm	40 to 210/220°C		10838	
0.32mm	0.25µm	40 to 210/220°C	10821	10824	
	0.50µm	40 to 210/220°C		10839	
	1.00µm	40 to 210/220°C	10851	10854	10857
0.53mm	0.50µm	40 to 210/220°C		10840	
	1.00µm	40 to 210/220°C	10852	10855	10858
	1.50µm	40 to 210/220°C		10869	

Hexamethylenediamine (HMD) on a Stabilwax®-DB column.



GC_CH00302

Excellent resolution and peak shape for impurities in HMD!

1. cyclohexane
2. hexamethyleneimine
3. 1,4-diaminobutane
4. pentamethylenediamine
5. 1,2-diaminocyclohexane
6. 1,5-diamino-2-methylpentane
7. aminomethylcyclopentylamine
8. hexamethylenediamine
9. 6-aminocapronitrile
10. *n*-valeramide
11. adiponitrile
12. bis-hexamethylenetriamine

Column:	Stabilwax®-DB, 30m, 0.32mm ID, 0.25µm (cat.# 10824)
Sample:	0.4µL direct injection of a neat hexamethylenediamine (HMD) sample
On-column conc.:	10 to 1,000ng/component
Oven temp.:	95°C (hold 6 min.) to 235°C @ 7°C/min. (hold 4 min.)
Inj./det. temp.:	250°C
Carrier gas:	hydrogen
Linear velocity:	40cm/sec.
FID sensitivity:	2 x 10^{-11} AFS

Acidic Compounds Analysis

Stabilwax®-DA Columns (fused silica)

(polar phase; Crossbond® acid-deactivated Carbowax® polyethylene glycol—for acidic compounds)

- Application-specific columns for free (underivatized) acids, some inorganic acids.
- Resistant to oxidative damage.
- Temperature range: 40 °C to 250 °C.
- Equivalent to USP G25, G35 phases.

Stabilwax®-DA bonded polyethylene glycol has an acidic functionality incorporated into the polymer structure. This permits analysis of acidic compounds without derivatization, significantly reduces adsorption of acids, and increases sample capacity for volatile free acids. Stabilwax®-DA columns last longer and give better peak shapes for high molecular weight acids. Some inorganic acids also chromatograph well on a Stabilwax®-DA column; the limitation is the volatility of the acidic compound.

similar phases

DB-FFAP, HP-FFAP, NUKOL, OV-351, CP-Wax 58 CB, FFAP

crossbond® technology

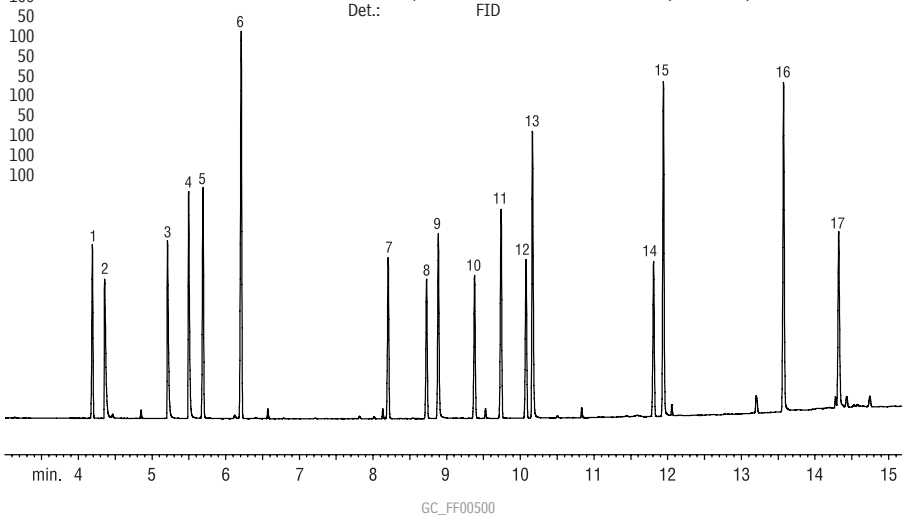
reduces bleed, prolongs column lifetime, and allows rejuvenation through solvent rinsing.

ID	df	temp. limits	15-Meter	30-Meter	60-Meter
0.25mm	0.10µm	40 to 250°C	11005	11008	11011
	0.25µm	40 to 250°C	11020	11023	11026
	0.50µm	40 to 250°C	11035	11038	11041
0.32mm	0.10µm	40 to 250°C	11006	11009	11012
	0.25µm	40 to 250°C	11021	11024	11027
	0.50µm	40 to 250°C	11036	11039	11042
	1.00µm	40 to 240/250°C	11051	11054	11057
0.53mm	0.10µm	40 to 250°C	11007	11010	11013
	0.25µm	40 to 250°C	11022	11025	11028
	0.50µm	40 to 250°C	11037	11040	11043
	1.00µm	40 to 240/250°C	11052	11055	11058
	1.50µm	40 to 230/240°C	11062	11065	11068

Underivatized alcoholic beverage acids and methyl esters on a Stabilwax®-DA column.

Peak List	Conc. (ppm)
1. ethyl octanoate	100
2. acetic acid	100
3. propionic acid	100
4. isobutyric acid	100
5. 3-decanol	50
6. ethyl decanoate	50
7. ethyl laurate	50
8. *cis*-lactone	100
9. 2-phenylethanol	50
10. *trans*-lactone	100
11. methyl myristate	50
12. ethyl myristate	50
13. octanoic acid	100
14. ethyl palmitate	50
15. decanoic acid	100
16. dodecanoic acid	100
17. vanillin	100

Column:	Stabilwax®-DA, 30m, 0.18mm ID, 0.18µm (cat.# 550752)
Inj.:	1µL splitless (hold 0.5 min.) at conc. shown in peak list, in ethyl acetate, 4mm ID splitless liner w/wool (cat.# 20814-202.1)
Inj. temp.:	240°C
Carrier gas:	hydrogen
Make-up gas:	nitrogen
Linear velocity:	28psi @ 240°C
Oven temp.:	70°C to 240°C at 12°C/min. (hold 3 min.)
Det.:	FID



GC_FF00500

Enantiomers Analysis

Cyclodextrin Columns for Analyzing Many Chiral Compounds

By adding β or γ cyclodextrin to our bonded Rtx®-1701 stationary phase, we greatly enhance overall utility and column lifetime for our chiral columns, compared to columns that have pure cyclodextrin stationary phases. Separations of more than one hundred chiral compounds have been achieved using our unique DEX columns, and our columns continue to demonstrate stability after hundreds of temperature program cycles.

Rt®-βDEXm Columns (fused silica)

(permethylated beta cyclodextrin doped into 14% cyanopropylphenyl/86% dimethyl polysiloxane)
Uses: General purpose chiral phase with many published applications.

ID	df	temp. limits	30-Meter
0.25mm	0.25µm	40 to 230°C	13100
0.32mm	0.25µm	40 to 230°C	13101

Rt®-βDEXsm Columns (fused silica)

(2,3-di-O-methyl-6-O-*tert*-butyl dimethylsilyl beta cyclodextrin doped into 14% cyanopropylphenyl/86% dimethyl polysiloxane)
Uses: Excellent column for most chiral compounds in essential oils.

ID	df	temp. limits	30-Meter
0.25mm	0.25µm	40 to 230°C	13105
0.32mm	0.25µm	40 to 230°C	13104

Rt®-βDEXse Columns (fused silica)

(2,3-di-O-ethyl-6-O-*tert*-butyl dimethylsilyl beta cyclodextrin doped into 14% cyanopropylphenyl/86% dimethyl polysiloxane)
Uses: Similar in performance to Rt-βDEXsm but provides better resolution for limonene, linalool, linalyl acetate, ethyl-2-methylbutyrate, 2,3-butane diol, and styrene oxides.

ID	df	temp. limits	30-Meter
0.25mm	0.25µm	40 to 230°C	13107
0.32mm	0.25µm	40 to 230°C	13106

Rt®-βDEXsp Columns (fused silica)

(2,3-di-O-propyl-6-O-*tert*-butyl dimethylsilyl beta cyclodextrin doped into 14% cyanopropylphenyl/86% dimethyl polysiloxane)
Uses: Often useful in dual-column configurations, with the Rt-βDEXsm column, for complex enantiomeric separations.

ID	df	temp. limits	30-Meter
0.25mm	0.25µm	40 to 230°C	13111
0.32mm	0.25µm	40 to 230°C	13110

Rt®-βDEXsa Columns (fused silica)

(2,3-di-acetoxy-6-O-*tert*-butyl dimethylsilyl beta cyclodextrin doped into 14% cyanopropylphenyl/86% dimethyl polysiloxane)
Uses: Unique selectivity for esters, lactones, and other fruit flavor components.

ID	df	temp. limits	30-Meter
0.25mm	0.25µm	40 to 230°C	13109
0.32mm	0.25µm	40 to 230°C	13108

Rt®-βDEXcst Columns (fused silica)

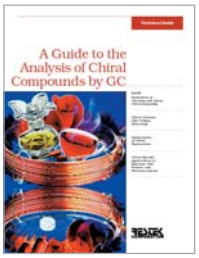
(Proprietary cyclodextrin material doped into 14% cyanopropylphenyl/86% dimethyl polysiloxane)
Uses: Proprietary stationary phase, developed specifically for the fragrance industry. Also used for pharmaceutical applications.

ID	df	temp. limits	30-Meter
0.25mm	0.25µm	40 to 230°C	13103
0.32mm	0.25µm	40 to 230°C	13102

Rt®-γDEXsa Columns (fused silica)

(2,3-di-acetoxy-6-O-*tert*-butyl dimethylsilyl gamma cyclodextrin doped into 14% cyanopropylphenyl/86% dimethyl polysiloxane)
Uses: Larger organic molecules. Also useful for flavor compounds in fruit juices.

ID	df	temp. limits	30-Meter
0.25mm	0.25µm	40 to 230°C	13113
0.32mm	0.25µm	40 to 230°C	13112



free literature

A Guide to the Analysis of Chiral Compounds by GC

Download your free copy from **www.restek.com**

lit. cat.# 59889

please **note**

Application-specific chiral column kits are available! See **www.restek.com**

tech tip

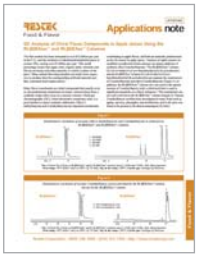
Chiral selectivity improves significantly by realizing lower elution temperatures.
This can be achieved by:

- Faster linear velocities (80 cm/sec.) with hydrogen carrier gas.
- Slower temperature ramp rates (1–2 °C/min.).
- Appropriate minimum operating temperature (40 or 60 °C).
- On-column concentrations of 50 ng or less.

free literature

Grape Flavor Analysis, Using an Rt®-γDEXsa GC Column

lit. cat.# 59553



GC Analysis of Chiral Flavor Compounds in Apple Juices, Using Rt®-βDEXsm and Rt®-βDEXse Columns

lit. cat.# 59546

Download your free copies from **www.restek.com**

cis/trans FAMEs

Rt®-2560 Column (fused silica)
(highly polar phase; biscyanopropyl polysiloxane—not bonded)

- Application-specific column for *cis/trans* FAMEs.
- Stable to 250 °C.

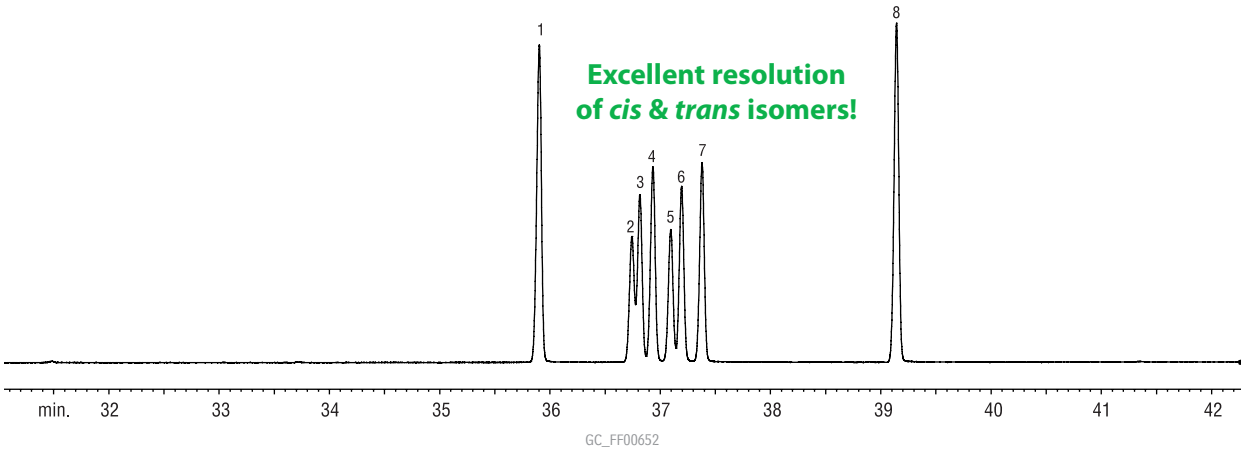
Because the Rt®-2560 stationary phase is not bonded, it should not be solvent rinsed.

ID	df	temp. limits	100-Meter
0.25mm	0.20µm	20 to 250°C	13199

similar **phases**

SPB-2560, HP-88, Silar 10C, CP-Sil 88 FAME, CP-Sil 88

FAMEs (*cis/trans* isomers) on an Rt®-2560 column.



GC_FF00652

Column:	Rt®-2560, 100m, 0.25mm ID, 0.2µm (cat.# 13199)
Sample:	*cis/trans* FAME Mix (cat.# 35079), 10mg/mL total FAMEs in methylene chloride
Inj.:	1.0µL split (split ratio 20:1), 4mm inlet liner (cat.# 20814)
Inj. temp.:	225°C
Carrier gas:	hydrogen, constant flow
Flow rate:	1.2mL/min.
Oven temp.:	100°C (4 min. hold) to 240°C @ 3°C/min. (10 min. hold)
Det.:	FID @ 250°C

Compound	% in Mix
1. C18:0 methyl stearate	20.0
2. C18:1 methyl petroselaidate (*trans*-6)	8.0
3. C18:1 methyl elaidate (*trans*-9)	10.0
4. C18:1 methyl transvaccenate (*trans*-11)	12.0
5. C18:1 methyl petroselinate (*cis*-6)	8.0
6. C18:1 methyl oleate (*cis*-9)	10.0
7. C18:1 methyl vaccenate (*cis*-11)	12.0
8. C18:2 methyl linoleate (*cis*-9,12)	20.0

Polyunsaturated FAME Analysis

FAMEWAX Columns (fused silica)
(polar phase; Crossbond® polyethylene glycol)

- Application-specific columns for FAMEs, specially tested with a FAME mixture.
- Temperature range: 20 °C to 250 °C.

The elution order of polyunsaturated FAMEs on FAMEWAX columns is comparable to that on other Carbowax® columns, but baseline resolution is achieved in significantly less time.

similar **phase**

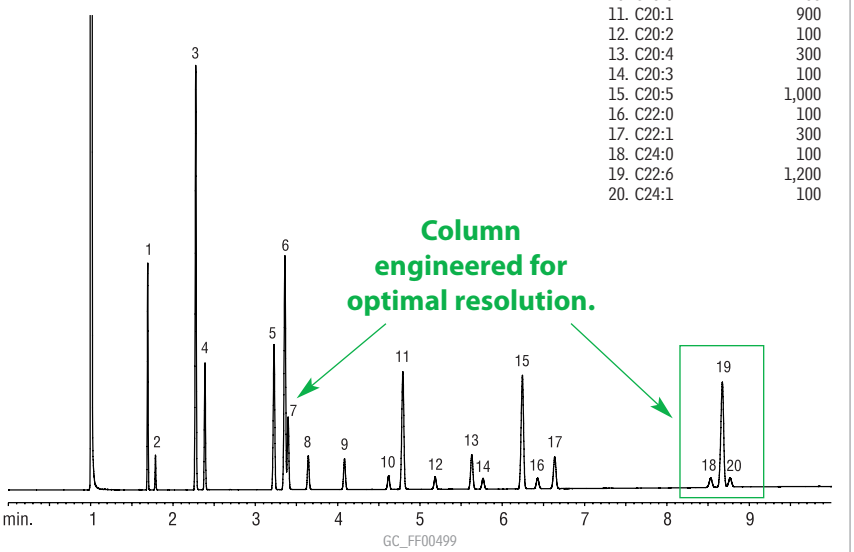
Omegawax

ID	df	temp. limits	30-Meter
0.25mm	0.25µm	20 to 250°C	12497
0.32mm	0.25µm	20 to 250°C	12498
0.53mm	0.50µm	20 to 250°C	12499

FAMEs (marine oil standard) on a FAMEWAX column.

Column:	FAMEWAX, 30m, 0.32mm ID, 0.25µm (cat.# 12498)
Inj.:	1µL
Conc.:	10,000µg/mL in isooctane (total FAMES; see breakdown in peak list)
Oven temp.:	195–240°C at 5°C/min., 1 min. hold
Inj./det. temp.:	250°C/275°C
Carrier gas:	hydrogen
Flow rate:	3mL/min. (constant flow)
Split ratio:	100:1

Peak List	Conc. (µg/mL)
1. C14:0	600
2. C14:1	100
3. C16:0	1,600
4. C16:1	500
5. C18:0	800
6. C18:1 (oleate)	1,300
7. C18:1 (vaccenate)	400
8. C18:2	200
9. C18:3	200
10. C20:0	100
11. C20:1	900
12. C20:2	100
13. C20:4	300
14. C20:3	100
15. C20:5	1,000
16. C22:0	100
17. C22:1	300
18. C24:0	100
19. C22:6	1,200
20. C24:1	100



Flavor & Fragrance Compounds Analysis

Perfect confirmation column for F&F analysis!

Rt®-CW20M F&F Columns (fused silica)

(polar phase; Carbowax® polyethylene glycol—not bonded)

- Application-specific columns for flavor and fragrance compounds, specially tested.
- True nonbonded Carbowax® 20M polarity.
- Temperature range: 60 °C to 220 °C.

ID	df	temp. limits	30-Meter	50-Meter
0.25mm	0.25µm	60 to 220°C	12523	
0.32mm	0.33µm	60 to 220°C		12539

similar **phases**

HP-20M, Carbowax® 20M

Rtx®-1 F&F Columns (fused silica)

(nonpolar phase; Crossbond® 100% dimethyl polysiloxane)

- Application-specific columns for flavor and fragrance compounds.
- Stable to 350 °C.

Retention index libraries in the flavor and fragrance industry have been compiled from years of data and thousands of compounds. Any slight variation in column selectivity could render the column useless. Rtx®-1 F&F columns are tailored to match the selectivity required in the industry, while offering excellent thermal stability. Our stringent quality testing ensures column-to-column reproducibility and extended column lifetimes over conventional 100% dimethyl polysiloxane columns.

ID	df	temp. limits	30-Meter	50-Meter
0.25mm	0.25µm	-60 to 330/350°C	18023	
	0.50µm	-60 to 330/350°C	18038	
	1.00µm	-60 to 320/340°C	18053	
0.32mm	0.25µm	-60 to 330/350°C	18024	
	0.50µm	-60 to 330/350°C	18039	18010
	1.00µm	-60 to 320°C	18054	

similar **phase**

HP-1

Al Carusone, Technical Service

Technical Service

Do you have a technical question? Restek's Technical Service group has answers! Drawing from our extensive libraries of technical information and many years of collective chromatography experience, the experts in Technical Service can help you from set-up to method development.

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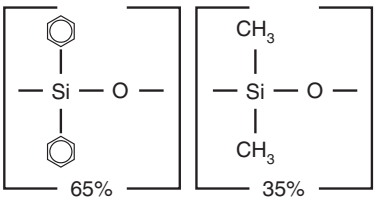
Triglycerides in Foods Analysis

Rtx®-65TG Structure



save **money**!

Get six columns for the price of five.
Call 800-356-1688, ext. 4, or your Restek representative for details!

crossbond® **technology**

reduces bleed, prolongs column lifetime, and allows rejuvenation through solvent rinsing.

please **note**

Triglycerides are often injected via on-column injection. Use 0.53 mm retention gaps and appropriate connectors.

- Vu2 Union® (see page 289)
- MXT®-Union Connector Kits for Fused Silica (see page 292)

Rtx®-65TG Columns (fused silica)
(high polarity phase; Crossbond® 65% diphenyl/35% dimethyl polysiloxane)

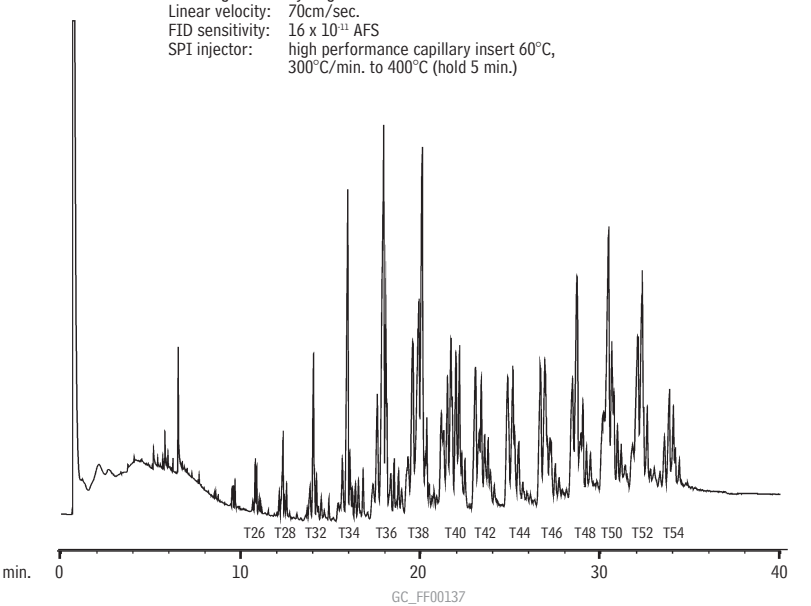
- Application-specific columns, specially tested for triglycerides.
- Stable to 370 °C.

The Rtx®-65TG phase resolves triglycerides by degree of unsaturation as well as by carbon number. Because of the chemistry required to achieve 370 °C thermal stability, an Rtx®-65TG column should not be used for the analyses of polar compounds.

ID	df	temp. limits	15-Meter	30-Meter
0.25mm	0.10µm	40 to 370°C	17005	17008
0.32mm	0.10µm	40 to 370°C	17006	17009
0.53mm	0.10µm	40 to 370°C	17007	17010

Sharp resolution of butter triglycerides on an Rtx®-65TG column.

Column: Rtx®-65TG, 30m, 0.25mm ID, 0.10µm (cat.# 17008)
Sample: 0.2µL cold on-column injection of 1% butterfat in isooctane
Oven temp.: 80°C (hold 1 min.) to 240°C @ 30°C/min. to 360°C @ 4°C/min. (hold 5 min.)
Det. temp.: 380°C
Carrier gas: hydrogen
Linear velocity: 70cm/sec.
FID sensitivity: 16 x 10^{-11} AFS
SPI injector: high performance capillary insert 60°C, 300°C/min. to 400°C (hold 5 min.)



PAHs in Foods Analysis

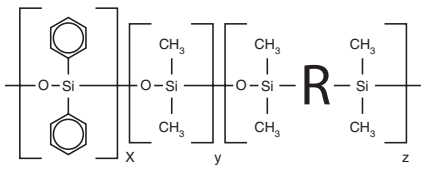
Rxi®-17Sil MS Columns (fused silica)

(midpolarity Crossbond® silarylene phase; equivalent to 50% phenyl/ 50% dimethyl arylene polysiloxane)

- 340/360 °C upper temperature limits.
- Excellent inertness for active compounds.
- Equivalent to USP phase G3.
- Low-bleed for use with sensitive detectors, such as GC/MS.
- Excellent separation of EU-PAHs, including fluoranthenes.

NEW!

Rxi®-17Sil MS Structure



ID	df	temp. limits*	15-Meter	30-Meter	60-Meter
0.25mm	0.25µm	40 to 340/360°C	14120	14123	14126
0.32mm	0.25µm	40 to 340/360°C	14121	14124	

ID	df	temp. limits	20-Meter
0.18mm	0.18µm	40 to 340/360°C	14102
	0.36µm	40 to 340/360°C	14111

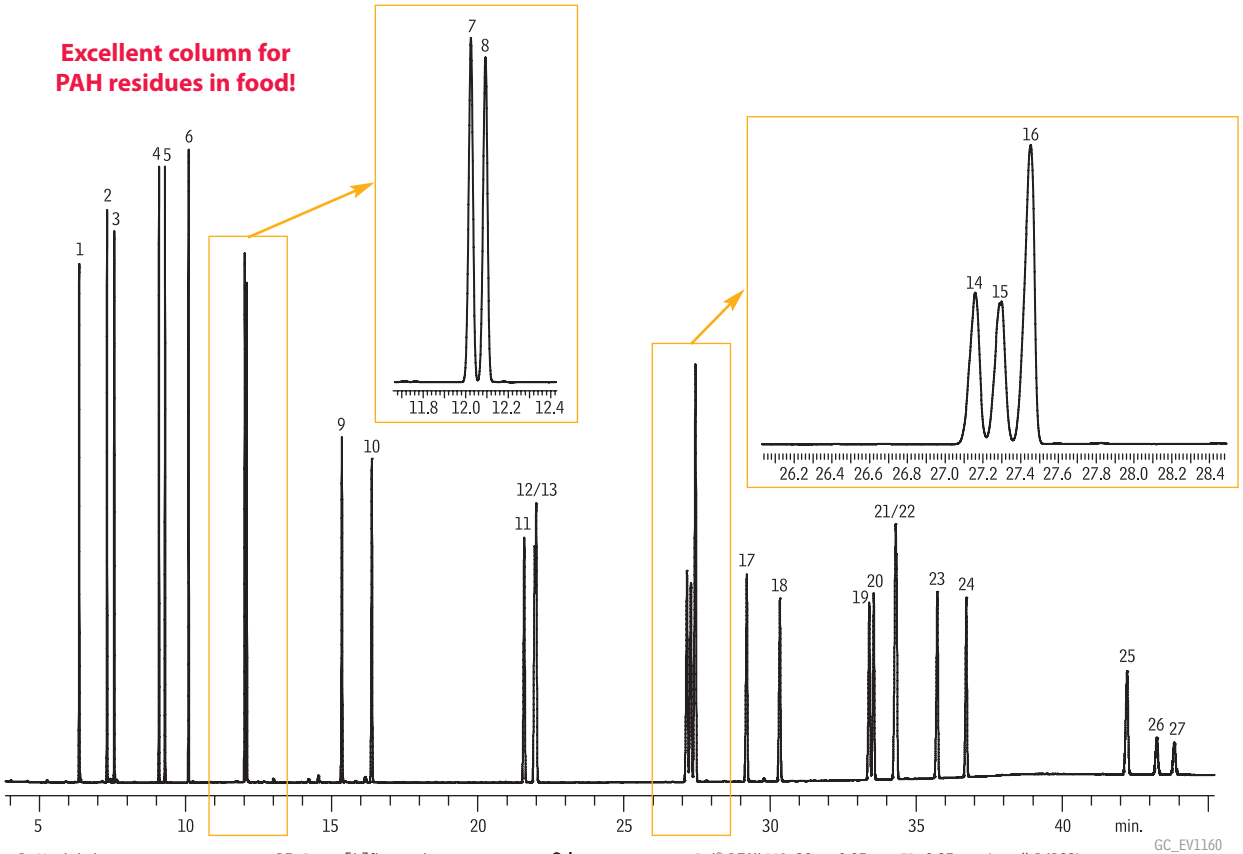
*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

similar phases

DB-17ms, VF-17ms, BPX-50

Polycyclic Aromatic Hydrocarbons on an Rxi®-17Sil MS column.

Excellent column for PAH residues in food!



1. Naphthalene
2. 2-Methylnaphthalene
3. 1-Methylnaphthalene
4. Acenaphthylene
5. Acenaphthene
6. Fluorene
7. Phenanthrene
8. Anthracene
9. Fluoranthene
10. Pyrene
11. Benz[a]anthracene
12. Chrysene
13. Triphenylene
14. Benzo[b]fluoranthene
15. Benzo[k]fluoranthene
16. Benzo(j)fluoranthene
17. Benzo[a]pyrene
18. 3-Methylcholanthrene
19. Dibenz(a,h)acridine
20. Dibenz[a,j]acridine
21. Indeno[1,2,3-cd]pyrene
22. Dibenz[a,h]anthracene
23. Benzo[ghi]perylene
24. 7H-Dibenzo[c,g]carbazole
25. Dibenzo[a,e]pyrene
26. Dibenzo(a,i)pyrene
27. Dibenzo(a,h)pyrene

Column	Rxi®-17Sil MS, 30 m, 0.25 mm ID, 0.25 µm (cat.# 14123)
Sample	SV Calibration Mix #5 / 610 PAH Mix (cat.# 31011) EPA Method 8310 PAH Mixture (cat.# 31841)
Diluent:	dichloromethane
Conc.:	10 ppm
Injection	
Inj. Vol.:	0.5 µL splitless (hold 1.75 min.)
Liner:	Auto SYS XL PSS Split/Splitless w/Wool (cat.# 21718)
Inj. Temp.:	320 °C
Purge Flow:	75 mL/min.
Oven	
Oven Temp:	65 °C (hold 0.5 min.) to 220 °C at 15 °C/min. to 330 °C at 4 °C/min. (hold 15 min.)
Carrier Gas	He, constant flow
Flow Rate:	2.0 mL/min.
Detector	FID @ 320 °C
Instrument	PE Clarus 600 GC
Acknowledgement	Instrument provided by PerkinElmer

Chlorinated Fluorocarbons (CFC) Analysis

NEW!

Rt®-Alumina BOND/CFC Columns (fused silica PLOT)

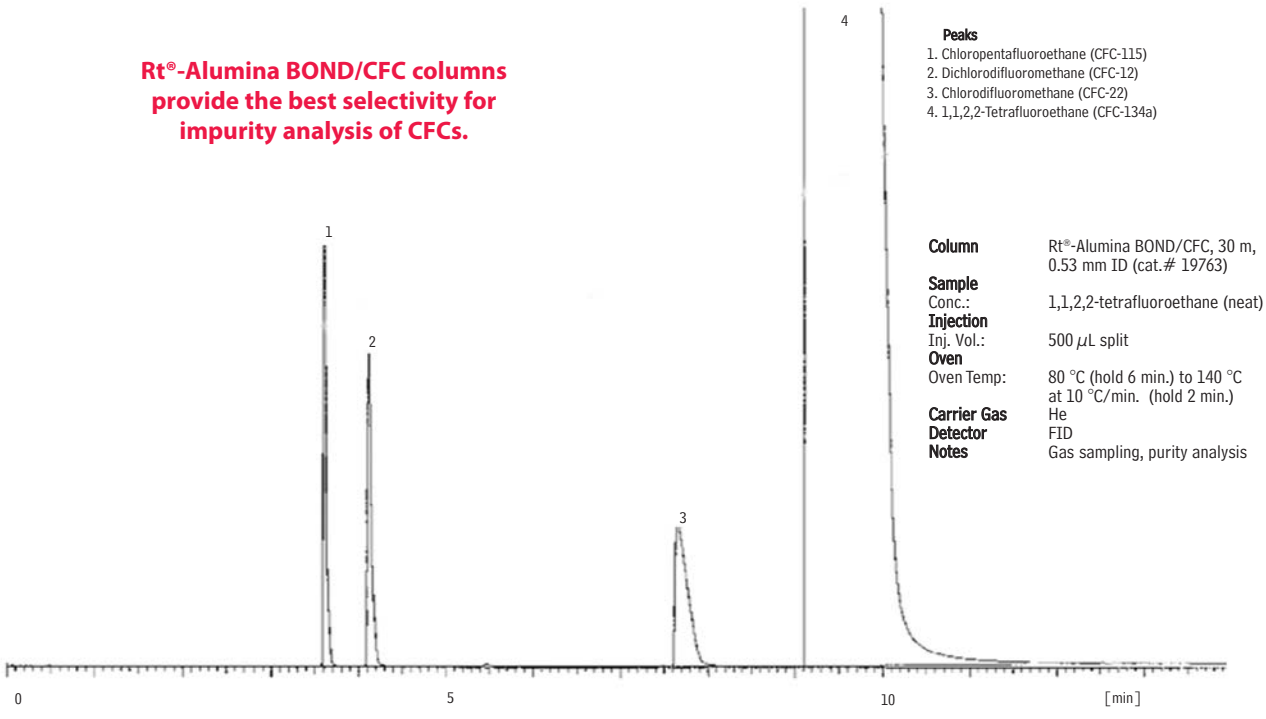
- Improved inertness for halogenated compounds.
- Highly selective alumina-based column, separates most CFCs.
- High retention and capacity for CFCs.

The alumina adsorbent is ideal for retaining halogenated compounds, especially CFC (chlorinated flourocarbons, freons). It offers high selectivity, allowing a wide range of CFC isomers to be resolved at above ambient temperatures. The Rt®-Alumina BOND/CFC column is thoroughly deactivated to reduce the reactivity of alumina. Even though there is still some residual reactivity for some mono- or di-substituted halogenated hydrocarbons, the majority of these compounds can be accurately quantified from main stream processes or in impurity analyses.

ID	df	temp. limits	30-Meter
0.53mm	10µm	to 200°C	19763

Impurity analysis of 1,1,2,2-tetrafluoroethane (CFC-134a) on an Rt®-Alumina BOND/CFC column.

Rt®-Alumina BOND/CFC columns provide the best selectivity for impurity analysis of CFCs.



Peaks
1. Chloropentafluoroethane (CFC-115)
2. Dichlorodifluoromethane (CFC-12)
3. Chlorodifluoromethane (CFC-22)
4. 1,1,2,2-Tetrafluoroethane (CFC-134a)

Column	Rt®-Alumina BOND/CFC, 30 m, 0.53 mm ID (cat.# 19763)
Sample Conc.:	1,1,2,2-tetrafluoroethane (neat)
Injection Inj. Vol.:	500 µL split
Oven Oven Temp:	80 °C (hold 6 min.) to 140 °C at 10 °C/min. (hold 2 min.)
Carrier Gas	He
Detector	FID
Notes	Gas sampling, purity analysis

Detailed Hydrocarbon Analysis (DHA)

Rtx®-DHA Columns (fused silica)

(Crossbond® 100% dimethyl polysiloxane—optimized for hydrocarbon analysis)

- Columns meet or exceed all ASTM D6730-01 and CAN/CGSB 3.0 No. 14.3-99 method guidelines; test report for method D6730 supplied with each column.
- Excellent responses and peak symmetry for polar oxygenates.

Gasolines are complex mixtures of hundreds of compounds. Information about concentrations of the individual components is important for evaluating raw materials and for controlling refinery processes. ASTM D6730-01 outlines a high-resolution GC method for detailed hydrocarbon analysis (DHA) of gasolines. Rtx®-DHA columns are ideal for DHA methods and easily meet or exceed both ASTM D6730-01 and Canadian General Standards Board CAN/CGSB 3.0 No. 14.3-99 requirements. Every Rtx®-DHA column is tested for retention, efficiency, stationary phase selectivity, and bleed—guaranteeing reproducible column-to-column performance.

ID	df	temp. limits	50-Meter	100-Meter	150-Meter
0.20mm	0.50µm	-60 to 300/340°C	10147		
0.25mm	0.50µm	-60 to 300/340°C		10148	
	1.00µm	-60 to 300/340°C			10149

Rtx®-5 DHA Tuning Column (fused silica)

(Crossbond® 5% diphenyl/95% dimethyl polysiloxane—optimized for hydrocarbon analysis)

ID	df	temp. limits	5-Meter
0.25mm	1.00µm	-60 to 340°C	10165

NOTE: Rtx®-1PONA columns have been renamed as Rtx®-DHA columns. There are no changes in the manufacturing process or column performance.

NEW!

Method Recommended

ASTM Method	Column	cat. #	Dimensions
D6729	Rtx-DHA-100	10148	100m x 0.25mm, 0.50µm
D6730	Rtx-DHA-100 & Rtx-5 DHA Tuning Column	10148 & 10165	100m x 0.25mm, 0.50µm w/ precolumn
D6733	Rtx-DHA-50	10147	50m x 0.20mm, 0.50µm
D5501	Rtx-DHA-150	10149	150m x 0.25mm, 1.0µm

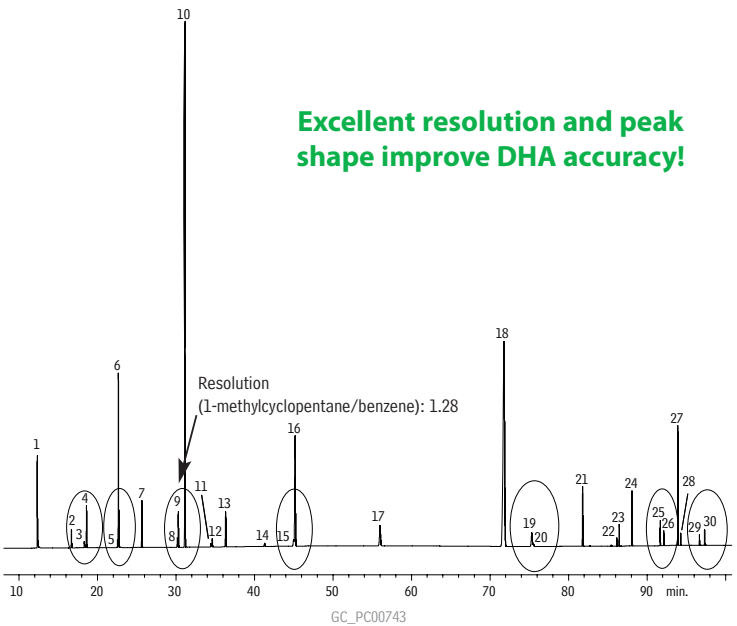
similar **phases**

Petrocol DH, DB-Petro, HP-PONA, CP-Sil PONA C8

did you **know**?

Using hydrogen instead of helium can cut analysis time in half! Visit **www.restek.com/petro** for complete analytical details.

Critical pairs of gasoline components resolved per ASTM specifications on an Rtx®-DHA column.



1. ethanol
2. C5
3. *tert*-butanol
4. 2-methylbutene-2
5. 2,3-dimethylbutane
6. methyl *tert*-butyl ether (MTBE)
7. C6
8. 1-methylcyclopentene
9. benzene
10. cyclohexane
11. 3-ethylpentane
12. 1-*tert*-2-dimethylcyclopentane
13. C7
14. 2,2,3-trimethylpentane
15. 2,3,3-trimethylpentane
16. toluene
17. C8
18. ethylbenzene
19. *p*-xylene
20. 2,3-dimethylheptane
21. C9
22. 5-methylnonane
23. 1,2-methylethylbenzene
24. C10
25. C11 (undecane)
26. 1,2,3,5-tetramethylbenzene
27. naphthalene
28. C12 (dodecane)
29. 1-methylnaphthalene
30. C13 (tridecane)

Column:	Rtx®-DHA, 100m, 0.25mm ID, 0.5µm (cat.# 10148) plus Rtx®-5DHA tuning column, 2.62m, 0.25mm ID, 1.0µm, connected via Press-Tight® connector (cat.# 20446)
Sample:	custom detailed hydrocarbon analysis (DHA) mix, neat
Inj.:	0.01µL, split (split ratio 150:1), 4mm cup inlet liner (cat.# 20709)
Inj. temp.:	200°C
Carrier gas:	helium, constant flow
Linear velocity:	28cm/sec. (2.3mL/min.)
Oven temp.:	5°C (hold 15 min.) to 50°C @ 5°C/min. (hold 50 min.) to 200°C @ 8°C/min. (hold 10 min.)
Det.:	FID @ 250°C

Circles indicate critical pairs that must be resolved.

Light Hydrocarbon Analysis

Rt®-Alumina BOND columns show unique retention characteristics for hydrocarbons.

Rt®-Alumina BOND Columns

1. Highly selective for C1-C5 hydrocarbons; separates all unsaturated hydrocarbon isomers above ambient temperatures.
2. Reactivity of aluminum oxide stationary phase is minimized so that column response for polar unsaturates, such as dienes, is optimized. Column sensitivity or response ensures a linear and quantitative chromatographic analysis for these compounds.
3. Strong bonding prevents particle generation. The column can be used in valve switching operations, without release of particles that can harm the injection and detection systems.
4. The Rt®-Alumina BOND column is stable up to 200 °C. If water is adsorbed on the column, it can be regenerated by conditioning at 200 °C. Full efficiency and selectivity will be restored.
5. High capacity and loadability give exceptionally symmetric peaks; ideal for volatile hydrocarbon separations at percent levels, as well as impurity analyses at ppm concentrations.

also available

Metal MXT® Columns
Rugged, flexible, Siltek® treated stainless steel tubing; inertness comparable to fused silica tubing. See **page 108** for our MXT®-Alumina BOND/Na_2SO_4 columns.

Rt®-Alumina BOND/Na_2SO_4 Columns (fused silica PLOT)

(Na_2SO_4 deactivation)

ID	df	temp. limits	30-Meter	50-Meter
0.25mm	4µm	to 200°C	19775	
0.32mm	5µm	to 200°C	19757	19758
0.53mm	10µm	to 200°C	19755	19756

Rt®-Alumina BOND/KCl Columns (fused silica PLOT)

(KCl deactivation)

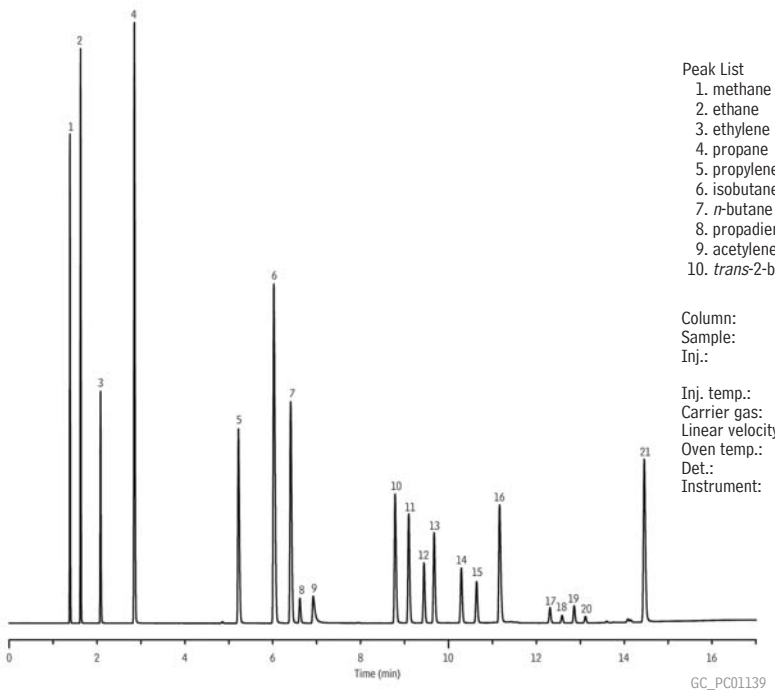
- Acetylene elutes before C4 hydrocarbons (impurities in butane/isobutane).
- Methyl acetylene (impurity in 1,3-butadiene) elutes before 1,3-butadiene.

similar phases

GC-Alumina KCl, CP-Al_2O_3/KCl

ID	df	temp. limits	30-Meter	50-Meter
0.25mm	4µm	to 200°C	19776	
0.32mm	5µm	to 200°C	19761	19762
0.53mm	10µm	to 200°C	19759	19760

Refinery gas hydrocarbons on an Rt®-Alumina BOND/Na_2SO_4 column.



GC_PC01139

Peak List
1. methane
2. ethane
3. ethylene
4. propane
5. propylene
6. isobutane
7. *n*-butane
8. propadiene
9. acetylene
10. *trans*-2-butene
11. 1-butene
12. isobutylene
13. *cis*-2-butene
14. isopentane
15. *n*-pentane
16. 1,3-butadiene
17. *trans*-2-pentene
18. 2-methyl-2-butene
19. 1-pentene
20. *cis*-2-pentene
21. *n*-hexane

Column:	Rt®-Alumina BOND/Na_2SO_4, 30m, 0.53mm ID, 10.0µm (cat.# 19755)
Sample:	refinery gas hydrocarbons through C6
Inj.:	10µL split, 40mL/min. split vent flow rate 2mm split Precision® liner w/wool (cat.# 20823)
Inj. temp.:	200°C
Carrier gas:	helium, constant pressure (5.0psi, 34.5kPa)
Linear velocity:	37.3cm/sec. @ 60°C
Oven temp.:	60°C (hold 2 min.) to 200°C @ 10°C/min. (hold 1 min.)
Det.:	FID @ 200°C
Instrument:	Agilent 5890

Simulated Distillation (C5-C44) Analysis

Rtx®-2887 Column (fused silica)

(nonpolar phase; Crossbond® 100% dimethyl polysiloxane—for simulated distillation)

- Application-specific column for simulated distillation.
- Stable to 360 °C.

The Rtx®-2887 column's stationary phase, column dimensions, and film thickness have been optimized to exceed the resolution and skewing factor requirements currently specified in ASTM method D2887. Each column is individually tested to guarantee a stable baseline with low bleed and reproducible retention times. The Crossbond® methyl silicone stationary phase has increased stability compared to packed columns, ensuring stable baselines and shorter conditioning times.

ID	df	temp. limits	10-Meter
0.53mm	2.65µm	-60 to 360°C	10199

MXT®-2887 Column (Siltek® treated stainless steel)

(nonpolar phase; Crossbond® 100% dimethyl polysiloxane—for simulated distillation)

- Application-specific columns for simulated distillation.
- Stable to 400 °C.

ID	df	temp. limits	10-Meter
0.53mm	2.65µm	-60 to 400°C	70199

MXT®-1HT SimDist Column (Siltek® treated stainless steel)

NEW!

(nonpolar phases)

- Stable up to 400 °C—lowest bleed for longest column lifetime.
- Reliably meets all ASTM D2887 specifications.
- 100% dimethyl polysiloxane phase allows easy comparisons to historical data.

ID	df	temp. limits	10-Meter
0.53mm	2.65µm	-60 to 360/400°C	70132

also available

Rtx®-1 SimDist 2887—a packed column for process instrumentation. See **page 126**.

similar phases

DB-2887, Petrocol EX2887

similar phases

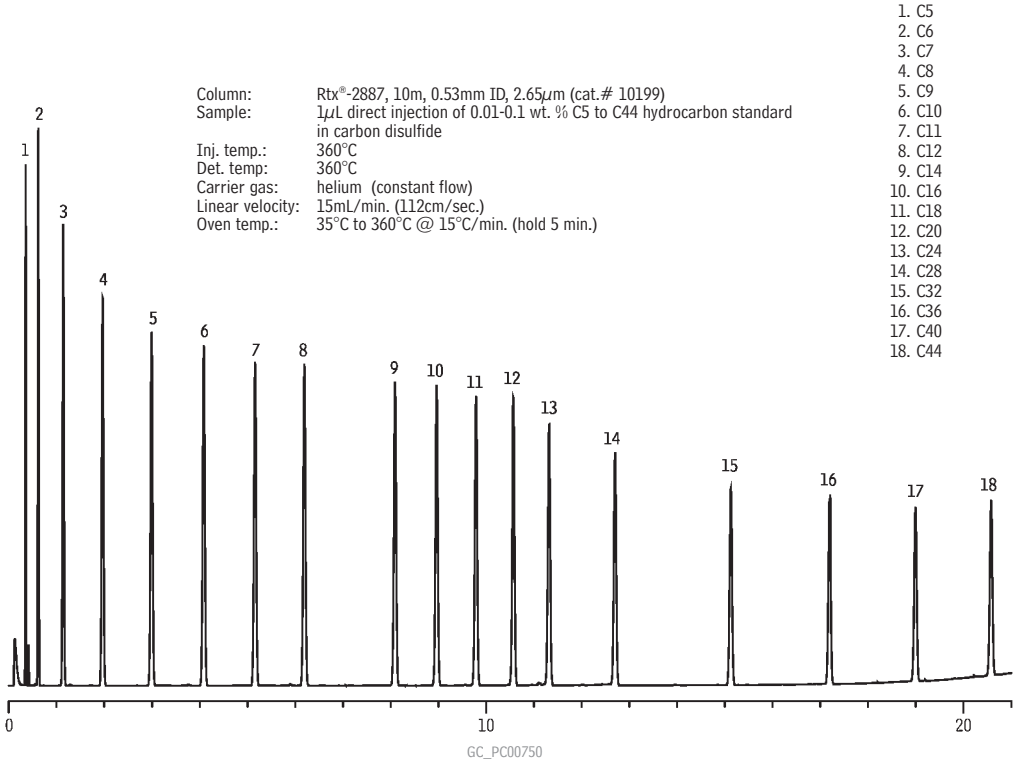
DB-2887, Petrocol EX2887, CP-HT-Simdist CB

similar phases

DB-1HT, CP-HT-Simdist CB

See page 78 for more dimensions.

Simulated distillation on an Rtx®-2887 column.



Simulated Distillation (C44-C100) Analysis

similar **phases**

DB-1HT, CP-HT-Simdist CB

NEW!

Method Recommended Columns

ASTM Method	Hydrocarbon Range	cat. #	Configuration
D2887	C5 - C44	70131	5m x 0.53mm, 0.88µm
		70132	10m x 0.53mm, 2.65µm
D7213 (D2887-ext)	C5 - C60	70131	5m x 0.53mm, 0.88µm
		70115	5m x 0.53mm, 0.20µm
		70112	5m x 0.53mm, 0.10µm
D3710	gasoline up to C14	70132	10m x 0.53mm, 2.65µm
D5307	crude up to C42	70115	5m x 0.53mm, 0.20µm
D6352	C10 - C90	70112	5m x 0.53mm, 0.10µm
		70115	5m x 0.53mm, 0.20µm
D7500	C7 - C110	70112	5m x 0.53mm, 0.10µm
		70115	5m x 0.53mm, 0.20µm
D7169	C5 - C100	70112	5m x 0.53mm, 0.10µm
		70115	5m x 0.53mm, 0.20µm

MXT®-1HT SimDist Column (Siltek® treated stainless steel)

(nonpolar phases)

- Stable up to 450 °C—lowest bleed for longest column lifetime.
- Reliably meet all ASTM D6352, D7169, and D7500 specifications.
- 100% dimethyl polysiloxane phase allows easy comparisons to historical data.

Accurate boiling point determination for medium and heavy fractions using GC simulated distillation requires columns and phase polymers that are robust enough to withstand high temperatures without significant degradation. Metal columns are a better alternative than fused silica, and the MXT®-1HT SimDist columns are the lowest bleed, highest efficiency columns available, outperforming other metal columns for critical method parameters.

ID	df	temp. limits	5-Meter	10-Meter
0.53mm	0.10µm	-60 to 430/450°C	70112	
	0.20µm	-60 to 430/450°C	70115	
	0.21µm	-60 to 430/450°C		70118
	0.88µm	-60 to 400/430°C	70131	70134
	1.00µm	-60 to 380/400°C		70130
	1.20µm	-60 to 380/400°C		70119
	2.65µm	-60 to 360/400°C		70132
	5.00µm	-60 to 360/400°C		70133

Low bleed, high efficiency MXT®-1HT SimDist columns outperform competitors (ASTM D6352 conditions).

Lower bleed means:

- Longer column lifetime.
- More stable calibrations.
- Accurate boiling point determinations.

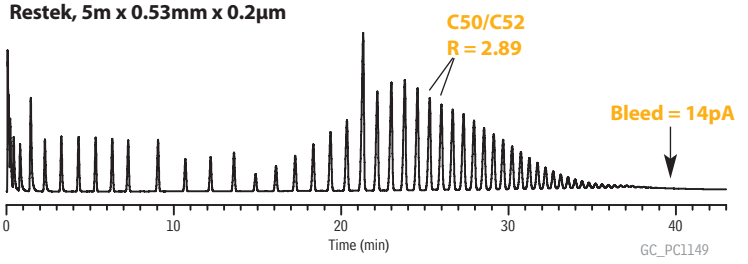
RESTEK ADVANTAGE:
Longer column lifetime and more accurate data!

Higher efficiency means:

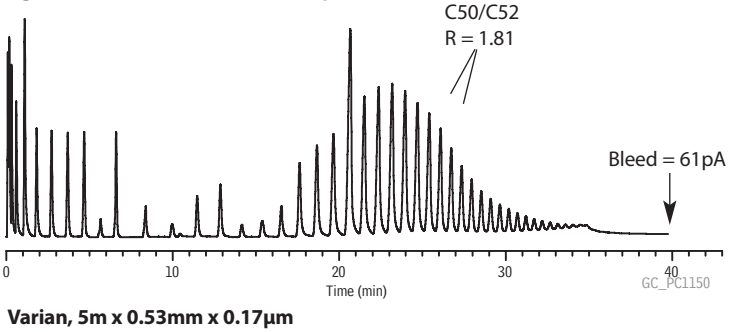
- Greater resolution; analyze more samples before method criteria are reached.
- Assured method performance.

RESTEK ADVANTAGE:
Run more samples within method specifications!

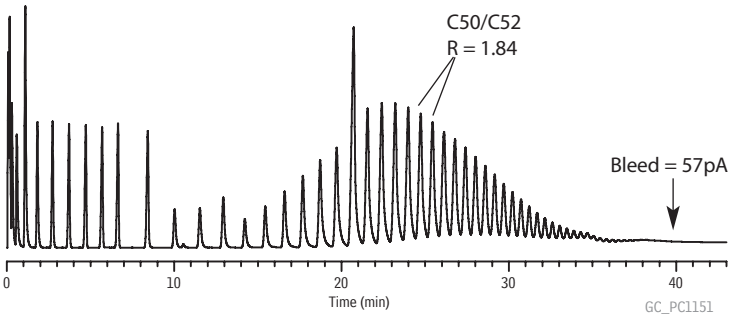
Restek, 5m x 0.53mm x 0.2µm



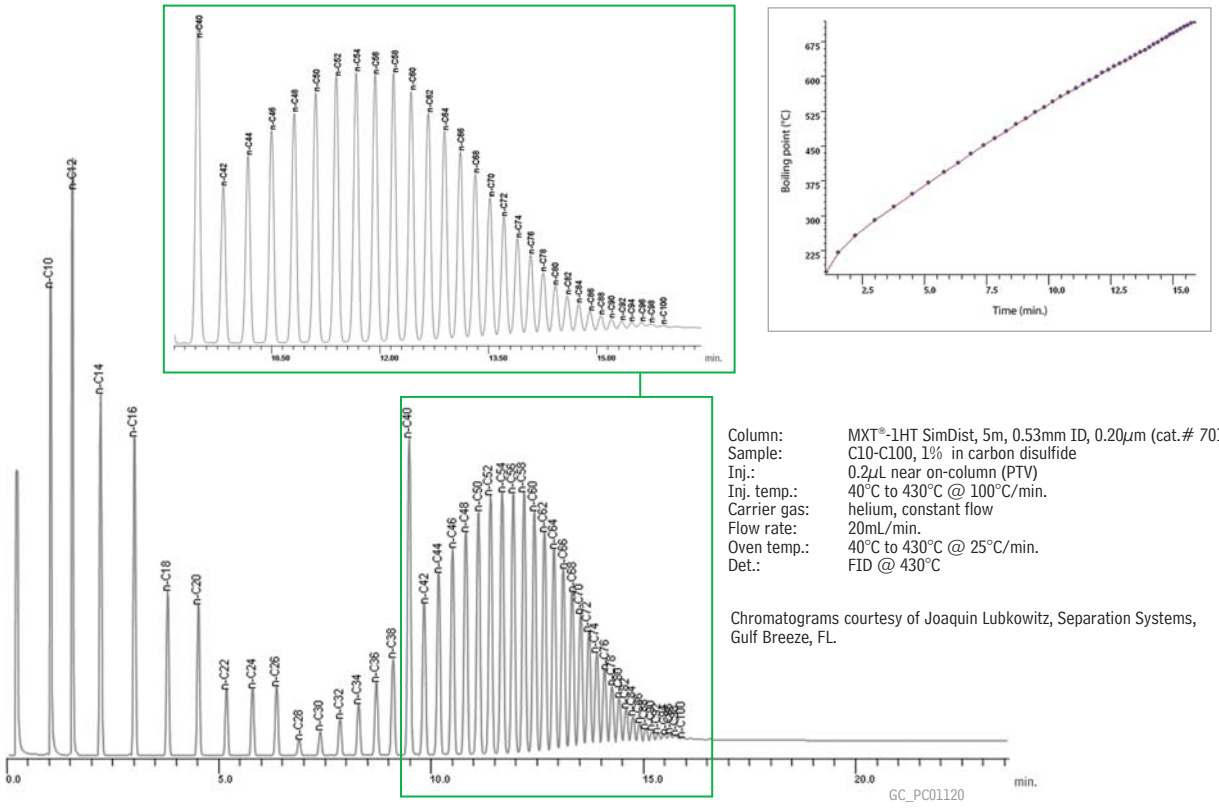
Agilent/ J&W, 5m x 0.53mm x 0.15µm



Varian, 5m x 0.53mm x 0.17µm



Robust MXT®-1HT SimDist columns meet all ASTM D6352 requirements, even under accelerated conditions.



Column: MXT®-1HT SimDist, 5m, 0.53mm ID, 0.20µm (cat.# 70115)
Sample: C10-C100, 1% in carbon disulfide
Inj.: 0.2µL near on-column (PTV)
Inj. temp.: 40°C to 430°C @ 100°C/min.
Carrier gas: helium, constant flow
Flow rate: 20mL/min.
Oven temp.: 40°C to 430°C @ 25°C/min.
Det.: FID @ 430°C

Chromatograms courtesy of Joaquin Lubkowitz, Separation Systems, Gulf Breeze, FL.

MXT®-1 SimDist/MXT®-500 SimDist

- Application-specific columns in unbreakable Siltek® treated stainless steel tubing meet all resolution criteria for high temperature simulated distillation (e.g., ASTM Method D2887 Extended).
- MXT®-1 SimDist phases offer true methyl silicone polarity; MXT®-500 SimDist phase is a carborane siloxane polymer.
- Stable to 430 °C.

MXT®-1 SimDist Column (Siltek® treated stainless steel)
(nonpolar phase)

ID	df	temp. limits	6-Meter
0.53mm	0.15µm	-60 to 430°C	70101

MXT®-500 SimDist Column (Siltek® treated stainless steel)
(nonpolar phase)

ID	df	temp. limits	6-Meter
0.53mm	0.15µm	-60 to 430°C	70104

Polywax® Calibration Materials

Description	qty.	cat.#	price
Polywax 655 calibration material	1g	36225	
Polywax 1000 calibration material	1g	36227	

Aromatics & Oxygenates in Gasoline Analysis

Rt®-TCEP Columns (fused silica)
(highly polar phase; 1,2,3-tris[2-cyanoethoxy]propane—not bonded)

- General purpose columns, ideal for aromatics and oxygenates in gasoline.
- Temperature range: 0 °C to 135 °C.

Most gasolines contain aliphatic hydrocarbons up to *n*-dodecane (C12). To improve identification of the aromatics and oxygenates, it is desirable to elute benzene after C11 and toluene after C12. The extremely polar Rt®-TCEP stationary phase provides a retention index for benzene greater than 1100 and permits the separation of alcohols and aromatics from the aliphatic constituents in gasoline.

Rt®-TCEP columns have the same high polarity as TCEP packed columns (precolumns in ASTM Method D4815 for the analysis of petroleum oxygenates), with the efficiency of a capillary column. The result is a column that can separate a wide variety of compounds with an elution pattern unattainable using other high polarity siloxanes.

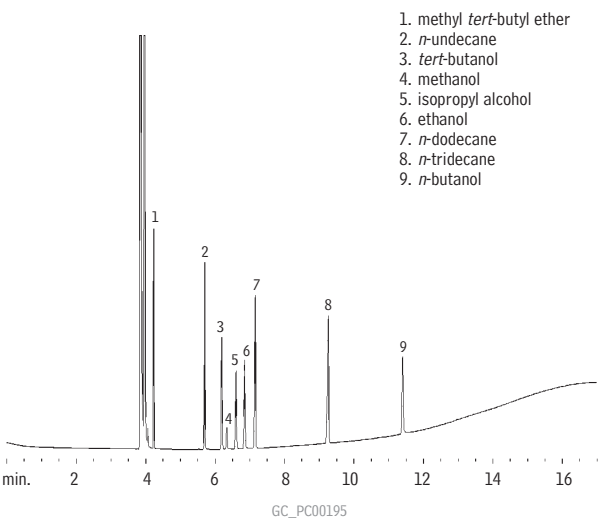
The Rt®-TCEP column incorporates a nonbonded stationary phase coated on a surface specialized for enhanced polymer stability and extended column lifetime. Solvent rinsing should be avoided. Conditioning is necessary only if the column is to be used at temperatures near the maximum operating temperature.

similar **phases**

SPB-TCEP, CP-TCEP

ID	df	temp. limits	30-Meter	60-Meter
0.25mm	0.40µm	0 to 135°C	10998	10999

Petroleum oxygenates on an Rt®-TCEP column.



Column:	Rt®-TCEP, 60m, 0.25mm ID, 0.4µm (cat.# 10999)
Inj.:	1.0µL split injection, components @ 500ppm.
Oven temp.:	60°C (hold 5 min.) to 100°C @ 5°C/min. (hold 10 min.)
Inj./det. temp.:	200°C
Carrier gas:	helium
Linear velocity:	30cm/sec. set @ 80°C
FID sensitivity:	6.4 x 10^{-11} AFS
Split flow:	46mL/min.

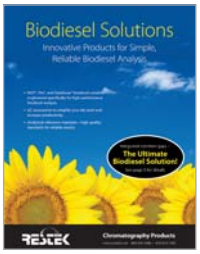
Biodiesel Fuels Analysis

MXT®-Biodiesel TG Columns (Siltek® treated stainless steel)

- Fast analysis times and sharp mono-, di-, and triglyceride peaks.
- Stable at 430 °C for reliable, consistent performance.
- Integra-Gap® built-in retention gap on 0.53 mm ID column eliminates column coupling completely.

Description	temp. limits	cat.#	price
14m, 0.53mm ID, 0.16µm with 2m Integra-Gap*	-60 to 380/430°C	70289	
10m, 0.32mm ID, 0.10µm	-60 to 380/430°C	70292	
10m, 0.32mm ID, 0.10µm with 2m x 0.53mm Retention Gap**	-60 to 380/430°C	70290	
15m, 0.32mm ID, 0.10µm	-60 to 380/430°C	70293	
15m, 0.32mm ID, 0.10µm with 2m x 0.53mm Retention Gap**	-60 to 380/430°C	70291	
2m x 0.53mm MXT Biodiesel TG		70294	

*Total column length = 16 meters.
**Connected with low-dead-volume MXT connector.



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Biodiesel Solutions: Innovative Products for Simple, Reliable Biodiesel Analysis

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lit. cat.# 580207

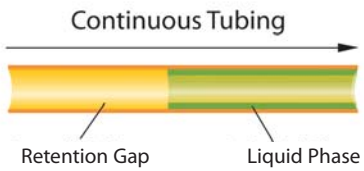
Rtx®-Biodiesel TG Columns (fused silica)

- Linearity for all reference compounds exceeds method requirements.
- Alumaseal® connector provides leak-free connection; guard column extends column life.
- Low column bleed at high temperatures.
- For glycerine and glycerides analysis, according to ASTM D6584 and EN 14105 methods.

Description	temp. limits	cat.#	price
10m, 0.32mm ID, 0.10µm	to 330/380°C	10292	
10m, 0.32mm ID, 0.10µm with 2m x 0.53mm ID Retention Gap	to 330/380°C	10291	
15m, 0.32mm ID, 0.10µm	to 330/380°C	10294	
15m, 0.32mm ID, 0.10µm with 2m x 0.53mm ID Retention Gap	to 330/380°C	10293	

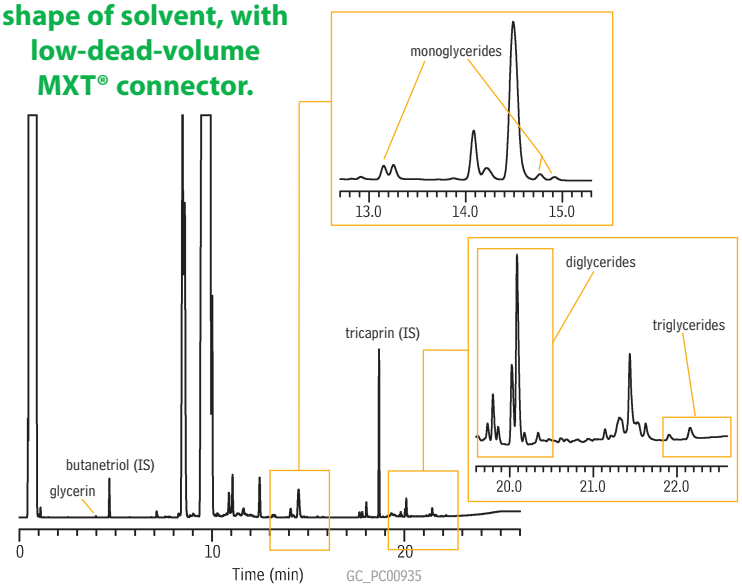
Integra-Gap® technology

- Built-in retention gap.
- Eliminates connector and leaks.
- Extends analytical column lifetime.



Derivatized B100 and internal standards on an MXT®-Biodiesel TG column with 2 m x 0.53 mm ID coupled retention gap, according to ASTM D6584.

Note perfect peak shape of solvent, with low-dead-volume MXT® connector.



Column:	MXT®-Biodiesel TG, 10m, 0.32mm ID, 0.1µm with 2m x 0.53mm retention gap (cat.# 70290)
Sample:	B100 + IS butanetriol & tricaprin derivatized with MSTFA as per ASTM D-6584
Inj.:	1.0µL cool on-column
Inj. temp.:	oven track
Carrier gas:	hydrogen, constant flow
Flow rate:	4mL/min.
Oven temp.:	50°C (hold 1 min.) to 180°C @ 15°C/min., to 230°C @ 7°C/min., to 430°C @ 30°C/min. (hold 5 min.)
Det.:	FID @ 430°C

Blood Alcohol Analysis

restek **innovation**!

Baseline resolution in less than 3 minutes.

similar **phases**

DB-ALC1, DB-ALC2

Rtx®-BAC1/Rtx®-BAC2

- Application-specific columns for blood alcohol analysis—achieve baseline resolution in less than 3 minutes. Also excellent for abused inhalant anesthetics, γ-hydroxybutyrate (GHB)/γ-butyrolactone (GBL), glycols, and common industrial solvents.
- Rtx®-BAC2 confirmation column provides four elution order changes under the same conditions.
- Stable to 260 °C.

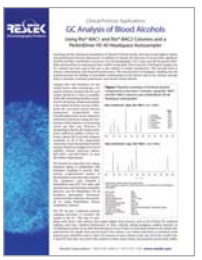
These columns separate to baseline all blood alcohol compounds in blood, breath, or urine, in less than 3 minutes, under isothermal conditions. Isothermal analysis increases productivity by eliminating the need for oven cycling. Confirmation is easily achieved with this tandem set because there are four elution order changes between the two columns.

Rtx®-BAC1 Columns (fused silica)
(proprietary Crossbond® phase)

ID	df	temp. limits	30-Meter
0.32mm	1.80µm	-20 to 240/260°C	18003
0.53mm	3.00µm	-20 to 240/260°C	18001

Rtx®-BAC2 Columns (fused silica)
(proprietary Crossbond® phase)

ID	df	temp. limits	30-Meter
0.32mm	1.20µm	-20 to 240/260°C	18002
0.53mm	2.00µm	-20 to 240/260°C	18000



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GC Analysis of Blood Alcohols

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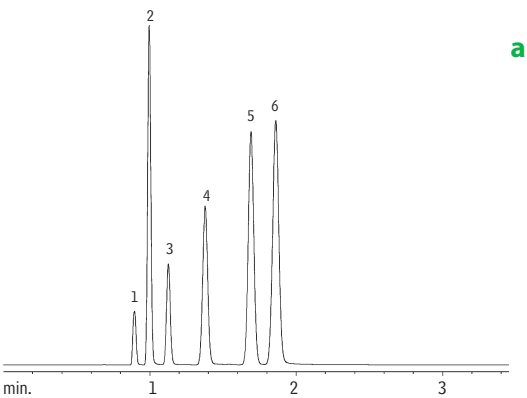
lit. cat.# 59598A

Rapid, reliable blood alcohol testing, using Rtx®-BAC 1 and Rtx®-BAC2 columns.

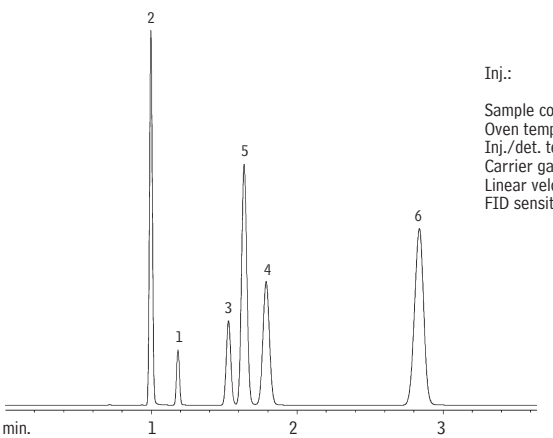
Rtx®-BAC1 30 m, 0.53 mm ID, 3.0 µm (cat.# 18001)



Blood alcohol analysis in less than 3 minutes!

1. methanol
2. acetaldehyde
3. ethanol
4. isopropanol
5. acetone
6. *n*-propanol

Rtx®-BAC2 30 m, 0.53 mm ID, 2.0 µm (cat.# 18000)



Inj.:	1.0mL headspace sample of a blood alcohol mix
Sample conc.:	0.1% per compound
Oven temp.:	40°C
Inj./det. temp.:	200°C
Carrier gas:	helium
Linear velocity:	80cm/sec. set @ 40°C
FID sensitivity:	1.28 x 10^{-10} AFS

GC_PH00239

Organic Volatile Impurities (OVI) Analysis

Rxi®-624Sil MS Columns

for USP<467> Residual Solvents analysis

NEW!

Improve system suitablility pass rates with the best resolution of acetonitrile and dichloromethane on any G43.

- Symmetric peak shape for bases provides accurate integration and unmatched sensitivity.
- High thermal stability ensures a consistent baseline, making it the only MS friendly column in its class.
- Reproducible Rxi® technology provides the column-to-column reproducibility needed in validated methods.

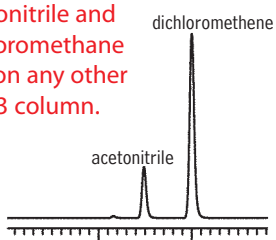
Rxi®-624Sil MS Columns (fused silica)
(midpolarity Crossbond® silarylene phase; equivalent to 6% cyanopropylphenyl/ 94% dimethyl arylene polysiloxane)

- Low bleed, high thermal stability column—maximum temperatures up to 320 °C.
- Inert—excellent peak shape for a wide range of compounds, including acidic and basic compounds.
- Selective—highly selective for residual solvents, great choice for USP<467>.
- Manufactured for column-to-column reproducibility—well-suited for validated methods.

ID	df	temp. limits	20-Meter	30-Meter	60-Meter
0.18mm	1.00µm	-20 to 300/320°C	13865		
0.25mm	1.40µm	-20 to 300/320°C		13868	
0.32mm	1.80µm	-20 to 300/320°C		13870	13872
0.53mm	3.00µm	-20 to 280/300°C		13871	

Class 2 Mix A

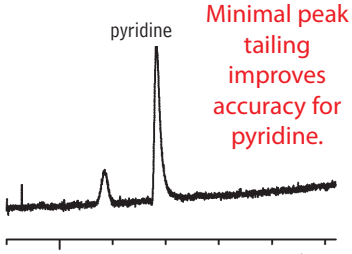
Better resolution of acetonitrile and dichloromethane than on any other G43 column.



GC_PH01116

Class 2 Mix B

Minimal peak tailing improves accuracy for pyridine.



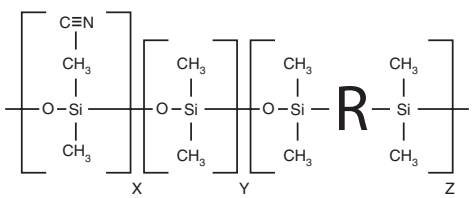
GC_PH01117

Column:	Rxi®-624Sil MS, 30m, 0.32mm ID, 1.8µm (cat.# 13870)
Inj.:	1.0mL manual headspace injection, split (3:1), 1mm split liner (cat.# 20972)
Inj. temp.:	140°C
Carrier gas:	helium, constant flow
Flow rate:	2.2mL/min.
Oven temp.:	40°C (hold 20 min.) to 240°C @ 10°C/min. (hold 20 min.)
Det:	FID @ 250°C
Hydrogen:	40mL/min.
Air:	450mL/min.
Makeup:	45mL/min.
Instrument:	Agilent 6890

Make the Switch to Rxi® columns!

Replaces: DB-624, HP-624, VF-624, BP-624, ZB-624, AT-624, 007-1301, G43R

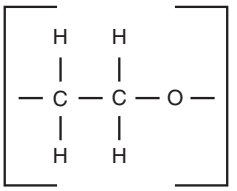
Rxi®-624Sil MS Structure



Visit **www.restek.com/ovi** for a complete product listing.

G16 phase

Stabilwax® Structure



similar phases

DB-WAX, DB-WAXetr, HP-Wax, HP-Innowax, Supelcowax 10, CP-Wax 52 CB

Organic Volatile Impurities (OVI) Analysis

Stabilwax® Columns (fused silica)
(polar phase; Crossbond® Carbowax® polyethylene glycol)

- Most stable polyethylene glycol (PEG) column available.
- Rugged enough to withstand repeated water injections.
- Lowest bleed PEG column on the market; long column lifetimes are assured
- Temperature range: 40 °C to 260 °C.
- Equivalent to USP G14, G15, G16, G20, and G39 phases.

Restek's polar-deactivated surface tightly binds the Carbowax® polymer and increases thermal stability, relative to competitive columns. Because of the increased stability produced by the bonding process, Stabilwax® columns exhibit long column lifetimes, even when programming repeatedly up to 260 °C. The bonding mechanism of the column also produces polar compound retention times that do not shift as is often observed on other wax-type columns. In addition, this bonding mechanism produces a column that can be rejuvenated by solvent washing.

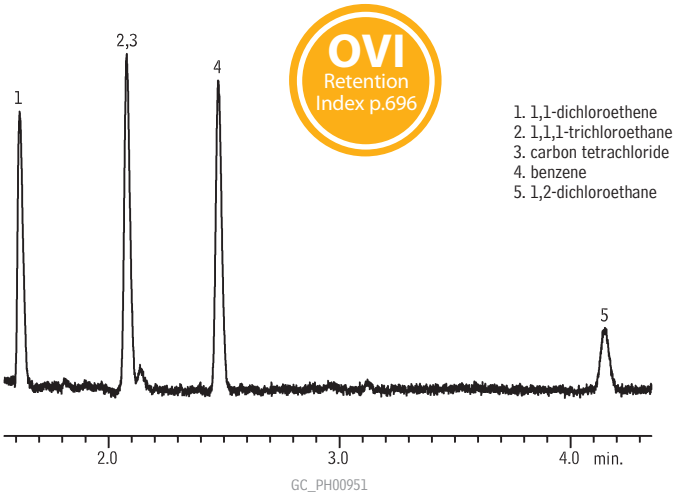
ID	df	temp. limits	30-Meter
0.32mm	0.25µm	40 to 250/260°C	10624
0.53mm	0.25µm	40 to 250/260°C	10625

For our complete listing of Stabilwax® columns, see **page 59**.

ordering note

Get the protection without the connection!
For Stabilwax® columns with built-in Integra-Guard® guard columns, see **page 35**.

Class 1 residual solvents on a Stabilwax® (G16) column.



Column:	Stabilwax®, 30m, 0.32mm ID, 0.25µm (cat.# 10624)
Sample:	USP Stock Mixture USP<467> Residual Solvents Class 1 Mix (cat.# 36279) in 20mL headspace vial (cat.# 24685), water diluent
Inj.:	headspace injection (split ratio 1:5), 2mm splitless liner IP deactivated (cat.# 20712)
Inj. temp.:	140°C
Carrier gas:	helium, constant flow
Flow rate:	2.15mL/min., 35.2cm/sec.
Oven temp.:	50°C for 20 min. to 165°C @ 6°C/min. (hold for 20 min.)
Det.:	FID @ 250°C

Headspace Conditions

Instrument:	Overbrook Scientific HT200H
Syringe temp.:	100°C
Sample temp.:	80°C
Sample equil. time.:	45 min.
Injection vol.:	1.0mL
Injection speed:	setting 8
Injection dwell:	5 sec.

free literature

Residual Solvent Analysis

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lit. cat.# PHFL1018A

Organic Volatile Impurities (OVI) Analysis

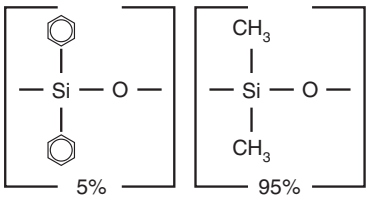
G27 phase

Rtx®-5 Columns (fused silica)
(low polarity phase; Crossbond® 5% diphenyl/95% dimethyl polysiloxane)

- General purpose columns for drugs, solvent impurities, pesticides, hydrocarbons, PCB congeners (e.g. Aroclor mixes), essential oils, semivolatiles.
- Temperature range: -60 °C to 350 °C.
- Equivalent to USP G27 and G36 phases.

The 5% diphenyl/95% dimethyl polysiloxane stationary phase is the most popular GC stationary phase and is used in a wide variety of applications. All residual catalysts and low molecular weight fragments are removed from the Rtx®-5 polymer, providing a tight mono-modal distribution and extremely low bleed.

Rtx®-5 Structure



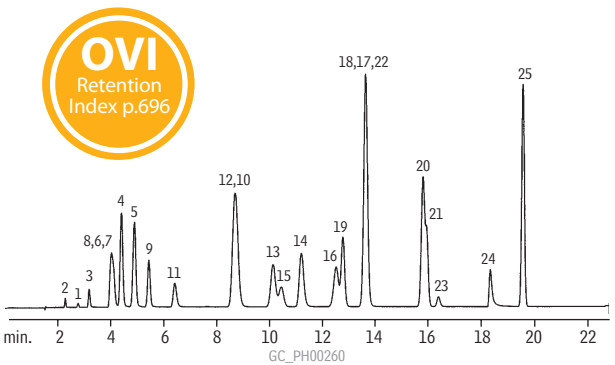
ID	df	temp. limits	30-Meter
0.53mm	5.00µm	-60 to 270/290°C	10279

For our complete listing of Rtx®-5 columns, see **page 50**.

similar phases

DB-5, HP-5, HP-5MS, Ultra-2, SPB-5, Equity-5, MDN-5

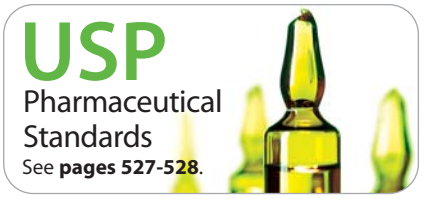
Organic volatile impurities on an Rtx®-5 (Rtx®-G27) column.



Rtx®-5 (Rtx®-G27) with 5m phenylmethyl Integra-Guard® guard column, 30m, 0.53mm ID, 5.0µm (cat.# 10279-126)

1. ethylene oxide
2. methanol
3. ethanol
4. diethyl ether
5. 1,1-dichloroethene
6. acetone
7. isopropanol
8. acetonitrile
9. methylene chloride
10. *n*-hexane
11. *n*-propanol
12. methyl ethyl ketone
13. ethyl acetate
14. tetrahydrofuran
15. chloroform
16. 1,1,1-trichloroethane
17. carbon tetrachloride
18. benzene
19. 1,2-dichloroethane
20. heptane
21. trichloroethylene
22. *n*-butanol
23. 1,4-dioxane
24. pyridine
25. toluene

Inj.:	Headspace injection of common solvents for pharmaceutical processing. Prepared to equal about 500ppm in the bulk pharmaceutical. Samples shaken and heated at 90°C for 15 minutes, 1mL headspace injection.
Oven temp.:	35°C (hold 10 min.) to 100°C @ 5°C/min., to 240°C @ 25°C/min. (hold 5 min.)
Inj./det. temp.:	220°C/240°C
FID sensitivity:	1.05 x 10^{-11} AFS
Carrier gas:	helium, 35cm/sec. set @ 35°C
Split ratio:	2:1



See **pages 527-528**.

Organic Volatile Impurities (OVI) Analysis

Rtx®-G27 Column (fused silica with 5-meter Integra-Guard® guard column)
(Crossbond® 5% diphenyl/95% dimethyl polysiloxane)

- Application-specific columns for residual solvents in pharmaceutical products. Meet all requirements of USP <467>.
- Analytical column with Integra-Guard® guard column eliminates connecting problems and leaks.
- Rtx®-G27 stable to 290 °C.

Some USP <467> methods require the use of a guard column. Our Integra-Guard® integrated guard column system makes it easy to comply.

ID	df	temp. limits	30-Meter with 5-Meter, 0.53mm ID Integra-Guard Guard Column
0.53mm	5.00µm	-60 to 270/290°C	10279-126

Rtx®-G43 Column (fused silica with 5-meter Integra-Guard® guard column)
(Crossbond® 6% cyanopropylphenyl/94% dimethyl polysiloxane)

- Application-specific columns for residual solvents in pharmaceutical products. Meet all requirements of USP <467>.
- Analytical column with Integra-Guard® guard column eliminates connecting problems and leaks.
- Rtx®-G43 stable to 240 °C.

Some USP <467> methods require the use of a guard column. Our Integra-Guard® integrated guard column system makes it easy to comply.

ID	df	temp. limits	30-Meter with 5-Meter, 0.53mm ID Integra-Guard Guard Column
0.53mm	3.00µm	-20 to 240°C	16085-126

free literature

A Technical Guide for Static Headspace Analysis Using GC

Download your free copy from **www.restek.com**

lit. cat.# 59895A

Diane Thompson, Customer Service

Restek Customer Service

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Online: www.restek.com—24-hours a day

Outside the U.S.

Contact your Restek representative:
Refer to our list on pages 4-5 or visit our website at www.restek.com

Semivolatiles Analysis

Rxi®-5Sil MS Columns (fused silica)
(low polarity Crossbond® silarylene phase; selectivity close to 5% phenyl/95% dimethyl arylene polysiloxane)

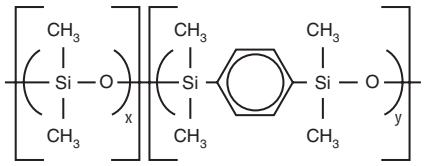
- Engineered to be a low bleed GC/MS column.
- Excellent inertness for active compounds.
- General purpose columns—ideal for GC/MS analysis of polycyclic aromatic compounds, chlorinated hydrocarbons, phthalates, phenols, amines, organochlorine pesticides, organophosphorus pesticides, drugs, solvent impurities, and hydrocarbons.
- Temperature range: -60 °C to 350 °C.

The Rxi®-5Sil MS stationary phase incorporates phenyl groups in the polymer backbone. This improves thermal stability, reduces bleed, and makes the phase less prone to oxidation. Rxi®-5Sil MS columns are ideal for GC/MS applications requiring high sensitivity, including use in ion trap systems.

ID	df	temp. limits	15-Meter	30-Meter	60-Meter
0.25mm	0.10µm	-60 to 330/350°C	13605	13608	
	0.25µm	-60 to 330/350°C	13620	13623	13626
	0.50µm	-60 to 330/350°C	13635	13638	
	1.00µm	-60 to 325/350°C	13650	13653	13697
0.32mm	0.25µm	-60 to 330/350°C	13621	13624	
	0.50µm	-60 to 330/350°C		13639	
	1.00µm	-60 to 325/350°C		13654	
0.53mm	1.50µm	-60 to 310/330°C		13670	

ID	df	temp. limits	10-Meter	20-Meter	40-Meter
0.10mm	0.10µm	-60 to 330/350°C	43601		
0.18mm	0.10µm	-60 to 320/350°C			
	0.18µm	-60 to 330/350°C		43602	43605
	0.36µm	-60 to 330/350°C		43604	

Rxi®-5Sil MS Structure



similar **phases**

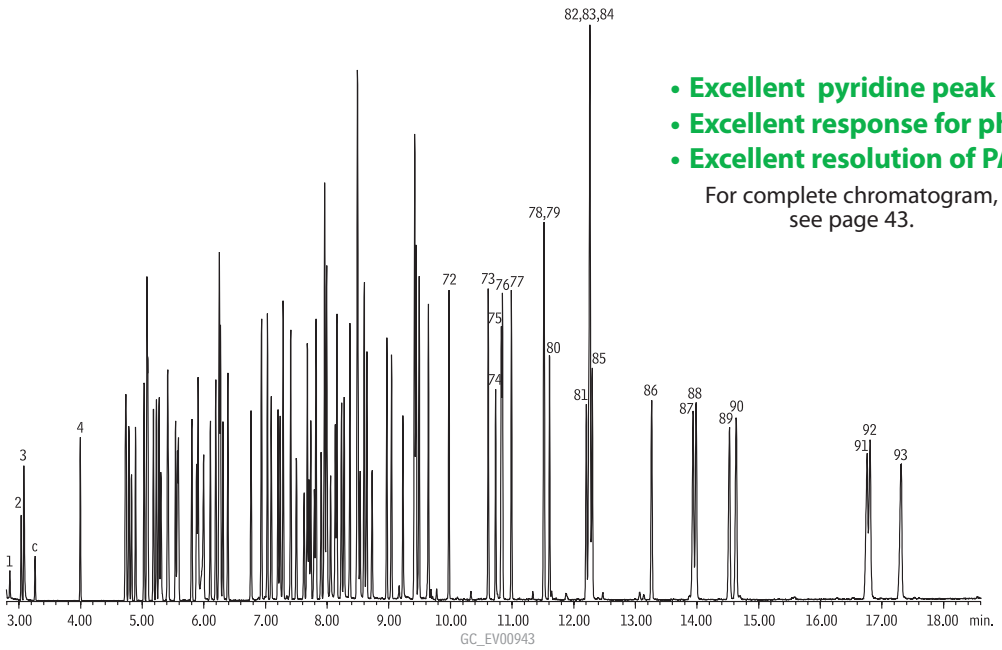
DB-5MS, VF-5ms, CP-Sil 8 Low-Bleed/MS

ordering **note**

Get the protection without the connection!
For Rxi®-5Sil MS columns with built-in Integra-Guard® guard columns, see **page 35**.

The Rxi®-5Sil MS column is recommended for US EPA Method 8270.

Semivolatile organics by US EPA Method 8270 on an Rxi®-5Sil MS column.



- **Excellent pyridine peak shape.**
- **Excellent response for phenols.**
- **Excellent resolution of PAHs.**

For complete chromatogram, see page 43.

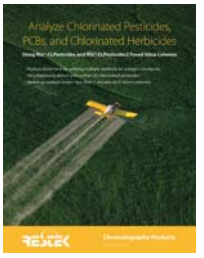
Chlorinated Pesticides Analysis

restek **innovation**!

- Very low bleed provides highest sensitivity.
- Faster analysis time with full separation of chlorinated pesticides.

CarboPrep® SPE Cartridges
See page 393.

How much time do column changes cost you? Switch to Rtx®-CLPesticides columns and analyze pesticides, herbicides, PCBs and more on a single column set.



Analyze Chlorinated Pesticides, PCBs and Chlorinated Herbicides

Download your free copy from **www.restek.com**

lit. cat.# EVFL1013

Rtx®-CLPesticides/Rtx®-CLPesticides2

(proprietary Crossbond® phases)

- Application-specific columns for organochlorine pesticides and herbicides.
- Low bleed—ideal for GC/ECD or GC/MS analyses.
- Baseline separations in less than 10 minutes.
- Stable to 340°C.

Improved resolution and faster analyses, compared to 1701 or phenyl phases, make these the pesticide columns of choice. Rtx®-CLPesticides columns are specially designed to overcome the coelutions and analyte breakdown typically encountered in chlorinated pesticide analyses for EPA Methods 8081, 608, and CLP. By achieving baseline resolution of the 20 target analytes, more accurate qualitative data can be obtained, providing reliable identification without GC/MS.

Rtx®-CLPesticides Columns (fused silica)

ID	df	temp. limits	10-Meter	15-Meter	20-Meter	30-Meter	60-Meter
0.10mm	0.10µm	-60 to 310/330°C	43101				
0.18mm	0.18µm	-60 to 310/330°C	42101		42102		
0.25mm	0.25µm	-60 to 320/340°C		11120		11123	11126
0.32mm	0.32µm	-60 to 320/340°C				11141	
	0.50µm	-60 to 320/340°C		11136		11139	
0.53mm	0.50µm	-60 to 300/320°C		11137		11140	

Rtx®-CLPesticides2 Columns (fused silica)

ID	df	temp. limits	10-Meter	15-Meter	20-Meter	30-Meter	60-Meter
0.10mm	0.10µm	-60 to 310/330°C	43301		43302		
0.18mm	0.14µm	-60 to 310/330°C	42301		42302		
0.25mm	0.20µm	-60 to 320/340°C		11320		11323	11326
0.32mm	0.25µm	-60 to 320/340°C		11321		11324	
	0.50µm	-60 to 320/340°C				11325	
0.53mm	0.42µm	-60 to 300/320°C		11337		11340	

Rtx®-CLPesticides Column Kits

(Note: Columns are not preconnected in these kits.)

Purchase one of these recommended combinations of guard and analytical columns and save money.

Rtx-CLPesticides Kit (0.25mm ID) **cat.# 11199 (kit), $1050** **SAVE $100**

Includes:	cat.#	price
30m, 0.25mm ID, 0.25µm Rtx-CLPesticides Column	11123	
30m, 0.25mm ID, 0.20µm Rtx-CLPesticides2 Column	11323	
Universal Angled "Y" Press-Tight Connector, Deactivated	20403-261	
5m, 0.25mm ID Siltek Guard Column	10026	

Rtx-CLPesticides Kit (0.32mm ID) **cat.# 11196 (kit), $1080** **SAVE $135**

Includes:	cat.#	price
30m, 0.32mm ID, 0.32µm Rtx-CLPesticides Column	11141	
30m, 0.32mm ID, 0.25µm Rtx-CLPesticides2 Column	11324	
Universal Angled "Y" Press-Tight Connector, Deactivated	20403-261	
5m, 0.32mm ID Siltek Guard Column	10027	

Rtx-CLPesticides Kit (0.53mm ID) **cat.# 11197 (kit), $1155** **SAVE $180**

Includes:	cat.#	price
30m, 0.53mm ID, 0.50µm Rtx-CLPesticides Column	11140	
30m, 0.53mm ID, 0.42µm Rtx-CLPesticides2 Column	11340	
Universal Angled "Y" Press-Tight Connector, Deactivated	20403-261	
5m, 0.53mm ID IP Deactivated Guard Column	10045	$67

ordering **note**

Add "-530" or "-535" to the catalog number for the column kit, to save on the cost of the reference mix.

also **available**

For a wide variety of column connectors, see **pages 287-293**.

Add a reference mix to your kit order and save!

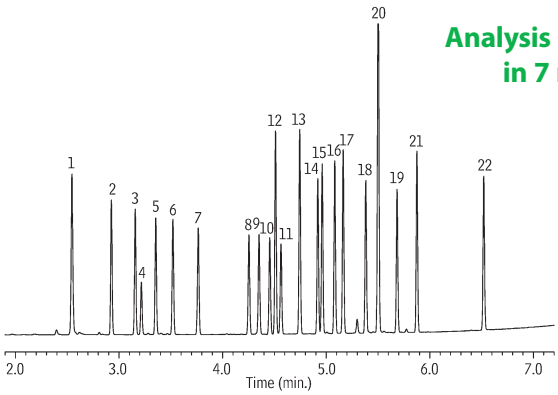
Description	list price	price with/kit	suffix #
Organochlorine Pesticide Mix AB #1 (cat.# 32291)	$50	$35	
Organochlorine Pesticide Mix AB #2 (cat.# 32292)	$40	$25	

Chlorinated Pesticides Analysis

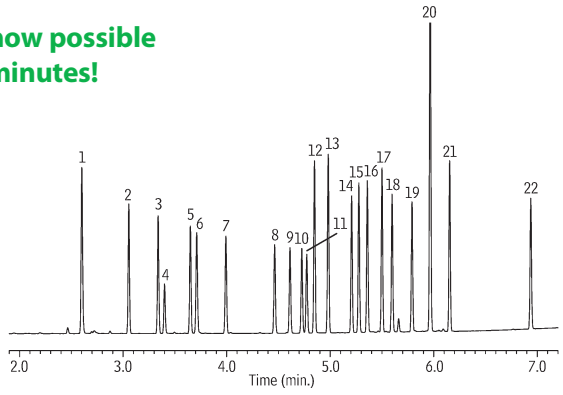
Fast GC analyses of chlorinated pesticides on Rtx®-CLPesticides and Rtx®-CLPesticides2 columns.

Rtx®-CLPesticides & Rtx®-CLPesticides2 columns (0.32 mm ID)

Rtx®-CLPesticides



Rtx®-CLPesticides2

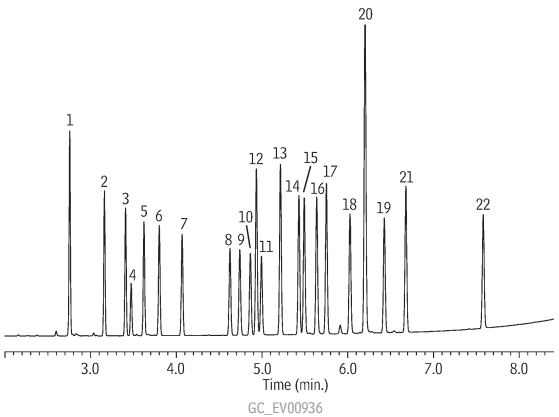


Columns:	Rtx®-CLPesticides, 30m, 0.32mm ID, 0.32µm (cat.# 11141) and Rtx®-CLPesticides2, 30m, 0.32mm ID, 0.25µm (cat.# 11324) with 5m x 0.32mm ID Rxi® deactivated guard tubing (cat.# 10039), connected using Deactivated Universal "Y" Press-Tight® connector (cat.# 20405-261)
Sample:	Organochlorine Pesticide Mix AB #2, 8-80µg/mL each component in hexane/toluene (cat.# 32292), Pesticide Surrogate Mix, 200µg/mL each component in acetone (cat.# 32000)
Inj.:	1.0µL splitless (hold 0.3 min.), 4mm single gooseneck inlet liner (cat.# 20799)
Inj. temp.:	250°C
Carrier gas:	helium, constant flow
Linear velocity:	60cm/sec. @ 120°C
Oven temp.:	120°C to 200°C @ 45°C/min. to 230°C @ 15°C/min. to 330°C (hold 2 min.) @ 30°C/min.
Det.:	Agilent 6890 w/µ-ECD @ 330°C

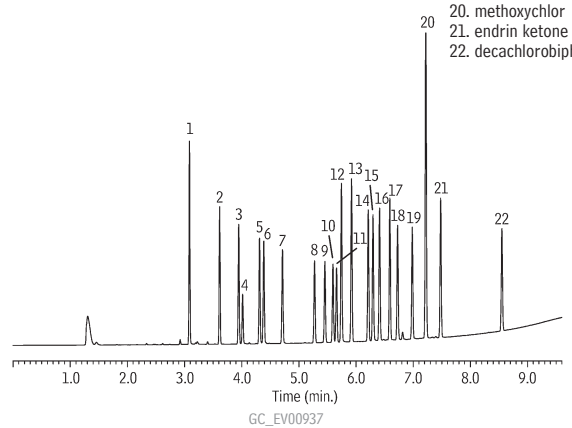
1. 2,4,5,6-tetrachloro-*m*-xylene (SS)
2. α-BHC
3. γ-BHC
4. β-BHC
5. δ-BHC
6. heptachlor
7. aldrin
8. heptachlor epoxide (isomer B)
9. γ-chlordane
10. α-chlordane
11. endosulfan I
12. 4,4'-DDE
13. dieldrin
14. endrin
15. 4,4'-DDD
16. endosulfan II
17. 4,4'-DDT
18. endrin aldehyde
19. endosulfan sulfate
20. methoxychlor
21. endrin ketone
22. decachlorobiphenyl (SS)

Rtx®-CLPesticides & Rtx®-CLPesticides2 columns (0.53 mm ID)

Rtx®-CLPesticides



Rtx®-CLPesticides2



Columns:	Rtx®-CLPesticides, 30m, 0.53mm ID, 0.50µm (cat.# 11140) and Rtx®-CLPesticides2, 30m, 0.53mm ID, 0.42µm (cat.# 11340) with 5m x 0.53mm ID Rxi® deactivated guard tubing (cat.# 10054), connected using Siltek® Treated Universal "Y" Press-Tight® connector (cat.# 20486)
Sample:	Organochlorine Pesticide Mix AB #2, 8-80µg/mL each component in hexane/toluene (cat.# 32292), Pesticide Surrogate Mix, 200µg/mL each component in acetone (cat.# 32000)
Inj.:	1.0µL splitless (hold 0.3 min.), 4mm single gooseneck inlet liner (cat.# 20799)
Inj. temp.:	250°C
Carrier gas:	helium, constant flow
Linear velocity:	45cm/sec. @ 120°C
Oven temp.:	120°C to 200°C @ 45°C/min. to 230°C @ 12.5°C/min. to 320°C (hold 2 min.) @ 20°C/min.
Det.:	Agilent 6890 w/µ-ECD @ 330°C

restek **innovation**!

Chlorinated Pesticides Analysis

Stx®-CLPesticides/Stx®-CLPesticides2

(proprietary Crossbond® phases)

- Application-specific columns for organochlorine pesticides and herbicides.
- Baseline separations in less than 10 minutes.
- Siltek® surface deactivation enhances responses for endrin, DDT, methoxychlor.
- Stable to 330 °C.

Many laboratories analyzing organochlorine pesticides struggle with breakdown and adsorption of endrin, DDT, and methoxychlor caused by active sites throughout the analytical system. Siltek® passivation technology enables these columns to offer unsurpassed inertness and the highest responses for active pesticides.

it's a **fact**

These columns are treated with Siltek® deactivation, which provides better responses for endrin, DDT, and methoxychlor.

Stx®-CLPesticides Columns (fused silica with Siltek® deactivation)

ID	df	temp. limits	15-Meter	30-Meter
0.25mm	0.25µm	-60 to 310/330°C	11540	11543
0.32mm	0.32µm	-60 to 310/330°C		11546
	0.50µm	-60 to 310/330°C	11541	11544

Stx®-CLPesticides2 Columns (fused silica with Siltek® deactivation)

ID	df	temp. limits	15-Meter	30-Meter
0.25mm	0.20µm	-60 to 310/330°C	11440	11443
0.32mm	0.25µm	-60 to 310/330°C	11441	11444

Stx®-CLPesticides Kits

(Note: Columns are not preconnected in these kits.)

kit

Stx-CLPesticides Kit (0.25mm ID) cat.# 11190 (kit), $1050 SAVE $100

Includes:	cat.#	price
30m, 0.25mm ID, 0.25µm Stx-CLPesticides Column	11543	
30m, 0.25mm ID, 0.20µm Stx-CLPesticides2 Column	11443	
Universal Angled "Y" Press-Tight Connector, Deactivated	20403-261	
5m, 0.25mm ID Siltek Guard Column	10026	

kit

Stx-CLPesticides Kit (0.32mm ID) cat.# 11193 (kit), $1080 SAVE $135

Includes:	cat.#	price
30m, 0.32mm ID, 0.32µm Stx-CLPesticides Column	11546	
30m, 0.32mm ID, 0.25µm Stx-CLPesticides2 Column	11444	
Universal Angled "Y" Press-Tight Connector, Deactivated	20403-261	
5m, 0.32mm ID Siltek Guard Column	10027	
Total cost if purchased separately		$1215

ordering **note**

Kits include Siltek® deactivated guard column.

Organophosphorus Pesticides Analysis

Rtx®-OPPesticides/Rtx®-OPPesticides2

(proprietary Crossbond® phases)

- Application-specific columns for organophosphorus pesticides; best column combination for US EPA Method 8141A.
- Low bleed—ideal for GC/FPD, GC/NPD, or GC/MS analyses.
- Stable to 330 °C.

FAST efficient analysis of OPPs in EPA Method 8141A

Using sophisticated computer modeling software, we created two stationary phases for separating the 53 organophosphorus pesticides (OPP) listed in EPA Method 8141A. Separation is improved, and analysis time is significantly reduced, compared to other columns. The extended upper temperature limit of these phases (330 °C) allows analysts to bake out high molecular weight contamination typically associated with pesticide samples. The low bleed columns are a perfect match for sensitive detection systems.

restek **innovation**!

- Better separations
- Faster analysis

Rtx®-OPPesticides Columns (fused silica)

ID	df	temp. limits	30-Meter
0.32mm	0.50µm	-20 to 310/330°C	11239
0.53mm	0.83µm	-20 to 310/330°C	11240

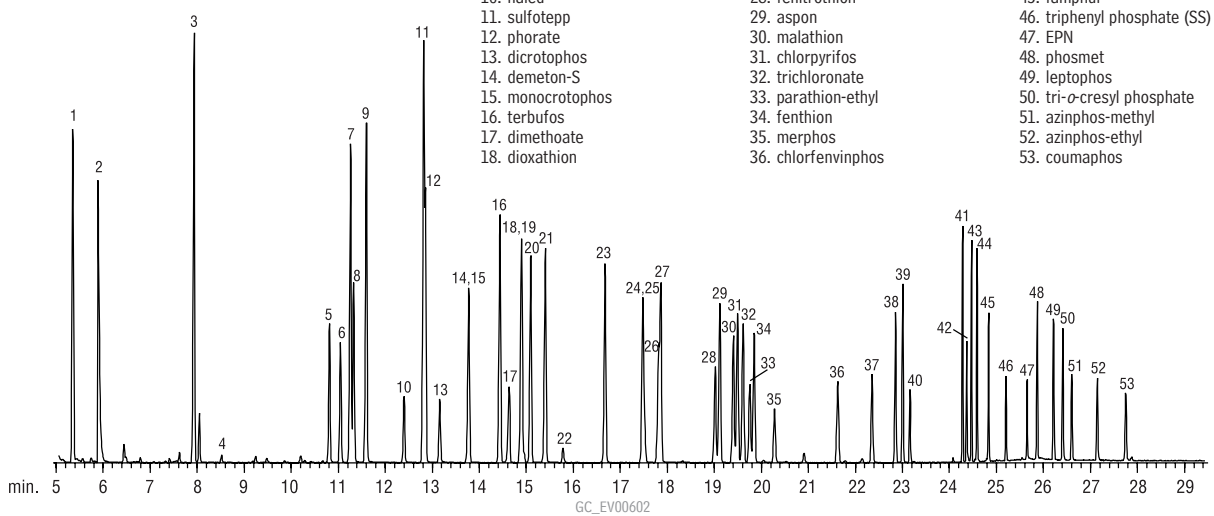
Rtx®-OPPesticides2 Columns (fused silica)

ID	df	temp. limits	20-Meter		30-Meter
0.18mm	0.20µm	-20 to 310/330°C	11244	$460	
0.25mm	0.25µm	-20 to 310/330°C			11243
0.32mm	0.32µm	-20 to 310/330°C			11241
0.53mm	0.50µm	-20 to 310/330°C			11242

Organophosphorus pesticides by US EPA Method 8141A on an Rtx®-OPPesticides2 column.

Best column choice to resolve Method 8141A compounds!

1. dichlorvos
2. hexamethylphosphoramide
3. mevinphos
4. trichlorfon
5. TEPP
6. demeton-O
7. thionazin
8. tributyl phosphate (IS)
9. ethoprop
10. naled
11. sulfotepp
12. phorate
13. dicrotophos
14. demeton-S
15. monocrotophos
16. terbufos
17. dimethoate
18. dioxathion
19. fonophos
20. diazinon
21. disulfoton
22. phosphamidon isomer
23. dichlorofenthion
24. chlorpyrifos methyl
25. phosphamidon
26. parathion-methyl
27. ronnel
28. fenitrothion
29. aspon
30. malathion
31. chlorpyrifos
32. trichloronate
33. parathion-ethyl
34. fenthion
35. merphos
36. chlorfenvinphos
37. crotoxyphos
38. stirofos
39. tokuthion
40. merphos oxone (breakdown product)
41. ethion
42. fensulfothion
43. bolstar
44. carbophenothion
45. famphur
46. triphenyl phosphate (SS)
47. EPN
48. phosmet
49. leptophos
50. tri-*o*-cresyl phosphate
51. azinphos-methyl
52. azinphos-ethyl
53. coumaphos



Column:	Rtx®-OPPesticides2, 30m, 0.25mm ID, 0.25µm (cat.# 11243)	Inj. temp.:	250°C
Sample:	US EPA Method 8141A Custom Standard Mix 1µL 100ppm (100ng on column)	Carrier gas:	helium, constant flow
	Triphenylphosphate Standard (cat.# 32281)	Flow rate:	1.0mL/min.
	Tributylphosphate Standard (cat.# 32280)	Oven temp.:	80°C (hold 0.5 min.) to 140°C @ 20°C/min. to 210°C @ 4°C/min. (hold 1 min.) to 280°C @ 30°C (hold 5 min.)
	8140/8141 OP Pesticides Calibration Mix A (cat.# 32277)		
	8141 OP Pesticides Calibration Mix B (cat.# 32278)	Det:	MS
	Custom Mixes: Call Restek for Information	Transfer line temp.:	280°C
Inj.:	1.0µL splitless (hold 0.4 min.), 4mm double gooseneck inlet liner (cat.# 20785)	Scan range:	35-400amu
		Ionization:	EI

Brominated Flame Retardants Analysis

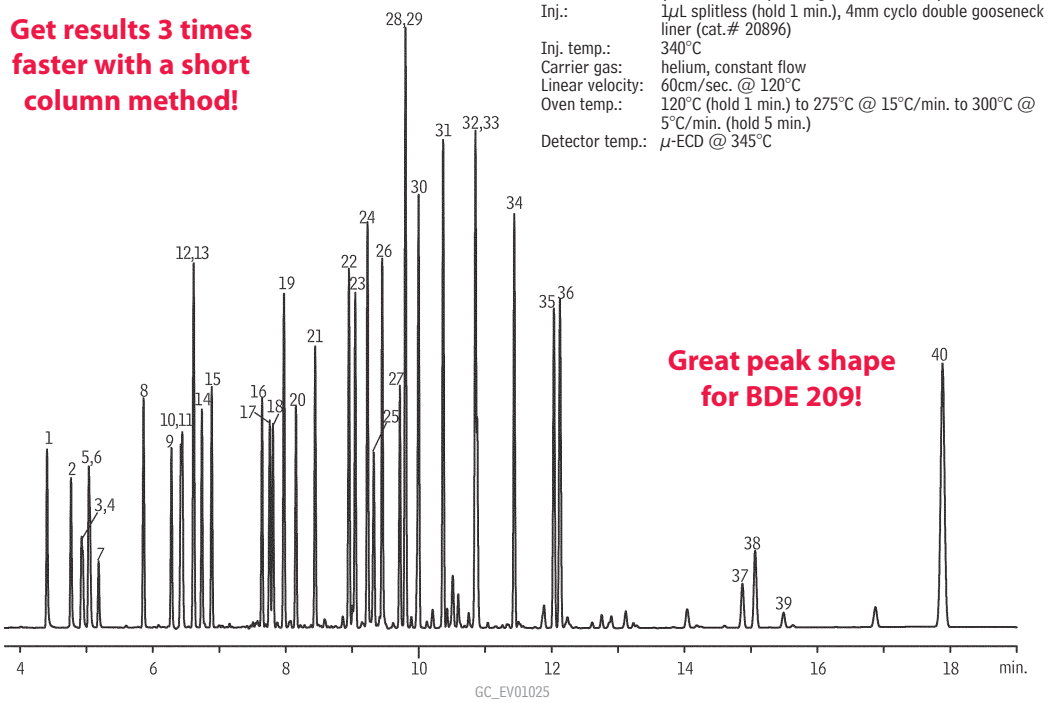
Rtx®-1614 Columns (fused silica)
(5% phenyl methyl)

- Optimized for PBDE analysis by EPA Method 1614.
- Short column option resolves BDE-209 3 times faster, with less thermal breakdown.
- Unique deactivation gives higher BDE-209 response, compared to DB-5HT columns, for greater analytical sensitivity.
- Exceeds EPA Method 1614 resolution criteria for BDE-49 and BDE-71.

Table of Contents for
GC Chromatograms
see **page 542**

ID	df	temp. limits	15-Meter	30-Meter
0.25mm	0.10µm	-60 to 330/360°C	10296	10295

Brominated flame retardants on an Rtx®-1614 column.



1. BDE-10
2. BDE-7
3. BDE-8
4. BDE-11
5. BDE-12
6. BDE-13
7. BDE-15
8. BDE-30
9. BDE-32
10. BDE-17
11. BDE-25
12. BDE-28
13. BDE-33
14. BDE-35
15. BDE-37
16. BDE-75
17. BDE-49
18. BDE-71
19. BDE-47
20. BDE-66
21. BDE-77
22. BDE-100
23. BDE-119
24. BDE-99
25. BDE-116
26. BDE-118
27. BDE-85
28. BDE-155
29. BDE-126
30. BDE-154
31. BDE-153
32. BDE-138
33. BDE-166
34. BDE-183
35. BDE-181
36. BDE-190
37. BDE-208
38. BDE-207
39. BDE-206
40. BDE-209

PCB Congeners Analysis

restek **innovation**!

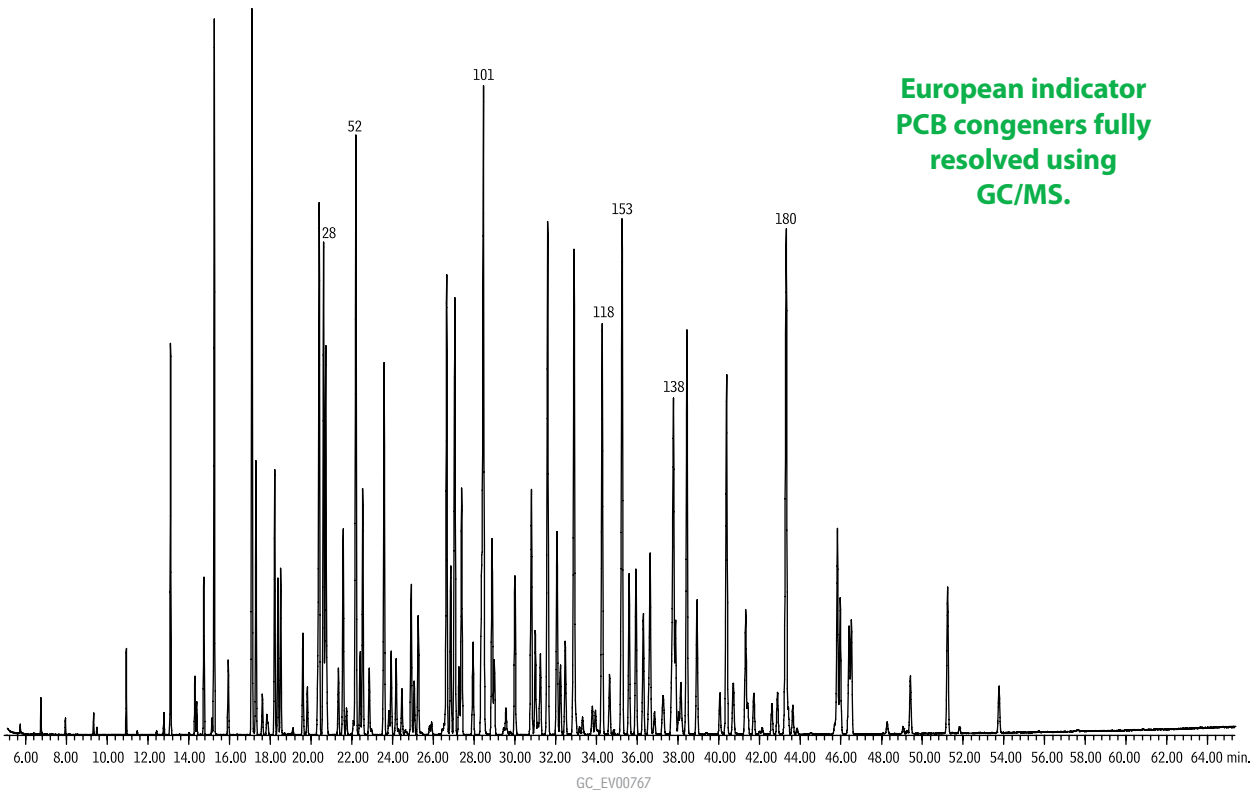
Rtx®-PCB Columns (fused silica)
(proprietary Crossbond® phase)

- Unique polymer for PCBs analysis by GC/ECD or GC/MS.
- Good results for other semivolatiles.
- Low polarity; inert to active compounds.
- Stable to 340 °C.

ID	df	temp. limits*	20-Meter	30-Meter	40-Meter	60-Meter
0.18mm	0.18µm	30°C to 320/340°C	41302		41303	41304
0.25mm	0.25µm	30°C to 320/340°C		13223		13226
0.32mm	0.50µm	30°C to 320/340°C		13239		

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

**Aroclor 1242/1254/1262 PCBs on Rtx®-PCB:
best available resolution of individual congeners.**



European indicator PCB congeners fully resolved using GC/MS.

Column:	Rtx®-PCB, 60m, 0.25mm ID, 0.25µm (cat.# 13226)
Sample:	Aroclor 1242 (cat.# 32009), 1254 (cat.# 32011), 1262 (cat.# 32409), 333ppm each
Inj.:	1.0µL splitless (hold 0.75 min.), 4mm single gooseneck inlet liner w/wool (cat.# 22405)
Inj. temp.:	280°C
Carrier gas:	helium, constant flow
Flow rate:	1.1mL/min.
Oven temp.:	100°C (hold 1 min.) to 200°C @ 30°C/min., to 320°C @ 2°C/min. (hold 1 min.)
Det.:	MS
Transfer line temp.:	280°C
Scan range:	50 to 550amu
Ionization:	EI
Mode:	scan

PCB Congeners Analysis

Rxi®-XLB Columns (fused silica)
(low polarity proprietary phase)

- General purpose columns exhibiting extremely low bleed. Ideal for many GC/MS applications, including pesticides, PCB congeners (e.g. Aroclor mixes), PAHs.
- Unique selectivity.
- Temperature range: 30 °C to 360 °C.

Improvements in polymer synthesis and tubing deactivation enable us to make inert, stable Rxi®-XLB columns especially well-suited for analyzing active, high molecular weight compounds with sensitive GC/MS systems, including ion trap detectors. Excellent efficiency, coupled with inertness, low bleed, and high thermal stability, make Rxi®-XLB columns ideal for analyzing semivolatile compounds in drinking water (e.g., US EPA Method 525).

similar **phases**

DB-XLB, VF-Xms

ID	df	temp. limits*	15-Meter	30-Meter	60-Meter
0.25mm	0.10µm	30 to 340/360°C	13705	13708	
	0.25µm	30 to 340/360°C	13720	13723	13726
	0.50µm	30 to 340/360°C		13738	
	1.00µm	30 to 340/360°C	13750	13753	
0.32mm	0.10µm	30 to 340/360°C		13709	
	0.25µm	30 to 340/360°C	13721	13724	13727
	0.50µm	30 to 340/360°C		13739	
	1.00µm	30 to 340/360°C		13754	
0.53mm	0.50µm	30 to 340/360°C		13740	
	1.50µm	30 to 320/340°C	13767	13770	

ID	df	temp. limits	10-Meter	20-Meter
0.10mm	0.10µm	30 to 340/360°C	43701	
0.18mm	0.18µm	30 to 340/360°C		43702

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

Dioxin & Furan Congeners Analysis

Rxi®-5Sil MS Columns (fused silica)
(low polarity Crossbond® silarylene phase; selectivity close to 5% phenyl/95% dimethyl arylene polysiloxane)

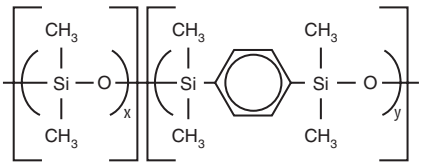
- Engineered to be a low bleed GC/MS column.
- Excellent inertness for active compounds.
- General purpose columns—ideal for GC/MS analysis of polycyclic aromatic compounds, chlorinated hydrocarbons, phthalates, phenols, amines, organochlorine pesticides, organophosphorus pesticides, drugs, solvent impurities, and hydrocarbons.
- Temperature range: -60 °C to 350 °C.

The Rxi®-5Sil MS stationary phase incorporates phenyl groups in the polymer backbone. This improves thermal stability, reduces bleed, and makes the phase less prone to oxidation. Rxi®-5Sil MS columns are ideal for GC/MS applications requiring high sensitivity, including use in ion trap systems.

ID	df	temp. limits	30-Meter	60-Meter*
0.18mm	0.10µm	-60 to 320/350°C		43607
0.25mm	0.25µm	-60 to 330/350°C	13623	

*60m, 0.18mm ID, 0.10µm column (cat.# 43607) intended for dioxin and furan analysis only.

Rxi®-5Sil MS Structure



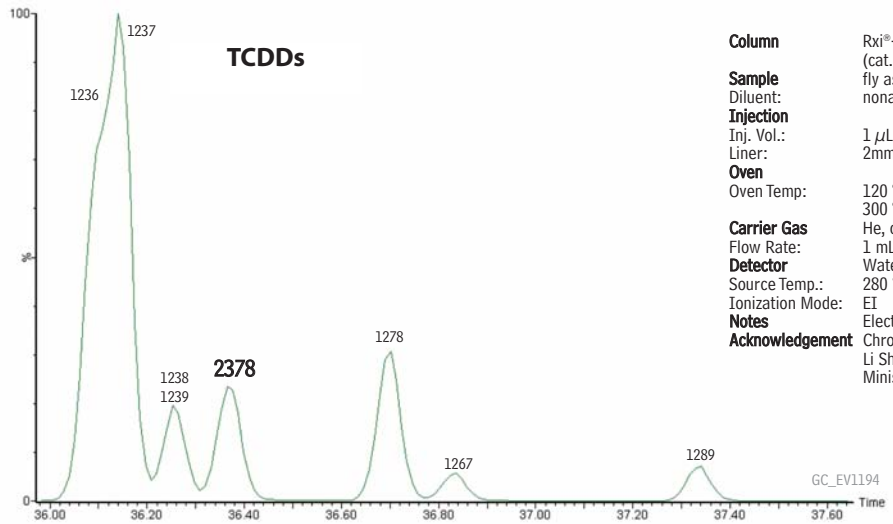
similar **phases**

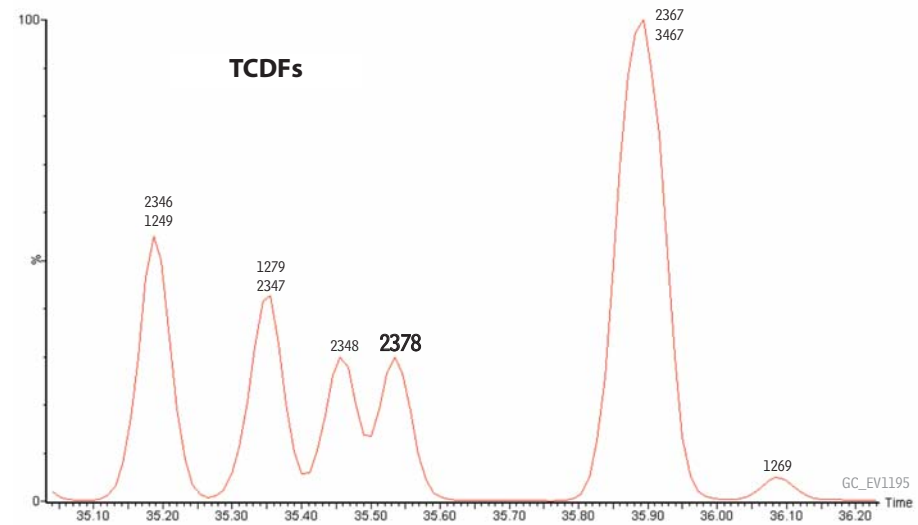
DB-5MS, VF-5ms, CP-Sil 8 Low-Bleed/MS

also **available**

Other Dimensions!
See **page 42** for our complete listing of Rxi®-5Sil MS columns.

Dioxins (TCDDs) and furans (TCDFs) in fly ash on an Rxi®-5Sil MS column.





Column	Rxi®-5Sil MS , 60 m, 0.18 mm ID, 0.10 µm (cat.# 43607)
Sample	fly ash extract
Diluent:	nonane
Injection	
Inj. Vol.:	1 µL splitless
Liner:	2mm Splitless liner (cat.# 20712)
Oven	
Oven Temp:	120 °C (hold 1 min.) to 160 °C at 10 °C/min. to 300 °C at 2.5 °C/min.
Carrier Gas	He, constant flow
Flow Rate:	1 mL/min.
Detector	Waters AutoSpec Ultima Mass Spectrometer
Source Temp.:	280 °C
Ionization Mode:	EI
Notes	Electron Ionization at 40eV
Acknowledgement	Chromatogram courtesy of Karen MacPherson, Li Shen, Terry Kolic, and Eric Reiner at the Ontario Ministry of the Environment

Dioxin & Furan Congeners Analysis

restek **innovation**!

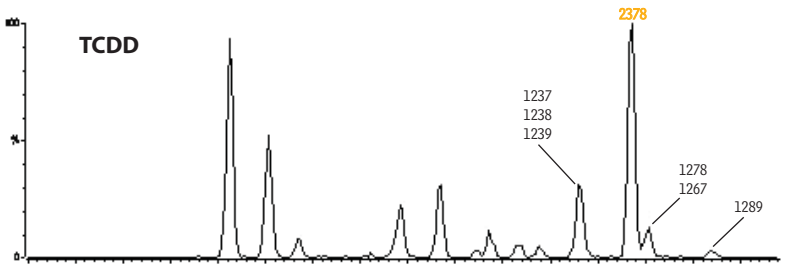
Excellent for dioxins or furans.

Rtx®-Dioxin2 Columns (fused silica)
(proprietary Crossbond® phase)

- Isomer specificity for 2,3,7,8-TCDD and 2,3,7,8-TCDF achieved with one GC column.
- Thermally stable to 340 °C for longer lifetime.
- Unique selectivity for toxic dioxin and furan congeners allow use as a confirmation GC column.

ID	df	temp. limits	40-Meter	60-Meter
0.18mm	0.18µm	20°C to 340°C	10759	
0.25mm	0.25µm	20°C to 340°C		10758

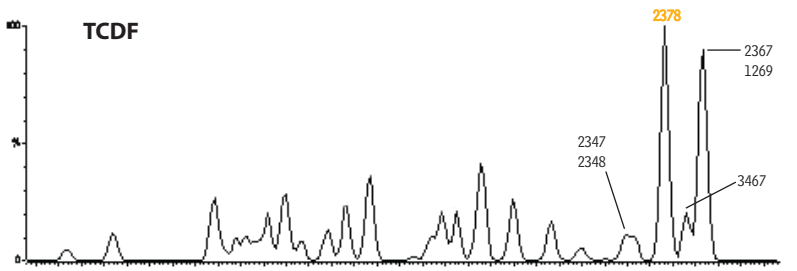
2,3,7,8-Tetrachlorodibenzodioxin resolved from other TCDD congeners, using an Rtx®-Dioxin2 column.



Other peak identifications available upon request. GC_EV00948

Column: Rtx®-Dioxin2, 60m, 0.25mm ID, 0.25µm (cat.# 10758)
Sample: WMS-01 Reference Material, Wellington Laboratories
Inj.: Splitless
Inj. temp.: 250°C
Carrier gas: helium, constant flow
Flow rate: 1.5mL/min.
Oven temp.: 130°C (hold 1.0 min.) to 200°C @ 40°C/min. to 235°C @ 3.0°C/min. to 300°C @ 5°C/min. (hold 10 min.)
Det.: Micromass Ultima high-resolution mass spectrometer
Ionization: EI
Mode: SIR

Tetrachlorodibenzofuran congeners on an Rtx®-Dioxin2 column.



Other peak identifications available upon request. GC_EV00949

Column: Rtx®-Dioxin2, 60m, 0.25mm ID, 0.25µm (cat.# 10758)
Sample: WMS-01 Reference Material, Wellington Laboratories
Inj.: Splitless
Inj. temp.: 250°C
Carrier gas: helium, constant flow
Flow rate: 1.5mL/min.
Oven temp.: 130°C (hold 1.0 min.) to 200°C @ 40°C/min. to 235°C @ 3.0°C/min. to 300°C @ 5°C/min. (hold 10 min.)
Det.: Micromass Ultima high-resolution mass spectrometer
Ionization: EI
Mode: SIR

Chromatograms courtesy of Terry Kolic, Karen MacPherson, Eric Reiner, Ontario Ministry of the Environment, Toronto, Ontario, Canada

Polycyclic Aromatic Hydrocarbon (PAH) Analysis

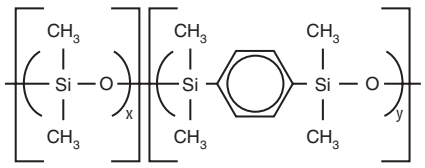
Rxi®-5Sil MS Columns (fused silica)
(low polarity Crossbond® silarylene phase; selectivity close to 5% phenyl/95% dimethyl arylene polysiloxane)

- Engineered to be a low bleed GC/MS column.
- Excellent inertness for active compounds.
- General purpose columns—ideal for GC/MS analysis of polycyclic aromatic compounds, chlorinated hydrocarbons, phthalates, phenols, amines, organochlorine pesticides, organophosphorus pesticides, drugs, solvent impurities, and hydrocarbons.
- Temperature range: -60 °C to 350 °C.

ID	df	temp. limits	15-Meter	30-Meter	60-Meter
0.25mm	0.10µm	-60 to 330/350°C	13605	13608	
	0.25µm	-60 to 330/350°C	13620	13623	13626
	0.50µm	-60 to 330/350°C	13635	13638	

ID	df	temp. limits	10-Meter	20-Meter
0.10mm	0.10µm	-60 to 330/350°C	43601	
0.18mm	0.18µm	-60 to 330/350°C		43602
	0.36µm	-60 to 330/350°C		43604

Rxi®-5Sil MS Structure



similar **phases**

DB-5MS, VF-5ms, CP-Sil 8 Low-Bleed/MS

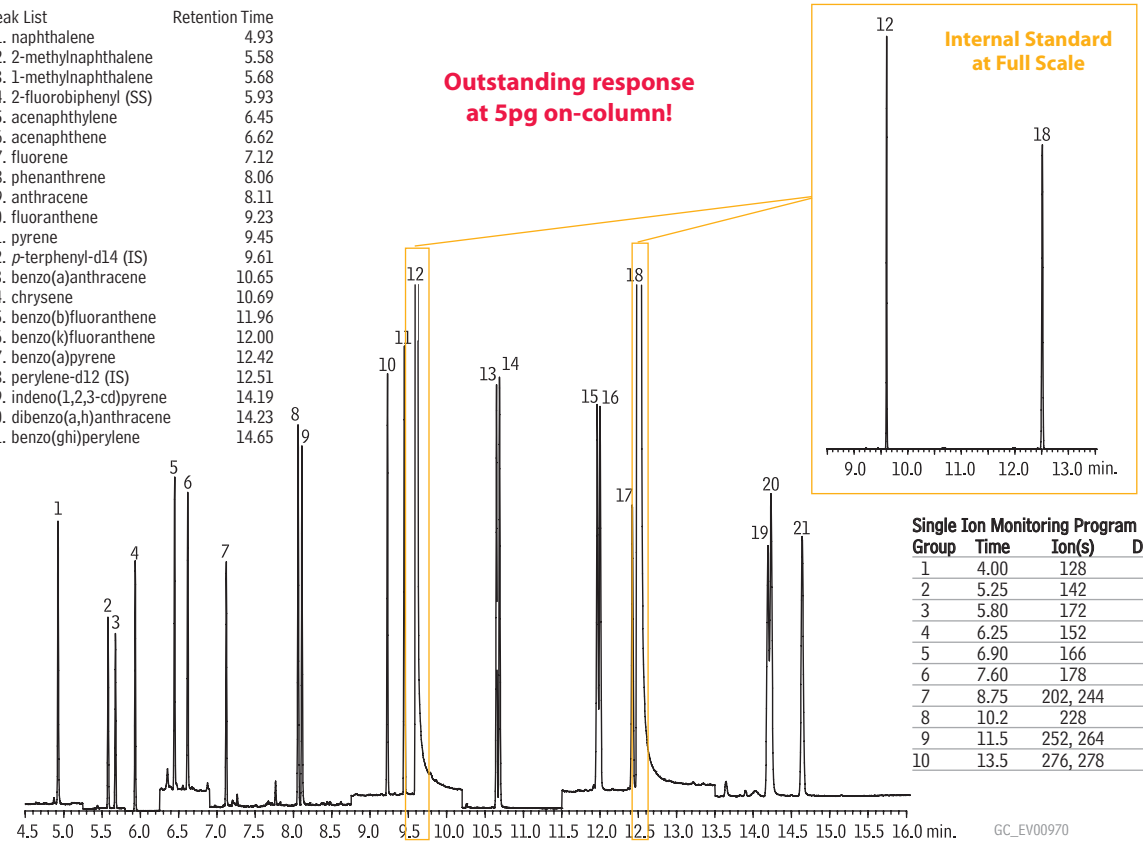
also **available**

Get the protection without the connection!
For Rxi®-5Sil MS columns with built-in Integra-Guard® guard columns, see **page 35**.

Other Dimensions!
See **page 42** for our complete listing of Rxi®-5Sil MS columns.

Polycyclic aromatic hydrocarbons on an Rxi®-5Sil MS column.

Peak List	Retention Time
1. naphthalene	4.93
2. 2-methylnaphthalene	5.58
3. 1-methylnaphthalene	5.68
4. 2-fluorobiphenyl (SS)	5.93
5. acenaphthylene	6.45
6. acenaphthene	6.62
7. fluorene	7.12
8. phenanthrene	8.06
9. anthracene	8.11
10. fluoranthene	9.23
11. pyrene	9.45
12. *p*-terphenyl-d14 (IS)	9.61
13. benzo(a)anthracene	10.65
14. chrysene	10.69
15. benzo(b)fluoranthene	11.96
16. benzo(k)fluoranthene	12.00
17. benzo(a)pyrene	12.42
18. perylene-d12 (IS)	12.51
19. indeno(1,2,3-cd)pyrene	14.19
20. dibenzo(a,h)anthracene	14.23
21. benzo(ghi)perylene	14.65



Single Ion Monitoring Program

Group	Time	Ion(s)	Dwell (ms)
1	4.00	128	100
2	5.25	142	100
3	5.80	172	100
4	6.25	152	100
5	6.90	166	100
6	7.60	178	100
7	8.75	202, 244	100
8	10.2	228	100
9	11.5	252, 264	100
10	13.5	276, 278	100

Column: Rxi®-5Sil MS, 30m, 0.25mm ID, 0.25µm (cat.# 13623)
Sample: PAH mix, 1µL of 0.005µg/mL (IS 2µg/mL)
SV Calibration Mix #5 (cat.# 31011)
1-methylnaphthalene (cat.# 31283)
2-methylnaphthalene (cat.# 31285)
2-fluorobiphenyl (cat.# 31091)
Inj.: 1.0µL (5pg on-column concentration),
4mm Drilled Uniliner® (hole near top) inlet liner w/wool (cat.# 21055-200.5),
pulsed splitless: pulse 20psi @ 0.2 min., 60mL/min. @ 0.15 min.

Inj. temp.: 300°C
Carrier gas: helium, constant flow
Flow rate: 1.4mL/min.
Oven temp.: 50°C (hold 0.5 min.) to 290°C @ 25°C/min. to 320°C @ 5°C/min.
Det.: MS
Transfer line temp: 290°C
Ionization: EI
Mode: SIM

NEW!

Polycyclic Aromatic Hydrocarbon (PAH) Analysis

Rxi®-17Sil MS Columns (fused silica)

(midpolarity Crossbond® silarylene phase; equivalent to 50% phenyl/50% dimethyl arylene polysiloxane)

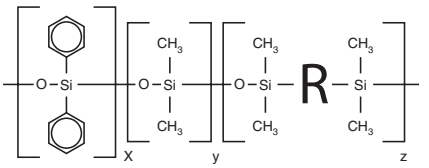
- 340/360 °C upper temperature limits.
- Excellent inertness for active compounds.
- Equivalent to USP phase G3.
- Low-bleed for use with sensitive detectors, such as MS.
- Excellent separation of EU-PAHs, including fluoranthenes.

ID	df	temp. limits*	15-Meter	30-Meter	60-Meter
0.25mm	0.25µm	40 to 340/360°C	14120	14123	14126
0.32mm	0.25µm	40 to 340/360°C	14121	14124	

ID	df	temp. limits	20-Meter
0.18mm	0.18µm	40 to 340/360°C	14102
	0.36µm	40 to 340/360°C	14111

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

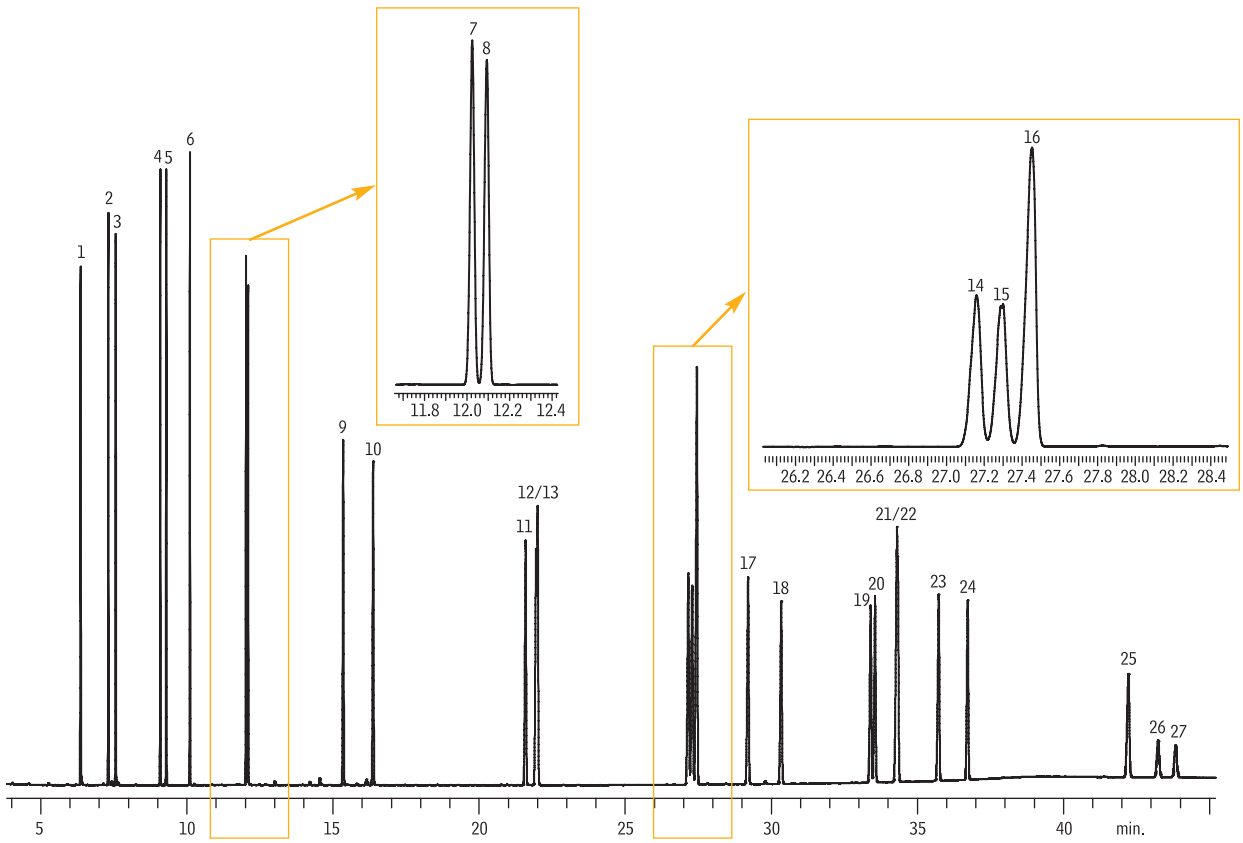
Rxi®-17Sil MS Structure



similar **phases**

DB-17ms, VF-17ms, BPX-50, DB-EUPAH

Polycyclic aromatic hydrocarbons on an Rxi®-17Sil MS column.



GC_EV1160

1. Naphthalene
2. 2-Methylnaphthalene
3. 1-Methylnaphthalene
4. Acenaphthylene
5. Acenaphthene
6. Fluorene
7. Phenanthrene
8. Anthracene
9. Fluoranthene
10. Pyrene
11. Benz[a]anthracene
12. Chrysene
13. Triphenylene
14. Benzo[b]fluoranthene
15. Benzo[k]fluoranthene
16. Benzo(j)fluoranthene
17. Benzo[a]pyrene
18. 3-Methylcholanthrene
19. Dibenz(a,h)acridine
20. Dibenz[a,j]acridine
21. Indeno[1,2,3-cd]pyrene
22. Dibenz[a,h]anthracene
23. Benzo[ghi]perylene
24. 7H-Dibenzo[c,g]carbazole
25. Dibenzo[a,e]pyrene
26. Dibenzo(a,i)pyrene
27. Dibenzo(a,h)pyrene

Column	Rxi®-17Sil MS, 30 m, 0.25 mm ID, 0.25 µm (cat.# 14123)
Sample	SV Calibration Mix #5 / 610 PAH Mix (cat.# 31011) EPA Method 8310 PAH Mixture (cat.# 31841)
Diluent:	dichloromethane
Conc.:	10 ppm
Injection	
Inj. Vol.:	0.5 µL splitless (hold 1.75 min.)
Liner:	Auto SYS XL PSS Split/Splitless w/Wool (cat.# 21718)
Inj. Temp.:	320 °C
Purge Flow:	75 mL/min.
Oven	
Oven Temp:	65 °C (hold 0.5 min.) to 220 °C at 15 °C/min. to 330 °C at 4 °C/min. (hold 15 min.)
Carrier Gas	He, constant flow
Flow Rate:	2.0 mL/min.
Detector	FID @ 320 °C
Instrument	PE Clarus 600 GC
Acknowledgement	Instrument provided by PerkinElmer

Mineral Oil Analysis

Rtx®-Mineral Oil Columns (fused silica)

- Application specific columns meet DIN EN ISO 9377-2:2000 requirements.
- Optimized column dimensions for fast mineral oil screening.
- Surface linked phase guarantees long lifetime, robustness, and stability to 400 °C.

NEW!

The Rtx®-Mineral Oil stationary phase and column dimensions were optimized for the fast screening of mineral oils in extracts from solids and water samples according to DIN EN ISO 9377-2: 2000. The 0.10 µm column is the gold standard for the method, whereas the 0.15 µm column provides more complete separation of C10 from the solvent peak when large injection sizes are used. Compared with common industry solutions, the unique surface bonding of the Rtx®-Mineral Oil column ensures long column lifetime, even at higher temperatures. These unique columns can be used at temperatures ranging from 380 °C (isothermal) to 400 °C (programmable), and each column is tested individually for bleed to ensure exceptional performance at these extreme conditions.

ID	df	temp. limits	15-Meter
0.32mm	0.10µm	-60 to 380/400°C	18079
	0.15µm	-60 to 380/400°C	18074
	0.30µm	-60 to 380/400°C	18075

similar **phases**

Varian Select Mineral Oil, VF-5HT, DB-1HT, DB-5HT

Volatile Organics Analysis

Rtx®-VMS Columns (fused silica)
(proprietary Crossbond® phase)

- Application-specific columns for volatile organic pollutants by GC/MS.
- Complete separation of US EPA Method 8260B compounds in less than 10 minutes.
- Stable to 260 °C.
- No known equivalent phases.

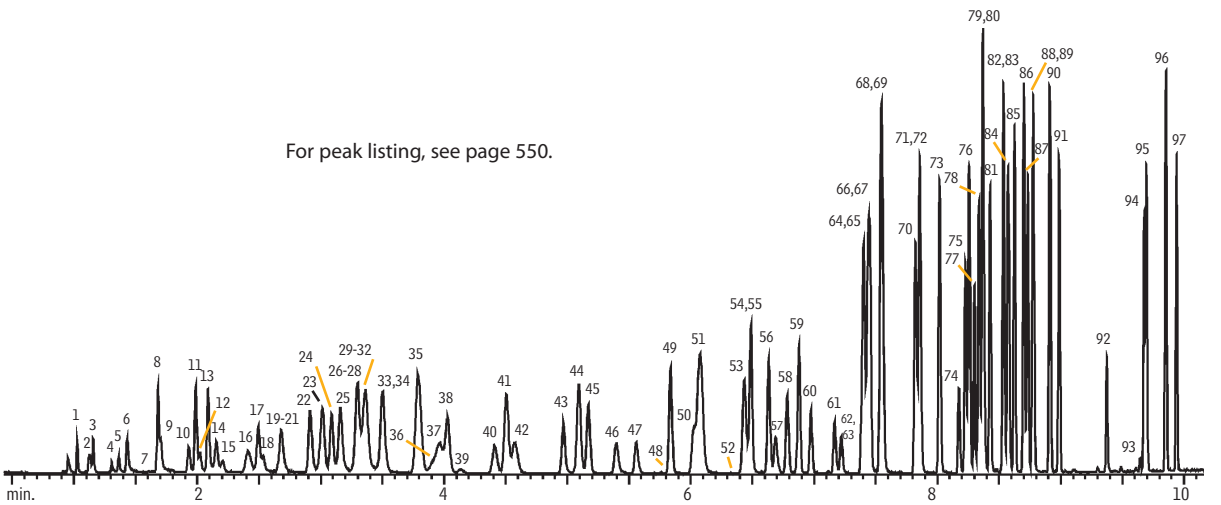
Rtx®-VMS columns offer lower bleed, better selectivity, and overall faster analysis for separating volatile organic compounds, such as those listed in US EPA Method 8260B. The Rtx®-VMS stationary phase is a highly stable polymer that provides outstanding analysis of volatile compounds, in combination with sensitive ion traps and Agilent 5973 mass spectrometers. 0.18 and 0.25 mm ID columns allow sample splitting at the injection port, eliminating the added expense and maintenance of a jet separator. A 0.45 mm or 0.53 mm ID column can be directly connected to the purge & trap transfer line in a system equipped with a jet separator.

ID	df	temp. limits	30-Meter	60-Meter	75-Meter
0.25mm	1.40µm	-40 to 240/260°C	19915	19916	
0.32mm	1.80µm	-40 to 240/260°C	19919	19920	
0.45mm	2.55µm	-40 to 240/260°C	19908	19909	
0.53mm	3.00µm	-40 to 240/260°C	19985	19988	19974

ID	df	temp. limits	20-Meter		40-Meter	
0.18mm	1.00µm	-40 to 240/260°C	49914	$450	49915	$755

Rapid analysis of volatile organics in US EPA Method 8260B, on an Rtx®-VMS column.

For peak listing, see page 550.



GC_EV00428

Column:	Rtx®-VMS, 20m, 0.18mm ID, 1.00µm (cat.# 49914)
Conc.:	10ppb in 5mL of RO water unless otherwise noted; ketones at 2.5X
Concentrator:	Tekmar LSC-3100 Purge and Trap
Trap:	Vocarb 3000 (type K)
Purge:	11 min. @ 40mL/min. (ambient temperature)
Dry purge:	1 min. @ 40mL/min.
Desorb preheat:	245°C
Desorb:	250°C for 2 min., flow 40mL/min.
Bake:	260°C for 8 min.
Interface:	0.53mm ID Silcosteel® tubing transfer line 1:40 split at injection port. 1mm ID liner.
Oven temp.:	50°C (hold 4 min.) to 100°C @ 18°C/min. (hold 0 min.) to 230°C @ 40°C/min. (hold 3 min.)
Carrier gas:	helium @ ~1.0mL/min. constant flow Adjust dichlorodifluoromethane to a retention time of 1.03 min. @ 50°C.
Detector:	Agilent 5973 MSD
Scan range:	35-300amu

Volatile Organics Analysis

Rtx®-VRX Columns (fused silica)
(proprietary Crossbond® phase)

- Application-specific columns for volatile organic pollutants.
- Excellent for US EPA Method 8021 compounds.
- Stable to 260 °C.

The Rtx®-VRX stationary phase and optimized column dimensions provide low bleed, excellent resolution, and fast analysis times for volatile compounds.

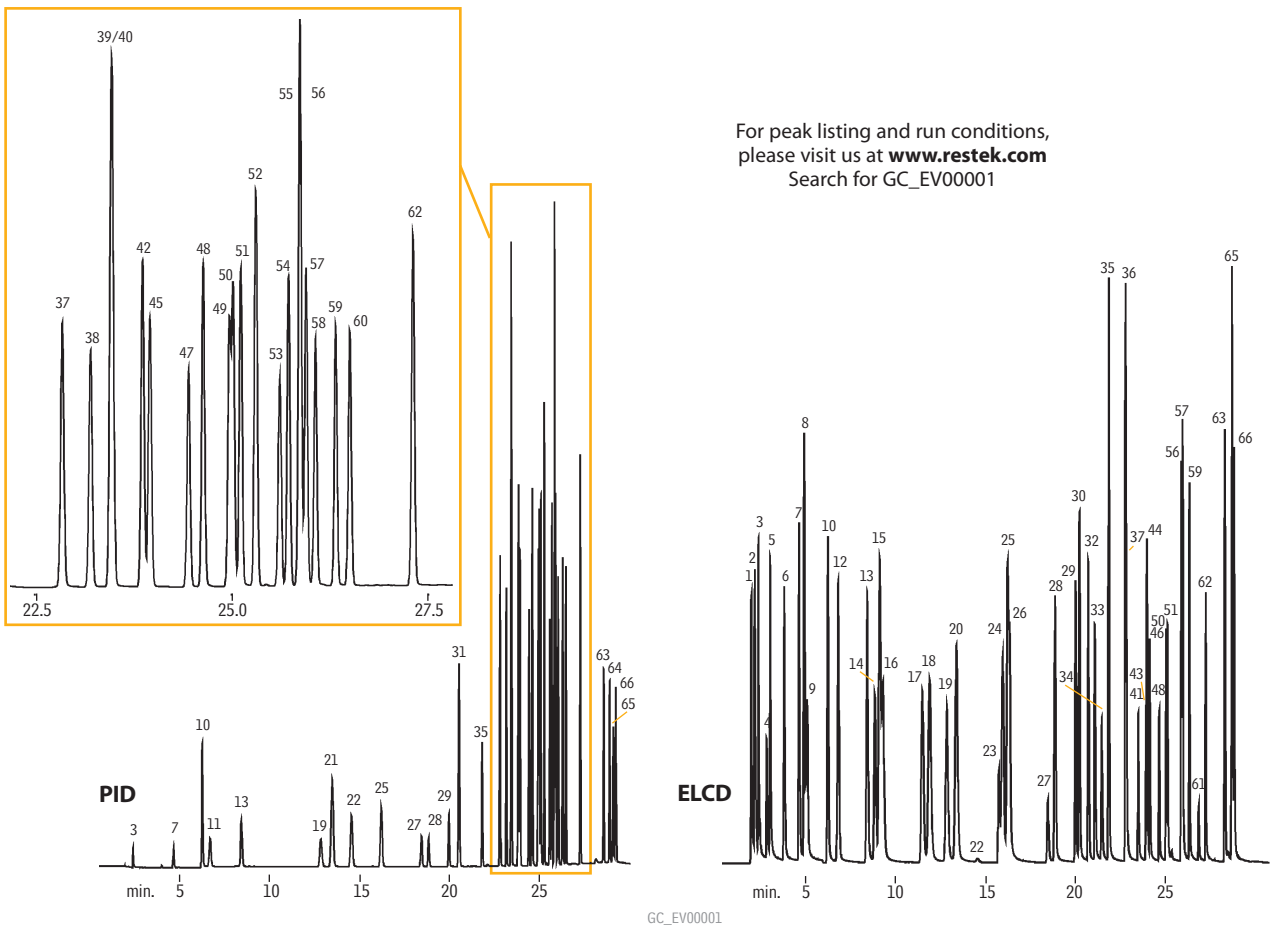
ID	df	temp. limits	30-Meter	60-Meter	75-Meter	105-Meter
0.25mm	1.40µm	-40 to 240/260°C	19315	19316		
0.32mm	1.80µm	-40 to 240/260°C	19319	19320		
0.45mm	2.55µm	-40 to 240/260°C	19308		19309	
0.53mm	3.00µm	-40 to 240/260°C	19385	19388	19374	19389

ID	df	temp. limits	20-Meter	40-Meter
0.18mm	1.00µm	-40 to 240/260°C	49314	49315

similar **phases**

DB-VRX

Excellent resolution of EPA Method 8021 volatile organics on an Rtx®-VRX column.



Acknowledgement: Finnigan 9001 GC, µGold Tandem Photoionization/HALL® 2000 Electrolytic Conductivity Detector provided courtesy of Thermo Electron GC & GC/MS Division, 2215 Grand Avenue Pkwy, Austin, Texas 78728

Volatile Organics Analysis

Rtx®-502.2 Columns (fused silica)

(proprietary Crossbond® diphenyl/dimethyl polysiloxane phase)

- Application-specific columns with unique selectivity for volatile organic pollutants. The Rtx®-502.2 column is cited in US EPA Method 502.2 and in many gasoline range organics (GRO) methods for monitoring underground storage tanks.
- Excellent separation of trihalomethanes; ideal polarity for light hydrocarbons and aromatics.
- Stable to 270 °C.

An Rtx®-502.2 column will enable you to quantify all compounds listed in US EPA methods 502.2 or 524.2, whether you use a mass spectrometer or a PID in tandem with an ELCD. The diphenyl/dimethyl polysiloxane based Rtx®-502.2 stationary phase provides low bleed and thermal stability to 270 °C. A 105-meter column can separate the light gases specified in EPA methods without subambient cooling. Narrow bore columns can interface directly in GC/MS systems.

similar phase

DB-502.2

ID	df	temp. limits	30-Meter	60-Meter	75-Meter	105-Meter
0.25mm	1.40µm	-20 to 250/270°C	10915	10916		
0.32mm	1.80µm	-20 to 250/270°C	10919	10920		10921
0.45mm	2.55µm	-20 to 250/270°C			10986	
0.53mm	3.00µm	-20 to 250/270°C	10908	10909		10910

ID	df	temp. limits	20-Meter	40-Meter
0.18mm	1.00µm	-20 to 250/270°C	40914	40915

also available

Metal MXT® Columns
Rugged, flexible, Siltek® treated stainless steel tubing; inertness comparable to fused silica tubing. See **page 121** for our MXT®-502.2 and MXT®- Volatiles columns.

Rtx®-Volatiles Columns (fused silica)

(proprietary Crossbond® diphenyl/dimethyl polysiloxane phase)

- Application-specific columns for volatile organic pollutants.
- Stable to 280 °C.

Rtx®-Volatiles columns were the first columns designed specifically for analyses of the 34 volatile organic pollutants listed in US EPA methods 601, 602, and 624. With these columns, you can quantify all compounds listed in these methods, whether you use a mass spectrometer or a PID in tandem with an ELCD. The diphenyl/dimethyl polysiloxane based Rtx®-Volatiles stationary phase provides low bleed and thermal stability to 280 °C. Narrow bore columns can interface directly in GC/MS systems.

similar phase

VOCOL

ID	df	temp. limits*	30-Meter	60-Meter	105-Meter
0.25mm	1.00µm	-20 to 270/280°C	10900	10903	
0.32mm	1.50µm	-20 to 270/280°C	10901	10904	
0.53mm	2.00µm	-20 to 270/280°C	10902	10905	10906

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

Volatile Organics Analysis

NEW!

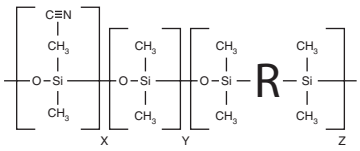
Rxi®-624Sil MS Columns (fused silica)

(midpolarity Crossbond® silarylene phase; equivalent to 6% cyanopropylphenyl/ 94% dimethyl arylene polysiloxane)

- Low bleed, high thermal stability column—maximum temperatures up to 320 °C.
- Inert—excellent peak shape for a wide range of compounds, including acidic and basic compounds.
- Selective—highly selective for residual solvents, great choice for USP<467>.
- Manufactured for column-to-column reproducibility—well-suited for validated methods.

ID	df	temp. limits	20-Meter	30-Meter	60-Meter
0.18mm	1.00µm	-20 to 300/320°C	13865		
0.25mm	1.40µm	-20 to 300/320°C		13868	
0.32mm	1.80µm	-20 to 300/320°C		13870	13872
0.53mm	3.00µm	-20 to 280/300°C		13871	

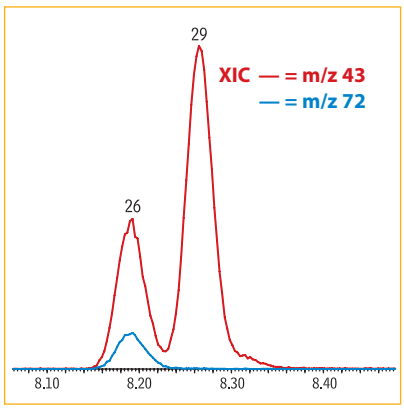
Rxi®-624Sil MS Structure



similar phases

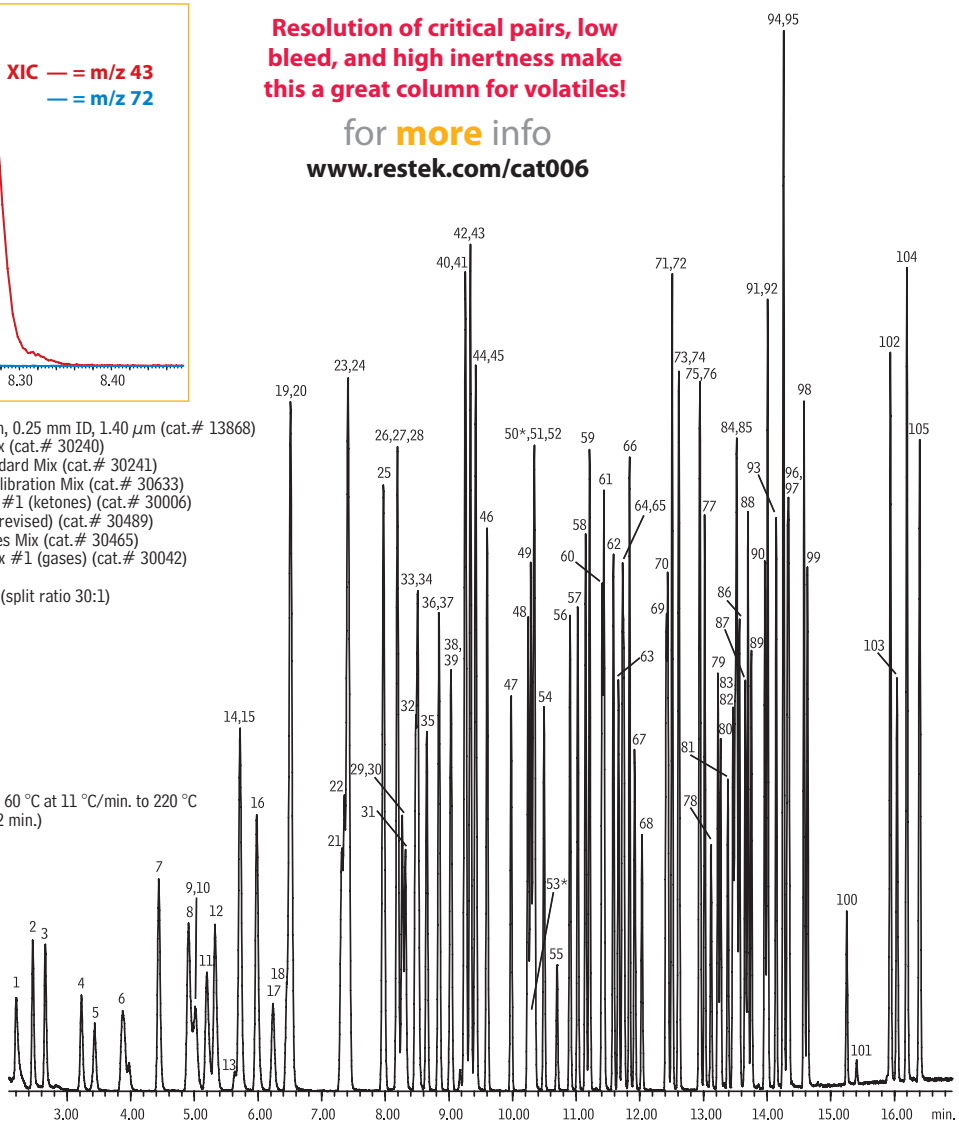
DB-624, HP-624, VF-624, BP-624, ZB-624, AT-624, 007-1301, G43R

Volatiles by EPA Method 8260 on Rxi®-624Sil MS (30m, 0.25mm ID, 1.40µm)



Resolution of critical pairs, low bleed, and high inertness make this a great column for volatiles!

for more info
www.restek.com/cat006



Column:	Rxi®-624Sil MS, 30 m, 0.25 mm ID, 1.40 µm (cat.# 13868)
Sample:	8260A Surrogate Mix (cat.# 30240) 8260A Internal Standard Mix (cat.# 30241) 8260B MegaMix® Calibration Mix (cat.# 30633) VOA Calibration Mix #1 (ketones) (cat.# 30006) 8260B Acetate Mix (revised) (cat.# 30489) California Oxygenates Mix (cat.# 30465) 502.2 Calibration Mix #1 (gases) (cat.# 30042)
Conc.:	25 ppb in RO water
Injection	purge and trap split (split ratio 30:1)
Inj. Temp.:	225 °C
Purge and Trap	
Instrument:	OI Analytical 4660
Trap Type:	10 Trap
Purge:	11 min. @ 20 °C
Desorb Preheat Temp.:	180 °C
Desorb:	0.5 min. @ 190 °C
Bake:	5 min. @ 210 °C
Interface Connection:	injection port
Oven	
Oven Temp:	35 °C (hold 5 min.) to 60 °C at 11 °C/min. to 220 °C at 20 °C/min. (hold 2 min.)
Carrier Gas:	He, constant flow
Flow Rate:	1.0 mL/min.
Detector:	MS
Mode:	Scan
Transfer Line Temp.:	230 °C
Analyzer Type:	Quadrupole
Source Temp.:	230 °C
Quad Temp.:	150 °C
Electron Energy:	70 eV
Solvent Delay Time:	1.5 min.
Tune Type:	BFB
Ionization Mode:	EI
Scan Range:	36-260 amu
Instrument:	Agilent 7890A GC & 5975C MSD

GC_EV1169

For peak list and complete conditions, see page 547.

GC COLUMNS
PLOT COLUMNS

PLOT Column Selection 105-107

Alumina BOND Columns

Rt-Alumina BOND/Na_2SO_4 108
Rt-Alumina BOND/KCl 108
Rt-Alumina Bond/CFC 108
MXT-Alumina BOND/Na_2SO_4 108

Molecular Sieve 5A Columns

Rt-Msieve 5A 109
MXT-Msieve 5A 109

Porous Polymer Columns

Rt-Q-BOND 110
Rt-QS-BOND 110
Rt-S-BOND 110
Rt-U-BOND 110
MXT-Q-BOND 110
MXT-S-BOND 110

PLOT Column Particle Trap 111

What's **NEW?** look for this circle

Next Generation GC PLOT Columns

- New bonding process minimizes particle release, reducing column blockage and protecting instrument parts.
- More consistent flow means stable retention times in Deans and related flow switching techniques.
- Outstanding peak symmetry improves impurity analysis for gases, solvents, and hydrocarbons.

Quick Reference Chart

PLOT Column	Application	Page
Rt-Alumina BOND/ MXT-Alumina BOND (Na_2SO_4 deactivation)	C1–C5 hydrocarbons. Purity analysis of ethylene, propylene, butenes, butadiene	108
Rt-Alumina BOND (KCl deactivation)	C1-C10 hydrocarbons, C1-C5 isomers. Purity analysis of ethylene, propylene, butene, butadiene.	108
Rt-Alumina BOND (CFC deactivation)	Multi-halogenated alkanes, C1-C-5 range. CFCs (chlorofluorocarbons)	108
Rt-Msieve 5A/ MXT-Msieve 5A	Permanent gas analysis (polarity between Q-BOND and S-BOND). He, Ne, Ar, O_2, N_2, Xe, Rn, SF6, and CH_4, C_2H_6, CO	109
Rt-Q-BOND/ MXT-Q-BOND	Nonpolar porous polymer. High retention for solvents, alcohols, polar volatiles, CO_2, sulfur, and ppm water in solvents	110
Rt-QS-BOND	Intermediate polarity porous polymer. Neutral solvents, ketones, esters, hydrocarbons, and baseline separation of ethane, ethene, acetylene	110
Rt-S-BOND/ MXT-S-BOND	Intermediate polarity porous polymer. Light gases in ethylene and propylene, ketones, esters, hydrocarbons	110
Rt-U-BOND	Polar porous polymer. More retention for polar compounds	110

PLOT Column Phase Cross-Reference: Similar Selectivity

Restek	Porous Layer	Agilent/J&W	Supelco	Alltech	Varian/Chrompack	Quadrex
Rt-Alumina BOND/Na_2SO_4 MXT-Alumina BOND	Aluminum oxide	GS-Alumina	Alumina-Sulfate	AT-Alumina	CP-Al_2O_3/NA_2SO_4	——
Rt-Alumina BOND/KCl	Aluminum oxide	GC-Alumina KCl HP PLOT Al203	Alumina-Chloride	——	CP-Al_2O_3/KCl	——
Rt-Alumina BOND/CFC			**unique** product			
Rt-Msieve 5A MXT-Msieve 5A	Molecular sieve 5A	HP PLOT Molesieve	Molsieve 5A PLOT	AT-Molesieve	CP-Molesieve 5A	PLT-5A
Rt-Q-BOND MXT-Q-BOND	DVB porous polymer	HP PLOT Q	Supel-Q-PLOT	AT-Q	CP-PoraPlot Q, PoraBond Q	——
Rt-QS-BOND	Intermediate polarity porous polymer	GS-Q	——	——	——	——
Rt-S-BOND MXT-S-BOND	DVB vinylpyridine polymer	——	——	——	CP-PoraPlot S	——
Rt-U-BOND	DVB ethyleneglycol-dimethylacrylate polymer	HP-PLOT U	——	——	CP-PoraPlot U, CP-PoraBond U	——

Next Generation of Porous Layer Open Tubular (PLOT) Columns

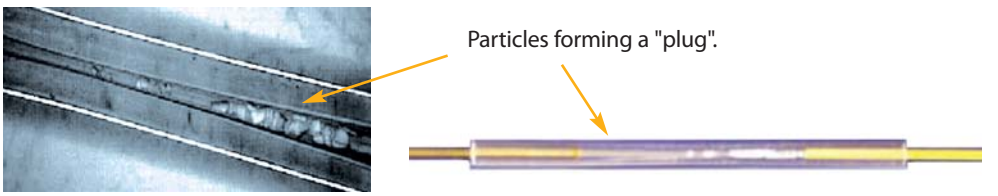
- Stabilized particle layers improve robustness and reproducibility of retention and flow.
- Fully compatible with valve switching and Deans switching systems.
- Highly efficient, reproducible analyses; ideal for permanent gases, solvents, and hydrocarbons.
- New manufacturing procedure reduces particle generation and improves performance of porous polymers, molecular sieves, and PLOT columns.

Porous layer open tubular (PLOT) columns are very beneficial for solving application problems, especially for the analysis of volatile compounds. PLOT columns have a unique selectivity, allowing for the separation of gaseous compounds at room temperature. Due to the adsorption mechanism of the supports used in PLOT columns, permanent gases and light hydrocarbons can be resolved at room temperature; columns can then be programmed to higher temperatures to elute higher boiling compounds.

Traditional PLOT Columns Offer Poor Stability

The traditional PLOT column is built with a 5-50µm layer of particles adhered to the tubing walls. Because this layer of particles generally lacks stability, PLOT columns must be used very carefully, as particle release is common and can cause unpredictable changes in retention time and flow behavior. PLOT columns generally must be used in conjunction with particle traps to prevent the contamination of valves, injectors, and GC detectors. Figure 1 shows an example of particle accumulation resulting in a blockage inside a Press-Tight® liner. If particle traps are not used, particles will hit the detector resulting in electronic noise, seen as spikes on the baseline. In the case of valves, particles can become lodged in the valve and result in leaks.

Figure 1 Particles released from traditional PLOT columns can cause blockages.



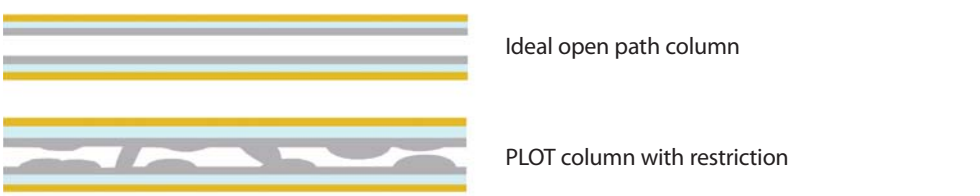
New PLOT Columns Minimize Particle Release

Restek has developed new procedures to manufacture PLOT columns with concentric stabilized adsorption layers. These new generation PLOT columns show a constant flow behavior (permeability) and have significantly improved mechanical stability, resulting in easier operation, better chromatography, and reduced particle release. Greater particle stability means more reproducible retention times, virtually no spiking, and longer column lifetimes. This innovative stabilization chemistry technology is currently applied to Rt®-Alumina BOND, Rt®-Msieve 5A, Rt®-Q-BOND, Rt®-QS-BOND, Rt®-S-BOND, and Rt®-U-BOND fused silica columns. It is also available for select metal columns including MXT®-Alumina BOND and MXT®-Msieve 5A columns.

Consistent Flow Restriction Factor (F) Guarantees Reproducible Flow

Thick layers of particles are difficult to deposit in a homogeneous layer and, in traditionally manufactured PLOT columns, this results in variable coating thicknesses. The positions where the layer is thicker act as restrictions and affect flow (Figure 2). Depending on the number and intensity of these restrictions, traditional PLOT columns often show greater variation in flow restriction than wall coated open tubular (WCOT) columns. In practice, conventional PLOT columns with the same dimensions can differ in flow by a factor of 4-6, when operated at the same nominal pressure. For applications where flow is important, such as with Deans switching, the nonreproducible flow behavior of most commercially available PLOT columns is a problem.

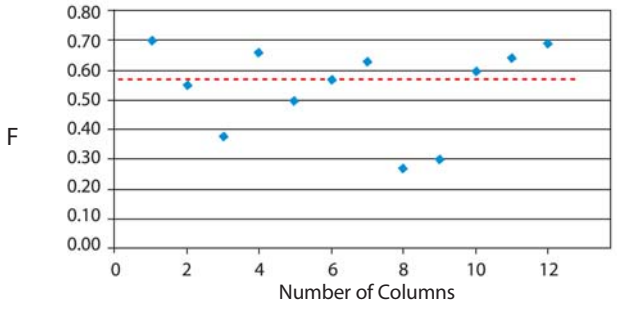
Figure 2 Inconsistent coating thicknesses result in restrictions that cause significant variation in flow.



In order to evaluate flow restriction reproducibility, Restek is introducing a new factor: the flow restriction factor (F). This factor is based on the retention time of an unretained marker compound, as measured on both coated and uncoated tubing using the same backpressure setting (Equation 1). For quality control purposes, methane is used as the marker when evaluating porous polymer columns and helium is used for testing Rt®-Msieve 5A columns.

Flow restriction factor determination can be used both to assess the degree of column restriction and to evaluate the reproducibility of the column coating process. Percent flow restriction can also be calculated (Equation 2). Figure 3 shows typical results for PLOT columns manufactured using a conventional process. Because of the difference in flow restriction, individual columns have very different flow characteristics. In contrast, Figure 4 shows results for columns made using the new PLOT column process (Rt®-QS-BOND, bonded porous polymer). Clearly, the new manufacturing process results in greater consistency in both column coating thickness and flow restriction; which, in turn, results in more stable retention times and better performance in Deans switching and related flow switching techniques.

Figure 3 Traditional PLOT columns show significant flow variability, indicating inconsistent column coating thicknesses.



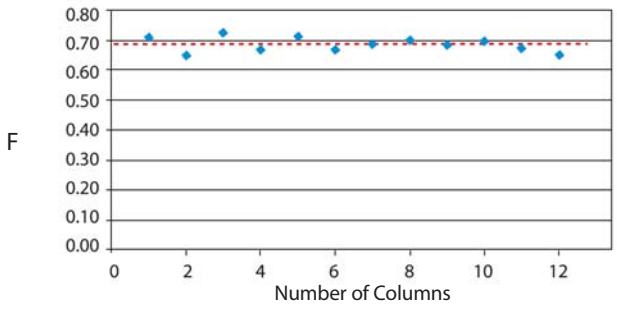
Equation 1 Flow restriction factor (F) is used to demonstrate coating consistency.

$$F = \frac{t_{R1} \text{ of unretained component (uncoated tubing)}}{t_{R2} \text{ of unretained component (coated column)}}$$

t_R = retention time

Note, F values will always be <1 as the coated column always has more restriction than the uncoated column.

Figure 4 New PLOT columns from Restek offer consistent flow resistance, giving more reproducible results column-to-column.



Equation 2 Percent flow restriction of coated column.

$$\% \text{ restriction} = (1 - F) \times 100$$

In summary, Restek's new PLOT column manufacturing process produces exceptionally robust PLOT columns, featuring concentric stabilized coating layers. These new columns have more consistent flow resistance and are recommended for applications sensitive to variation in retention time or flow. These columns are a significant advance in PLOT column technology and are ideal for more efficient, reproducible analyses of permanent gases, solvents, and hydrocarbons.

NEW!

advanced technology

Details on **pages 106-107**.

did you **know**?

Rt®-Alumina BOND columns show unique retention characteristics for hydrocarbons.

tech tip

Traces of water in the carrier gas and in the sample will affect the retention and the selectivity of alumina. If exposed to water, the retention times will shorten. The column can be regenerated by conditioning for 15-30 min. at 200 °C under normal carrier gas flow. Periodic conditioning ensures excellent run-to-run retention time reproducibility.

The maximum programmable temperature for an Rt®-Alumina BOND column is 200 °C. Higher temperatures cause irreversible changes to the porous layer adsorption properties.

for **more** info

For more information on Rt®-Alumina BOND/CFC columns, see page 74.

Rt®-Alumina BOND Columns

1. Highly selective for C1-C5 hydrocarbons; separates all unsaturated hydrocarbon isomers above ambient temperatures.
2. Reactivity of aluminum oxide stationary phase is minimized so that column response for polar unsaturates, such as dienes, is optimized. Column sensitivity or response ensures a linear and quantitative chromatographic analysis for these compounds.
3. Strong bonding prevents particle generation. The column can be used in valve switching operations, without release of particles that can harm the injection and detection systems.
4. The Rt®-Alumina BOND column is stable up to 200 °C. If water is adsorbed on the column, it can be regenerated by conditioning at 200 °C. Full efficiency and selectivity will be restored.
5. High capacity and loadability give exceptionally symmetric peaks; ideal for volatile hydrocarbon separations at percent levels, as well as impurity analyses at ppm concentrations.

Guaranteed Reproducibility

Each Rt®-Alumina BOND column is tested with a hydrocarbon test mix to ensure proper phase thickness and selectivity. 1,3-Butadiene is used to calculate k (capacity factor), which is a measure of phase thickness. Selectivity is measured using retention indices for propadiene and methyl acetylene. The resolution of *trans*-2-butene and 1-butene is also verified. To measure coating efficiency, plates per meter are checked using 1,3-butadiene. Extensive testing assures reproducible retention times and predictable flow behavior column-to-column.

Rt®-Alumina BOND/Na_2SO_4 Columns (fused silica PLOT)

(Na_2SO_4 deactivation)

- Acetylene/propadiene elute after butanes (impurities in acetylene/propadiene).
- Best separation for butene isomers (impurities in butene streams).
- Methyl acetylene elutes after 1,3-butadiene.
- Cyclopropane (impurity in propylene) elutes well before propylene.

ID	df	temp. limits	30-Meter	50-Meter
0.25mm	4µm	to 200°C	19775	
0.32mm	5.00µm	to 200°C	19757	19758
0.53mm	10µm	to 200°C	19755	19756

Rt®-Alumina BOND/KCl Columns (fused silica PLOT)

(KCl deactivation)

- Acetylene elutes before C4 hydrocarbons (impurities in butane/isobutane).
- Methyl acetylene (impurity in 1,3-butadiene) elutes before 1,3-butadiene.

ID	df	temp. limits	30-Meter	50-Meter
0.25mm	4µm	to 200°C	19776	
0.32mm	5.00µm	to 200°C	19761	19762
0.53mm	10µm	to 200°C	19759	19760

NEW!

Rt®-Alumina BOND/CFC Columns (fused silica PLOT)

- Improved inertness for halogenated compounds such as CFCs.
- Highly selective alumina based column, separates most CFCs.
- High retention and capacity for CFCs.

NEW!

ID	df	temp. limits	30-Meter
0.53mm	10µm	to 200°C	19763

MXT®-Alumina BOND/Na_2SO_4 Columns (Siltek®-treated stainless steel PLOT)

Advantages of metal MXT® PLOT columns include:

- Can be made in small coil diameters—perfect for tight spaces.
- Will not spontaneously break, making them ideal for rugged environments.
- Designed for robust performance in process GCs and field instruments.

NEW!

ID	df (µm)	temp. limits	3.5" coil 30-Meter	7" diameter 11-pin cage 30-Meter
0.53mm	10µm	to 200°C	79714-273	79714

Molecular Sieve 5A PLOT Columns

Restek's molecular sieve 5A PLOT columns are designed for efficient separation of Ar/O_2 and other permanent gases, including CH_4, C_2H_6, and CO. Special coating and deactivation procedures ensure chromatographic efficiency and the integrity of the porous layer coating. Molecular sieves have very high retention, allowing separations of permanent gases at temperatures above ambient. Additionally, our unique immobilization process guarantees that the uniform particles remain adhered to the tubing—even after continuous valve-cycling.

Our revolutionary molecular sieve 5A PLOT columns separate Ar/O_2 and H_2/He at ambient temperature or above (see figure). These columns also are an excellent choice for rapid separation of permanent gases in refinery or natural gas.

NEW! advanced technology
Details on **pages 106-107**.

Rt®-Msieve 5A Columns (fused silica PLOT)

ID	df	temp. limits	15-Meter	30-Meter
0.25mm	20µm	to 300°C	19773	
0.32mm	30µm	to 300°C	19720	19722
0.53mm	50µm	to 300°C	19721	19723

MXT®-Msieve 5A Columns (Siltek®-treated stainless steel PLOT)

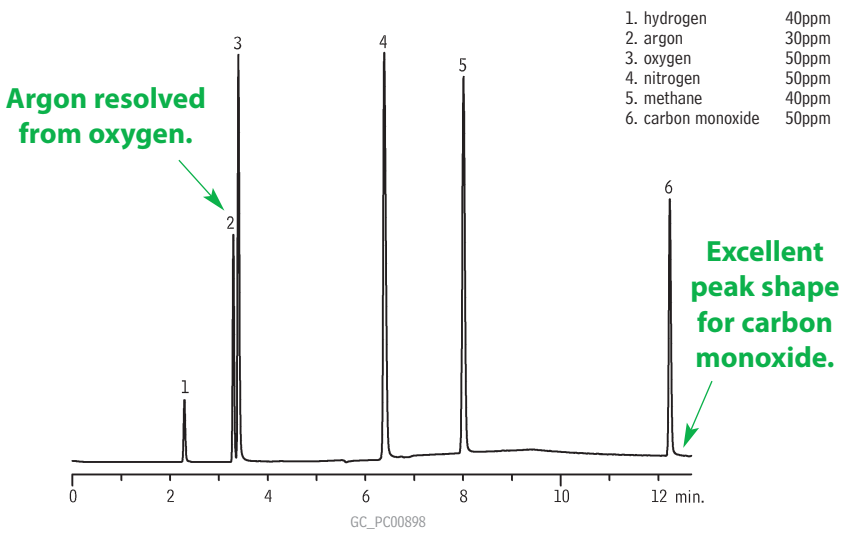
NEW!

Advantages of metal MXT® PLOT columns include:

- Can be made in small coil diameters—perfect for tight spaces.
- Will not spontaneously break, making them ideal for rugged environments.
- Designed for robust performance in process GCs and field instruments.
- Available in 3.5" coil diameter or 7" diameter 11-pin cage.

ID	df	temp. limits	15-Meter	3.5" coil 30-Meter	7" diameter 11-pin cage 30-Meter
0.25mm	20µm	to 300°C	79717		
0.53mm	50µm	to 300°C		79723-273	79723

Permanent gases on an Rt®-Msieve 5A PLOT column.



Column:	Rt®-Msieve 5A, 30m, 0.53mm ID, 50µm (cat.# 19723)
Sample:	permanent gases (ppm)
Inj.:	5µL sample loop, 6-port Valco® valve, valve temp.: ambient
Inj. temp.:	200°C
Carrier gas:	helium, constant flow
Flow:	5mL/min.
Oven temp.:	27°C (hold 5 min.) to 100°C @ 10°C/min. (hold 5 min.)
Det.:	Valco® helium ionization detector @ 150°C

did you know?

Rt®-Msieve 5A PLOT columns are designed for efficient separation of Ar/O_2 and other permanent gases, including CH_4, C_2H_6, and CO.

tech tip

Because molecular sieve materials are very hydrophilic, they will adsorb water from the sample or carrier gas. Water contamination can have a detrimental effect on peak symmetry and can reduce the resolution of all compounds. If water contamination occurs, reactivate your Rt®-Msieve 5A PLOT column by conditioning at 300 °C with dry carrier gas flow for 3 hours.

tech tip

Carbon dioxide will not elute from molecular sieve columns. Rt®-Q-BOND is a good choice for this analysis.

did you know?

ShinCarbon ST micropacked columns are another alternative for analyzing permanent gases.

See **page 130** for information.

NEW! advanced technology
Details on **pages 106-107**.

Porous Polymers: Rt®-Q-BOND, Rt®-QS-BOND, Rt®-S-BOND, Rt®-U-BOND

Restek chemists have developed a new process for the manufacturing of porous polymer PLOT columns. The process incorporates the particles to the walls of the tubing, so there is virtually no particle generation. Because of the particle adhering to the walls of the tubing, there is reproducible performance from column to column, including selectivity and flow.

least polar

most polar

For more chromatograms, see pages 652, 654 and 701-703, or use our chromatogram search tool at **www.restek.com/chromatograms**

Rt®-Q-BOND Columns (fused silica PLOT)

100% divinylbenzene

- Nonpolar PLOT column incorporating 100% divinyl benzene.
- Excellent for analysis of C1 to C3 isomers and alkanes up to C12.
- High retention for CO_2 simplifies gas analysis; CO_2 and methane separated from $O_2/N_2/CO$ (Note: $O_2/N_2/CO$ not separated at room temperature).
- Use for analysis of oxygenated compounds and solvents.
- Maximum temperature of 300 °C.

ID	df	temp. limits	15-Meter	30-Meter
0.25mm	8µm	to 280/300°C	19764	19765
0.32mm	10µm	to 280/300°C	19743	19744
0.53mm	20µm	to 280/300°C	19741	19742

Rt®-QS-BOND Columns (fused silica PLOT)

porous divinyl benzene homopolymer

- Intermediate polarity PLOT column incorporating low 4-vinyl pyridine.
- Separates ethane, ethylene and acetylene to baseline.

ID	df	temp. limits	15-Meter	30-Meter
0.25mm	8µm	to 250°C	19767	19768
0.32mm	10µm	to 250°C	19739	19740
0.53mm	20µm	to 250°C	19737	19738

Rt®-S-BOND Columns (fused silica PLOT)

divinylbenzene 4-vinylpyridine

- Midpolarity PLOT column, incorporating high 4-vinyl pyridine.
- Use for the analysis of nonpolar and polar compounds.

ID	df	temp. limits	15-Meter	30-Meter
0.25mm	8µm	to 250°C	19769	19770
0.32mm	10µm	to 250°C	19747	19748
0.53mm	20µm	to 250°C	19745	19746

Rt®-U-BOND Columns (fused silica PLOT)

divinylbenzene ethylene glycol/dimethylacrylate

- Polar PLOT column, incorporating divinylbenzene ethylene glycol/dimethylacrylate.
- Use for the analysis of polar and nonpolar compounds.

ID	df	temp. limits	15-Meter	30-Meter
0.25mm	8µm	to 190°C	19771	19772
0.32mm	10µm	to 190°C	19751	19752
0.53mm	20µm	to 190°C	19749	19750

Advantages of Metal MXT® PLOT columns include:

- Can be made in small coil diameters—perfect for tight spaces.
- Will not spontaneously break, making them ideal for rugged environments.
- Designed for robust performance in process GCs and field instruments.
- Available in 3.5" coil diameter or 7" diameter 11-pin cage.

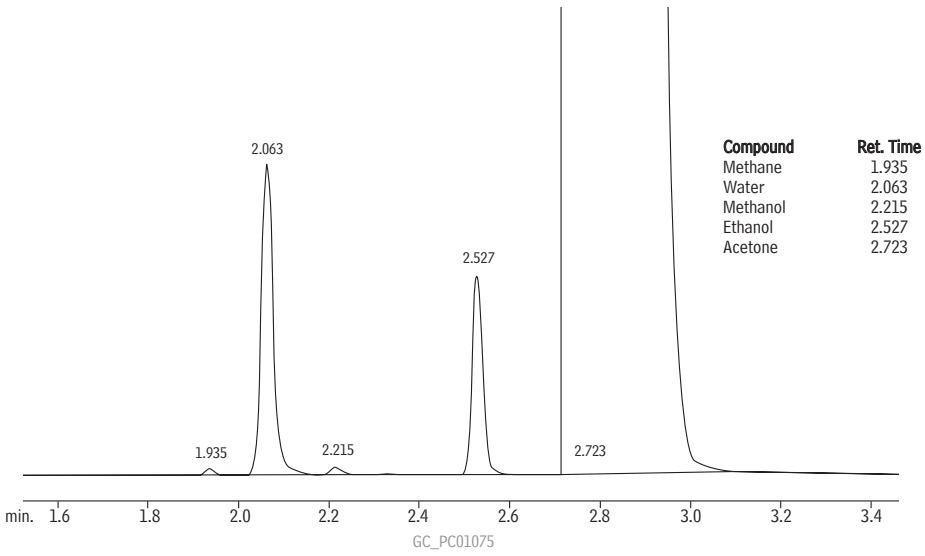
MXT®-Q-BOND Columns (Siltek®-treated stainless steel PLOT)

ID	df	temp. limits	15-Meter	3.5" coil 30-Meter	7" diameter 11-pin cage 30-Meter
0.25mm	8µm	to 300/320°C	79718		
0.53mm	20µm	to 300/320°C		79716-273	79716

MXT®-S-BOND Columns (Siltek®-treated stainless steel PLOT)

ID	df	temp. limits	3.5" coil 30-Meter	7" diameter 11-pin cage 30-Meter
0.53mm	20µm	to 250°C	79712-273	79712

Water and ethanol in acetone on an Rt®-Q-BOND PLOT column.



Compound	Ret. Time
Methane	1.935
Water	2.063
Methanol	2.215
Ethanol	2.527
Acetone	2.723

Column:	Rt®-Q-BOND, 30m, 0.53mm ID, 20µm (cat.# 19742)
Sample:	0.5% water and ethanol in acetone
Inj.:	3µL split (split ratio 11:1), 4mm single gooseneck liner w/ wool (cat.# 22405)
Inj. temp.:	250°C
Carrier gas:	helium, constant flow
Linear velocity:	28.7cm/sec. @ 200°C
Oven temp.:	200°C, isothermal
Det.:	TCD @ 260°C

PLOT Column Particle Trap

- Includes two Press-Tight® connectors and a 2.5 m column.
- Protects detector and valves; connects between column and detector or valve.
- Eliminates detector spikes and scratches in valve rotors.

The technology used to adhere particles in PLOT columns is excellent; however, there is still a possibility for particles to dislodge when extreme pressure shocks and gas flow changes are anticipated. This sometimes happens when valve backflush or MS detection is used. In those extreme cases, using particle traps is recommended.

Particle Trap

Description	qty.	cat.#	price
PLOT Column Particle Trap, 2.5m, 0.32mm ID with 2 Press-Tight Connectors	ea.	19753	
PLOT Column Particle Trap, 2.5m, 0.53mm ID with 2 Press-Tight Connectors	ea.	19754	

Restek Customer Service

In the U.S.

Call: 800-356-1688 (ext. 3) or 814-353-1300 (ext. 3)

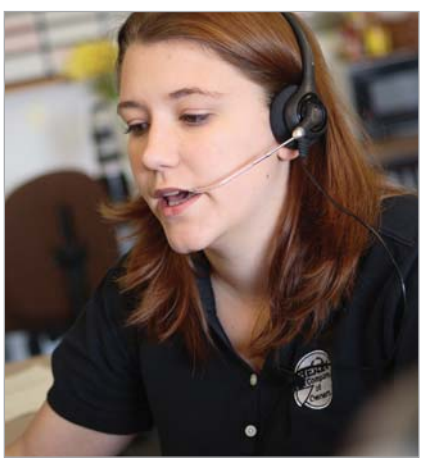
Monday–Friday 8:00 a.m.–6:00 p.m. ET

Fax: 814-353-1309—24-hours a day

Online: www.restek.com—24-hours a day

Outside the U.S.

Contact your Restek representative:
Refer to our list on pages 4-5 or visit our website at www.restek.com



Melissa Decker, Customer Service

GC COLUMNS
METAL (MXT®) CAPILLARY COLUMNS

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What's **NEW?** look for this circle

What is an MXT® column?

MXT® columns are made from stainless steel tubing that has had the internal surface treated with our exclusive Siltek® surface treatment. The Siltek® layer makes the surface as inert as deactivated fused silica. The unique Siltek® process enables us to offer MXT® columns in a wide range of internal diameters, including 0.18 mm, 0.25 mm, 0.32 mm, and 0.53 mm. Because the Siltek® layer permeates the stainless steel surface, rather than simply coating it, the layer is exceptionally flexible, so the tubing can be coiled to very small diameters. The standard coil diameter for MXT® columns is 4.5 inches. The minimum coil diameter for 0.53 mm ID columns is 2.5 inches, and the minimum coil diameter for 0.25 mm ID columns is 1.5 inches.

The unique properties of the Siltek® treated surface enable us to treat the tubing with a wide variety of polymer phases. The many choices of MXT® columns include:

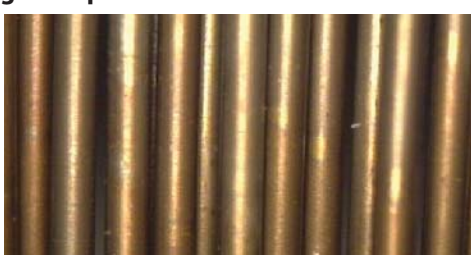
- MXT®-1
- MXT®-5
- MXT®-20
- MXT®-35
- MXT®-50
- MXT®-65
- MXT®-1301
- MXT®-1701
- MXT®-200
- MXT®-WAX
- MXT®-65TG
- MXT®-Biodiesel TG
- MXT®-2887
- MXT®-1HT SimDist
- MXT®-1 SimDist
- MXT®-500 SimDist
- MXT®-502.2
- MXT®-Volatiles
- MXT®-624
- Guard tubing

MXT ideal for high-temperature analyses

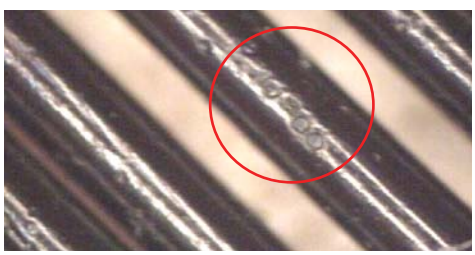
Compare MXT® columns and fused silica columns:

- Metal tubing allows MXT® columns to be used to higher temperatures (430 °C) than fused silica columns (standard rating is 360 °C). This is because the polyimide resin that encases the fused silica becomes brittle over time at high temperatures. MXT® columns do not become brittle.
- Inertness of MXT® columns and fused silica columns is similar, due to the unique properties of the Siltek® surface treatment in MXT® columns.
- Metal columns can be coiled under 4.5 inches without breaking, ideal for small instruments.
- Coating efficiency (plates/meter) of MXT® columns is similar to that of fused silica.
- MXT® columns will not break under stress, and they can be coiled to small diameters.

MXT®-Biodiesel TG columns are undamaged by high thermal cycles compared to high-temperature fused silica columns which break down under the same conditions.



MXT®-Biodiesel TG columns are undamaged by high thermal cycles.



HT fused silica columns, labeled as stable to 430 °C, show pitting and breakdown.

100 temperature cycles to 430 °C totaling 500 minutes at maximum temperature.

also **available**

Metal PLOT columns!
See pages 108-110.

MXT® columns are your best choice for:

- Situations in which the potential for column breakage is high:
  - field instruments
  - process GC
  - GCs with small ovens, such as portable instruments, requiring tightly coiled columns.
- High temperature chromatography. Siltek® deactivated stainless steel tubing can withstand temperatures exceeding 430 °C; the only limitation to oven temperature is the polymer itself.

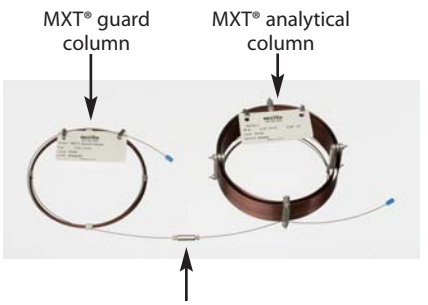
Custom MXT® columns

We are able to supply 0.18, 0.25, 0.28, 0.32, and 0.53 mm ID columns with the phases listed above in many different configurations. If you do not see the column you need listed in the following pages, call us or your Restek representative, and we will be happy to help.

Guard/Retention Gap Columns, Tubing Scorer

MXT® guard columns are tested for inertness and bleed.

Connect MXT® columns using an MXT® Low-Dead-Volume Connector!



also available

Column connector kits & ferrules
See page 292.

Intermediate-Polarity Deactivated MXT® Guard/Retention Gap Columns/Transfer Lines (passivated stainless steel)

- Useful for a wide range of applications.
- Compatible with most common solvents.
- Maximum temperature: 350 °C

Nominal ID	Nominal OD	5-Meter	5-Meter/6-pk.	10-Meter
0.28mm	0.56 ± 0.025mm	70044	70044-600	70046
0.53mm	0.74 ± 0.025mm	70045	70045-600	70047

Hydroguard® Treated MXT® Guard/Retention Gap Columns/Transfer Lines (passivated stainless steel)

- Extend analytical column lifetime by preventing degradation by harsh "steam-cleaning" water injections.
- Maximum temperature: 430 °C.

When transfer lines from purge & trap systems, air monitoring equipment, or other instruments carry condensed water vapor, deactivated column tubing quickly becomes active because of the creation of free silanol groups. These silanol groups adsorb active oxygenated compounds such as alcohols and diols.

Restek chemists have addressed this concern and found a solution—the Hydroguard® deactivation process. A unique deactivation chemistry creates a high-density surface that is not readily attacked by aggressive hydrolysis. The high-density surface coverage of the Hydroguard® deactivation layer effectively prevents water vapor from reaching the fused silica surface beneath. Use Hydroguard® tubing for connecting GCs to:

- Headspace analyzers.
- Air analysis equipment and concentrator units.

Nominal ID	Nominal OD	5-Meter	10-Meter	30-Meter*	60-Meter*†
0.28mm	0.56 ± 0.025mm	70080	70083	70086	70089
0.53mm	0.74 ± 0.025mm	70081	70084	70087	70090

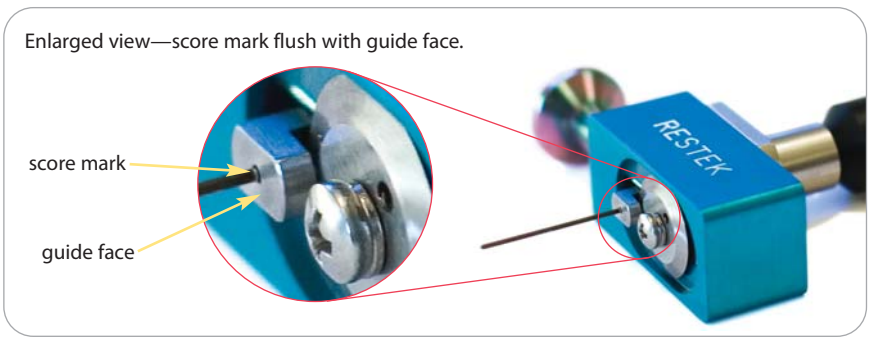
*30- and 60-meter lengths are banded in 5-meter sections.
†Recommendation: Cut 60m guard columns into shorter lengths. Using full length may cause peak distortion. Diameters greater than 0.10mm are tested with the Grob test mix to ensure high inertness.

Restek Tubing Scorer for MXT® Columns

- Makes a perfect cut every time.
- Easy to use.
- Leaves column entrance perfectly round.

Metal MXT® columns are easy to cut. Scoring wafers can be used, but may leave the column end irregularly shaped. The Restek tubing scorer is designed to make a perfect cut every time, leaving the column entrance perfectly round.

Make a perfect column cut every time!



Description	qty.	cat.#	price
Restek Tubing Scorer for MXT Columns (0.25-0.53mm ID & 0.5-0.8mm OD)	ea.	20523	$195
Replacement Scoring Wheel	ea.	20522	$40

MXT®-1 Columns (Siltek® treated stainless steel)

(nonpolar phase; Crossbond® 100% dimethyl polysiloxane)

- General purpose columns for solvent impurities, PCB congeners (e.g. Aroclor mixes), simulated distillation, drugs of abuse, gases, natural gas odorants, sulfur compounds, essential oils, hydrocarbons, semivolatiles, pesticides, and oxygenates.
- Temperature range: -60 °C to 430 °C.
- Equivalent to USP G1, G2, G38 phases.

MXT®-1 columns exhibit long lifetime and very low bleed at high operating temperatures. A proprietary synthesis process eliminates residual catalysts that could cause degradation and increase bleed.

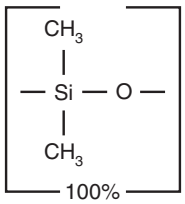
ID	df	temp. limits	6-Meter		15-Meter	30-Meter	60-Meter	105-Meter
0.25mm	0.10µm	-60 to 330/430°C			70105	70116	70117	70114
	0.25µm	-60 to 430°C			70120	70123	70126	70129
	0.50µm	-60 to 400°C			70135	70138	70141	70144
	1.00µm	-60 to 340/360°C			70150	70153	70156	70159
0.28mm	0.10µm	-60 to 430°C	70102	$310	70106	70109		
	0.25µm	-60 to 430°C			70121	70124	70127	
	0.50µm	-60 to 400°C			70136	70139	70142	
	1.00µm	-60 to 320/360°C			70151	70154	70157	
	3.00µm	-60 to 285/360°C			70181	70184	70187	
0.53mm	0.15µm	-60 to 430°C	70101*	$310	70107			
	0.25µm	-60 to 430°C			70122	70125	70128	
	0.50µm	-60 to 400°C			70137	70140	70143	
	1.00µm	-60 to 320/360°C			70152	70155	70158	
	1.50µm	-60 to 310/360°C			70167	70170	70173	
	3.00µm	-60 to 285/360°C			70182	70185	70188	
	5.00µm	-60 to 270/360°C			70177	70179	70183	
	7.00µm	-60 to 250/360°C			70191	70192	70193	

ID	df	temp. limits	10-Meter	20-Meter	40-Meter
0.18mm	0.20µm	-60 to 330/430°C	71811	71812	71813
	0.40µm	-60 to 320/400°C	71814	71815	71816

*For simulated distillation.

Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

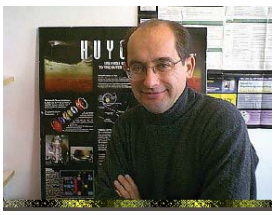
MXT®-1 Structure



similar **phases**

DB-1, DB-1MS, HP-1, HP-1MS, Ultra-1, SPB-1, Equity-1, MDN-1, CP-Sil 5 CB, VF-1ms

a **plus 1** story



"Since now almost 15 years , the Laboratoire Interuniversitaire des Systèmes Atmosphériques (LISA) of the University of Paris XII has been developing GC subsystems for on-board space probe GCMS experiments dedicated to the *in situ* analysis of extraterrestrial environments. Most of the capillary columns used in these subsystems were and still are provided by the Restek company.

One capillary column, MXT®-1701[1], was aboard the Huygens probe of the Cassini-Huygens mission which explored successfully in 2005 the atmosphere of Titan, the largest moon of Saturn. Four columns, MXT®-1, 20, 1701 and MXT®-UPLOT[2], are "en route" towards the comet Churyumov-Gerasimenko in the frame of the ESA Rosetta mission launched in 2004 to arrive by 2014. They will be used for the first time *in situ* analysis of a cometary nucleus. And finally, so far, 4 other PLOT (MXT® U) and WCOT[3,4] (MXT®-1, 20 and CLP) columns have been selected and are currently being built in the GC of the Sample Analysis at Mars (SAM) Pyr/GCMS instrument, part of the payload of the NASA MSL 2009 Mars exploratory mission.

I would like to mention that all the columns selected for space mission are Silcosteel® treated metal capillary columns and they have all been submitted successfully to space qualification tests such as vibration, radiation and thermal cycles[5], which demonstrated their robustness for space application.

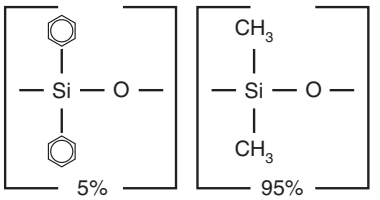
Since the beginning, the Restek company has been more than a manufacturer providing LISA with columns. Indeed, it has been strongly collaborating and helping LISA to develop custom-made columns able to meet the requirements of such an unusual scientific goal for chromatographic columns. That is why LISA is very grateful to Restek for being this ideal partner without the help of which the study and development of chromatographic columns for space use could not have been possible."

Robert STERNBERG
Responsible for the space GC team at LISA (Paris, France)

References

[1]Sternberg, R., C. Szopa, D. Coscia, S. Zubrzycki, F. Raulin, C. Vidal-Madjar, H. Niemann and G. Israel *J. Chromatogr.*, 846, 307-315, (1999)
[2]C. Szopa, R. Sternberg, F. Raulin and H. Rosenbauer *Planetary and Space Science*, 51 (13) 863-877 (2003)
[3]Cabane, M., P. Coll, C. Szopa, G. Israël, F. Raulin, R. Sternberg, P. Mahaffy, A. Person, C. Rodier, R. Navarro-Gonzalez, H. Niemann, D. Harpold and W. Brinckerhoff *Adv. Space Research*, 33, 2240-2245 (2004)
[4]Zampolli, M-G., D. Meunier, R. Sternberg, C. Szopa., F, Raulin, M. C. Pietrogrande, F. Dondi *Chirality* 18 (5):383-394 (2006)
[5]C. Szopa, U.J. Meierhenrich, D. Coscia, L. Janin, F. Goesmann, R. Sternberg, J.-F. Brun, G. Israel, M. Cabane, R. Roll, F. Raulin, W. Thiemann and C. Vidal-Madjar and H. Rosenbauer *J. Chromatogr. A*, 982 303-312 (2002)

MXT®-5 Structure



similar **phases**

DB-5, HP-5, HP-5MS, Ultra-2, SPB-5, Equity-5, MDN-5, CP-Sil 8 CB

Note: DB-5MS is a silarylene based polymer similar to Rxi®-5Sil MS.

MXT®-5 Columns (Siltek® treated stainless steel)

(low polarity phase; Crossbond® 5% diphenyl/95% dimethyl polysiloxane)

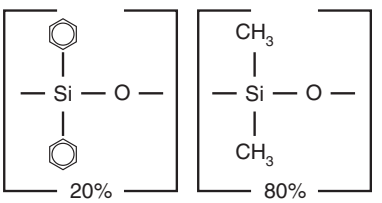
- General purpose columns for drugs, solvent impurities, pesticides, hydrocarbons, PCB congeners (e.g. Aroclor mixes), essential oils, and semivolatiles.
- Temperature range: -60 °C to 430 °C.
- Equivalent to USP G27, G36 phases.

The 5% diphenyl/95% dimethyl polysiloxane stationary phase is the most popular GC stationary phase and is used in a wide variety of applications. All residual catalysts and low molecular weight fragments are removed from the MXT®-5 polymer, providing a tight monomodal distribution and extremely low bleed.

ID	df	temp. limits*	15-Meter	30-Meter	60-Meter
0.25mm	0.10µm	-60 to 430°C	70205	70208	70211
	0.25µm	-60 to 430°C	70220	70223	70226
	0.50µm	-60 to 400°C	70235	70238	70241
	1.00µm	-60 to 340°C	70250	70253	70256
0.28mm	0.25µm	-60 to 430°C	70221	70224	70227
	0.50µm	-60 to 400°C	70236	70239	70242
	1.00µm	-60 to 325/360°C	70251	70254	70257
	3.00µm	-60 to 290/360°C	70281	70284	70287
0.53mm	0.25µm	-60 to 430°C	70222	70225	70228
	0.50µm	-60 to 400°C	70237	70240	70243
	1.00µm	-60 to 325/360°C	70252	70255	70258
	1.50µm	-60 to 300/360°C	70267	70270	70273
	3.00µm	-60 to 290/360°C	70282	70285	70288
	5.00µm	-60 to 270/360°C	70277	70279	70283

ID	df	temp. limits	10-Meter	20-Meter	40-Meter
0.18mm	0.20µm	-60 to 325/430°C	71821	71822	71823
	0.40µm	-60 to 325/400°C	71824	71825	71826

MXT®-20 Structure



similar **phases**

SPB-20, VOCOL

MXT®-20 Columns (Siltek® treated stainless steel)

(low to midpolarity phase; Crossbond® 20% diphenyl/80% dimethyl polysiloxane)

- General purpose columns for volatile compounds, flavor compounds, and alcoholic beverages.
- Temperature range: -20 °C to 340 °C.
- Equivalent to USP G28, G32 phases.

MXT®-20 polymer is synthesized to exacting standards. All residual catalysts and low molecular weight fragments are removed from the polymer, providing a tight monomodal distribution and extremely low bleed.

ID	df	temp. limits*	15-Meter	30-Meter	60-Meter
0.25mm	0.25µm	-20 to 320/340°C	70320	70323	70326
	1.00µm	-20 to 300/340°C	70350	70353	70356
0.28mm	0.25µm	-20 to 310/340°C	70321	70324	70327
	1.00µm	-20 to 295/340°C	70351	70354	70357
	3.00µm	-20 to 260/340°C	70381	70384	70387
0.53mm	0.25µm	-20 to 310/340°C	70322	70325	70328
	1.00µm	-20 to 295/340°C	70352	70355	70358
	3.00µm	-20 to 260/340°C	70382	70385	70388

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

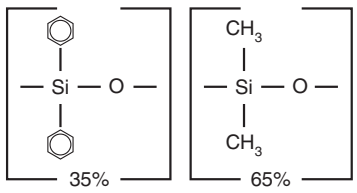
MXT®-35 Columns (Siltek® treated stainless steel)

(midpolarity phase; Crossbond® 35% diphenyl/65% dimethyl polysiloxane)

- General purpose columns for organochlorine pesticides, PCB congeners (e.g. Aroclor mixes), herbicides, pharmaceuticals, sterols, rosin acids, and phthalate esters.
- Temperature range: 0 °C to 340 °C.
- Equivalent to USP G42 phase.

ID	df	temp. limits*	15-Meter	30-Meter		60-Meter
0.25mm	0.50µm	0 to 310/340°C	70435	70438		
	1.00µm	0 to 300/340°C	70450	70453		
0.53mm	1.00µm	0 to 260/340°C	70452	70455		70458
	1.50µm	0 to 250/340°C	70467	70470		70473
	3.00µm	0 to 240/340°C	70482	70485	$580	70488

MXT®-35 Structure



similar phases

DB-35, HP-35, SPB-35, SPB-608

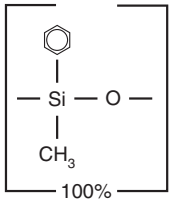
MXT®-50 Columns (Siltek® treated stainless steel)

(midpolarity phase; Crossbond® 100% methylphenyl polysiloxane)

- General purpose columns for pesticides, herbicides, rosin acids, phthalate esters, triglycerides, and sterols.
- Temperature range: 0 °C to 300 °C.
- Equivalent to USP G3 phase.

ID	df	temp. limits*	15-Meter	30-Meter	60-Meter
0.53mm	0.83µm	0 to 270/300°C		70569	
	1.00µm	0 to 260/280°C	70552	70555	70558
	1.50µm	0 to 250/280°C	70567	70570	70573

MXT®-50 Structure



similar phases

HP-17, SPB-50, SP-2250

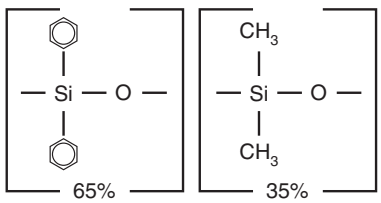
MXT®-65 Columns (Siltek® treated stainless steel)

(mid to high polarity phase; Crossbond® 65% diphenyl/35% dimethyl polysiloxane)

- General purpose columns for phenols and fatty acids.
- Temperature range: 50 °C to 300 °C.
- Equivalent to USP G17 phase.

ID	df	temp. limits	15-Meter	30-Meter
0.25mm	0.25µm	50 to 300°C	77020	77023
	0.50µm	50 to 300°C	77035	77038
	1.00µm	50 to 280/300°C	77050	77053

MXT®-65 Structure



similar phases

TAP-CB, 400-65HT, 007-65HT

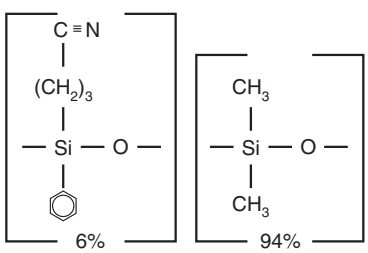
MXT®-1301 Columns (Siltek® treated stainless steel)

(low to midpolarity phase; Crossbond® 6% cyanopropylphenyl/94% dimethyl polysiloxane)

- General purpose columns for residual solvents, alcohols, oxygenates, and volatile organic compounds.
- Temperature range: -20 °C to 280 °C.
- Equivalent to USP G43 phase.

ID	df	temp. limits*	15-Meter	30-Meter	60-Meter
0.25mm	0.25µm	-20 to 280°C	76020	76023	76026
	1.00µm	-20 to 260/280°C	76050	76053	76056
0.28mm	0.25µm	-20 to 280°C	76021	76024	76027
	1.00µm	-20 to 260/280°C	76051	76054	76057
	1.50µm	-20 to 250/280°C	76066	76069	76072
0.53mm	0.25µm	-20 to 280°C	76022	76025	76028
	1.00µm	-20 to 260/280°C	76052	76055	76058
	1.50µm	-20 to 250/280°C	76067	76070	76073
	3.00µm	-20 to 240/280°C	76082	76085	76088

MXT®-1301 Structure

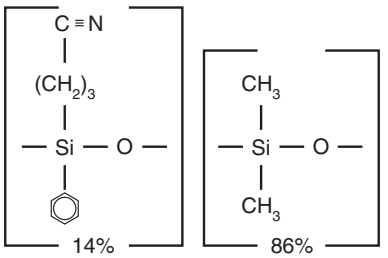


similar phases

DB-1301, DB-624, HP-1301, SPB-1301, SPB-624

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

MXT®-1701 Structure



similar **phases**

DB-1701, HP-1701, SPB-1701

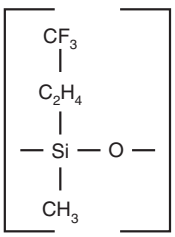
MXT®-1701 Columns (Siltek® treated stainless steel)

(midpolarity phase; Crossbond® 14% cyanopropylphenyl/86% dimethyl polysiloxane)

- General purpose columns for alcohols, oxygenates, PCB congeners (e.g. Aroclor mixes), and pesticides.
- Temperature range: -20 °C to 280 °C.
- Equivalent to USP G46 phase.

ID	df	temp. limits*	15-Meter	30-Meter	60-Meter
0.25mm	0.25µm	-20 to 280°C	72020	72023	72026
	1.00µm	-20 to 260°C	72050	72053	72056
0.28mm	0.25µm	-20 to 280°C	72021	72024	72027
	1.00µm	-20 to 260°C	72051	72054	72057
	1.50µm	-20 to 250°C	72066	72069	72072
0.53mm	0.25µm	-20 to 280°C	72022	72025	72028
	0.50µm	-20 to 270/280°C	72037	72040	72043
	1.00µm	-20 to 260°C	72052	72055	72058
	1.50µm	-20 to 250°C	72067	72070	72073
	3.00µm	-20 to 240°C	72082	72085	72088

MXT®-200 Structure



similar **phases**

DB-200, DB-210

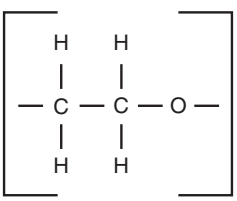
MXT®-200 Columns (Siltek® treated stainless steel)

(midpolarity phase; Crossbond® trifluoropropylmethyl polysiloxane)

- General purpose columns for solvents, Freon® fluorocarbons, alcohols, ketones, silanes, and glycols. Excellent confirmation column with an Rtx®-5 column, for phenols, nitrosamines, organochlorine pesticides, chlorinated hydrocarbons, and chlorophenoxy herbicides.
- Temperature range: -20 °C to 400 °C.
- Equivalent to USP G6 phase.

ID	df	temp. limits*	15-Meter	30-Meter	60-Meter
0.25mm	0.50µm	-20 to 400°C	75035	75038	
	1.00µm	-20 to 310/360°C	75050	75053	
0.53mm	1.00µm	-20 to 290/360°C	75052	75055	75058
	1.50µm	-20 to 280/360°C	75067	75070	75073
	3.00µm	-20 to 260/360°C	75082	75085	75088

MXT®-WAX Structure



similar **phases**

DB-WAX, DB-WAXetr, HP-Wax, HP-Innowax, Supelcowax 10, CP-Wax 52 CB

MXT®-WAX Columns (Siltek® treated stainless steel)

(polar phase; Crossbond® Carbowax® polyethylene glycol—provides oxidation resistance)

- General purpose columns for FAMEs, flavor compounds, essential oils, amines, solvents, xylene isomers, and US EPA Method 603 (acrolein/acrylonitrile).
- Resistant to oxidative damage.
- Temperature range: 40 °C to 260 °C.
- Equivalent to USP G14, G15, G16, G20, and G39 phases.

ID	df	temp. limits	15-Meter	30-Meter	60-Meter
0.25mm	0.10µm	40 to 260°C	70605	70608	70611
	0.25µm	40 to 260°C	70620	70623	70626
	0.50µm	40 to 260°C	70635	70638	70641
0.28mm	0.25µm	40 to 250/260°C	70621	70624	70627
	0.50µm	40 to 250/260°C	70636	70639	70642
	1.00µm	40 to 240/250°C	70651	70654	70657
0.53mm	0.25µm	40 to 250/260°C	70622	70625	70628
	0.50µm	40 to 250/260°C	70637	70640	70643
	1.00µm	40 to 240/250°C	70652	70655	70658
	1.50µm	40 to 230/250°C	70666	70669	70672
	2.00µm	40 to 220/250°C	70667	70670	

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

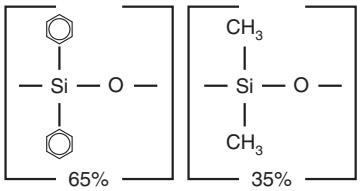
Triglycerides in Foods Analysis

MXT®-65TG Columns (Siltek® treated stainless steel)
(high polarity phase; Crossbond® 65% diphenyl/35% dimethyl polysiloxane)

- Application-specific columns, specially tested for triglycerides.
- Stable to 370 °C.

The MXT®-65TG phase resolves triglycerides by degree of unsaturation as well as by carbon number. Because of the chemistry required to achieve 370 °C thermal stability, an MXT®-65TG column should not be used for analyses of compounds that contain active oxygenated groups.

MXT®-65TG Structure



ID	df	temp. limits	15-Meter	30-Meter
0.25mm	0.10µm	20 to 370°C	77005	77008
0.53mm	0.10µm	20 to 370°C	77007	77010

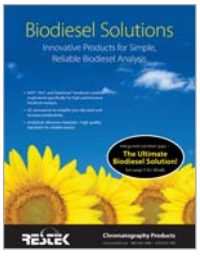
Biodiesel Fuels Analysis

MXT®-Biodiesel TG Columns (Siltek® treated stainless steel)

- Fast analysis times and sharp mono-, di-, and triglyceride peaks.
- Stable at 430 °C for reliable, consistent performance.
- Integra-Gap® built-in retention gap on 0.53 mm ID column eliminates column coupling completely.

Description	temp. limits	cat.#	price
14m, 0.53mm ID, 0.16µm with 2m Integra-Gap*	-60 to 380/430°C	70289	
10m, 0.32mm ID, 0.10µm	-60 to 380/430°C	70292	
10m, 0.32mm ID, 0.10µm with 2m x 0.53mm Retention Gap**	-60 to 380/430°C	70290	
15m, 0.32mm ID, 0.10µm	-60 to 380/430°C	70293	
15m, 0.32mm ID, 0.10µm with 2m x 0.53mm Retention Gap**	-60 to 380/430°C	70291	
2m x 0.53mm MXT Biodiesel TG Retention Gap		70294	

*Total column length=16 meters.
**Connected with low-dead-volume MXT connector.



free literature

Biodiesel Solutions: Innovative Products for Simple, Reliable Biodiesel Analysis

Download your free copy from **www.restek.com**

lit. cat.# 580207

Simulated Distillation (C5-C44) Analysis

MXT®-2887 Column (Siltek® treated stainless steel)
(nonpolar phase; Crossbond® 100% dimethyl polysiloxane—for simulated distillation)

- Application-specific columns for simulated distillation.
- Stable to 400 °C.

MXT®-2887 columns' stationary phase, column dimensions, and film thickness have been optimized to exceed the resolution and skewing factor requirements currently specified in ASTM method D2887. Each column is individually tested to guarantee a stable baseline with low bleed and reproducible retention times. The Crossbond® methyl silicone stationary phase has increased stability compared to packed columns, ensuring stable baselines and shorter conditioning times. Manufactured from Siltek®-treated stainless steel tubing, MXT® columns are the most durable high temperature GC columns available.

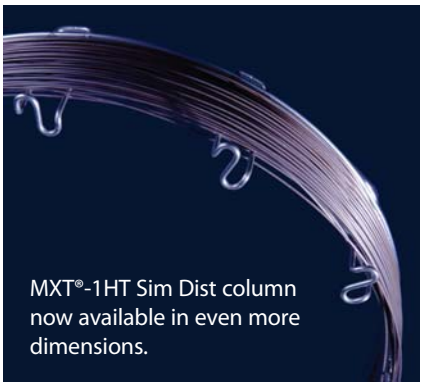
similar **phases**

DB-2887, Petrocol EX2887, CP-HT-Simdist CB

ID	df	temp. limits	10-Meter
0.53mm	2.65µm	-60 to 400°C	70199

Simulated Distillation (C44-C100) Analysis

NEW!



similar **phases**

DB-1HT, CP-HT-Simdist CB

MXT®-1HT SimDist Column (Siltek® treated stainless steel)

(nonpolar phases)

- Stable up to 450 °C—lowest bleed for longest column lifetime.
- Reliably meet all ASTM D6352 and D7500 specifications.
- 100% dimethyl polysiloxane phase allows easy comparisons to historical data.

Accurate boiling point determination for medium and heavy fractions using GC simulated distillation requires columns and phase polymers that are robust enough to withstand high temperatures without significant degradation. Metal columns are a better alternative than fused silica, and the new MXT®-1HT SimDist columns are the lowest bleed, highest efficiency columns available, outperforming other metal columns for critical method parameters.

ID	df	temp. limits	5-Meter	10-Meter
0.53mm	0.10µm	-60 to 430/450°C	70112	
	0.20µm	-60 to 430/450°C	70115	
	0.21µm	-60 to 430/450°C		70118
	0.88µm	-60 to 400/430°C	70131	70134
	1.00µm	-60 to 380/400°C		70130
	1.20µm	-60 to 380/400°C		70119
	2.65µm	-60 to 360/400°C		70132
	5.00µm	-60 to 360/400°C		70133

MXT®-1 SimDist/MXT®-500 SimDist

- Application-specific columns in unbreakable Siltek® treated stainless steel tubing meet all resolution criteria for high temperature simulated distillation (e.g., ASTM Method D2887 Extended).
- MXT®-1HT SimDist and MXT®-1 SimDist phases offer true methyl silicone polarity; MXT®-500 SimDist phase is a carborane siloxane polymer.
- Stable to 430 °C.

MXT®-1 SimDist Column (Siltek® treated stainless steel)

(nonpolar phase)

ID	df	temp. limits	6-Meter
0.53mm	0.15µm	-60 to 430°C	70101

MXT®-500 SimDist Column (Siltek® treated stainless steel)

(nonpolar phase)

ID	df	temp. limits	6-Meter
0.53mm	0.15µm	-60 to 430°C	70104

Polywax® Calibration Materials

Description	qty.	cat.#	price
Polywax 655 calibration material	1g	36225	
Polywax 1000 calibration material	1g	36227	

Volatile Organics Analysis

MXT®-502.2 Columns (Siltek® treated stainless steel)

(proprietary Crossbond® diphenyl/dimethyl polysiloxane phase)

- Application-specific columns with unique selectivity for volatile organic pollutants, cited in US EPA Method 502.2 and in many gasoline range organics (GRO) methods for monitoring underground storage tanks. Excellent separation of trihalomethanes; ideal polarity for light hydrocarbons and aromatics.
- Temperature range: -20 °C to 320 °C.

An MXT®-502.2 column will enable you to quantify all compounds listed in US EPA methods 502.2 or 524.2, whether you use a mass spectrometer or a PID in tandem with an ELCD. The diphenyl/dimethyl polysiloxane based MXT®-502.2 stationary phase provides low bleed and thermal stability to 320 °C. A 105-meter column can separate the light gases specified in EPA methods without subambient cooling.

ID	df	temp. limits	30-Meter	60-Meter	105-Meter
0.25mm	1.40µm	-20 to 270/320°C	70915	70916	
0.28mm	1.60µm	-20 to 250/320°C	70919	70920	70921
0.53mm	3.00µm	-20 to 270/320°C	70908	70909	70910

ID	df	temp. limits	10-Meter	20-Meter
0.18mm	1.00µm	-20 to 270/320°C	71891	71892

similar **phase**

DB-502.2

MXT®-Volatiles Columns (Siltek® treated stainless steel)

(proprietary Crossbond® diphenyl/dimethyl polysiloxane phase)

- Application-specific columns for volatile organic pollutants.
- Temperature range: -20 °C to 320 °C.

MXT®-Volatiles columns were the first columns designed specifically for analyses of the 34 volatile organic pollutants listed in US EPA methods 601, 602, and 624. With these columns, you can quantify all compounds listed in these methods, whether you use a mass spectrometer or a PID in tandem with an ELCD. The diphenyl/dimethyl polysiloxane based MXT®-Volatiles stationary phase provides low bleed and thermal stability to 320 °C.

ID	df	temp. limits*	30-Meter	60-Meter	105-Meter
0.25mm	1.00µm	-20 to 280/320°C	70900	70903	
0.28mm	1.25µm	-20 to 280/320°C	70924	70926	70928
0.53mm	2.00µm	-20 to 280/320°C	70925	70927	70929
	3.00µm	-20 to 250/320°C	70922	70923	

*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

similar **phase**

VOCOL

MXT®-624 Columns (Siltek® treated stainless steel)

(low to midpolarity phase; Crossbond® 6% cyanopropylphenyl/94% dimethyl polysiloxane)

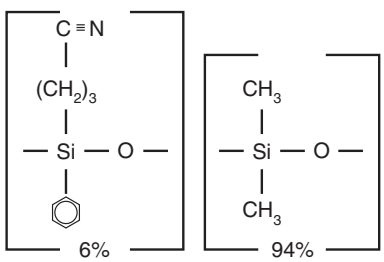
- Application-specific columns for volatile organic pollutants. Recommended in US EPA methods for volatile organic pollutants.
- Temperature range: -20 °C to 280 °C.
- Equivalent to USP G43 phase.

The unique polarity of "624" columns makes them ideal for analyses of volatile organic pollutants. Although the MXT®-502.2 column is recommended in many methods, MXT®-624 columns offer the best separation of the early-eluting gases.

ID	df	temp. limits	30-Meter	60-Meter
0.25mm	1.40µm	-20 to 240/280°C	70968	70969
0.53mm	3.00µm	-20 to 240/280°C	70971	70973

ID	df	temp. limits	10-Meter	20-Meter	
0.18mm	1.00µm	-20 to 240/280°C	71893	71894	$745

MXT®-624 Structure



similar **phases**

DB-624, HP-624

GC COLUMNS
PACKED/MICROPACKED COLUMNS

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What's **NEW?** look for this circle

Bonded Stationary Phases

We combined our stationary phase synthesis experience with our unique Silcoport® packing deactivation process to create bonded phase packings that provide longer lifetimes, lower bleed, and shorter conditioning times.

Bonded methyl silicone phases (Rtx®-1 and Rtx®-5) and bonded Carbowax® phase (Stabilwax®) are completely cross-linked on Silcoport® packing. We have evaluated Rtx®-1 and Rtx®-5 bonded packed column phases side-by-side with nonbonded phases of comparable polarity; the bonded phases last longer than the equivalent nonbonded packing materials. Table I shows that retention times on an Rtx®-1 bonded packed column are highly repeatable after only 30 minutes of conditioning.

Table I Retention data shows the perfect reproducibility of the bonded phase packed columns with respect to retention times.

	Retention Time			
Hydrocarbon	Min.	Max.	Mean	Stand. Dev.
C5	0.241	0.243	0.242	0.001
C6	0.493	0.497	0.495	0.002
C10	5.746	5.765	5.752	0.005
C20	18.482	18.491	18.486	0.004
C28	25.093	25.103	25.098	0.004
C40	32.160	32.171	32.166	0.004
C44	34.316	34.328	34.326	0.007

n = 9 columns

NEW!

0.53 mm ID micropacked columns now available. See **page 132**.

Bonded Packed Column Stationary Phases

- Short conditioning times.
- Low bleed levels.
- Higher sensitivities.
- Longer column lifetimes.
- Unsurpassed inertness for active compounds.

Bonded phases are used in capillary columns because they provide a dramatic increase in column quality. To truly bridge the gap between traditional packed columns and capillary columns, it was necessary to develop bonded liquid phases for packed columns. Packed column chromatographers can expect shorter conditioning times, lower bleed, and longer column lifetimes by using Restek bonded phase packed columns.

Bonded phases also last much longer than nonbonded phases. Bonded phases are more resistant to oxidation than nonbonded phases because of the stronger intermolecular forces produced by cross-linking. Because the material is thoroughly cross-linked, the phase will not migrate or puddle, as often happens with nonbonded phases. Figure 1 shows a comparison of a bonded and a nonbonded methyl silicone column after 170 temperature cycles. The results show the impressive durability of bonded phases.

Restek's packed columns deliver the

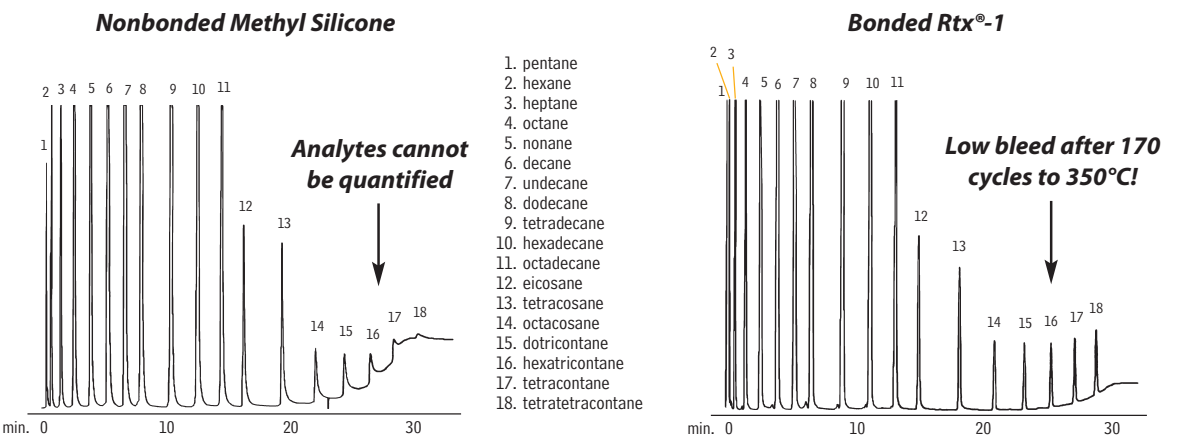
1-2-3 PUNCH!

1. Bonded stationary phases mean short conditioning times, low bleed, and unsurpassed column lifetimes.
2. SilcoSmooth® tubing provides the inertness of glass and the durability of stainless steel.
3. Silcoport® diatomaceous earth provides unsurpassed inertness for trace analysis.

Equivalent Liquid Phases

Rtx-1	BP-1, CC-1, CP-Sil 5CB, DB-1, DC-200, GE-SF-96, HP-1, HP-101, OV-1, OV-101, RSK-150, RH-1, SE-30, SP-2100, SPB-1, UCC W-98
Rtx-5	BP-5, CB-5, CC-5, CP-Sil 8CB, DB-5, HP-5, OV-73, SE-52, SE-54, SPB-5, Ultra-5
Stabilwax	BP-20, CP-Wax, CW-20, DB-Wax, HP-Innowax, PE-Wax, Supelcowax-10

Figure 1 Bonded packed columns exhibit longer lifetime than nonbonded packed columns.



25" x 1/8" x 2mm ID Rtx®-1 SimDist 2887 SilcoSmooth® stainless steel (cat.# 80000-800)
1.0µl direct injection, 1–12% (w/w) each component
Oven temp.: 35°C to 350°C @ 10°C/min. (hold 5 min.)
Inj. & det. temp.: 350°C
Carrier gas: helium @ 25mL/min.
FID sensitivity: 256 x 10^{-11} AFS

cat.# 31674 (1% each listed analyte in CS_2) and cat.# 31675 (5% each, neat) meet requirements of ASTM D2887-01.

Packed Column Tubing

Restek offers a wide range of tubing choices for our packed columns, including SilcoSmooth® (Siltek®-treated stainless steel), stainless steel, Hastelloy®, nickel, copper, and Teflon® tubing. SilcoSmooth® and stainless steel tubing are our two most popular column materials. SilcoSmooth® tubing is an excellent replacement for fragile glass columns. Stainless steel tubing works well with most applications for nonreactive compounds.

SilcoSmooth® Tubing

If your analysis involves reactive compounds, you can use fragile and inflexible glass columns, or you can step up to SilcoSmooth® tubing which combines the inertness of glass with the strength and flexibility of stainless steel. Made from ultra-smooth, seamless 304 stainless steel and treated with the innovative Siltek® deactivation process, SilcoSmooth® tubing can replace glass columns for virtually any application.

Stainless Steel Tubing

If you are analyzing hydrocarbons or nonreactive compounds, you can use our rugged, flexible, and economical stainless steel columns. Restek stainless steel columns are made from high-quality weldrawn tubing.

Hastelloy® Tubing

Hastelloy® tubing is a nickel-chromium alloy with excellent inertness. It is normally used only for highly corrosive or oxidizing compounds or gases.

Nickel Tubing

Nickel tubing is often used for analyses of caustic or oxidizing compounds or gases.

Copper Tubing

Copper is a general purpose tubing that is only recommended for nonactive compounds.

Teflon® Tubing

Teflon® tubing is often used for reactive compounds or other special applications. Note that this tubing is permeable to gases.

Table I Packed column tubing dimensions

Material	1/4-inch OD x 5.3mm ID	3/16-inch OD x 3.1mm ID[1]	1/8-inch OD x 2.0mm ID[2]	1/16-inch OD x 1.0mm ID[3]	0.95mm OD x 0.75mm ID[4]	0.74 mm OD x 0.53mm ID
SilcoSmooth	✔	✔	✔	✔	✔	✔
Stainless Steel	✔	✔	✔	✔	✔	
Hastelloy			✔			
Nickel			✔			
Copper	✔		✔			
Teflon			✔			

[1] 3/16-inch OD x 3.1mm ID replaces 1/4-inch OD x 4mm ID glass columns.
[2] 1/8-inch OD x 2mm ID replaces 1/4-inch OD x 2mm ID glass columns.
[3] 1/16-inch OD x 1.2mm and 1.0mm ID micropacked columns are designed for packed column injection systems.
[4] 0.95mm OD x 0.75mm ID micropacked columns are designed for capillary injection systems.

1/8- or 3/16-inch OD columns are easily adaptable to 1/4-inch or 5mm ID injection ports, using inexpensive adaptors. All Restek packed columns can be coiled to fit any instrument configuration.

please **note**

We do not offer packed glass columns. SilcoSmooth® columns offer the inertness of glass, without breakage problems.

did you **know**?

Restek's advanced packed column technology provides columns with unmatched inertness and efficiency.

Packed Column Reduction Fittings

We will weld tubing reducers or VCR fittings to your column. Call Customer Service (ext. 3) or your Restek representative for pricing & availability.

Welded Tubing Reducers

Welded VCR Fittings

Frits—A new alternative to glass wool and braided end plugs!

Hastelloy® and Siltek® treated frits are now available for select packed and micropacked columns!

NEW!

Hastelloy® frit

Siltek® frit

Fill out the form on page 142, visit **www.restek.com/packed**, contact Customer Service or your Restek representative for pricing and availability.

Stock Packed Columns

Bonded Packed Column Stationary Phases

- Low bleed levels.
- Longer column lifetimes.
- Short conditioning times.

Bonded Phase on 100/120 Silcoport W	Stainless Steel Tubing L (ft.)	OD (in.)	ID (mm)	cat.#*	price	SilcoSmooth Tubing** L (m)	OD (in.)	ID (mm)	cat.#*	price
3% Rtx-1	6	1/8	2.1	80441-		2	1/8	2	80401-	
10% Rtx-1	6	1/8	2.1	80442-		2	1/8	2	80405-	
20% Rtx-1	6	1/8	2.1	80443-		2	1/8	2	80409-	
3% Rtx-5	6	1/8	2.1	80444-		2	1/8	2	80477-	
10% Rtx-5	6	1/8	2.1	80445-		2	1/8	2	80478-	
20% Rtx-5	6	1/8	2.1	80446-		2	1/8	2	80479-	
5% Rtx-Stabilwax	6	1/8	2.1	80447-		2	1/8	2	80415-	
10% Rtx-Stabilwax	6	1/8	2.1	80448-		2	1/8	2	80416-	
20% Rtx-Stabilwax	6	1/8	2.1	80449-		2	1/8	2	80417-	
Rtx-1 SimDist 2887***	25"	1/8	2.1	80450-		25"	1/8	2	80000-	

please **note**

Stock packed columns are designed with a 2" void on the inlet end for on-column injections. For column configurations containing no void, add suffix -901 to the part number.

Frits—A new alternative to glass wool and braided end plugs!

Hastelloy® and Siltek® treated frits are now available for select packed and micropacked columns!

NEW!

Hastelloy® frit

Siltek® frit

Fill out the form on page 142, visit **www.restek.com/packed**, contact Customer Service or your Restek representative for pricing and availability.

Chromosorb®-Based Packed Columns

On 100/120 Silcoport W***	Stainless Steel Tubing L (ft.)	OD (in.)	ID (mm)	cat.#*	price	SilcoSmooth Tubing** L (m)	OD (in.)	ID (mm)	cat.#*	price
3% Rt-101	6	1/8	2.1	80461-		2	1/8	2	80400-	
3% Rt-2100	6	1/8	2.1	80462-		2	1/8	2	80420-	
5% Rt-1200/1.75% Bentone 34	6	1/8	2.1	80463-		2	1/8	2	80125-	
5% Rt-1200/5% Bentone 34	6	1/8	2.1	80464-		2	1/8	2	80129-	

On Chromosorb PAW	Mesh	Stainless Steel Tubing L (ft.)	OD (in.)	ID (mm)	cat.#*	price	SilcoSmooth Tubing** L (m)	OD (in.)	ID (mm)	cat.#*	price
10% TCEP	100/120	8	1/8	2.1	80465-		2.5	1/8	2	80126-	
23% Rt-1700	80/100	30	1/8	2.1	80466-		9.2	1/8	2	80128-	

Porous Polymer Packed Columns

Restek offers a full range of porous polymers, including HayeSep®, Porapak, Chromosorb® Century Series polymers, and Tenax® TA packing, for analyses of volatile components and light solvents. Our QA procedures give you the confidence that every batch you purchase will deliver consistent column-to-column performance.

Porous Polymers 80/100 Mesh	Stainless Steel Tubing L (ft.)	OD (in.)	ID (mm)	cat.#*	price	SilcoSmooth Tubing** L (m)	OD (in.)	ID (mm)	cat.#*	price
HayeSep Q	6	1/8	2.1	80467-		2	1/8	2	80433-	
Porapak Q	6	1/8	2.1	80468-		2	1/8	2	80427-	
Porapak QS	6	1/8	2.1	80469-		2	1/8	2	80426-	
Porapak R	6	1/8	2.1	80470-		2	1/8	2	80425-	
Chromosorb 101	6	1/8	2.1	80471-		2	1/8	2	80435-	
Chromosorb 102	6	1/8	2.1	80472-		2	1/8	2	80434-	

please **note**

Temperature limits for stationary phases are listed on **page 138**.

*Please add column instrument configuration suffix number to cat.# when ordering. See chart on the next page.
**Siltek-treated stainless steel.
***Modified version of Chromosorb W; highest inertness, most consistent performance.

also **available**

Chromosorb®, Porapak, HayeSep®, and Tenax® packing materials.
See **pages 136-137.**

CarboBlack Solid Supports

Graphitized carbon black offers unique selectivity and very little adsorption for alcohol analyses. Two types of CarboBlack supports are available, CarboBlack B and CarboBlack C. CarboBlack B support, with its higher surface area, can hold up to a 10% loading of a nonsilicone liquid phase. CarboBlack C support can hold up to a 1% loading of a nonsilicone liquid phase. Many Carbowax® 20M-loaded CarboBlack packings are available. CarboBlack packings are treated with KOH or picric acid for basic or acidic compounds, and special alcoholic beverage loadings are available. CarboBlack supports provide resolution and retention similar to Carbopack™ and Carbograph supports.

		Stainless Steel Tubing					SilcoSmooth Tubing**				
On CarboBlack B	Mesh	L (ft.)	OD (in.)	ID (mm)	cat.#*	price	L (m)	OD (in.)	ID (mm)	cat.#*	price
5% Carbowax 20M	80/120	—	—	—	—	—	2	1/8	2	80105-	
5% Carbowax 20M	60/80	6	1/8	2.1	88012-		1.8	1/8	2	80106-	
6.6% Carbowax 20M	80/120	6	1/8	2.1	80451-		2	1/8	2	80107-	
4% Carbowax 20M/ 0.8% KOH	60/80	—	—	—	—	—	2	1/8	2	80116-	
1% Rt-1000	60/80	8	1/8	2.1	88013-		2.4	1/8	2	80206-	
1% Rt-1000	60/80	6	1/8	2.1	80452-		2	1/8	2	80207-	
3% Rt-1500	80/120	10	1/8	2.1	80453-		3.05	1/8	2	80211-	
1% Rt-1510	60/80	10	1/8	2.1	80454-		3.05	1/8	2	80216-	
1.5% XE-60/1% H_3PO_4	60/80	6	1/8	2.1	80455-		1.8	1/8	2	80305-	

		Nickel 200 Tubing				
On CarboBlack B	Mesh	L (m)	OD (in.)	ID (mm)	cat.#*	price
5% Krytox (Ni 200 tubing)	60/80	3.05	1/8	2.1	80127-	$315

		Stainless Steel Tubing					SilcoSmooth Tubing**				
On CarboBlack C	Mesh	L (ft.)	OD (in.)	ID (mm)	cat.#*	price	L (m)	OD (in.)	ID (mm)	cat.#*	price
0.2% Carbowax 1500	60/80	6	1/8	2.1	80456-		2	1/8	2	80121-	
0.2% Carbowax 1500	80/100	6	1/8	2.1	80457-		2	1/8	2	80122-	
0.1% Rt-1000	80/100	6	1/8	2.1	80458-		1.8	1/8	2	80205-	
0.19% picric acid	80/100	6	1/8	2.1	80459-		2	1/8	2	80311-	
0.3% Carbowax 20M/0.1% H_3PO_4	60/80	2.5	3/16	3.1	80460-		0.75	3/16	3.1	80111-	

Molecular Sieve Packed Columns

Molecular sieve packed columns easily separate permanent gases at above-ambient temperatures. Restek's R&D chemists have developed a process for preparing molecular sieve packings, which result in excellent batch-to-batch reproducibility. In addition, our molecular sieves are preactivated and ready to use. Each column comes with metal end-fittings to prevent water or carbon dioxide from adsorbing into the packing during shipment.

		Stainless Steel Tubing					SilcoSmooth Tubing**				
Molecular Sieve	Mesh	L (ft.)	OD (in.)	ID (mm)	cat.#*	price	L (m)	OD (in.)	ID (mm)	cat.#*	price
Molesieve 5A	60/80	6	1/8	2.1	80473-		2	1/8	2	80428-	
Molesieve 5A	80/100	3	1/8	2.1	88015-		1	1/8	2	80440-	
Molesieve 5A	80/100	6	1/8	2.1	80474-		2	1/8	2	80429-	
Molesieve 5A	80/100	10	1/8	2.1	88014-		3.05	1/8	2	80430-	
Molesieve 13X	60/80	6	1/8	2.1	80475-		2	1/8	2	80480-	
Molesieve 13X	80/100	6	1/8	2.1	80476-		2	1/8	2	80439-	

*Please add column instrument configuration suffix number to cat.# when ordering. See chart on this page.
**Siltek-treated stainless steel.

also available

CarboBlack packing materials. See **page 134**.

Column Instrument Configurations


General Configuration
Suffix -800


Agilent 5880, 5890, 5987, 6890, 7890:
Suffix -810*


Varian 3700, Vista Series, FID:
Suffix -820

PE 900-3920, Sigma 1,2,3:
Suffix -830

PE Auto System 8300, 8400, 8700
Suffix -840

See page 143 for additional configurations.

Note: Initial 2" of column will be empty, to accommodate a needle. For a completely filled column (not on-column) add suffix -901.
*-810 suffix also includes 1½" void on detector side.

free
literature

Resolve Benzene and Toluene in Spark Ignition Fuels Containing Ethanol

Download your free copy from **www.restek.com**

lit. cat.# 580227

Aromatics Analysis

D3606 Application Column (2 column set)

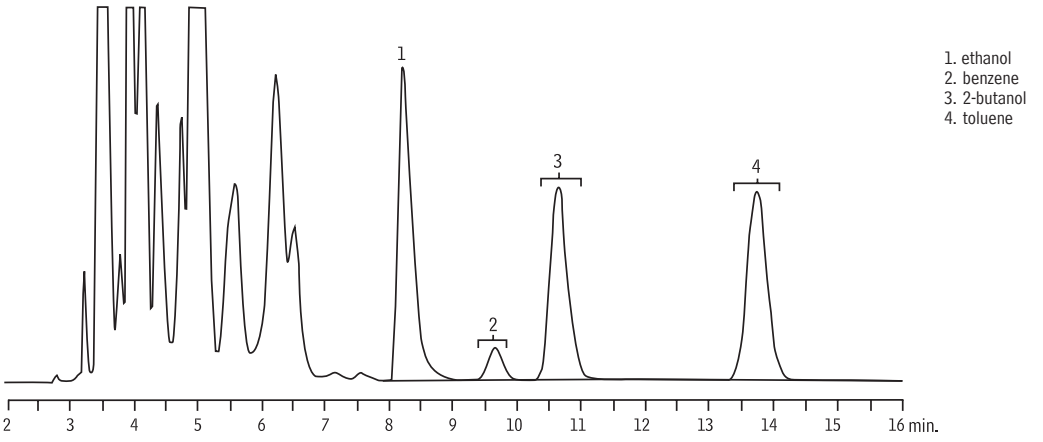
- Complete separation of ethanol and benzene, with a resolution value > 3.00.
- Accurate quantification of benzene and toluene.
- Fully conditioned two column set—ready to use out of the box.
- A chromatogram is provided with each column set demonstrating conformance to the revised ASTM method.

Conforms to the specifications established in ASTM method D3606-07 for the quantitation of benzene and toluene in spark ignition fuel containing ethanol.

Description	cat.#*	price
D3606 Application Column (2 column set)**		
Column 1: 6' (1.8m), 1/8" OD, 2.0mm ID, nonpolar Rtx-1		
Column 2: 16' (4.9m), 1/8" OD, 2.0mm ID, proprietary packing material	83606-	

*Please add column instrument configuration suffix number to cat.# when ordering. See page 143.
**The column set is designed to accommodate both valve injection and/or syringe injection. Column 1 is configured with a 2" inlet void to facilitate on-column injection. The inlet is identified on both column 1 and column 2. Note: The inlet of column 2 is identified for proper orientation for connection to the valve.

Gasoline containing ethanol on a D3606 Application Column set.



GC_PC01079

Column:	D3606 Application Column (2 column set, cat.# 83606-800) Column 1: nonpolar Rtx®-1, 6' (1.8m), 1/8" OD, 2.0mm ID Column 2: proprietary packing material, 16' (4.9m), 1/8" OD, 2.0mm ID
Sample:	1.5µL gasoline with internal standard
Inj.:	200°C
Backflush:	3 min.
Carrier gas:	helium, constant flow
Flow rate:	20mL/min.
Oven temp.:	135°C, isothermal
Det.:	TCD @ 200°C

Chromatogram courtesy of Boguslaw Dudek, Conoco Phillips, Linden, NJ.

Light Hydrocarbon Analysis

Special Columns for Unsaturated Light Hydrocarbons

- Faster separations of C1 to C4 hydrocarbons.
- Res-Sil® packing replaces Porasil materials.

n-Octane on Res-Sil® C Packed Column

This packed column has unique selectivity for resolving unsaturated light hydrocarbons (Figure 1).

OPN on Res-Sil® C Packed Column

This column separates the light hydrocarbons, and baseline resolves *cis*-2-butene from 1,3-butadiene (Figure 2).

2abc Refinery Gas Column Set

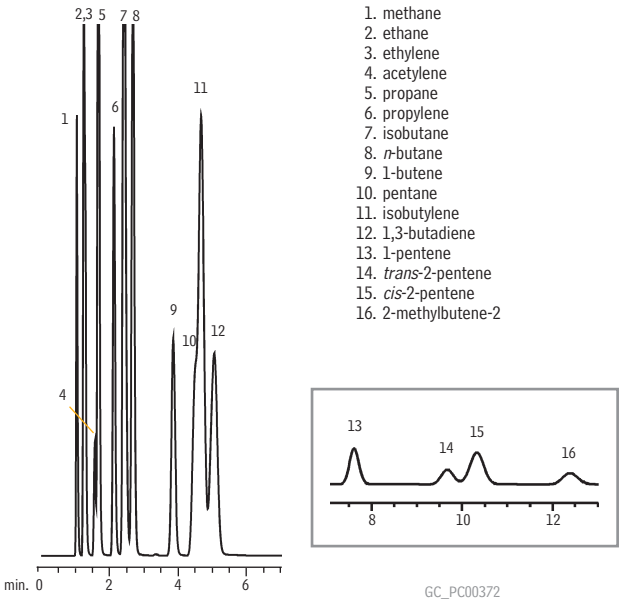
This 3-column set is finely tuned to resolve light hydrocarbons. When used in the proper valving system, it will elute C5+ hydrocarbons ahead of C1 through C4 hydrocarbons. (Figure 3)

Description	cat.#*	price
n-Octane on Res-Sil C, 80/100 (20', 2.0mm ID, 1/8" Silcosmooth OD)	80436-	
OPN on Res-Sil C, 80/100 (12', 2.0mm ID, 1/8" Silcosmooth OD)	80437-	
2abc Refinery Gas Column Set (3 column set)**	88000-	

*Please add column instrument configuration suffix number to cat.# when ordering. See page 143.

**This column set is for a valving system; therefore, packing material is filled to ends of columns.

Figure 1 *n*-Octane on Res-Sil® C packing has unique selectivity for unsaturated light hydrocarbons.

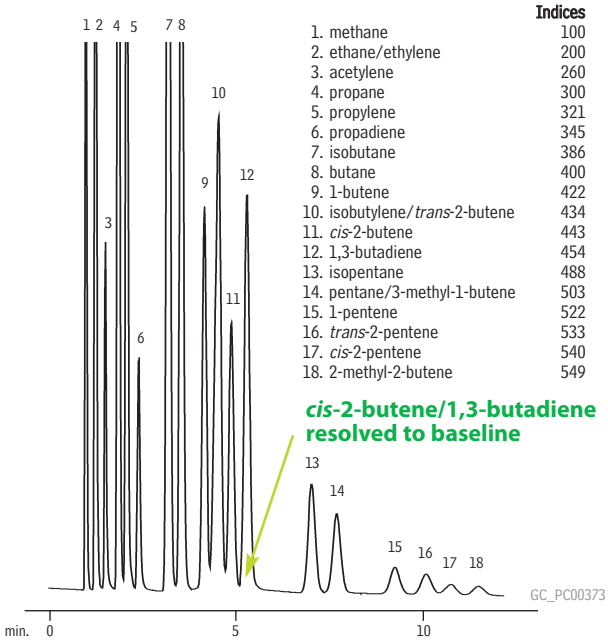


1. methane
2. ethane
3. ethylene
4. acetylene
5. propane
6. propylene
7. isobutane
8. *n*-butane
9. 1-butene
10. pentane
11. isobutylene
12. 1,3-butadiene
13. 1-pentene
14. *trans*-2-pentene
15. *cis*-2-pentene
16. 2-methylbutene-2

n-octane 80/100 Res-Sil® C
20', 1/8" OD x 2mm ID, SilcoSmooth® tubing (cat. # 80436)

Oven temp.:	60°C
Inj. temp.:	150°C
Det. temp:	150°C FID
Flow rate:	30mL/min. He
Sample:	refinery gas C1-C5
Sample size:	20µL

Figure 2 OPN on Res-Sil® C packing has unique selectivity for *cis*-2-butene and 1,3-butadiene.



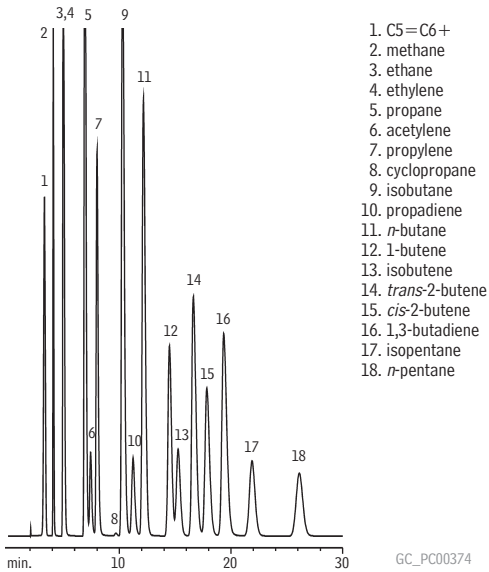
	Retention Indices
1. methane	100
2. ethane/ethylene	200
3. acetylene	260
4. propane	300
5. propylene	321
6. propadiene	345
7. isobutane	386
8. butane	400
9. 1-butene	422
10. isobutylene/*trans*-2-butene	434
11. *cis*-2-butene	443
12. 1,3-butadiene	454
13. isopentane	488
14. pentane/3-methyl-1-butene	503
15. 1-pentene	522
16. *trans*-2-pentene	533
17. *cis*-2-pentene	540
18. 2-methyl-2-butene	549

OPN on Res-Sil® C, 80/100 mesh, 12' x 2mm ID x 1/8" OD in SilcoSmooth® tubing (cat.# 80437). 20µL on-column injection of refinery gas.

Concentration:	0.1-6 absolute mole %
Oven temp.:	50°C
Inj. & det. temp.:	200°C
Carrier gas:	helium
Flow rate:	30mL/min

Reference standard courtesy of AC Analytical Controls, Bensalem, PA.

Figure 3 Refinery gas calibration standard on a Restek refinery gas packed column set.



1. C5=C6+
2. methane
3. ethane
4. ethylene
5. propane
6. acetylene
7. propylene
8. cyclopropane
9. isobutane
10. propadiene
11. *n*-butane
12. 1-butene
13. isobutene
14. *trans*-2-butene
15. *cis*-2-butene
16. 1,3-butadiene
17. isopentane
18. *n*-pentane

2abc Refinery Gas Column Set (cat.# 88000-875) (3 column set)

Oven temp.:	60°C
Inj. temp.:	150°C
Det. temp:	150°C FID
Flow rate:	30mL/min., helium
Sample:	refinery gas
Sample size:	1cc

for more info

See **page 135** for more information on Res-Sil® packing materials.

Permanent Gases & Hydrocarbon Analysis

ShinCarbon ST Packed/Micropacked Columns

- Separate permanent gases, including CO/CO_2, without cryogenic cooling.
- Rapid separations of permanent gas/light hydrocarbon mixtures.
- Excellent compatibility with most GC detectors—minimal bleed, minimal baseline rise.
- Preconditioned, less than 30 minutes to stabilize.

Analyze oxygen, nitrogen, methane, carbon monoxide, and carbon dioxide with one column and at room temperature. ShinCarbon ST material, a high surface area carbon molecular sieve (~1,500 m^2/g), is the ideal medium for separating gases and highly volatile compounds by gas solid chromatography (GSC). The rapid, above-ambient analyses these columns provide will be a great convenience. Excellent thermal stability of the high surface area carbon, combined with careful conditioning during column manufacturing, ensures low-bleed operation and rapid stabilization when installing a new column. Custom-made ShinCarbon ST columns are available on request.

ShinCarbon ST is a highly stable material. Its 330 °C upper temperature limit minimizes bleed and baseline rise during temperature programming, making the material compatible with most detection systems used for gas analysis, including TCD or HID. All ShinCarbon ST columns are fully conditioned in an oxygen/moisture free environment to prevent contamination. This minimizes stabilization time (less than 30 minutes) when installing a new column which, in turn, minimizes downtime.

it's a **fact**

ShinCarbon ST is an ideal packing material for permanent gases, low molecular weight hydrocarbons, sulfur dioxide, and Freon® gases.

also **available**

For adapter kits for installing packed/micropacked columns, see **page 133.**

ShinCarbon ST 80/100 Columns (packed)
(SilcoSmooth® Stainless Steel)*

OD	ID	2-Meter
1/8" Silcosmooth	2.0mm	80486-

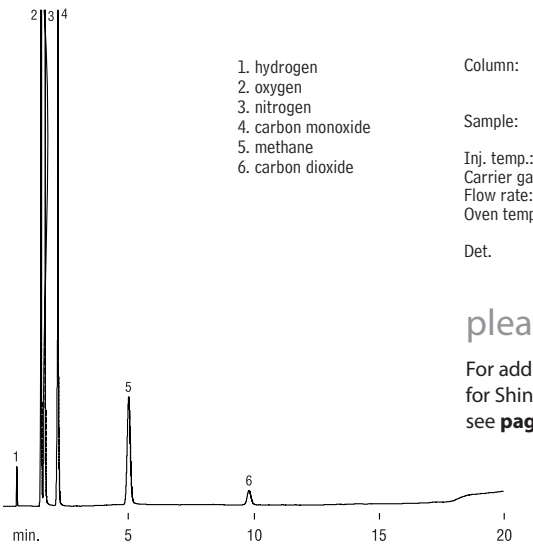
ShinCarbon ST 100/120 Columns (micropacked)
(SilcoSmooth® Stainless Steel)**

OD	ID	1-Meter		2-Meter
1/16"	1.0mm	19809	$245	19808
0.95mm	0.75mm	19810	$245	

*Please add column instrument configuration suffix number to cat.# when ordering. See chart on the next page.

**Does not include column nuts and ferrules. Optional installation kits can be ordered separately—see page 133.

Separate permanent gases in 10 minutes, without cryogenics.



1. hydrogen
2. oxygen
3. nitrogen
4. carbon monoxide
5. methane
6. carbon dioxide

Column:	ShinCarbon ST, 100/120 mesh, 2m, 1mm ID micropacked (cat.# 19808)
Sample:	5µL permanent gases mix, approx. 5 mole % each
Inj. temp.:	100°C
Carrier gas:	helium
Flow rate:	10mL/min.
Oven temp.:	40°C (hold 3 min.) to 250° @ 8°/min. (hold 10 min.)
Det.	HID @ 200°C

GC_PC00666

please **note**

For additional chromatograms for ShinCarbon ST columns, see **pages 647, 649, and 652**.

Sulfur Analysis

Rt®-XLSulfur Packed/Micropacked Columns

- Optimized columns for low pbbv sulfur analyses.
- Eliminate the need for Teflon® tubing.
- Column and end-fittings are Sulfinert® treated for maximum inertness.

Sulfur analyses are traditionally performed using Teflon® tubing to improve column inertness. Unfortunately, Teflon® tubing is gas permeable, difficult to pack with high efficiency, prone to shrinkage, and has poor thermal stability. The Rt®-XLSulfur packed or micropacked column eliminates these problems. The packing material for Rt®-XLSulfur columns is extensively deactivated for analysis of low ppbv levels of hydrogen sulfide and methyl mercaptan. It is then treated to achieve effective separation of hydrocarbons from sulfur compounds. The interior wall and the end-fittings of the Rt®-XLSulfur column are Siltek® treated, making the column as inert as Teflon®. The extra care taken to manufacture this column ensures more accurate analyses of sulfur compounds.

Rt®-XLSulfur Columns (packed)*

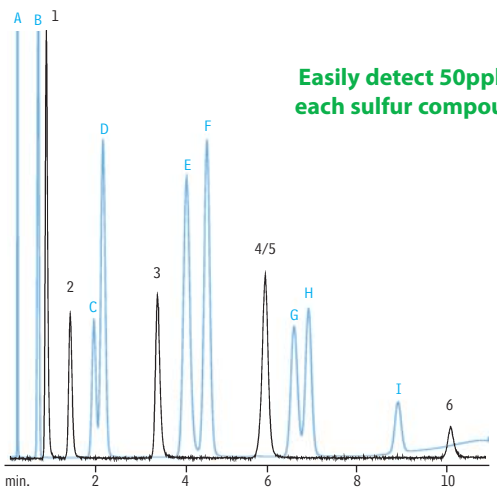
OD	ID	1-Meter	2-Meter
1/8"	2.0mm	80484-	80485-
3/16"	3.1mm	80482-	80483-

Rt®-XLSulfur Columns (micropacked)**

OD	ID	1-Meter	2-Meter
1/16"	1.0mm	19804	19805
0.95mm	0.75mm	19806	19807

*Please add column instrument configuration suffix number to cat.# when ordering. See chart on this page.
**Does not include column nuts and ferrules. Optional installation kits can be ordered separately—see page 133.

Rt®-XLSulfur micropacked column separates hydrocarbons from sulfur compounds.



Easily detect 50ppb of each sulfur compound!

sulfurs
1. hydrogen sulfide
2. carbonyl sulfide
3. methyl mercaptan
4. ethyl mercaptan
5. dimethyl sulfide
6. dimethyl disulfide

hydrocarbons
A. methane
B. ethane
C. propylene
D. propane
E. isobutane
F. butane
G. isopentane
H. pentane
I. hexane

GC_PC00436

Column:	Rt®-XLSulfur micropacked column, 1m, 0.75mm ID (cat.# 19806)
Conc.:	50ppb each
Oven temp.:	60°C to 230°C @ 15°C/min.
Carrier gas:	helium
Flow rate:	9mL/min.
Det.:	SCD/FID

Sulfur standards courtesy of DCG Partnership 1 Ltd., Pearland, TX.

did you **know**?

Rt®-XLSulfur columns are optimized for low ppb-level sulfur analysis!

also **available**

For adapter kits for installing packed/micropacked columns, see **page 133**.

Column Instrument Configurations


General Configuration
Suffix -800


Agilent 5880, 5890, 5987, 6890, 7890:
Suffix -810*


Varian 3700, Vista Series, FID:
Suffix -820

PE 900-3920, Sigma 1,2,3:
Suffix -830

PE Auto System 8300, 8400, 8700
Suffix -840

See page 143 for additional configurations.

Note: Initial 2" of column will be empty, to accommodate a needle. For a completely filled column (not on-column) add suffix -901.
*-810 suffix also includes 1½" void on detector side.

Micropacked Columns

Made with INERT SilcoSmooth tubing!

All micropacked columns are made with inert SilcoSmooth® tubing, which is Siltek® treated for maximum inertness. See **page 125**.

Micropacked Columns

- Increased efficiency over traditional packed columns.
- Higher capacity than PLOT columns.
- Made from inert, flexible Siltek®-treated stainless steel tubing.
- Siltek®-treated, braided-wire end plug keeps packing intact, even under intense pressure surges during valve switching.
- Wide range of packings available.

Efficient, inert, and flexible

Micropacked columns are highly efficient and provide good sample capacity. With inert Siltek® treatment, micropacked columns are a powerful tool for solving many difficult application problems. The unsurpassed inertness of SilcoSmooth® tubing is based on Siltek® deactivation, which allows the column to be flexed and coiled without any fear of chipping or cracking the inert surface.

Easy to install—multiple internal diameters

Our micropacked columns are designed to fit packed and capillary injection systems. Standard wall ($^{1}/_{16}$-inch OD) micropacked columns offer improved efficiency in packed column instruments, without the expense of converting to capillary injection systems. Smaller OD (0.74 mm and 0.95 mm OD) micropacked columns install easily into a capillary injector, using slightly larger ferrules. Micropacked columns operate at flows exceeding 10 cc/min., for trouble-free operation.

Braided wire end plugs

Glass wool end plugs can be dislodged easily by carrier gas pressure surges. Restek's chemists insert braided wire into the column and secure it by making a small crimp near the column outlet. End plugs are Siltek® treated—the sample contacts only inert surfaces.

Frits—A new alternative to glass wool and braided end plugs!

Hastelloy® and Siltek® treated frits are now available for select packed and micropacked columns!

NEW!

Hastelloy® frit

Siltek® frit

Fill out the form on page 142, visit **www.restek.com/packed**, contact Customer Service or your Restek representative for pricing and availability.

NEW!

0.53 mm ID Micropacked Columns

- Available in a variety of packing materials.
- High capacity and retention for volatile compounds.
- Can be coiled to fit any GC.

	Mesh	ID	OD	Temp. Range	2-Meter
HayeSep Q	80/100	0.53mm	0.74mm	up to 275°C	19042
Molesieve 5A	80/100	0.53mm	0.74mm	up to 300°C	19041
Rt-XLSulfur	80/100	0.53mm	0.74mm	up to 300°C	19044
ShinCarbon ST	80/100	0.53mm	0.74mm	up to 330°C	19043

0.75 mm ID Micropacked Columns

	ID	OD	Temp. Range	0.56-Meter	
20% TCEP on 80/100 Chromosorb PAW	0.75mm	$^{1}/_{16}$"	0–175°C	19040	$110

	Mesh	ID	OD	Temp. Range	1-Meter	2-Meter
HayeSep R	100/120	0.75mm	0.95mm	up to 250°C	19014	19015
HayeSep Q	100/120	0.75mm	0.95mm	up to 275°C	19018	19019
HayeSep N	100/120	0.75mm	0.95mm	up to 165°C	19022	19023
HayeSep S	100/120	0.75mm	0.95mm	up to 250°C	19010	19011
Molesieve 5A	80/100	0.75mm	0.95mm	up to 300°C	19002	19003
Molesieve 13X	80/100	0.75mm	0.95mm	up to 350°C	19006	19007

1.00 mm ID Micropacked Columns

	Mesh	ID	OD	Temp. Range	1-Meter	2-Meter	
HayeSep R	100/120	1.00mm	$^{1}/_{16}$"	up to 250°C	19012	19013	
HayeSep Q	100/120	1.00mm	$^{1}/_{16}$"	up to 275°C	19016	19017	
HayeSep N	100/120	1.00mm	$^{1}/_{16}$"	up to 165°C	19020	19021	
HayeSep S	100/120	1.00mm	$^{1}/_{16}$"	up to 250°C	19008	19009	
Molesieve 5A	80/100	1.00mm	$^{1}/_{16}$"	up to 300°C	19000	19001	
Molesieve 13X	80/100	1.00mm	$^{1}/_{16}$"	up to 350°C	19004	19005	$140

Custom

Packed/Micropacked Column Request Form

See page 142 or visit **www.restek.com/packed**

also available

For adapter kits for installing micropacked columns, see **page 133**.

Packed/Micropacked Column Installation Kits

Packed Column Inlet Adaptor Kits

- Use 1/8" and 3/16" OD columns in 1/4" on-column injection ports.
- Centers column perfectly in injection port to eliminate bent syringe needles.
- Slotted design prevents carrier gas occlusion.
- Vespel®/graphite reducing ferrules make installation easy.
- Includes all nuts & ferrules used to attach tubing to the injector or detector.

Adaptor kit centers the packed column in the injection port, so the syringe will not scrape the sides of the column.

	For 1/8" Columns			For 3/16" Columns		
Description	**qty.**	**cat.#**	**price**	**qty.**	**cat.#**	**price**
Packed Column Inlet Adaptor Kit for 1/4" Injection Ports	kit	21651	$28	kit	21650	

Installation Kits for Micropacked Columns

Description	**qty.**	**cat.#**	**price**
Micropacked Column Installation Kit for 1mm ID columns; for valve applications. Kit contains: 1/16" Valco nut (1), 1/16" stainless steel nut (1), 1/16" Vespel/graphite ferrule (1), 1/16" graphite ferrule (1), stainless steel ferrule (1), 1/16" stainless steel front ferrule (1), 1/16" stainless steel back ferrule (1).	kit	21065	
Micropacked Column Installation Kit for 1mm ID columns; for direct injections. Kit contains: 1/16" stainless steel nuts (2), 1/16" Vespel/graphite ferrules (2), 1/16" graphite ferrules (2), 1/16" stainless steel front ferrules (2), 1/16" stainless steel back ferrules (2).	kit	21066	

Installation Kit for Packed Columns

Description	**qty.**	**cat.#**	**price**
Packed Column Installation Kit for 2mm ID columns; for valve applications. Kit contains: 1/8" stainless steel nut (1), stainless steel Valco nut (1), 1/8" Vespel/graphite ferrule (1), stainless steel Valco ferrule (1), 1/8" stainless steel front ferrule (1), 1/8" stainless steel back ferrule (1).	kit	21067	

Large-Bore Dual Vespel® Ring Inlet Seals

Micropacked Inlet Conversion Kits

Convert a capillary GC split/splitless inlet for use with 1/16" OD micropacked columns.

- For use with Agilent 5890 and 6890 GCs.
- Sample pathways deactivated for ultimate inertness.

Description	**qty.**	**cat.#**	**price**
Micropacked Column Adaptor Kit for Split/Splitless Injection *Injection Port Adaptor Kit* Kit includes: Dual Vespel Ring Inlet Seal, large bore; reducing nut, large bore; 1/16" ferrule, Vespel/graphite; 1/16" nut, stainless steel; 4mm splitless liner, intermediate polarity deactivated	kit	22426	
Micropacked Column Adaptor Kit for On-Column Injection *Injection Port Adaptor Kit* Kit includes: Dual Vespel Ring Inlet Seal, large bore; reducing nut, large bore; 1/16" ferrule, Vespel/graphite; Siltek treated metal liner installation guide; 1/16" nut, stainless steel	kit	22427	
Replacement Inlet Seals for Micropacked Column Adaptor Dual Vespel Ring Inlet Seals, large bore (2)	2-pk.	22429	
Replacement Metal Liner Installation Guide for On-Column Injection, Siltek Treated	ea.	22430	
Replacement 4mm Splitless Liner	ea.	20772	

1/4" SS Nut

Large-Bore FID Adaptor

1/4" Vespel®/Graphite Ferrule

1/16" SS Nut

Large-Bore Reducing Nut

1/16" Vespel®/Graphite Ferrules

22430

20772

restek **innovation**!

Most **INERT** solid support available!

Silcoport® Packing Materials

Outperform Any Deactivated Diatomaceous Earth Supports Available!

- Superior deactivation technology for improved inertness.
- Available in 80/100 and 100/120 mesh.
- Uniform particle distribution for maximum efficiency.

The increased sensitivity of modern detection systems and the desire to reduce detection limits requires a solid support to meet the challenging demands faced by analysts. Unlike conventional dimethyldichlorosilane (DMDCS) deactivation, Silcoport® incorporates our proprietary fused silica deactivation technology on diatomaceous earth solid supports. Silcoport® supports were developed using a special mixture of deactivants that yields the highest inertness without changing the polarity of the stationary phase. Silcoport® supports from Restek are the perfect match for highly inert SilcoSmooth® tubing.

Description	Temp. Limit	Mesh	Min. Qty.†	cat.#
Silcoport P*	400°C	80/100	100g	25641
	400°C	100/120	100g	25642

*Prepared from Chromosorb P; Restek acid washed deactivation.
†Bulk quantities are available.

Please call for availability.

did you **know**?

Silcoport support replaces

- Supelcoport
- Chromosorb W HP
- GasChrom Q 2

please **note**

Silcoport® is available uncoated or coated with the liquid stationary phase of your choice on 80/100 or 100/120 mesh sizes. Call Restek at 800-356-1688 or 814-353-1300, ext. 3, or contact your Restek representative for pricing and availability.

CarboBlack Packing Materials

- CarboBlack B supports up to 10% loading of a nonsilicone liquid phase.
- CarboBlack C supports up to 1% loading of a nonsilicone liquid phase.
- Equivalent to Supelco's Carbopack™ packings.

Graphitized carbon black offers unique selectivity and very little adsorption for alcohol analyses. Two types of CarboBlack supports are available, CarboBlack B and CarboBlack C. CarboBlack B support, with its higher surface area, can hold up to a 10% loading of a nonsilicone liquid phase. CarboBlack C support can hold up to a 1% loading of a nonsilicone liquid phase. Many Carbowax® 20M-loaded CarboBlack packings are available. CarboBlack packings are treated with KOH or picric acid for basic or acidic compounds, and special alcoholic beverage loadings are available. CarboBlack supports provide resolution and retention similar to Carbopack™ and Carbograph supports.

Description	Temp. Limit	Mesh	Min. Qty.	cat.#	price/g
CarboBlack B	500°C	60/80	10g	25500	
	500°C	80/120	10g	25501	
CarboBlack C	500°C	60/80	10g	25502	
	500°C	80/100	10g	25503	
CarboBlack BHT-100	150°C	40/60	10g	25504	
CarboBlack III (F)	175°C	80/100	10g	25506	
5% Carbowax 20m on CarboBlack B	225°C	80/120	10g	25507	
6.6% Carbowax 20m on CarboBlack B	225°C	80/120	10g	25508	
4% Carbowax 20m / 0.8% KOH on CarboBlack B	220°C	60/80	10g	25509	
0.19% picric acid on CarboBlack C	120°C	80/100	10g	25510	
4% Carbowax 20m on CarboBlack B-DA	200°C	80/120	10g	25511	

Res-Sil® Packing Materials

- Unique separation of saturated and unsaturated hydrocarbons.
- Innovative bonding chemistry for batch-to-batch reproducibility, excellent thermal stability, and long life.
- Wide range of bonded phases available.
- Equivalent to Waters Durapak packings.

Bonded silica packings with *n*-octane or cyanopropyl (OPN) functional groups yield faster separations of C1 to C4 hydrocarbons, higher thermal stability, shorter conditioning times, and longer lifetimes than conventional packings. However, bonded silica packings have had inconsistent reproducibility and limited availability. Restek's research team has solved these age-old problems by developing Res-Sil® C packings for consistent performance.

Unique Selectivity for Process GC and High-Speed Analysis of Petrochemicals

Res-Sil® C bonded packings are ideal for fast resolution of difficult-to-separate saturated and unsaturated C4 hydrocarbons (see page 129). This unique selectivity, when combined with other columns in series, provides petroleum and petrochemical method developers with a powerful tool for fast determination of C1 to C5 hydrocarbons.[1]

Innovative Research and Stringent QA Provide Batch-to-Batch Consistency

Restek's synthesis procedure eliminates batch-to-batch variations. The amount of bonded liquid phase is precisely controlled in every batch, for reproducible retention times and separations. Each production batch of Res-Sil® C packing is tested with a complex hydrocarbon mixture to meet demanding retention time and retention index specifications. Column bleed is also evaluated to ensure that there are no retention shifts or high baselines.

OPN on Res-Sil® C Packing—the Latest in a Line of Bonded GC Phases

Restek offers a wide range of bonded packings for packed column GC, including Rtx®-1, Stabilwax®, and Carbowax® phases. We have extended this technology to make *n*-octane on Res-Sil® C packing, and OPN on Res-Sil® C packing. Each of these packings has low bleed, conditioning times of less than 30 minutes, long lifetime, and consistent batch-to-batch reproducibility.

Description	Temp. Limit (°C)	Mesh	Min. Qty.	cat.#	price/g
Res-Sil C	300°C	60/80	10g	25400	
	300°C	80/100	10g	25028	
Res-Sil B	300°C	60/80	10g	25401	
	300°C	80/100	10g	25080	
1% TCEP on Res-Sil B	175°C	80/100	10g	25081	
OPN on Res-Sil C	150°C	80/100	10g	25042	
n-Octane on Res-Sil C	150°C	80/100	10g	25030	
2% Carbowax 1540 on Res-Sil C	150°C	80/100	10g	25044	

[1]N.C. Saha, S.K. Jain, and R.K. Dua. J. Chromat. Sci 1978, 323-328.

also available

Custom packing materials are also available. See **page 140**.

did you know?

Res-Sil replaces

- Porasil B
- Porasil C

Packed Column Packing Materials

Tim Herring, Technical Service

Technical Service

Do you have a technical question? Restek's Technical Service group has answers! Drawing from our extensive libraries of technical information and many years of collective chromatography experience, the experts in Technical Service can help you from set-up to method development.

Contact us:

For quick answers to commonly asked questions any time of the day, visit **www.restek.com/answers** or contact us directly:

In the U.S.

Phone: 1-800-356-1688, ext. 4
Fax: 814-353-1568
e-mail: support@restek.com

Outside the U.S.

Contact your Restek representative.

Chromosorb® Packings

Restek offers the full line of Chromosorb® solid supports. Choosing the appropriate support will depend on your application. Need assistance? Call Technical Service at 800-356-1688 or 814-353-1300, ext. 4, or contact your Restek representative.

Chromosorb® P (used to prepare Silcoport® P)
Chromosorb® P support is manufactured from hard firebrick, making it a rugged material. This support is available acid washed (AW), nonacid washed (NAW), and traditional dimethyldichlorosilane (DMDCS) treated. Chromosorb® P support can hold up to 30 weight% of liquid stationary phase, making it the highest loading support available.

Chromosorb® W (used to prepare Silcoport® W and Silcoport® BW)
Chromosorb® W support is a flux-calcinated diatomite. This solid support is very fragile but offers the highest inertness of all diatomaceous earth supports. It can be prepared with up to 25 weight% of liquid stationary phase. Chromosorb® W support is available in AW, NAW, and DMDCS, or treated with Restek's proprietary (Silcoport®) deactivation. Chromosorb® W-HP is an acid washed, silanized version of Chromosorb® W.

Chromosorb® G
Chromosorb® G support is the hardest support available and has the lowest surface area of all the diatomaceous earth supports. Chromosorb® G support is available as AW, NAW, and DMDCS-treated. It can hold up to 10 weight% of liquid stationary phase.

Chromosorb® T
Chromosorb® T support is made from Teflon® material and is an extremely inert solid support.

Chromosorb® G and Chromosorb® T are available as custom products. Contact us for more information.

Description	Mesh	gm/btl.
Chromosorb P NAW	45/60	100g
	60/80	100g
	80/100	100g
	100/120	100g
Chromosorb P AW	60/80	100g
	80/100	100g
	100/120	100g
Chromosorb P AW/DMDCS	60/80	100g
	80/100	100g
	100/120	100g
Chromosorb W NAW	60/80	100g
Chromosorb W AW	60/80	100g
Chromosorb W AW/DMDCS	60/80	100g
Chromosorb W-HP	60/80	100g

NAW—nonacid washed
AW—acid washed
DMDCS—dimethyldichlorosilane
BW—base washed

Please call for availability.

Custom
Packed/Micropacked
Column Request Form
See page 142 or visit
www.restek.com/packed

Chromosorb® Century Packings

Description	Temp. Limits	g/btl.	Mesh 60/80 cat.#	Mesh 80/100 cat.#	Mesh 100/120 cat.#
Chromosorb 101	275/325°C	50g	25608	25609	25610
Chromosorb 102	250/300°C	50g	25611	25612	25613
Chromosorb 103	275/300°C	50g	25614	25615	25616
Chromosorb 104	(equivalent to HayeSep C)				
Chromosorb 106	250/275°C	50g	25620	25621	25622
Chromosorb 107	250/275°C	50g	25623	25624	25625
Chromosorb 108	250/275°C	50g	25626	25627	25628

Please call for availability.

Porapak Series Packings

Description	Temp. Limit	g/btl.	Mesh 50/80 cat.#	price	Mesh 80/100 cat.#	price	Mesh 100/120 cat.#	price
Porapak P	250°C	20g	25576		25577		25578	
Porapak PS	250°C	20g	25579		25580		25581	
Porapak Q	250°C	26g	25582		25583		25584	
Porapak QS	250°C	26g	25585		25586		25587	
Porapak R	250°C	24g	25588		25589		25590	
Porapak S	250°C	26g	25591		25592		25593	
Porapak N	190°C	29g	25594		25595		25596	
Porapak T	190°C	31g	25597		25598		25599	

HayeSep® Series Packings

Description	Temp. Limit	g/btl.	Mesh 60/80 cat.#	price	Mesh 80/100 cat.#	price	Mesh 100/120 cat.#	price
HayeSep A	165°C	24g	22560		25032		25033	
HayeSep B	190°C	24g	25561		25034		25035	
HayeSep C	250°C	24g	25562		25036		25037	
HayeSep D	290°C	24g	25563		25038		25039	
HayeSep DIP	290°C	24g	25564		25565		25566	
HayeSep DB	290°C	24g	25567		25568		25569	
HayeSep DOX	(Use HayeSep DB)							
HayeSep N	165°C	24g	25570		25045		25046	
HayeSep P	250°C	24g	25571		25047		25048	
HayeSep Q	275°C	24g	25572		25049		25050	
HayeSep R	250°C	24g	25573		25051		25052	
HayeSep S	250°C	24g	25574		25053		25054	
HayeSep T	165°C	24g	25575		25055		25056	$150

Tenax® Packings

Description	Temp. Limit	Min. Qty.	Mesh 60/80 cat.#	price/g	Mesh 80/100 cat.#	price/g
Tenax-TA	350°C	10g	25550		25551	
Tenax-GR	350°C	10g	25552		25553	

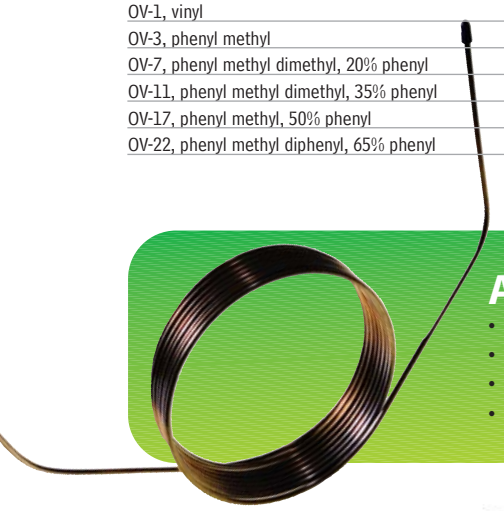
also available

Custom packing materials are also available. See **page 140**.

Liquid Phases

We can prepare packed columns from the extensive list of liquid phases shown here. We have many more liquid phases. If you don't see the phase you need, call technical service or contact your Restek representative for availability.

Phase	min./max. temp. (°C)
Apiezon L	50/300
p,p'-Azoxydiphenetole	132/140
BC-120	0/125
Bentone-34	0/180
bis (2-ethoxyethyl) adipate	0/150
bis (2-ethylhexyl) phthalate	150 max.
bis (2-methoxyethyl) adipate	20/100
n,n'-Bis(*p*-methoxylbenzylidene)-α,α'-bi-*p*-toluidine (BMBT)	189/225
Carbowax 1000	40/150
Carbowax 20M	60/225
Carbowax 20M-terephthalic acid	60/225
Carbowax 400	10/100
Carbowax 600	30/125
Cyclohexanedimethanol succinate	100/250
DC-11	0/300
DC-200	0/200
DC-550	20/250
DEGS-PS	20/200
Di(2-ethylhexyl)sebacate	0/125
Diethylene glycol succinate (DEGS)	20/200
Diethylene glycol adipate (DEGA)	0/200
Diisodecyl phthalate	0/175
2,4-Dimethylsulfolane	0/50
Di-*n*-decyl phthalate	10/175
Dinonyl phthalate	20/150
Ethylene glycol adipate	100/225
Ethylene glycol phthalate	100/200
Ethylene glycol succinate	100/200
FFAP	50/250
Fluorad FC-431, 50% solution in ethyl acetate	40/200
Hallcomid M-18-OL	8/150
Halocarbon 10-25	20/100
Halocarbon K-352	0/250
Halocarbon wax	50/150
Igepal® CO-880 (Nonoxynol)	100/200
Igepal CO-890	100/200
Krytox	-30/260
Neopentyl glycol adipate	50/225
Neopentyl glycol sebacate	50/225
Neopentyl glycol succinate	50/225
Nonoxynol (Igepal CO-880)	100/200
β,β-Oxydipropionitrile	0/75
OV-1, dimethyl (gum)	100/350
OV-1, vinyl	100/350
OV-3, phenyl methyl	0/350
OV-7, phenyl methyl dimethyl, 20% phenyl	0/350
OV-11, phenyl methyl dimethyl, 35% phenyl	0/350
OV-17, phenyl methyl, 50% phenyl	0/375
OV-22, phenyl methyl diphenyl, 65% phenyl	0/350
OV-25, phenyl methyl diphenyl, 75% phenyl	0/350
OV-61, diphenyl, 33% phenyl	0/350
OV-73, 5.5% diphenyl	0/325
OV-101, dimethyl (fluid)	0/350
OV-105, cyanopropyl methyl	0/275
OV-202, trifluoropropyl (fluid)	0/275
OV-210, trifluoropropyl (fluid)	0/275
OV-215, trifluoropropyl (gum)	0/275
OV-225, cyanopropyl methylphenyl methyl	0/265
OV-275, dicyanoallyl	25/250
OV-330, silicone - Carbowax	0/250
OV-351	50/270
OV-1701, vinyl	0/250
Phenyldiethanolamine succinate	0/230
Polethylene glycol adipate (EGA)	100/225
Polyphenyl ether (5 rings) OS-124	0/200
Polyphenyl ether (6 rings) OS-138	0/225
Polypropylene glycol	0/150
Rtx-1 (Rt-101)	0/350
Rt-1000	50/250
Rt-1200	25/200
Rt-1220	50/200
Rt-1500, Rt-1510	50/230
Rt-2100	0/350
Rt-2300	20/275
Rt-2330, Rt-2340	25/275
Rt-608Pkd	0/275
Rt-Sebaconitrile	25/110
Rt-XLSulfur	250 max.
SE-30, SE-52, SE-54	50/300
Silar 5 CP, Silar 10 CP	0/250
Sorbitol	150 max.
Squalane	20/100
Squalene	0/100
Stabilwax	40/240
Tetracyanoethylated pentaerythritol	30/175
THEED (Tetrahydroxyethlenediamine)	0/125
β,β-Thiodipropionitrile (TDPN)	100
Tricresyl phosphate	20/125
1,2,3-Tris (2-cyanoethoxy) propane (TCEP)	0/175
Triton X-100, Triton X-305	0/200
UC W982	0/300
UCON 50-HB-2000	0/200
UCON 50-HB-280-X	0/200
UCON 50-HB-5100	0/200
UCON HB-1800-X	200 max.
UCON LB-550-X	0/200
Versamid 9000	190/275



Advantages of using Restek packed columns

- Reasonably priced.
- Low-bleed, long-lifetime bonded phases.
- Wide variety of supports and packings.
- Produced by experienced packed column chromatographers.

USP Liquid Phase & Solid Support Cross-Reference

Restek can meet all of your packed column needs for US Pharmacopeia methods. Commonly used USP liquid phases and supports are listed below. Call Restek or your representative for a quote on your next packed column for pharmaceuticals.

USP	Phase Description	Restek-Supplied Equivalent
G1	dimethylpolysiloxane oil	Rt-2100, OV-101, Rtx-1
G2	dimethylpolysiloxane gum	OV-1, Rtx-1
G3	50% phenyl-50% methylpolysiloxane	Rt-2250, OV-17
G4	diethylene glycol succinate polyester	Rt-DEGS
G5	3-cyanopropylpolysiloxane	Rt-2340
G6	trifluoropropylmethylpolysiloxane	Rt-2401, OV-210
G7	50% 3-cyanopropyl-50% phenylmethylsilicone	Rt-2300
G8	80% bis (3-cyanopropyl)-20% phenylpolysiloxane	Rt-2330
G9	methylvinylpolysiloxane	UCW 98
G10	polyamide	polyamide
G11	bis(2 ethylhexyl) sebecate polyester	bis(2 ethylhexyl) sebecate polyester
G12	phenyldiethanolamine succinate polyester	phenyldiethanolamine succinate polyester
G13	sorbitol	sorbitol
G14	polyethylene glycol (average mol. wt. 950-1050)	Carbowax 1000
G15	polyethylene glycol (average mol. wt. 3000-3700)	Carbowax 4000
G16	polyethylene glycol compound (average mol. wt. 15,000), a high molecular weight compound of polyethylene glycol and a diepoxide linker	Carbowax 20M
G17	75% phenyl-25% methylpolysiloxane	OV-25
G18	polyalkylene glycol	UCON LB 550X
G19	25% phenyl-25% cyanopropyl-50% methylsilicone	OV 225
G20	polyethylene glycol (average mol. wt. 380-420)	Carbowax 400
G21	neopentyl glycol succinate	neopentyl glycol succinate
G22	bis(2 ethylhexyl) phthalate	bis(2 ethylhexyl) phthalate
G23	polyethylene glycol adipate	EGA
G24	diisodecyl phthalate	diisodecyl phthalate
G25	polyethylene glycol compound TPA, a high molecular weight compound of a polyethylene glycol and a diepoxide that is esterified with terephthalic acid	Carbowax 20M TPA
G26	25% 2-cyanoethyl-75% methylpolysiloxane	Rt-XE 60
G27	5% phenyl-95% methylpolysiloxane	SE-52, Rtx-5
G28	25% phenyl-75% methylpolysiloxane	DC 550
G29	3,3'-thiodipropionitrile	TDPN
G30	tetraethylene glycol dimethyl ether	tetraethylene glycol dimethyl ether
G31	nonylphenoxypoly(ethyleneoxy)ethanol (average ethyleneoxy chain length is 30): nonoxynol 30	Igepal CO 880
G32	20% phenylmethyl-80% dimethylpolysiloxane	OV-7
G33	20% Carborane®-80% methylsilicone	Dexsil 300
G34	diethylene glycol succinate polyester stabilized with phosphoric acid	Rt-DEGS PS
G35	a high molecular weight compound of a polyethylene glycol and a diepoxide that is esterified with nitroterephthalic acid	Rt-1000
G36	1% vinyl-5% phenylmethylpolysiloxane	SE 54, Rtx-5
G37	polyimide	polyimide
G38	phase G1 containing a small amount of tailing inhibitor	Rt-2100/0.1% Carbowax 1500
G39	polyethylene glycol (average mol. wt. 1500)	Carbowax 1500
G40	ethylene glycol adipate	Rt-EGA

USP	Support Description	Restek-Supplied Equivalent
S1A	siliceous earth, see method for details on treatment	Silcoport W
S1AB	siliceous earth, treated as S1A and both acid- and base-washed	Silcoport WBW
S1C	crushed firebrick, calcined or burned with a clay binder >900°C, acid-washed, may be silanized	Chromosorb PAW or PAW DMDCS
SINS	untreated siliceous earth	Chromosorb W- Non Acid Washed
S2	styrene-divinylbenzene copolymer with nominal surface area of less than 50m^2/g and an average pore diameter of 0.3 to 0.4μm	Chromosorb 101
S3	ethylvinylbenzene-divinylbenzene copolymer with nominal surface area of 500 to 600m^2/g and an average pore diameter of 0.0075μm	Hayesep Q
S4	styrene-divinylbenzene copolymer with aromatic -O and -N groups having a nominal surface area of 400 to 600m^2/g and an average pore diameter of 0.0076μm	Hayesep R
S5	high molecular weight tetrafluorethylene polymer, 40- to 60-mesh	Chromosorb T
S6	styrene-divinylbenzene copolymer having a nominal surface area of 250 to 350m^2/g and an average pore diameter of 0.0091μm	Chromosorb 102
S7	graphitized carbon having a nominal surface area of 12m^2/g	CarboBlack C
S8	copolymer of 4-vinyl-pyridine and styrene-divinylbenzene	Hayesep S
S9	porous polymer based on 2,6-diphenyl-*p*-phenylene oxide	Tenax TA
S10	highly cross-linked copolymer of acrylonitrite and divinylbenzene	HayeSep C
S11	graphitized carbon having a nominal surface area of 100m^2/g, modified with small amounts of petrolatum and polyethylene glycol compound	CarboBlack B 80/120 3% Rt 1500
S12	graphitized carbon having a nominal surface area of 100m^2/g	CarboBlack B

Custom Coated Packing Materials

Custom coated packing materials can be made with any of the supports listed below. The liquid stationary phases available are listed on page 138 and the coating ranges are listed in the chart. Coated packings are available in minimum orders of 20 grams.

To order, please call your Restek representative for pricing and specify the following:

1) stationary phase and stationary phase concentration
2) support and support mesh size
3) amount of packing needed

Ordering Example: (3%) (Rtx®-1) (Silcoport® P) (80/100) (20 g).

Support	Max. Coating %	Mesh Sizes	Price /gram
CarboBlack B	1–10%*	60/80, 80/120	
CarboBlack B HT	1–10%	40/60	
CarboBlack C	0.1–1%*	60/80, 80/100	
HayeSep	15%	60/80, 80/100, 100/120	
Porapak	15%	50/80, 80/100, 100/120	

Please call for availability of the following supports.

Chromosorb 101-108	5%*/10%**	60/80, 80/100, 100/120	
Chromosorb W HP	20%	45/60, 60/80, 80/100, 100/120	
Chromosorb G HP	20%	45/60, 60/80, 80/100, 100/120	
Chromosorb G, P or W (AW or NAW)	10% (G) 25% (W) 30% (P)	45/60, 60/80, 80/100, 100/120	
Chromosorb G, P or W (AW or DMDCS)	10% (G) 25% (W) 30% (P)	45/60, 60/80, 80/100, 100/120	
Chromosorb T	15%	40/60	
Silcoport P	30%	80/100, 100/120	
Silcoport W BW	20%	80/100, 100/120	
Silcoport W (replacement for Chromosorb 750)	20%	80/100, 100/120	

*Nonsilicone phase.
**Silicone phase.

NAW—nonacid washed
AW—acid washed
DMDCS—dimethyldichlorosilane
BW—base washed

For coatings over 15% or quantities over 50 grams, please call your Restek representative.

ordering **note**

Mesh Size
When ordering a packed column solid support, please specify mesh size. Refer to this chart to convert microns to mesh size.

Example:
150–180 micron particles = 80/100 mesh

(µm)	Mesh Size
850	20
710	25
600	30
500	35
425	40
355	45
300	50
250	60
212	70
180	80
150	100
125	120
106	140
90	170
75	200
63	230
53	270

ordering **note**

Special phases that require a surcharge:
OV®-275, OV®-330, OV®-225, BMBT, 2,4-dimethylsulfolane, Silar, OV®-1701, and XE-60. Call your Restek representative for pricing.

Custom
Packed/Micropacked Column Request Form
See page 142 or visit
www.restek.com/packed

Custom Packed/Micropacked Columns

Custom Packed Columns

To order, specify the following:

1) column dimensions (length, ID) and tubing material
2) packing description (percent coating and phase, support mesh size, and treatment)
3) column configuration (instrument manufacturer, model number, on-column injection or not) and with or without nuts and ferrules

Ordering Example: (6' x 1/8") (stainless steel) (3%) (Rtx®-1) (Silcoport® 80/100) (Agilent 6890) (on-column injection) (fittings kit).

Please use the custom order form on page 142 or visit
www.restek.com/packed

Custom Micropacked Columns

To order, contact your Restek representative and specify the following:

1) physical dimensions (length, OD, ID, and tubing material)
2) packing description (percent coating and phase, support mesh size)
3) installation kit (see page 133), frit type

Ordering Example: (2 m x 1/16" OD x 1.00 mm ID) (Siltek®-treated tubing) (5%) (Carbowax® 20M) (CarboBlack B) (80/120) (installation kit for valve applications, cat. #21065) (Siltek® frits)

Please use the custom order form on page 142 or visit
www.restek.com/packed

Frits—A new alternative to glass wool and braided end plugs!

Hastelloy® and Siltek® treated frits are now available for select packed and micropacked columns!

NEW!

Hastelloy® frit

Siltek® frit

Fill out the form on page 142, visit **www.restek.com/packed**, contact Customer Service or your Restek representative for pricing and availability.

did you **know**?

Packing material in packed and micropacked columns is secured using wire braids or frits. This prevents packing material from exiting the column.

ordering **note**

For international pricing on custom packed or micropacked columns, please contact your Restek representative.

Packed/Micropacked Column Custom Order Form

Order: _____ Quote: _____ Reference # from previous order (if available): _____

Date: _____

Restek Account #: _____

Contact: _____

Company: _____

Address: _____

_____

Phone: _____

Fax: _____

Email: _____

Restek Use Only:

Custom No.: _____

Stock No.: _____

Price: _____

Fitting Costs: _____

Authorization: _____

Number of Columns: _____

1) Column Dimensions:
   Length _____ OD x ID: _____
2) Tubing (choose one): ❍ SilcoSmooth® ❍ Stainless Steel ❍ Hastelloy® ❍ Nickel ❍ Copper ❍ Teflon®
3) Packing Description:
   Liquid Phase A (% + description): _____
   Liquid Phase B (% + description): _____
   Liquid Phase C (% + description): _____
   Solid Support: _____ Mesh: _____
4) Column Configuration:
   Instrument (mfr. + model): _____
   Inlet: Packed Full? ❍ Yes ❍ No, leave_____" void (for on-column injection)
   Outlet: Packed Full? ❍ Yes ❍ No, leave_____" void
   Do you want this column preconditioned? ❍ Yes (additional charge): $30 ❍ No
   Standard configuration suffix number (next page)**:**
   Frits ❍ Hastelloy® ❍ Siltek®
   Special configuration (next page): Figure: _____ Dimensions: _____
   Welded Tubing Reducers ❍ (additional charge): $140
   Special Instructions: _____

Fittings (check appropriate circle)

❍ **KIT 1S**
1/4" brass nuts
1/4" to 1/8" V/G reducing ferrules
No additional charge

❍ **KIT 2S**
1/4" brass nuts
1/4" to 3/16" V/G reducing ferrules
No additional charge

❍ **KIT A**
1/8" brass nuts
1/8" V/G ferrules
No additional charge

❍ **KIT B**
1/8" brass nuts
1/8" brass front & back ferrules
No additional charge

❍ **KIT C**
1/8" stainless steel nuts
1/8" stainless steel front & back ferrules
Additional charge

❍ **KIT D**
1/8" stainless steel nuts
1/8" V/G ferrules
Additional charge

❍ **KIT E**
1/4" stainless steel nuts
1/4" to 1/8" V/G reducing ferrules
Additional charge

❍ **KIT F**
1/4" stainless steel nuts
1/4" to 3/16" V/G reducing ferrules
Additional charge

❍ **KIT V**
1/8" VCR fitting
check appropriate circle:
❍ Stainless Steel (additional charge)
❍ Nickel (additional charge)

for a **quote:**

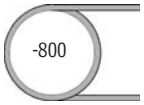
Complete this form and fax to Restek at 814-353-1309, or to your Restek representative.

This form is also available online at:
www.restek.com/packed

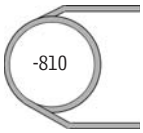
V/G = Vespel®/graphite

Standard Configurations (choose one)

General Configuration



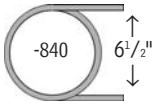
Agilent 5880, 5890, 5987, 6890, 7890



Varian 3700, Vista Series, FID

PE 900-3920, Sigma 1,2,3

PE Auto System 8300, 8400, 8700



-810 Agilent 5880, 5890, 5987, 6890, 7890
-811 Agilent 6850
-820 Varian 3700,Vista Series, FID
-821 Varian 3800
-830 PerkinElmer 900-3920, Sigma 1,2,3
-840 PerkinElmer Auto System 8300, 8400, 8700, Clarus 500 (C500)
-841 PerkinElmer Auto Sys XL
-845 ABB 3100, AAI (4" coil)
-850 Shimadzu 14A, 2014
-851 Shimadzu 8A
-852 Shimadzu 9A
-853 Shimadzu 17A, 2010
-854 Shimadzu Mini 2
-860 Thermo Scientific - TRACE 2000
-865 Carlo Erba
-870 Tremetrics/Tracor
-874 HNU 310 & 311 (4.5" coil)
-875 Analytical Controls Configuration
-880 Carle 40030
-881 Hitachi 263
-885 Pye Unicam 4500
-890 Gow Mac 590
-891 Gow Mac 550
-892 Gow Mac 750
-893 Gow Mac 816 (3" coil, 3" spread on the arms, and a total height of 5")
-894 Gow Mac 580
-895 SRI 8610C
-895R SRI 8610C Dual GC Right Side
-895L SRI 8610C Dual GC Left Side
-896 SRI 9300

Custom Configurations (Please provide dimensions on order form, page 142, or at **www.restek.com/packed**)

Figure 1

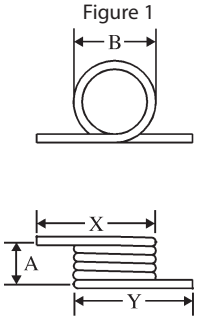


Figure 2

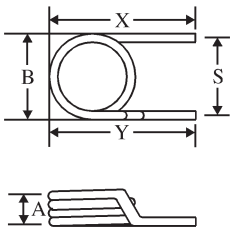


Figure 3

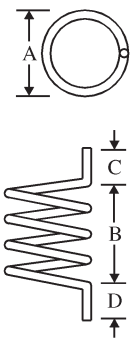


Figure 4

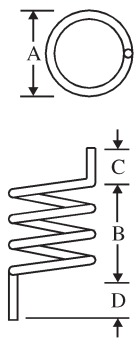


Figure 5

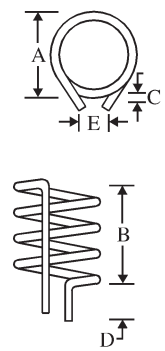


Figure 6

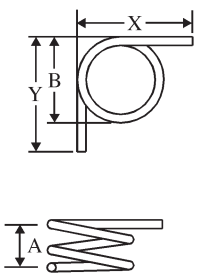


Figure 7

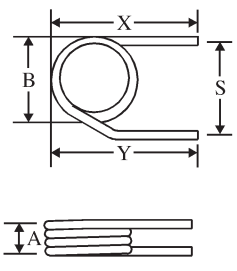


Figure 8

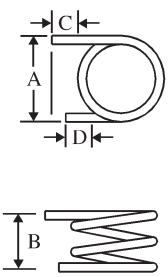


Figure 9

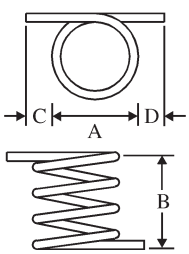


Figure 10

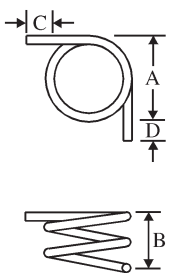


Figure 11

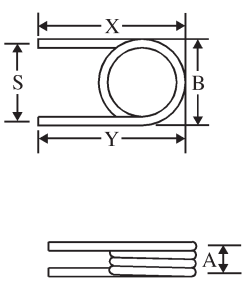


Figure 12

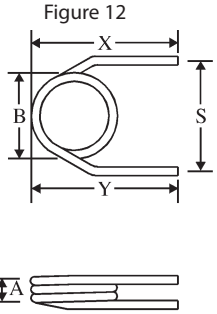


Figure 13

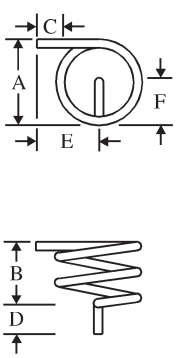


Figure 14

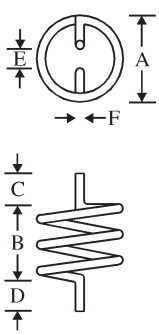
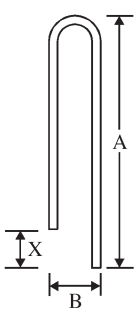


Figure 15



HPLC Columns

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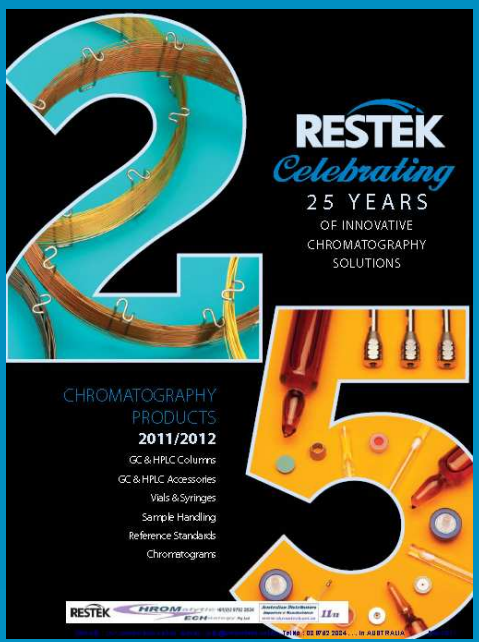


Selecting an LC Column

Column Dimensions

Particle Size and Column Length

When choosing a column, the first two parameters that should be considered are the particle diameter and column length. These two parameters are the major contributors to separation efficiency (N), also known as theoretical plates. The number of theoretical plates is directly proportional to the length of the column over the diameter of the particle.

Equation 1 The resolution equation defines variables affecting separations.

$$R = 1/4 \sqrt{N} \times \left(k' / k'+1 \right) \times \left(\alpha - 1/\alpha \right)$$

Efficiency — Retention capacity — Selectivity

Particle Diameter

Particle diameter (dp), is commonly expressed in micrometers (µm), and has an inverse relationship to the efficiency of the separation. As the particle diameter decreases, the efficiency of the separation increases proportionately. If all other parameters remain equal, a 3 µm particle diameter offers an approximate 60% increase in efficiency over a 5 µm particle, and a 1.9 µm particle diameter offers an additional 60% over a 3 µm particle. System backpressure also increases proportionally as particle size decreases. Selecting the proper particle diameter is a way of controlling separation efficiency, and even analysis speed, but is limited by the pressure capabilities of the system. Often, particle diameters are determined by instrumentation. Table I is a guideline for selecting the optimal particle size, based upon pressure capability for common mobile phases.

Table I Emperically determined maximum pressures exhibited for acetonitrile and methanol gradients for various particle sizes and flow rates

Bold blue numbers represent optimal linear velocity for the given particle size and ID. For longer column lengths, the approximate pressure corresponds to the increase in column length. A 2-fold increase in column length yields a 2-fold increase in back pressure.

Flow rate (mL/min.)	Pressure (psi) Acetonitrile @ 25°C			Flow rate (mL/min.)	Pressure (psi) Methanol @ 25°C		
	1.9µm	2.2µm	3µm		1.9µm	2.2µm	3µm
0.2	2436	1755	1045	0.2	3198	2304	1371
0.3	3655	2633	**1567**	0.3	4797	3455	**2057**
0.4	4873	3510	2090	0.4	6395	4607	2743
0.5	6091	**4388**	2612	0.5	7994	**5759**	3429
0.55	**6700**	4826	2873	0.55	**8794**	6335	3771
0.6	7309	5265	3135	0.6	9593	6911	4114
0.7	8527	6143	3657	0.7	11192	8062	4800
0.8	9745	7020	4180	0.8	12791	9214	5486
0.9	10964	7898	4702	0.9	14390	10366	6171
1	12182	8775	5224	1	15989	11518	6857

Data are for 2.1 x 50 mm columns using a gradient of 5% B to 95% B (A: water, B: organic solvent). See Table II for optimal flow rates for alternate column internal diameters.

When choosing a particle diameter, it is not recommended to operate significantly below the optimal linear velocity, as losses in efficiency can be observed due to axial dispersion. As a quick estimate of particle diameter usability, check the optimal linear velocity for the organic solvent used and ensure maximum pressures observed are within the pressure specifications of your instrument. Please note that these are maximum pressures observed during gradient analyses. Isocratic mobile phases of lesser viscosity will operate with less back pressure.

Column Length

Column length (L) directly relates to efficiency. Increasing column length increases efficiency. It is important to note that column length is not an ideal way to increase resolution. Doubling the column length yields only a 1.4x gain in resolution (efficiency is a square root term in the resolution equation), while doubling both analysis time and system backpressure. Shorter column lengths are suitable for fast gradients and higher sample throughput, while longer column lengths are more suitable for higher peak capacity and shallow gradients.

Column Internal Diameter

Column internal diameter (ID) is the inner diameter of the column hardware holding the packing material, and is commonly expressed in millimeters (mm). Column ID is ultimately related to efficiency and flow rate through the van Deemter equation. This chromatographic concept relates column efficiency (often called band broadening) to linear velocity. Linear velocity is the distance mobile phase travels per unit time, while flow rate is the volume of mobile phase per unit time. A specific linear velocity has a flow rate that is dependent upon the internal diameter of the column. As column ID is lowered, a lower flow rate is needed to maintain the same linear velocity. Flow rate is the volume of mobile phase needed to create the desired liner velocity. It is important to note that as particle size decreases, optimal linear velocity increases. Columns with smaller particle sizes, namely 1.9 and 2.2 µm, are capable of running much higher flow rates and therefore creating higher sample throughput. Table II (next page) can be used to find the optimal flow rate, as it relates to particle size and internal diameter, and is a good starting point for method development.

Table II Optimal flow rates for various particle diameters and column internal diameters.

Column ID (mm)	Optimal flow rate (mL/min.)			
	1.9 µm dp	2.2 µm dp	3µm dp	5 µm dp
4.6			1.50	1.00
3.2			0.73	0.50
3.0	1.12	1.00	0.65	0.40
2.1	0.55	0.47	0.31	0.20
1.0			0.07	0.05

Table III Common classifications for LC columns by internal diameter.

Classification	Internal Diameter
Capillary	<1.0 mm ID
Micro bore	1.0 mm ID
Narrow bore	2.1-3.0 mm ID
Standard bore	3.2-4.6 mm ID
Semi-prep	10 to 21.2 mm ID
Prep	30 to 50 mm ID

System volume, or extra column volume, also affects efficiency. As extra column volume increases, lower efficiency is experienced as band broadening increases. Typically, column IDs less than 3.0 mm, considered narrow bore columns, require systems with minimized extra column volume. Table III defines the classification of columns according to internal diameter or bore. Another contributor to overall system volume and column ID choice is the system delay volume. Delay volume is the volume contained between the pumps and the column, often including the mixing chamber and injection valve. Delay volume is especially significant during gradient analysis. Narrow bore columns often require lower flow rates, and these lower flow rates will not sweep the delay volume in high volume systems quickly. This extends analysis time and creates an increased gradient lag time. For fast gradient analysis and LC/MS, narrow bore columns and systems with low extra column volume are recommended.

Physical Characteristics

Silica Type

The physical characteristics of the support material can be selected to control retention and peak shape. The base silica, commonly porous spherical particles, used in the manufacturing of the column can first be selected by type, namely Type A, Type B, or Base Deactivated. Type B silica is typically higher in purity and provides limited silanol activity. When analyzing basic compounds, especially without the use of mobile phase modifiers, Type B silica is recommended for more symmetric peak shape. Type A and Base Deactivated silica are recommended for acidic, neutral, and slightly basic compounds.

Another criterion for choosing a column line is the porosity of the silica. The pore size, or pore diameter, which is commonly expressed in Å, is the average diameter of the silica pores. This relates inversely to available surface area. Smaller pore volumes create a larger surface area in a given particle and, therefore, can be used to control the amount of stationary phase bonded to the particle.

The carbon load, or % carbon in the packing material, is the measure of the amount, or load, of stationary phase. Carbon load directly affects retention. Higher carbon loads typically result in higher retention characteristics. Figure 1 illustrates the relative retention capacities of commercially available columns for hydrophobic compounds. Allure® columns were designed for maximum retention of small molecules by utilizing high carbon load, surface area, and ligand density. In contrast, Viva columns, considered wide pore, have a large pore diameter and are used for the analysis of larger molecules as commonly seen in biological separations. Table IV summarizes the physical characteristics and recommended uses for Restek column lines.

Silica columns commonly have a temperature limit of 80 °C. Increased temperature can be used to decrease mobile phase viscosity and, therefore, lower the back pressure of a

Table IV Physical characteristics and recommended uses for Restek columns, based on silica lines.

Column Line	Pore Size (Å)	Surface Area (m^2/g)	Carbon Load Range* (%)	Usage
Allure	60	450	12–27	Very high retention (highest retention available) High purity 5 µm particle size only
Ultra II	100	300	11–19	High retention High purity Full range particle size - 1.9, 2.2, 3 and 5 µm for UHPLC and HPLC
Ultra	100	300	2–20	High retention High purity 3 and 5 µm particle size only
Pinnacle II	110	180	2–13	Moderate retention Acidic Type A (not for RP analyses of bases) 3 and 5 µm particle size only
Pinnacle DB	140	150	4–11	Moderate retention Base deactivated silica 1.9, 3 and 5 µm particle sizes
Viva	300	100	3.5–9	Low retention Wide-pore silica for biological separations

*Ranges are based on phases available for each silica line. See column product listings for more specific information.

system. It is important to note that while altering the temperature of a separation can lower back pressure, it also lowers retention and can change selectivity. pH can also be used to control the selectivity and retention of ionizable compounds. Acid-base equilibrium can be employed to directly affect the retention characteristics of acidic and basic compounds, mainly in reversed phase chromatography (RPC). The pH limit of most silica columns is between 2 and 8.

Stationary Phases

Stationary phase, or the specific chemical ligand bonded to the silica support, plays a primary role in resolving compounds. Through selectivity, the major contributor to resolution, a stationary phase can control the retention characteristics of the solutes. Identifying the appropriate stationary phase can greatly ease method development and create less need for mobile phase additives. The decision tree in Figure 2 (next page) can help analysts select appropriate stationary phases, based upon analyte solubility and polarity. Liquid chromatography employs specific modes of separation which are denoted by the polarity distinction between the stationary and mobile phases; the most common are reversed phase, normal phase and HILIC.

Reversed phase chromatography (RPC) consists of a nonpolar stationary phase and a polar mobile phase. RPC is the most commonly used mode and works well for the analysis of water-soluble hydrophobic compounds. The most common types of columns used in RPC are alkyls (most often a C18, also known as octadecyl or ODS). End-capping is often employed in reversed phase columns. End-capping refers to the dense bonding or modification of the silica surface to further limit silanol activity. This acts to provide better peak symmetry, especially for basic compounds. Alternate ligands and bonding chemistries can be applied to RPC columns to incorporate phenyl, cyano, amino, and other polar groups into the stationary phase, providing alternate selectivity to a C18.

Normal phase chromatography (NPC), named because it was the first type of liquid chromatography, not for being more common, employs a polar stationary phase and a nonpolar mobile phase. NPC is suited for the analysis of fat soluble compounds and can also provide more selectivity for positional isomers than is commonly observed in RPC. Bare silica columns are most commonly used for NPC. Other phases for NPC include cyano and amino.

Hydrophilic Interaction Chromatography (HILIC) employs a polar stationary phase and a less polar mobile phase. HILIC differentiates itself from RPC and NPC as it uses traditional NPC stationary phases and RPC mobile phases. HILIC is recommended for the analysis of very polar compounds, often having negative log P values, and for analysis by LC/MS. Bare silica, cyano and amino columns are also commonly used in HILIC mode. Some stationary phases, like IBD, PFP propyl and cyano, incorporate both nonpolar and polar functionality and can be used in multiple or mixed-mode separation mechanisms.

Restek stationary phases and recommended uses are presented in Figure 3 (page 149). For additional help selecting a column, contact Restek at **support@restek.com** or call your local Restek representative.

Figure 1 Relative retention capabilities of commercially available columns for hydrophobic compounds.

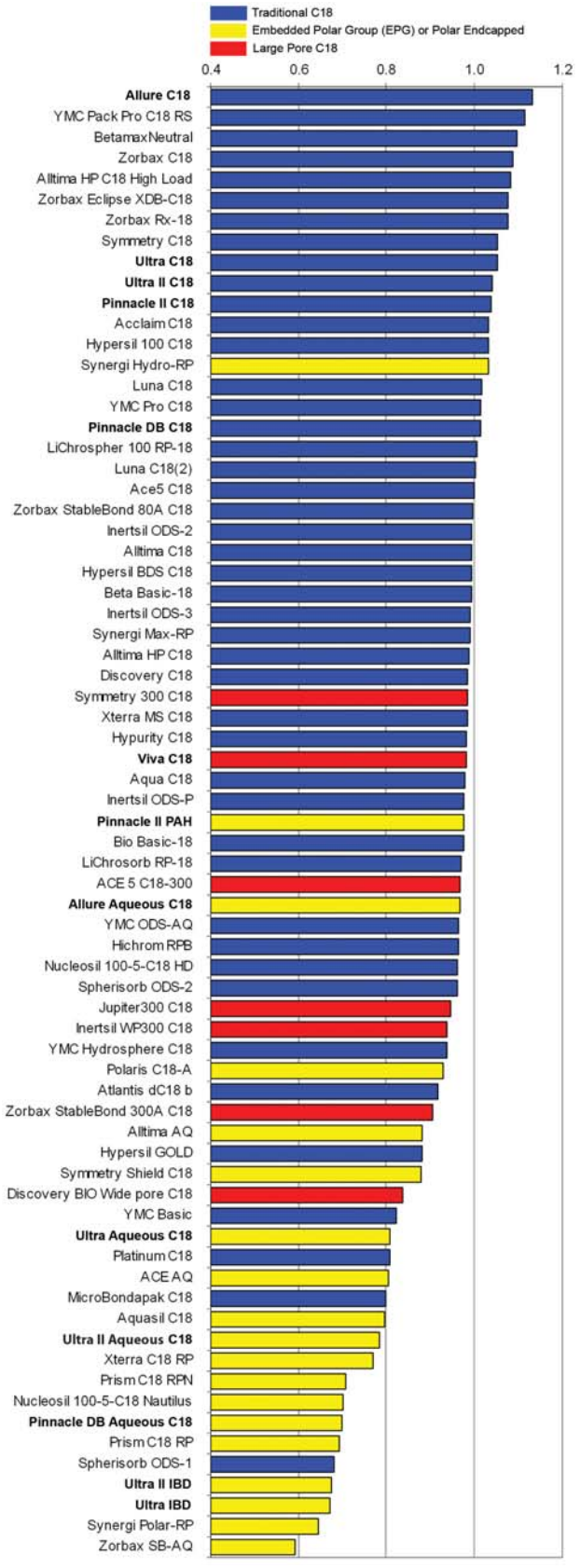
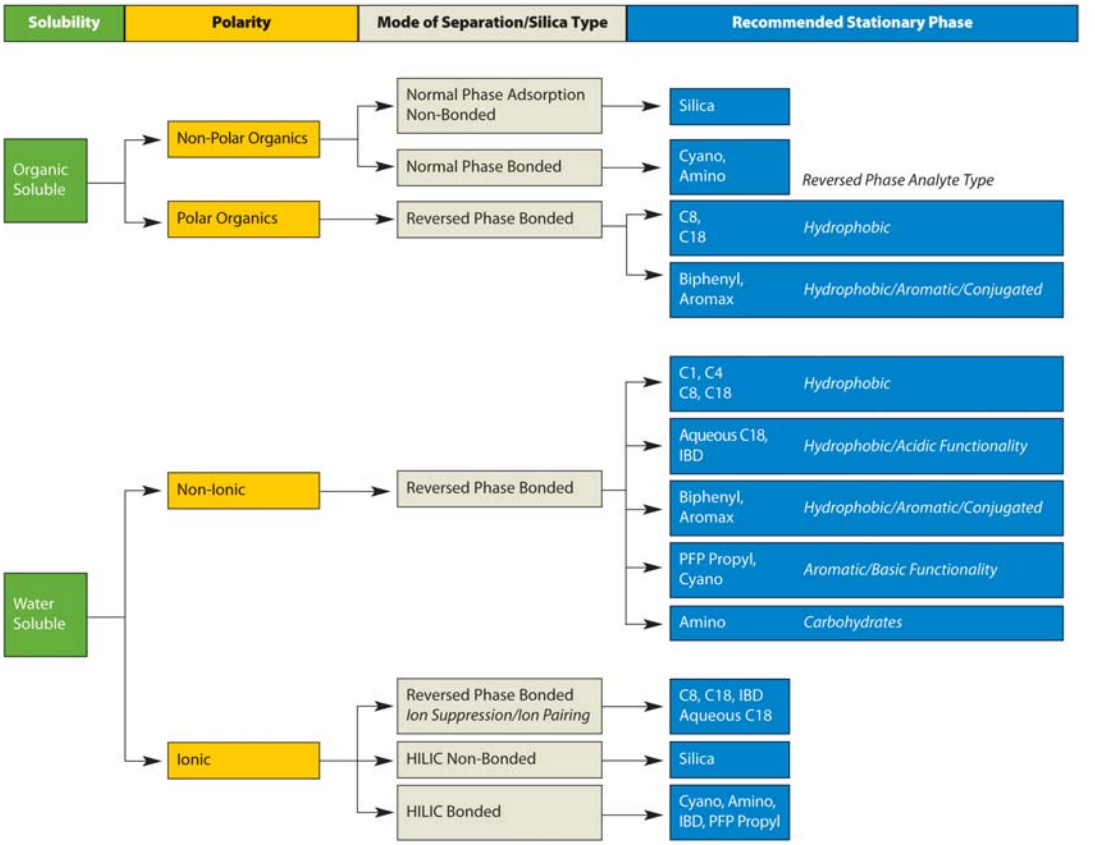


Figure 2 Decision tree for LC mode of separation and column selection.



Solvent Miscibility and Solubility

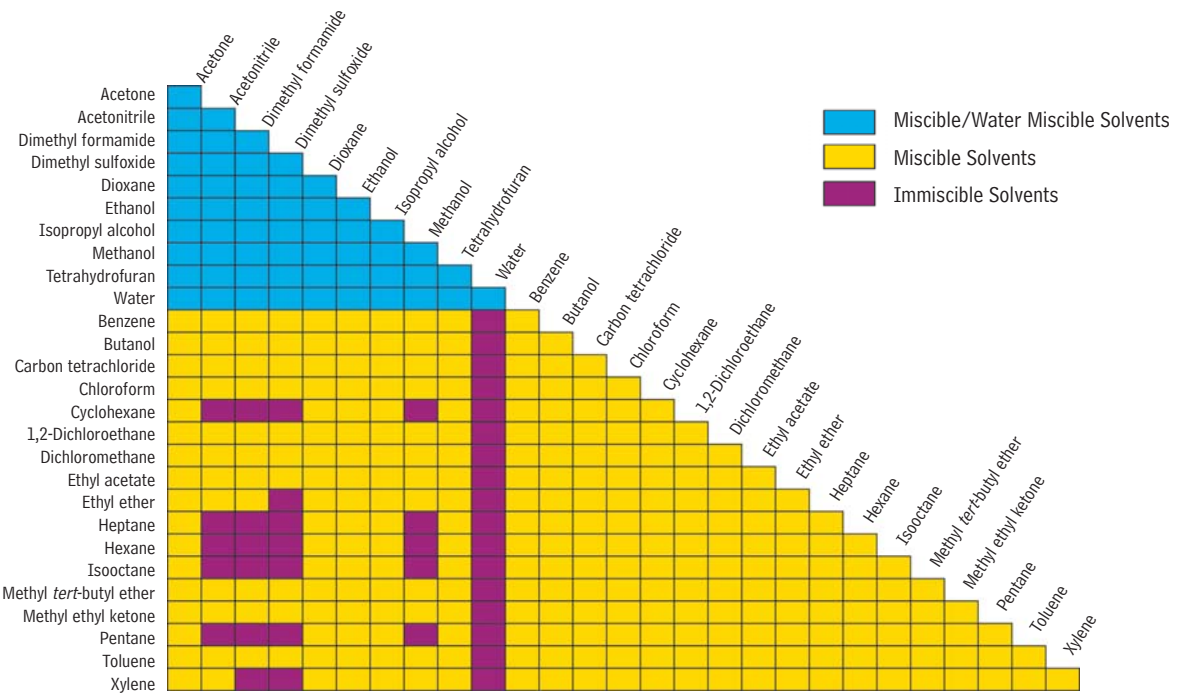
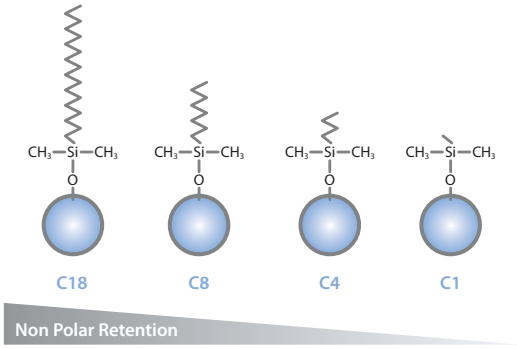


Figure 3 Restek stationary phases and recommended uses.

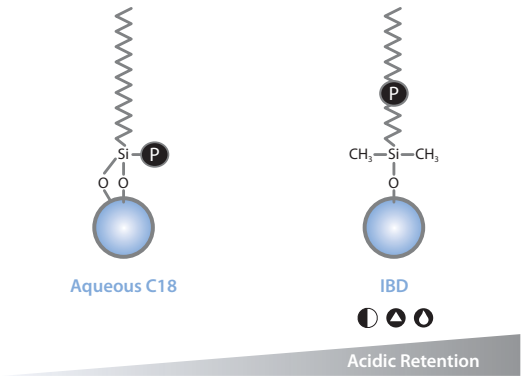
Alkyl Phases

- General purpose reversed phase columns rely on dispersive interaction to separate molecules.
- Elution order is hydrophilic to hydrophobic; increased chain length increases retention.



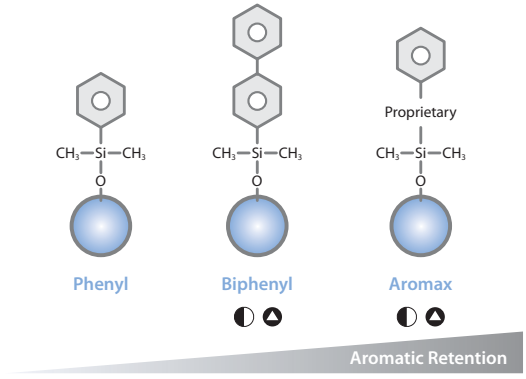
Modified Alkyl Phases

- Alkyl phases with modified bonding chemistry to increase polarity.
- Columns are compatible with 100% aqueous mobile phases.
- Rely on dispersive interaction with additional hydrogen bonding.
- Aqueous columns show balanced retention and are a great starting point for method development.
- Polar embedded IBD columns provide good peak symmetry for bases and offer orthogonal selectivity to a C18.
- IBD phases are capable of mixed mode mechanisms and can operate in both reversed phase and HILIC modes.



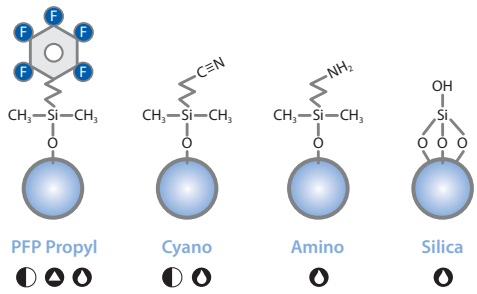
Phenyl Phases

- Phenyl columns rely on dispersive and pi-pi (π-π) interactions.
- Enhanced retention and selectivity are seen with aromatic, conjugated molecules, and compounds containing electron withdrawing ring substituents.
- Biphenyl and Aromax columns show more interaction and greater aromatic retention and selectivity, relative to conventional phenyl and phenyl-hexyl phases.



Polar Phases

- Polar phases rely on aromatic and dipole interactions.
- Cyano and PFP Propyl phases show increased retention for aromatic compounds and charged bases.
- PFP Propyl phases are commonly used for increased retention of ionic and basic compounds.
- Amino columns are commonly used for the analysis of saccharides.
- Silica columns are used for normal phase and HILIC separations.



Legend

◐ orthogonal selectivity to a C18 ▲ good choice for LC/MS ◆ HILIC compatible

HPLC Pump Pressure Conversion Table

Pressure	psi	atm	kg/cm²	torr	kPa	bar	inches Hg
1 psi =	1	0.068	0.0703	51.713	6.8948	0.06895	2.0359
1 atm =	14.696	1	1.0332	760	101.32	1.0133	29.921
1 kg/cm² =	14.223	0.967	1	735.5	98.06	0.9806	28.958
1 torr =	0.0193	0.00132	0.00136	1	0.1330	0.00133	0.0394
1 kPa =	0.1450	0.00987	0.0102	7.52	1	0.0100	0.2962
1 bar =	14.5038	0.9869	1.0197	751.88	100	1	29.5300
1 in Hg =	0.49612	0.0334	0.0345	25.400	3.376	0.03376	1

Multiply units in the left-most column by the conversion factors listed in the columns to the right.
e.g., 10 psi x 0.068 = 0.68atm
10 bar x 29.5300 = 295.300 inches Hg

Physical Characteristics

Restek HPLC Column	End Cap?	Pore Size (Å)	Carbon load (%)	Applications
Ultra II C18	Y	100	19	Ideal for anilines, barbiturates, carbonyls, fat-soluble vitamins, fatty acids, glycerides, phthalates, PTH amino acids, steroids, other acids.
Ultra II Aqueous C18	N	100	15	Ideal for analyses that require >90% water in the mobile phase. Excellent for highly water soluble or poorly organic soluble compounds. Excellent for water-soluble vitamins and organic acids.
Ultra II C8	Y	100	12	Selectivity and peak shape similar to Ultra C18, but less hydrophobic retention.
Ultra II Biphenyl	Y	100	15	Excellent choice for the analysis of steroids, tetracyclines, drug metabolites, and other compounds that contain some degree of unsaturation.
Ultra II Aromax	Y	100	17	Alternative to Biphenyl when more retention is required.
Ultra II IBD	N	100	12	A polar group assists in deactivating surface silanols and contributes to unique separation selectivities for acids, bases, zwitterions, and other polar compounds.
Ultra II PFP Propyl	Y	100	11	Highly retentive for basic analytes. An excellent phase for separating nucleosides, nucleotides, purines, pyrimidines, and halogenated compounds.
Ultra II Silica	N	100	0	Ideal for normal phase applications.
Ultra II Carbamate	N	100	15	Rapid analysis of carbamates.
Ultra II Quat	Y	100	12	Proprietary phase for the analysis of paraquat and diquat and other quaternary amines.
Pinnacle DB C18	Y	140	11	Hydrophobic C18 phase suitable for analyses of a wide range of compounds, from acidic through slightly basic.
Pinnacle DB Aqueous C18	—	140	6	Ideal for applications that require highly aqueous mobile phases, such as organic acids and water-soluble vitamins.
Pinnacle DB C8	Y	140	6	Applications similar to Pinnacle DB C18, but with less hydrophobic retention. Less retention can be useful for shortening analysis time, if resolution is adequate.
Pinnacle DB PFP Propyl	Y	140	6	Exhibits excellent peak shapes for a wide range of compounds, including nucleosides, nucleotides, and halogenated compounds.
Pinnacle DB Biphenyl	Y	140	8	Excellent choice for the analysis of steroids, tetracyclines, drug metabolites, and other compounds that contain some degree of unsaturation.
Pinnacle DB Cyano	Y	140	4	Suitable for a wide range of compounds, from acidic through slightly basic. Also useful for confirmation of analyses on a C18 or C8 column. Can be used in normal phase or reversed phase mode of separation.
Pinnacle DB Phenyl	Y	140	5.3	Suitable for polar aromatic compounds, fatty acids, purines and pyrimidines.
Pinnacle DB Silica	—	140	—	Normal phase mode of separation.
Pinnacle DB IBD	Y	140	—	A polar group assists in deactivating surface silanols and contributes to unique separation selectivities for acids, bases, zwitterions, and other polar compounds.
Pinnacle DB PAH	Y	140	—	Ideal for polycyclic aromatic hydrocarbons.
Pinnacle II C18	Y	110	13	Superior general purpose C18 for non-basic analytes.
Pinnacle II PAH	Y	110	—	Maximum resolution of polycyclic aromatic hydrocarbons.
Pinnacle II C8	Y	110	7	Superior general purpose C8 for non-basic analytes.
Pinnacle II Cyano	Y	110	4	Superior general purpose cyano for weakly-basic analytes. Used in either normal or reversed phase analyses.
Pinnacle II Phenyl	Y	110	6	Superior general purpose phenyl for neutral analytes.
Pinnacle II Amino	N	110	2	Excellent general purpose amino phase. Excellent choice for carbohydrate analysis.
Pinnacle II Biphenyl	Y	110	—	Multiple aromatic ring structures; excellent for explosives.
Pinnacle II Silica	—	110	—	Ideal for polar analytes.
Allure C18	Y	60	27	Ideal for MS and light-scattering detection of neutral to slightly polar solutes. Separates basic compounds, showing good deactivation; excellent for explosives or steroids.
Allure Aqueous C18	N	60	—	Ideal for analyses that require >90% water in the mobile phase. Excellent for highly water soluble or poorly organic soluble compounds. Excellent for water-soluble vitamins and organic acids. More retention than Ultra Aqueous columns.
Allure AK	Y	60	—	Ideal for the analysis of aldehydes and ketones as DNPH derivatives.
Allure Basix	Y	60	12	Ideal for LC/MS of basic solutes. Excellent for basic pharmaceuticals or other amine-containing compounds.
Allure PFP Propyl	Y	60	17	Ideal for MS, ELSD, or NPD detection of nucleosides, nucleotides, purines, pyrimidines, or halogenated compounds.
Allure Organic Acids	N	60	—	Excellent resolution of challenging organic acids.

pH ranges and temperature limits: see product listings on pages listed here.
Column lifetime will be shorter when operating at pH and/or temperature extremes.

Chromatographic Properties	Similar Phases	USP Code	Page #
A very retentive, high-purity phase that exhibits excellent peak shape for a wide range of compounds. Recommended as a general purpose reversed phase column.	Discovery C18, Symmetry C18, Hypersil Gold C18, Luna C18, Zorbax C18, Kromasil C18, LiChrospher RP-18, Inertsil ODS-2, Develosil C18	L1	157
Highly retentive and selective for reversed phase separations of polar analytes. Highly base deactivated. Compatible with highly aqueous (up to 100%) mobile phases.	AQUA C18, Aquasil C18, Hypersil Gold AQ, YMC ODS-Aq	L1	159
Very retentive, high-purity, base-deactivated reversed phase packing that exhibits excellent peak shape for a wide range of compounds.	Luna C8, Symmetry C8, Hypersil Gold C8	L7	158
A unique reversed phase material that exhibits both increased retention and selectivity for aromatic and/or unsaturated compounds, compared to conventional alkyl and phenyl phases.	Unique	L11	160
A unique reversed phase material that exhibits superior retention and selectivity for aromatic and/or unsaturated compounds, compared to conventional alkyl and phenyl phases.	Unique	L11	161
One of a group of intrinsically base-deactivated (IBD) phases, with a polar group within, or intrinsic to, the alkyl bonded phase. Provides unique selectivity and high level of base deactivation while reducing or eliminating the need for mobile phase additives.	SymmetryShield, Discovery ABZ & ABZ+, Prism	L68	162
A pentafluorophenyl with a propyl spacer.	Fluophase PFP, Discovery HS F5	L43	163
High purity, high surface area.	—	L3	164
Proprietary stationary phase can process up to twice as many samples per hour, compared to a conventional C18 phase.	Unique	—	165
High purity silica.	Unique	—	165
Highly base-deactivated spherical silica manufactured by Restek. Monomeric C18 bonding.	Hypersil BDS C18, Zorbax Eclipse XDB-C18, Spherisorb ODS	L1	166
Highly selective phase for polar analytes. Compatible with highly aqueous (up to 100%) mobile phases. Silica manufactured by Restek.	Aquasil C18, AQUA C18, Hypersil Gold AQ, YMC ODS-Aq	L1	171
Highly base-deactivated spherical silica manufactured by Restek. Monomeric C8 bonding. Similar to Pinnacle DB C18, but the shorter alkyl chain provides less hydrophobic retention.	Hypersil BDS C8, Spherisorb C8	L7	167
Highly base-deactivated spherical silica manufactured by Restek. Unique pentafluorophenyl phase with a propyl spacer.	Discovery HS F5	L43	169
Highly base-deactivated spherical silica manufactured by Restek. Unique reversed phase material that displays both increased retention and selectivity for aromatic and/or unsaturated compounds when compared to conventional alkyl and phenyl phases.	Unique	L11	170
Highly base-deactivated spherical silica manufactured by Restek. Cyano bonding.	Hypersil BDS Cyano, Spherisorb Cyano, Zorbax Eclipse XDB-CN	L10	168
Highly base-deactivated spherical silica manufactured by Restek. Phenyl bonding.	Hypersil BDS Phenyl, Spherisorb Phenyl Zorbax Eclipse XDB-Phenyl	L11	168
Highly base-deactivated spherical silica manufactured by Restek.	—	L3	172
One of a group of intrinsically base-deactivated (IBD) phases, with a polar group within, or intrinsic to, the alkyl bonded phase. Provides unique selectivity and high level of base deactivation while reducing or eliminating the need for mobile phase additives.	Unique	L68	171
Specifically designed to resolve complex mixtures of polycyclic aromatic hydrocarbons.	Unique	—	172
Intermediate carbon load and surface area, suitable for a wide range of neutral to acidic compounds. Silica manufactured by Restek.	Hypersil ODS	L1	173
Proprietary stationary phase; resolves 16 PAHs in US EPA Method 610. Silica manufactured by Restek.	Unique	—	174
Provides shorter retention times for hydrophobic compounds than C18. Silica manufactured by Restek.	Hypersil C8	L7	174
More rugged than bare silica for normal phase analyses. Silica manufactured by Restek.	Hypersil CPS	L10	175
Offers unique selectivity versus traditional alkyl chain phases, especially for aromatic compounds. Silica manufactured by Restek.	Hypersil Phenyl	L11	175
Silica manufactured by Restek.	Hypersil APS 2 Amino, Spherisorb Amino	L8	176
Silica manufactured by Restek. Unique biphenyl phase.	Unique	L11	176
Superior value phase for normal phase separation of polar analytes. Lower retention than Ultra C18. Silica manufactured by Restek.	Hypersil Silica	L3	177
Most retentive phase for hydrophobic and slightly polar analytes. Mobile phase containing higher percentage of organic modifier contributes to higher sensitivity in ESI-based LC/MS.	Ultracarb C18, BetaMax Neutral, Discovery C18	L1	178
Highly retentive and selective for reversed phase separations of polar analytes. Highly base deactivated. Compatible with highly aqueous (up to 100%) mobile phases.	Unique	L1	179
Highly retentive, highly selective phase, developed specifically for the analysis of aldehydes and ketones as DNPH derivatives.	Unique	—	181
Highly retentive phase for analytes containing amino functionality.	BetaMax Base, Maxsil CN	L10	178
A pentafluorophenyl phase with a propyl spacer. Highly retentive for basic analytes. Excellent for beta-blockers, halogenated compounds, nucleosides, nucleotides, pyridines, pyrimidines, tricyclic antidepressants.	Discovery HS F5	L43	179
Single 30cm column performs equally to two C18 columns in series. (AOAC Method 986.13)	Unique	—	180

Continued on next page. . .

Restek HPLC Column	End Cap?	Pore Size (Å)	Carbon load (%)	Applications
Allure Biphenyl	Y	60	23	Multiple ring structure; excellent for aromatic and unsaturated compounds. Increased retention over traditional phenyl phases.
Allure Silica	—	60	—	Highly retentive phase for normal phase separation.
Ultra C18	Y	100	20	Ideal for anilines, barbiturates, carbonyls, fat-soluble vitamins, fatty acids, glycerides, phthalates, PTH amino acids, steroids, other acids.
Ultra Aqueous C18	N	100	15	Ideal for analyses that require >90% water in the mobile phase. Excellent for highly water soluble or poorly organic soluble compounds. Excellent for water-soluble vitamins and organic acids.
Ultra IBD	N	100	12	A polar group assists in deactivating surface silanols and contributes to unique separation selectivities for acids, bases, zwitterions, and other polar compounds.
Ultra C8	Y	100	12	Selectivity and peak shape similar to Ultra C18, but less hydrophobic retention.
Ultra C4	Y	100	9	Ideal for peptides and small proteins.
Ultra C1	—	100	5	Alternative selectivity to Ultra C18 or C8 columns, especially for polar analytes. Shortest chain alkyl phase available for reversed phase separations.
Ultra Cyano	Y	100	8	Excellent for basic pharmaceuticals, steroids (normal or reversed phase conditions), or other basic compounds.
Ultra Phenyl	Y	100	10	Ideal for fatty acids, polycyclic aromatic hydrocarbons, purines and pyrimidines, and polar aromatics.
Ultra Amino	N	100	2	Superior general purpose amino phase. Ideal for carbohydrates.
Ultra PFP	Y	100	7	Ideal for taxol and precursors, or halogenated compounds, amines, esters, or ketones.
Ultra Silica	—	100	—	Ideal for normal phase applications.
Ultra Carbamate	—	100	—	Rapid analysis of carbamates.
Ultra Quat	—	100	—	Proprietary phase for the analysis of paraquat and diquat and other quaternary amines.
Viva Wide Pore C18	Y	300	9	Proteins and other higher molecular weight compounds.
Viva Wide Pore C8	Y	300	5	Proteins and other higher molecular weight compounds. Less retentive than C18 phase.
Viva Wide Pore C4	Y	300	3.5	Proteins and other higher molecular weight compounds. Less retentive than C18 and C8 phases.
Viva Wide Pore Biphenyl	Y	300	6.7	Exhibits excellent peak shape for a wide range of compounds; ideal for large molecule and biomolecule assays.
Viva Wide Pore PFP Propyl	Y	300	5	Exhibits excellent peak shape for a wide range of compounds, including nucleosides, nucleotides, and halogenated compounds.
Viva Wide Pore Silica	—	300	—	Normal phase applications for highly retained high molecular weight compounds.

pH ranges and temperature limits: see product listings on pages listed here.
Column lifetime will be shorter when operating at pH and/or temperature extremes.

tech tip

Managing High Backpressure

High backpressure is one of the most common problems encountered in HPLC analyses. Normal column backpressure is observed after a new column has been installed and equilibrated with mobile phase. Unfortunately, this pressure often will increase as the column is used because particles collect on the column inlet frit. These particles can be sample impurities, mobile phase contaminants, or materials from the injector or autosampler rotor seal.

In addition to increasing backpressure, particles on the frit can cause split peaks, peak tailing, and, eventually, over-pressure shut-down. In some circumstances, these problems can be corrected by back-flushing the column. However, in many cases the result is an unusable column.

To minimize backpressure problems, all samples and mobile phase solvents must be filtered before use, and rotor seals should be changed on a routine basis. Along with these preventive measures, it is advisable to use precolumn filters such as the Trident guard column protection system, pages 196-198. Particles build up on the inexpensive, replaceable frit in the filter, instead of on the permanent frit at the column inlet.

Chromatographic Properties	Similar Phases	USP Code	Page #
High purity, highly retentive phase for aromatic and unsaturated compounds.	Unique	L11	180
High purity, highly retentive phase for normal phase separation of polar analytes. Very high surface area.	Maxsil Si	L3	181
A very retentive, high-purity phase that exhibits excellent peak shape for a wide range of compounds. Recommended as a general purpose reversed phase column.	Discovery C18, Symmetry C18, Hypersil Gold C18, Luna C18, Zorbax C18, Kromasil C18, LiChrospher RP-18, Inertsil ODS-2, Develosil C18	L1	182
Highly retentive and selective for reversed phase separations of polar analytes. Highly base deactivated. Compatible with highly aqueous (up to 100%) mobile phases.	AQUA C18, Aquasil C18, Hypersil Gold AQ, YMC ODS-Aq	L1	183
One of a group of intrinsically base-deactivated (IBD) phases, with a polar group within, or intrinsic to, the alkyl bonded phase. Provides unique selectivity and high level of base deactivation while reducing or eliminating the need for mobile phase additives.	SymmetryShield, Discovery ABZ & ABZ+, Prism	L68	184
Very retentive, high-purity, base-deactivated reversed phase packing that exhibits excellent peak shape for a wide range of compounds.	Luna C8, Symmetry C8, Hypersil Gold C8	L7	183
Exceptionally stable C4 packing, with high bonding coverage and silanol base-deactivation. Exhibits shorter retention than C18 or C8 phases.	Supelcosil Butyl (C4), Delta-Pak C4	L26	184
Exceptionally stable C1 packing resists hydrolysis, even under acidic mobile phase conditions. Least retentive reversed phase hydrocarbon packing.	Spherisorb C1	L13	185
High-purity cyano phase with reduced silanol activity. Often a better choice than C18 for basic pharmaceuticals. Cyano is the most stable bonded phase for normal phase mode.	Platinum CN, Develosil Cyano, Luna CN, Hypersil Gold CN	L10	185
High-purity, highly retentive, base-deactivated phase with alternate selectivity to hydrocarbon phases, especially for aromatic analytes.	Platinum Phenyl, Supelcosil Phenyl, Betasil Phenyl	L11	186
Recommended for normal phase analyses of mono- and disaccharides and other similar compounds. Can also serve as a weak anion exchanger, with aqueous buffers.	Platinum Amino, Develosil NH2	L8	186
A pentafluorophenyl phase. Unique selectivity by interaction with functional groups of organohalogens or other basic analytes.	Fluophase PFP, Fluosep-RP Phenyl, Curosil PFP	L43	187
High purity, high surface area.	—	L3	188
Proprietary stationary phase can process up to twice as many samples per hour, compared to a conventional C18 phase.	Unique	—	188
High purity silica.	Unique	—	189
Silica manufactured by Restek.	BioBasic 18, Symmetry 300 C18, Jupiter 300 C18, Zorbax 300 OSB C18, Synchropak C18, 208 TP C18	L1	190
Silica manufactured by Restek.	BioBasic 8, Zorbax 300 OSB C8, Synchropak C8, 208 TP C8	L7	191
Silica manufactured by Restek.	BioBasic 4, Symmetry 300 C4, Jupiter 300 C4, Synchropak C4, 208 TP C4	L26	191
Silica manufactured by Restek.	Unique	L11	192
Silica manufactured by Restek.	Unique	L43	192
Silica manufactured by Restek.	—	L3	193

US Pharmacopeia Cross Reference

L1 Octadecyl silane chemically bonded to porous silica or ceramic microparticles, 1.7 to 10µm in diameter, or a monolithic rod.
Ultra II C18 (p. 157), Ultra II Aqueous C18 (p. 159), Pinnacle DB C18 (p. 166), Pinnacle DB Aqueous C18 (p. 171), Pinnacle II C18 (p. 173), Allure C18 (p. 178), Allure Aqueous C18 (p. 179), Ultra C18 (p. 182), Ultra Aqueous C18 (p. 183), Viva C18 (p. 190)

L3 Porous silica particles, 5 to 10µm in diameter.
Ultra II Silica (p. 164), Pinnacle DB Silica (p. 172), Pinnacle II Silica (p. 177), Allure Silica (p. 181), Ultra Silica (p. 188), Viva Silica (p. 193)

L7 Octylsilane chemically bonded to totally porous silica particles, 1.7 to 10µm in diameter.
Ultra II C8 (p. 158), Pinnacle DB C8 (p. 167), Pinnacle II C8 (p. 174), Ultra C8 (p. 183), Viva C8 (p. 191)

L8 An essentially monomolecular layer of aminopropylsilane chemically bonded to totally porous silica gel support, 3 to 10µm in diameter.
Pinnacle II Amino (p. 176), Ultra Amino (p. 186)

L10 Nitrile groups chemically bonded to porous silica particles, 3 to 10µm in diameter.
Pinnacle DB Cyano (p. 168), Pinnacle II Cyano (p. 175), Allure Basix (p. 178), Ultra Cyano (p. 185)

L11 Phenyl groups chemically bonded to porous silica particles, 1.7 to 10µm in diameter. *Ultra II Aromax (p. 161), Ultra II Biphenyl (p. 160), Pinnacle DB Phenyl (p. 168), Pinnacle DB Biphenyl (p. 170), Pinnacle II Phenyl (p. 175), Pinnacle II Biphenyl (p. 176), Allure Biphenyl (p. 180), Ultra Phenyl (p. 186), Viva Biphenyl (p. 192)*

L13 Trimethylsilane chemically bonded to porous silica particles, 3 to 10µm in diameter. *Ultra C1 (p. 185)*

L26 Butyl silane chemically bonded to totally porous silica particles, 3 to 10µm in diameter. *Ultra C4 (p.184), Viva C4 (p.191)*

L43 Pentafluorophenyl groups chemically bonded to silica particles by a propyl spacer, 5 to 10µm in diameter.
Ultra II PFP Propyl (p. 163), Pinnacle DB PFP Propyl (p. 169), Allure PFP Propyl (p. 179), Ultra PFP (p. 187), Viva PFP Propyl (p. 192)

L68 Spherical, porous silica, 100µm or less in diameter, the surface of which has been covalently modified with alkyl amide groups and not end capped.
Ultra II IBD (p. 162), Pinnacle DB IBD (p. 171), Ultra IBD (p. 184)

RESTEK USLC™

Ultra Selective Liquid Chromatography™

USLC™ is the directed application of selectivity—the most influential factor affecting resolution—to optimize separations and improve method performance. Restek has extensively studied reversed phase selectivity to provide practicing chromatographers with the most effective and widest range of USLC™ stationary phase chemistries available.

Selectivity Drives Separations

By understanding and controlling selectivity through USLC™, chromatographers have the best opportunity for fast, effective analyte resolution.

One of the most significant challenges in method development is finding the proper stationary and mobile phase chemistry for a particular separation. As sample complexity increases, achieving adequate resolution between matrix components and target analytes becomes more difficult. Despite recent advancements in column format, such as sub-2 micron packings and pellicular particles, resolution can still be difficult to obtain because, while these formats can increase chromatographic efficiency and analysis speed, they do not significantly influence resolution. Selectivity, as shown in Equation 1, is the single most powerful factor affecting resolution, and it is largely dependent upon stationary phase composition.

Real Diversity in Phase Chemistry

Restek columns offer the widest range of selectivities available on a single column line. More choices mean optimized separations and more robust methods.

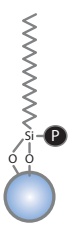
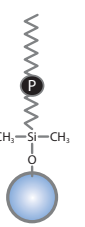
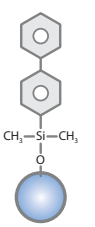
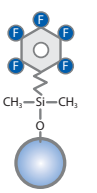
Equation 1 Selectivity drives resolution—USLC™ considers column selectivity during method development, resulting in fast, effective separations.

$$R = \frac{1}{4}\sqrt{N} \times \left(\frac{k'}{k'+1}\right) \times \left(\frac{\alpha-1}{\alpha}\right)$$

Efficiency *Retention capacity* *Selectivity*

While numerous bonded phases are available for reversed phase chromatography, many are similar and offer only moderate changes in retention (e.g. C8 and C18), rather than significant differences in selectivity. Method development is less laborious and time-consuming when using a full range of column selectivities, including orthogonal phase chemistries like polar embedded, phenyl, and fluorophenyl columns. Restek has led the development of unique USLC™ phases across these phase classes in order to provide chromatographers with a more effective range of column selectivities and innovative column chemistries for method development. The phases shown in Figure 1 provide the widest range of reversed phase selectivity available on any column line, and can be used to guide the least understood and most practically significant part of method development—proper column selection.

Figure 1 Restek offers the widest range of unique column chemistries to aid in fast, easy method development.

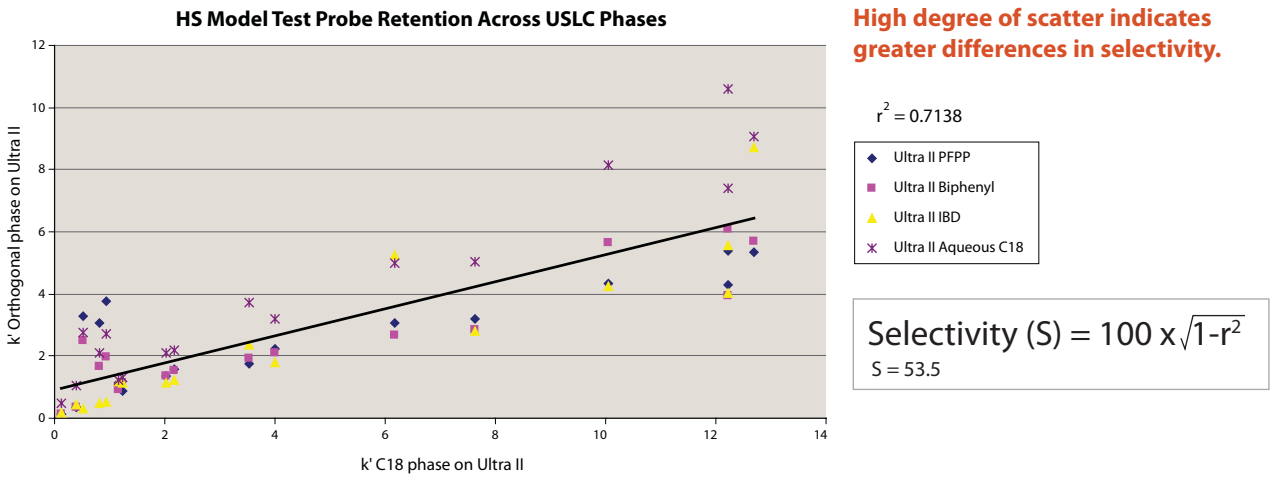
Restek phase (column class)	**Aqueous C18** (alkyl)	**IBD** (polar embedded)	**Biphenyl** (phenyl)	**PFP Propyl** (fluorophenyl)
				
Ligand type	Proprietary polar modified and functionally bonded C18	Proprietary polar functional embedded alkyl	Unique Biphenyl	Proprietary end-capped pentafluorophenyl propyl
Characteristics and uses	• C18 phase for balanced retention of multiple solute types. • Compatible with up to 100% aqueous mobile phases.	• Enhanced retention of polar acids. • Moderate retention of both acidic and basic solutes.	• Increased retention of aromatic, unsaturated, conjugated solutes, or solutes containing an electron withdrawing ring substituent. • Enhanced retention and selectivity when used with methanolic mobile phases.	• Increased retention of protonated bases and solutes containing aromatic moieties.

Evaluating and Extending Selectivity

Restek leads the industry in USLC™ phase diversity because optimal differences in selectivity are built in during the research and development of our bonded phases.

The diversity in selectivity provided by USLC™ columns can be demonstrated empirically using the hydrophobic-subtraction (HS) model [1]. This model is a novel procedure for characterizing selectivity that uses test probes to define the solute and stationary phase interactions in reversed phase separations. Restek is leading the commercial application of this model by implementing it in the research and development of USLC™ bonded phases. To evaluate phase selectivity using the hydrophobic-subtraction model, the retention characteristics of the solute probes are compared across different phases on the same silica base. In this approach, the range of selectivity is indicated by the degree of scatter along the regression line; high correlations indicate similarity and low correlations represent changes in selectivity across phases (Figure 2). The difference in selectivity across columns can then be quantified based on the correlation by calculating the selectivity (S) statistic for the comparison [2].

Figure 2 Restek has extended the selectivity range for reversed phase separations as illustrated by the hydrophobic-subtraction model and corresponding selectivity (S) value.



USLC™ Columns: Selectivity Choices Optimize Separations

Restek USLC™ columns offer the widest range of selectivities available and are an integral part of successful method development (Figure 3). Ideal for column switching systems, these columns provide the orthogonal separations needed to create optimal resolution and robust methods. Combining USLC™ phases with a suitable column format gives practicing chromatographers the most powerful tool available for successful method development.

Figure 3: Restek offers the widest range of selective phases available on any column line.

	Column Line						
Common Reversed Phase Column Type	**Restek Ultra II** 1.9, 2.2, 3, 5 and 10µm	**Waters Acquity CSH** 1.7, 3.5 and 5 µm	**Waters Acquity HSS** 1.8, 3.5 and 5 µm	**Waters Acquity BEH** 1.7, 2.5, 3.5, 5 and 10 µm	**Phenomenex Kinetex** 1.7 and 2.6 µm	**Agilent Zorbax RRHD** 1.8, 3.5 and 5 µm	**Agilent Poroshell 120** 2.7 µm
Alkyl (C18 and C8)	●	●	●	●	●	●	●
Phenyl	●	●		●			
Polar Embedded Alkyl	●						
Fluorophenyl	●	●			●		

References (Not available from Restek.)
[1] L.R. Snyder, J.W. Dolan, P.W. Carr, J. Chromatogr. A 1060 (2004) 77.
[2] U.D. Neue, J.E. O'Gara, A. Mendez, J. Chromatogr. A 1127 (2006) 161.

We're here to help!

To discuss the right selectivity for your separation or to find a comparable column, **contact us at support@restek.com or 800-356-1688.**

Combine Speed and Selectivity with

Ultra II® UHPLC and HPLC Columns

- **Ultra Selectivity** - Widest variety of stationary phases and selectivity of any HPLC and UHPLC column line.
- **Ultra Utility** - Full range of particle sizes for use on any HPLC or UHPLC system.
- **Ultra Reproducibility** – 100% Restek manufactured silica for column-to column reproducibility.
- **Ultra Scalability** – Both HPLC and UHPLC columns manufactured from identical silica support to allow reliable scaling of methods across systems.

Ultra II® LC Columns

NEW!

Excellent choice
for method development using column switching systems and systematic Quality by Design approaches

Available Particle Sizes:
- 1.9µm for UHPLC
- 2.2µm for UFLC and RRLC
- 3µm, 5µm, & 10µm for HPLC

Get UHPLC Speed at HPLC Prices!

Restek lets you speed up analyses without paying a premium.
Compare today and save!

Widest Selectivity Available of Any HPLC & UHPLC Column Line!

Available Phases	Phase Description
Ultra II C18	Inert and rugged reversed phase octadecyl.
Ultra II C8	Inert and rugged general purpose.
Ultra II Aqueous C18	Uniquely modified alkyl for balanced retention and improved mobile phase compatibility, relative to a conventional C18.
Ultra II IBD	Unique polar embedded alkyl for symmetry of bases and increased retention of acids. Orthogonal selectivity to a C18.
Ultra II Biphenyl	Unique Biphenyl phase for enhanced retention and selectivity compared to phenyl and phenyl hexyl phases. Orthogonal selectivity to a C18.
Ultra II Aromax	Proprietary phenyl phase for maximum aromatic selectivity and retention. Orthogonal selectivity to a C18.
Ultra II PFP Propyl	Pentafluorophenyl phase for increased retention of basic compounds. Orthogonal selectivity to a C18.
Ultra II Silica	General purpose silica column for normal phase and HILIC separations.
Ultra II Carbamate	Specifically designed for carbamate analysis.
Ultra II Quat	Ideal for the analysis of paraquat and diquat or other quaternary amines.

Innovative phase developed by Restek!

Ultra II® C18 Columns (USP L1)

Chromatographic Properties:

A retentive, highly pure material that exhibits excellent peak shape for a wide range of compounds. This is a robust and very reproducible general-purpose reversed phase column.

Restek manufactured silica

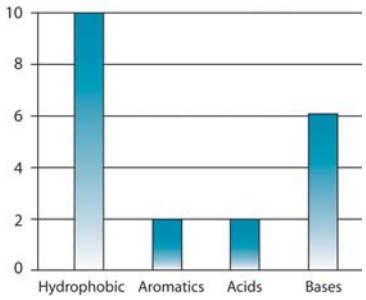
NEW!

Physical Characteristics:

particle size: 1.9µm, 2.2µm, 3µm or 5µm, spherical
pore size: 100Å
carbon load: 19%
endcap: fully endcapped
pH range: 2.5 to 8
temperature limit: 80°C

	1.0mm ID		2.1mm ID		3.0mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
1.9µm Columns								
30mm			9604232		960423E			
50mm			9604252		960425E			
100mm			9604212		960421E			
2.2µm Columns								
30mm			9604832		960483E			
50mm			9604852		960485E			
100mm			9604812		960481E			
3µm Columns								
30mm	9604331	$404	9604332		960433E		9604335	
50mm	9604351	$404	9604352		960435E		9604355	
100mm	9604311	$435	9604312		960431E		9604315	
150mm	9604361	$466	9604362		960436E		9604365	
5µm Columns								
30mm	9604531	$378	9604532		960453E		9604535	
50mm	9604551	$378	9604552		960455E		9604555	
100mm	9604511	$404	9604512		960451E		9604515	
150mm	9604561	$435	9604562		960456E		9604565	
200mm	9604521	$466	9604522		960452E		9604525	
250mm	9604571	$492	9604572		960457E		9604575	

Ultra II® C18 Retention Profile



Ultra II® C18 Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Ultra II C18 Guard Cartridge	960450212	960450210	960450222	960450220	

.....Page #
vitamins 733

Ultra II® C18 HPLC Prep Columns

	10mm ID		21.2mm ID		30mm ID		50mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
50mm	9604557		9604558		9604559		9604550	
100mm	9604517		9604518		9604519		9604510	
150mm	9604567		9604568		9604569		9604560	
250mm	9604577		9604578		9604579		9604570	

Available in 10µm particle size upon request.

ordering **note**

To order a 2.1mm, 3.2mm, or 4.6mm ID column with a Trident Integral Inlet Fitting, add "-700" to the catalog number for the column.

Nominal additional charge $15.00

Example: 100mm x 4.6mm ID Ultra C18 column with Trident Integral Inlet Fitting: 9174315-700

Also order an XG-XF fitting (10mm: cat.#25026 or 20mm: 25062), see page 196.

also **available**

Bulk Packing Materials
See page 194.

Restek manufactured silica

NEW!

Ultra II® C8 Columns (USP L7)

Chromatographic Properties:

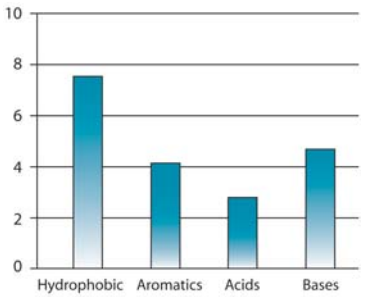
A retentive, high-purity, base-deactivated reversed phase packing that exhibits excellent peak shape for a wide range of compounds. Less retention for neutral, hydrophobic compounds, compared to the Ultra II® C18 column.

Physical Characteristics:

particle size: 3µm or 5µm, spherical
pore size: 100Å
carbon load: 12%
endcap: fully endcapped
pH range: 2.5 to 8
temperature limit: 80°C

	1.0mm ID		2.1mm ID		3.0mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
3µm Columns								
30mm	9603331		9603332		960333E		9603335	
50mm	9603351		9603352		960335E		9603355	
100mm	9603311		9603312		960331E		9603315	
150mm	9603361		9603362		960336E		9603365	
5µm Columns								
30mm	9603531		9603532		960353E		9603535	
50mm	9603551		9603552		960355E		9603555	
100mm	9603511		9603512		960351E		9603515	
150mm	9603561		9603562		960356E		9603565	
200mm	9603521		9603522		960352E		9603525	
250mm	9603571		9603572		960357E		9603575	

Ultra II® C8 Retention Profile



Ultra II® C8 Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Ultra II C8 Guard Cartridge	960350212	960350210	960350222	960350220	

Ultra II® C8 HPLC Prep Columns

	10mm ID		21.2mm ID		30mm ID		50mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
50mm	9603557		9603558		9603559		9603550	
100mm	9603517		9603518		9603519		9603510	
150mm	9603567		9603568		9603569		9603560	
250mm	9603577		9603578		9603579		9603570	

Available in 10µm particle size upon request.

ordering **note**

To order a 2.1mm, 3.2mm, or 4.6mm ID column with a Trident Integral Inlet Fitting, add "-700" to the catalog number for the column.

Nominal additional charge $15.00

Example: 100mm x 4.6mm ID Ultra C18 column with Trident Integral Inlet Fitting: 9174315-700

Also order an XG-XF fitting (10mm: cat.#25026 or 20mm: 25062), see page 196.

Ultra II® Aqueous C18 Columns (USP L1)

Chromatographic Properties:

Highly retentive and selective for reversed phase separations of polar analytes. Highly base-deactivated. Compatible with highly aqueous (up to 100%) mobile phases.

	1.0mm ID		2.1mm ID		3.0mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
3µm Columns								
30mm	9608331	$424	9608332	$398	960833E		9608335	
50mm	9608351	$424	9608352	$398	960835E		9608355	
100mm	9608311	$455	9608312	$430	960831E		9608315	
150mm	9608361	$518	9608362	$502	960836E		9608365	
5µm Columns								
30mm	9608531	$393	9608532	$373	960853E		9608535	
50mm	9608551	$393	9608552	$373	960855E		9608555	
100mm	9608511	$414	9608512	$398	960851E		9608515	
150mm	9608561	$455	9608562	$430	960856E		9608565	
200mm	9608521	$486	9608522	$461	960852E		9608525	
250mm	9608571	$512	9608572	$492	960857E		9608575	

Restek manufactured silica

NEW!

Physical Characteristics:

particle size: 3µm or 5µm, spherical
pore size: 100Å
carbon load: 15%
endcap: no
pH range: 2.5 to 8
temperature limit: 80°C

Ultra II® Aqueous C18 Guard Cartridges

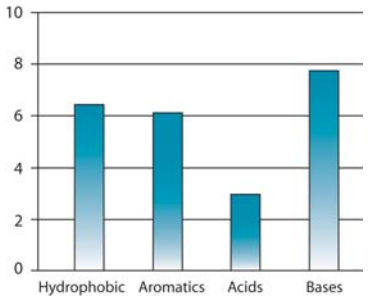
Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Ultra II Aqueous C18 Guard Cartridge	960850212	960850210	960850222	960850220	$145

Ultra II® Aqueous C18 HPLC Prep Columns

	10mm ID		21.2mm ID		30mm ID		50mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
50mm	9608557		9608558		9608559		9608550	
100mm	9608517		9608518		9608519		9608510	
150mm	9608567		9608568		9608569		9608560	
250mm	9608577		9608578		9608579		9608570	

Available in 10µm particle size upon request.

Ultra II® Aqueous C18 Retention Profile



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Restek manufactured silica

NEW!

Ultra II® Biphenyl Columns (USP L11)

Chromatographic Properties:

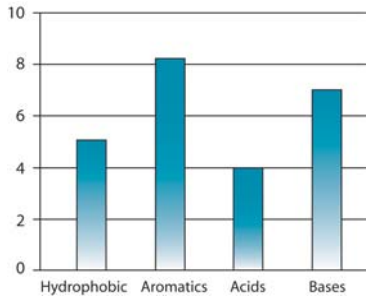
A unique reversed phase material that exhibits both increased retention and selectivity for aromatic and/or unsaturated compounds, compared to conventional alkyl and phenyl phases. This is a great alternative to a C18 column when alternative selectivity is desired. An excellent choice for the analysis of steroids, tetracyclines, drug metabolites, and other compounds that contain some degree of unsaturation.

Physical Characteristics:

particle size: 1.9µm, 3µm or 5µm, spherical
pore size: 100Å
carbon load: 15%
endcap: fully endcapped
pH range: 2.5 to 8
temperature limit: 80°C

	1.0mm ID		2.1mm ID		3.0mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
1.9µm Columns								
30mm			9609232		960923E			
50mm			9609252		960925E			
100mm			9609212		960921E			
3µm Columns								
30mm	9609331		9609332		960933E		9609335	
50mm	9609351		9609352		960935E		9609355	
100mm	9609311		9609312		960931E		9609315	
150mm	9609361		9609362		960936E		9609365	
5µm Columns								
30mm	9609531		9609532		960953E		9609535	
50mm	9609551		9609552		960955E		9609555	
100mm	9609511		9609512		960951E		9609515	
150mm	9609561		9609562		960956E		9609565	
200mm	9609521		9609522		960952E		9609525	
250mm	9609571		9609572		960957E		9609575	

Ultra II® Biphenyl Retention Profile



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antibiotics 725
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drugs of abuse 748
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pain management drugs in urine 747
sulfa drugs 725
THC & metabolites 748

Ultra II® Biphenyl Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Ultra II Biphenyl Guard Cartridge	960950212	960950210	960950222	960950220	$145

Ultra II® Biphenyl HPLC Prep Columns

	10mm ID		21.2mm ID		30mm ID		50mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
50mm	9609557		9609558		9609559		9609550	
100mm	9609517		9609518		9609519		9609510	
150mm	9609567		9609568		9609569		9609560	
250mm	9609577		9609578		9609579		9609570	

Available in 10µm particle size upon request.

Ultra II® Aromax Columns (USP L11)

Chromatographic Properties:

Ultra II® Aromax is a unique reversed phase material that exhibits superior retention and selectivity for aromatic and/or unsaturated compounds, compared to conventional alkyl and phenyl phases. This column is a great alternative to our Biphenyl phase when increased retention is required. A very suitable choice for analysis of steroids, tetracyclines, drug metabolites, and other compounds that contain some degree of unsaturation.

	1.0mm ID		2.1mm ID		3.0mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
1.9µm Columns								
30mm			9607232		960723E			
50mm			9607252		960725E			
100mm			9607212		960721E			
3µm Columns								
30mm	9607331		9607332		960733E		9607335	
50mm	9607351		9607352		960735E		9607355	
100mm	9607311		9607312		960731E		9607315	
150mm	9607361		9607362		960736E		9607365	
5µm Columns								
30mm	9607531		9607532		960753E		9607535	
50mm	9607551		9607552		960755E		9607555	
100mm	9607511		9607512		960751E		9607515	
150mm	9607561		9607562		960756E		9607565	
200mm	9607521		9607522		960752E		9607525	
250mm	9607571		9607572		960757E		9607575	

Ultra II® Aromax Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Ultra II Aromax Guard Cartridge	960750212	960750210	960750222	960750220	$145

Ultra II® Aromax HPLC Prep Columns

	10mm ID		21.2mm ID		30mm ID		50mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
50mm	9607557		9607558		9607559		9607550	
100mm	9607517		9607518		9607519		9607510	
150mm	9607567		9607568		9607569		9607560	
250mm	9607577		9607578		9607579		9607570	

Available in 10µm particle size upon request.

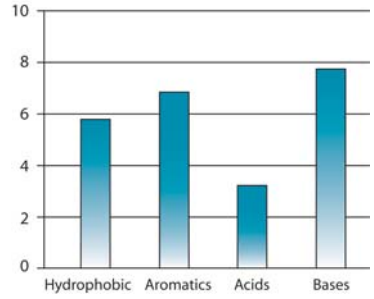
Restek manufactured silica

NEW!

Physical Characteristics:

particle size: 1.9µm, 3µm or 5µm, spherical
pore size: 100Å
carbon load: 17%
endcap: fully endcapped
pH range: 2.5 to 8
temperature limit: 80°C

Ultra II® Aromax Retention Profile



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famotidine and USP impurities 736
potential genotoxic impurities 737
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ordering **note**

To order a 2.1mm, 3.2mm, or 4.6mm ID column with a Trident Integral Inlet Fitting, add "-700" to the catalog number for the column.

Nominal additional charge $15.00

Example: 100mm x 4.6mm ID Ultra C18 column with Trident Integral Inlet Fitting: 9174315-700

Also order an XG-XF fitting (10mm: cat.#25026 or 20mm: 25062), see page 196.

Restek manufactured silica

NEW!

Ultra II® IBD Columns

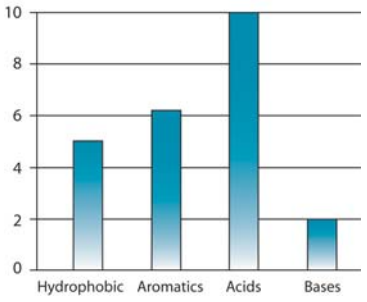
Chromatographic Properties:

An intrinsically base-deactivated (IBD) phase, containing a polar group within, or intrinsic to, the hydrocarbon bonded phase. Unique selectivity and high level of base deactivation, while reducing or eliminating the need for mobile phase additives. Great for mixed polar and nonpolar compounds.

Physical Characteristics:

particle size: 3µm or 5µm, spherical
pore size: 100Å
carbon load: 12%
endcap: no
pH range: 2.5 to 8
temperature limit: 80°C

Ultra II® IBD Retention Profile



	1.0mm ID		2.1mm ID		3.0mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
3µm Columns								
30mm	9605331		9605332		960533E		9605335	
50mm	9605351		9605352		960535E		9605355	
100mm	9605311		9605312		960531E		9605315	
150mm	9605361		9605362		960536E		9605365	
5µm Columns								
30mm	9605531		9605532		960553E		9605535	
50mm	9605551		9605552		960555E		9605555	
100mm	9605511		9605512		960551E		9605515	
150mm	9605561		9605562		960556E		9605565	
200mm	9605521		9605522		960552E		9605525	
250mm	9605571		9605572		960557E		9605575	

Ultra II® IBD Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Ultra II IBD Guard Cartridge	960550212	960550210	960550222	960550220	$145

Ultra II® IBD HPLC Prep Columns

	10mm ID		21.2mm ID		30mm ID		50mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
50mm	9605557		9605558		9605559		9605550	
100mm	9605517		9605518		9605519		9605510	
150mm	9605567		9605568		9605569		9605560	
250mm	9605577		9605578		9605579		9605570	

Available in 10µm particle size upon request.

Supersize without surprise!

ordering **note**

We strongly recommend ordering a semi-prep or prep column only after evaluating the desired separation on an equivalent analytical-scale column. Because we cannot re-use a column or the silica it contains once it has left our facility, we cannot accept returns of large-scale columns (except in cases of our error).

Ultra II® PFP Propyl Columns (USP L43)

Chromatographic Properties:

A pentafluorophenyl phase with a propyl spacer. Highly retentive for basic analytes. An excellent phase for separating nucleosides, nucleotides, purines, pyrimidines, and halogenated compounds.

Restek manufactured silica

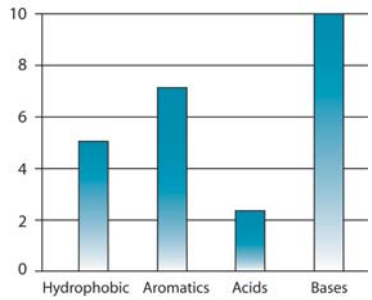
NEW!

Physical Characteristics:

particle size: 1.9µm, 3µm or 5µm, spherical
pore size: 100Å
carbon load: 11%
endcap: fully endcapped
pH range: 2.5 to 8
temperature limit: 80°C

	1.0mm ID		2.1mm ID		3.0mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
1.9µm Columns								
30mm			9606232		960623E			
50mm			9606252		960625E			
100mm			9606212		960621E			
3µm Columns								
30mm	9606331		9606332		960633E		9606335	
50mm	9606351		9606352		960635E		9606355	
100mm	9606311		9606312		960631E		9606315	
150mm	9606361		9606362		960636E		9606365	
5µm Columns								
30mm	9606531		9606532		960653E		9606535	
50mm	9606551		9606552		960655E		9606555	
100mm	9606511		9606512		960651E		9606515	
150mm	9606561		9606562		960656E		9606565	
200mm	9606521		9606522		960652E		9606525	
250mm	9606571		9606572		960657E		9606575	

Ultra II® PFP Propyl Retention Profile



Ultra II® PFP Propyl Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Ultra II PFP Propyl Guard Cartridge	960650212	960650210	960650222	960650220	$145

Ultra II® PFP Propyl HPLC Prep Columns

	10mm ID		21.2mm ID		30mm ID		50mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
50mm	9606557		9606558		9606559		9606550	
100mm	9606517		9606518		9606519		9606510	
150mm	9606567		9606568		9606569		9606560	
250mm	9606577		9606578		9606579		9606570	

Available in 10µm particle size upon request.

ordering **note**

To order a 2.1mm, 3.2mm, or 4.6mm ID column with a Trident Integral Inlet Fitting, add "-700" to the catalog number for the column.

Nominal additional charge $15.00

Example: 100mm x 4.6mm ID Ultra C18 column with Trident Integral Inlet Fitting: 9174315-700

Also order an XG-XF fitting (10mm: cat.#25026 or 20mm: 25062), see page 196.

Restek manufactured silica

NEW!

Ultra II® Silica Columns (USP L3)

Chromatographic Properties:

High surface area. Type B silica packing.

Physical Characteristics:

particle size: 1.9µm, 2.2µm, 3µm or 5µm, spherical
pore size: 100Å
carbon load: 0%
endcap: no
pH range: 2.5 to 8
temperature limit: 80°C

	1.0mm ID		2.1mm ID		3.0mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
1.9µm Columns								
30mm			9600232		960023E			
50mm			9600252		960025E			
100mm			9600212					
2.2µm Columns								
30mm			9600832		960083E			
50mm			9600852		960085E			
100mm			9600812		960081E			
3µm Columns								
30mm	9600331		9600332		960033E		9600335	
50mm	9600351		9600352		960035E		9600355	
100mm	9600311		9600312		960031E		9600315	
150mm	9600361		9600362		960036E		9600365	
5µm Columns								
30mm	9600531		9600532		960053E		9600535	
50mm	9600551		9600552		960055E		9600555	
100mm	9600511		9600512		960051E		9600515	
150mm	9600561		9600562		960056E		9600565	
200mm	9600521		9600522		960052E		9600525	
250mm	9600571		9600572		960057E		9600575	

Ultra II® Silica Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Ultra II Silica Guard Cartridge	960050212	960050210	960050222	960050220	$145

also **available**

Bulk Packing Materials

See page 194.

Ultra II® Silica HPLC Prep Columns

	10mm ID		21.2mm ID		30mm ID		50mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
50mm	9600557		9600558		9600559		9600550	
100mm	9600517		9600518		9600519		9600510	
150mm	9600567		9600568		9600569		9600560	
250mm	9600577		9600578		9600579		9600570	

Available in 10µm particle size upon request.

ordering **note**

To order a 2.1mm, 3.2mm, or 4.6mm ID column with a Trident Integral Inlet Fitting, add "-700" to the catalog number for the column.

Nominal additional charge $15.00

Example: 100mm x 4.6mm ID Ultra C18 column with Trident Integral Inlet Fitting: 9174315-700

Also order an XG-XF fitting (10mm: cat.#25026 or 20mm: 25062), see page 196.

Ultra II® Carbamate Columns

Chromatographic Properties:

Specifically designed for carbamates analysis. The unique packing separates 10 target carbamates in just 7 minutes, and is compatible with fluorescence or LC/MS detection. This improved run time will boost productivity and sample throughput, while reducing solvent usage and disposal expenses.

	1.0mm ID		2.1mm ID		3.0mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
3µm Columns								
30mm	9611331		9611332		961133E		9611335	
50mm	9611351		9611352		961135E		9611355	
100mm	9611311		9611312		961131E		9611315	
150mm	9611361		9611362		961136E		9611365	
5µm Columns								
30mm	9611531		9611532		961153E		9611535	
50mm	9611551		9611552		961155E		9611555	
100mm	9611511		9611512		961151E		9611515	
150mm	9611561		9611562		961156E		9611565	
200mm	9611521		9611522		961152E		9611525	
250mm	9611571		9611572		961157E		9611575	

Restek manufactured silica

NEW!

Physical Characteristics:

particle size: 3µm or 5µm, spherical
pore size: 100Å
carbon load: 15%
endcap: no
pH range: 2.5 to 8
temperature limit: 80°C

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Ultra II® Carbamate Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Ultra II Carbamate Guard Cartridge	961150212	961150210	961150222	961150220	$145

Ultra II® Carbamate HPLC Prep Columns

	10mm ID		21.2mm ID		30mm ID		50mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
50mm	9611557		9611558		9611559		9611550	
100mm	9611517		9611518		9611519		9611510	
150mm	9611567		9611568		9611569		9611560	
250mm	9611577		9611578		9611579		9611570	

Available in 10µm particle size upon request.

Ultra II® Quat Columns

Chromatographic Properties:

Ideal for the analysis of paraquat and diquat or other quaternary amines when used with Ultra Quat reagent solution mobile phase additive (cat.# 32441).

	4.6mm ID	
Length	cat.#	price
5µm Column		
150mm	9612565	

Restek manufactured silica

NEW!

Physical Characteristics:

particle size: 5µm, spherical
pore size: 100Å
carbon load: 12%
endcap: fully endcapped
pH range: 2.5 to 8
temperature limit: 80°C

Pinnacle® DB Columns: 1.9, 3, or 5µm particle sizes; 140Å pore size

Prepared using a highly base-deactivated silica support; ideal for analyses of basic compounds, or bases mixed with acids/neutrals. Silica manufactured at Restek, for total control of quality and reproducibility.

Restek manufactured silica

Physical Characteristics:

particle size: 1.9µm, 3µm, or 5µm, spherical
pore size: 140Å
carbon load: 11%
endcap: yes
pH range: 2.5 to 8
temperature limit: 80°C

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Pinnacle® DB C18 Columns (USP L1)

Chromatographic Properties:

Highly base-deactivated spherical silica manufactured by Restek. Monomeric C18 bonding. Hydrophobic C18 phase suitable for analyses of a wide range of compounds, from acidic through slightly basic. Replaces Hypersil® BDS C18 and Pinnacle® ODS Amine.

	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
1.9µm Columns								
30mm			9414232					
50mm			9414252					
100mm			9414212					
3µm Columns								
30mm	9414331		9414332		9414333		9414335	
50mm	9414351		9414352		9414353		9414355	
100mm	9414311		9414312		9414313		9414315	
5µm Columns								
30mm	9414531		9414532		9414533		9414535	
50mm	9414551		9414552		9414553		9414555	
100mm	9414511		9414512		9414513		9414515	
150mm	9414561		9414562		9414563		9414565	
200mm	9414521		9414522		9414523		9414525	
250mm	9414571		9414572		9414573		9414575	

3.0mm ID available on request for 3µm particle applications above 4,000 psi (275 Bar).

Pinnacle® DB C18 Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Pinnacle DB C18 Guard Cartridge	941450212	941450210	941450222	941450220	$148

Pinnacle® DB C18 HPLC Prep Columns

	10mm ID		21.2mm ID		30mm ID		50mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
50mm	9414557		9414558		9414559		9414550	
100mm	9414517		9414518		9414519		9414510	
150mm	9414567		9414568		9414569		9414560	
250mm	9414577		9414578		9414579		9414570	

ordering **note**

To order a 2.1mm, 3.2mm, or 4.6mm ID column with a Trident Integral Inlet Fitting, add "-700" to the catalog number for the column.

Nominal additional charge $15.00

Example: 100mm x 4.6mm ID Ultra C18 column with Trident Integral Inlet Fitting: 9174315-700

Also order an XG-XF fitting (10mm: cat.#25026 or 20mm: 25062), see page 196.

Pinnacle® DB C8 Columns (USP L7)

Chromatographic Properties:

Highly base-deactivated spherical silica manufactured by Restek. Monomeric C8 bonding. Similar to Pinnacle® DB C18, but the shorter alkyl chain provides less hydrophobic retention. Less retention can be useful for reducing analysis time, if resolution is adequate. Replaces Hypersil® BDS C8 and Pinnacle® C8 Amine.

Restek manufactured silica

Physical Characteristics:

particle size: 1.9µm, 3µm, or 5µm, spherical
pore size: 140Å
carbon load: 6%
endcap: yes
pH range: 2.5 to 8
temperature limit: 80°C

	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
1.9µm Columns								
30mm			9413232					
50mm			9413252					
100mm			9413212					
3µm Columns								
30mm	9413331		9413332		9413333		9413335	
50mm	9413351		9413352		9413353		9413355	
100mm	9413311		9413312		9413313		9413315	
5µm Columns								
30mm	9413531		9413532		9413533		9413535	
50mm	9413551		9413552		9413553		9413555	
100mm	9413511		9413512		9413513		9413515	
150mm	9413561		9413562		9413563		9413565	
200mm	9413521		9413522		9413523		9413525	
250mm	9413571		9413572		9413573		9413575	

3.0mm ID available on request for 3µm particle applications above 4,000 psi (275 Bar).

Pinnacle® DB C8 Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Pinnacle DB C8 Guard Cartridge	941350212	941350210	941350222	941350220	$148

Pinnacle® DB C8 HPLC Prep Columns

	10mm ID		21.2mm ID		30mm ID		50mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
50mm	9413557		9413558		9413559		9413550	
100mm	9413517		9413518		9413519		9413510	
150mm	9413567		9413568		9413569		9413560	
250mm	9413577		9413578		9413579		9413570	

Anthony Hahn, Customer Service

Restek Customer Service

In the U.S.

Call: 800-356-1688 (ext. 3) or 814-353-1300 (ext. 3)

Monday–Friday 8:00 a.m.–6:00 p.m. ET

Fax: 814-353-1309—24-hours a day

Online: www.restek.com—24-hours a day

Outside the U.S.

Contact your Restek representative:
Refer to our list on pages 4-5 or visit our website at www.restek.com

Pinnacle® DB Cyano Columns (USP L10)

Restek manufactured silica

Physical Characteristics:

particle size: 1.9µm or 5µm, spherical
pore size: 140Å
carbon load: 4%
endcap: yes
pH range: 2.5 to 8
temperature limit: 80°C

Chromatographic Properties:

Highly base-deactivated spherical silica manufactured by Restek. Cyano bonding. Suitable for analyses of a wide range of compounds, from acidic through slightly basic. Also useful for confirmation of analyses on a C18 or C8 column. Can be used in normal phase or reversed phase mode of separation. Replaces Hypersil® BDS Cyano and Pinnacle® Cyano Amine.

	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
1.9µm Columns								
30mm			9416232					
50mm			9416252					
100mm			9416212					
5µm Columns								
30mm	9416531		9416532		9416533		9416535	
50mm	9416551		9416552		9416553		9416555	
100mm	9416511		9416512		9416513		9416515	
150mm	9416561		9416562		9416563		9416565	
200mm	9416521		9416522		9416523		9416525	
250mm	9416571		9416572		9416573		9416575	

also **available**

Bulk Packing Materials
See page 194.

Pinnacle® DB Cyano Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Pinnacle DB Cyano Guard Cartridge	941650212	941650210	941650222	941650220	

Pinnacle® DB Cyano HPLC Prep Columns

	10mm ID		21.2mm ID		30mm ID		50mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
50mm	9416557		9416558		9416559		9416550	
100mm	9416517		9416518		9416519		9416510	
150mm	9416567		9416568		9416569		9416560	
250mm	9416577		9416578		9416579		9416570	

Pinnacle® DB Phenyl Columns (USP L11)

Restek manufactured silica

Physical Characteristics:

particle range: 5µm, spherical
pore size: 140Å
carbon load: 5.3%
endcap: yes
pH range: 2.5 to 8
temperature limit: 80°C

Chromatographic Properties:

Highly base-deactivated spherical silica manufactured by Restek. Pinnacle® DB Phenyl columns offer alternate selectivity to straight chain hydrocarbon phases, especially for aromatic analytes. Replaces Hypersil® BDS Phenyl and Pinnacle® Phenyl Amine.

	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
30mm	9415531		9415532		9415533		9415535	
50mm	9415551		9415552		9415553		9415555	
100mm	9415511		9415512		9415513		9415515	
150mm	9415561		9415562		9415563		9415565	
200mm	9415521		9415522		9415523		9415525	
250mm	9415571		9415572		9415573		9415575	

Pinnacle® DB Phenyl Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Pinnacle DB Phenyl Guard Cartridge	941550212	941550210	941550222	941550220	

Pinnacle® DB PFP Propyl Columns (USP L43)

Chromatographic Properties:

Pinnacle® DB PFP Propyl, a unique pentafluorophenyl phase with a propyl spacer, uses a highly base-deactivated spherical silica manufactured by Restek. This highly base-deactivated packing exhibits excellent peak shapes for a wide range of compounds, including nucleosides, nucleotides, and halogenated compounds.

Restek manufactured silica

Physical Characteristics:

particle size: 1.9µm, 3µm, or 5µm, spherical
pore size: 140Å
carbon load: 6%
endcap: yes
pH range: 2.5 to 8
temperature limit: 80°C

	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
1.9µm Columns								
30mm			9419232					
50mm			9419252					
100mm			9419212					
3µm Columns								
30mm	9419331		9419332		9419333		9419335	
50mm	9419351		9419352		9419353		9419355	
100mm	9419311		9419312		9419313		9419315	
150mm	9419361		9419362		9419363		9419365	
5µm Columns								
30mm	9419531		9419532		9419533		9419535	
50mm	9419551		9419552		9419553		9419555	
100mm	9419511		9419512		9419513		9419515	
150mm	9419561		9419562		9419563		9419565	
200mm	9419521		9419522		9419523		9419525	
250mm	9419571		9419572		9419573		9419575	

3.0mm ID available on request for 3µm particle applications above 4,000 psi (275 Bar).

Pinnacle® DB PFP Propyl Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Pinnacle DB PFP Propyl Guard Cartridge	941950212	941950210	941950222	941950220	

Pinnacle® DB PFP Propyl HPLC Prep Columns

	10mm ID		21.2mm ID		30mm ID		50mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
50mm	9419557		9419558		9419559		9419550	
100mm	9419517		9419518		9419519		9419510	
150mm	9419567		9419568		9419569		9419560	
250mm	9419577		9419578		9419579		9419570	

Restek manufactured silica

Physical Characteristics:

particle size: 1.9µm, 3µm, or 5µm, spherical
pore size: 140Å
carbon load: 8%
endcap: yes
pH range: 2.5 to 8
temperature limit: 80°C

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steroids 742

Pinnacle® DB Biphenyl Columns (USP L11)

Chromatographic Properties:

Pinnacle® DB Biphenyl is a unique reversed phase material that displays both increased retention and selectivity for aromatic and/or unsaturated compounds when compared to conventional alkyl and phenyl phases. Highly base-deactivated spherical silica manufactured by Restek. An excellent choice for the analysis of steroids, tetracyclines, drug metabolites, and other compounds that contain some degree of unsaturation.

	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
1.9µm Columns								
30mm			9409232					
50mm			9409252					
100mm			9409212					
3µm Columns								
30mm	9409331		9409332		9409333		9409335	
50mm	9409351		9409352		9409353		9409355	
100mm	9409311		9409312		9409313		9409315	
150mm	9409361		9409362		9409363		9409365	
5µm Columns								
30mm	9409531		9409532		9409533		9409535	
50mm	9409551		9409552		9409553		9409555	
100mm	9409511		9409512		9409513		9409515	
150mm	9409561		9409562		9409563		9409565	
200mm	9409521		9409522		9409523		9409525	
250mm	9409571		9409572		9409573		9409575	

3.0mm ID available on request for 3µm particle applications above 4,000 psi (275 Bar).

Pinnacle® DB Biphenyl Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Pinnacle DB Biphenyl Guard Cartridge	940950212	940950210	940950222	940950220	$148

Pinnacle® DB Biphenyl HPLC Prep Columns

	10mm ID		21.2mm ID		30mm ID		50mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
50mm	9409557		9409558		9409559		9409550	
100mm	9409517		9409518		9409519		9409510	
150mm	9409567		9409568		9409569		9409560	
250mm	9409577		9409578		9409579		9409570	

ordering **note**

To order a 2.1mm, 3.2mm, or 4.6mm ID column with a Trident Integral Inlet Fitting, add "-700" to the catalog number for the column.

Nominal additional charge $15.00

Example: 100mm x 4.6mm ID Ultra C18 column with Trident Integral Inlet Fitting: 9174315-700

Also order an XG-XF fitting (10mm: cat.#25026 or 20mm: 25062), see page 196.

Pinnacle® DB Aqueous C18 Columns (USP L1)

Chromatographic Properties:

Highly selective phase for polar analytes. Compatible with highly aqueous (up to 100%) mobile phases. Silica manufactured by Restek.

Restek manufactured silica

Physical Characteristics:

particle size: 1.9µm, 3µm, or 5µm, spherical
pore size: 140Å
carbon load: 6%
pH range: 2.5 to 8
temperature limit: 80°C

	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
1.9µm Columns								
30mm			9418232					
50mm			9418252					
100mm			9418212					
3µm Columns								
30mm	9418331		9418332		9418333		9418335	
50mm	9418351		9418352		9418353		9418355	
100mm	9418311		9418312		9418313		9418315	
150mm	9418361		9418362		9418363		9418365	
5µm Columns								
30mm	9418531		9418532		9418533		9418535	
50mm	9418551		9418552		9418553		9418555	
100mm	9418511		9418512		9418513		9418515	
150mm	9418561		9418562		9418563		9418565	
200mm	9418521		9418522		9418523		9418525	
250mm	9418571		9418572		9418573		9418575	

3.0mm ID available on request for 3µm particle applications above 4,000 psi (275 Bar).

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Pinnacle® DB Aqueous C18 Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Pinnacle DB Aqueous C18 Guard Cartridge	941850212	941850210	941850222	941850220	

Pinnacle® DB Aqueous C18 HPLC Prep Columns

	10mm ID		21.2mm ID		30mm ID		50mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
50mm	9418557		9418558		9418559		9418550	
100mm	9418517		9418518		9418519		9418510	
150mm	9418567		9418568		9418569		9418560	
250mm	9418577		9418578		9418579		9418570	

Pinnacle® DB IBD UHPLC Columns

Chromatographic Properties:

An intrinsically base-deactivated (IBD) phase, containing a polar group within, or intrinsic to, the hydrocarbon bonded phase. Unique selectivity and a high level of base deactivation, while reducing or eliminating the need for mobile phase additives.

Restek manufactured silica

Physical Characteristics:

particle size: 1.9µm
pore size: 140Å
endcap: yes
pH range: 2.5 to 8
temperature limit: 80°C

	2.1mm ID	
Length	cat.#	price
1.9µm Columns		
30mm	9425232	
50mm	9425252	
100mm	9425212	

Pinnacle® DB IBD HPLC Prep Columns

	10mm ID		21.2mm ID		30mm ID		50mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
50mm	9425557		9425558		9425559		9425550	
100mm	9425517		9425518		9425519		9425510	
150mm	9425567		9425568		9425569		9425560	
250mm	9425577		9425578		9425579		9425570	

Restek manufactured silica

Physical Characteristics:

particle size: 1.9µm, 3µm, or 5µm, spherical
pore size: 140Å
endcap: no
pH range: 2.5 to 8
temperature limit: 80°C

Pinnacle® DB Silica Columns (USP L3)

Chromatographic Properties:

Highly base-deactivated spherical silica manufactured by Restek. Useful for normal phase separations. Replaces Hypersil® BDS and Pinnacle® Amine.

	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
1.9µm Columns								
30mm			9410232					
50mm			9410252					
100mm			9410212					
3µm Columns								
30mm	9410331		9410332		9410333		9410335	
50mm	9410351		9410352		9410353		9410355	
100mm	9410311		9410312		9410313		9410315	
150mm	9410361		9410362		9410363		9410365	
5µm Columns								
30mm	9410531		9410532		9410533		9410535	
50mm	9410551		9410552		9410553		9410555	
100mm	9410511		9410512		9410513		9410515	
150mm	9410561		9410562		9410563		9410565	
200mm	9410521		9410522		9410523		9410525	
250mm	9410571		9410572		9410573		9410575	

3.0mm ID available on request for 3µm particle applications above 4,000 psi (275 Bar).

also **available**

HPLC Syringes
See pages 285-289.

Pinnacle® DB Silica Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Pinnacle DB Silica Guard Cartridge	941050212	941050210	941050222	941050220	

Pinnacle® DB Silica HPLC Prep Columns

	10mm ID		21.2mm ID		30mm ID		50mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
50mm	9410557		9410558		9410559		9410550	
100mm	9410517		9410518		9410519		9410510	
150mm	9410567		9410568		9410569		9410560	
250mm	9410577		9410578		9410579		9410570	

Restek manufactured silica

Physical Characteristics:

particle size: 1.9µm
pore size: 140Å
endcap: yes
pH range: 2.5 to 8
temperature limit: 80°C

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polycyclic aromatic hydrocarbons 718

Pinnacle® DB PAH UHPLC Columns

- Complete resolution of EPA 610 PAHs in less than 4 minutes.
- Greatly reduces run times, increasing sample throughput.

Chromatographic Properties:

Specifically designed to resolve complex mixtures of polycyclic aromatic hydrocarbons.

	2.1mm ID	
Length	cat.#	price
1.9µm Columns		
30mm	9470232	
50mm	9470252	
100mm	9470212	

Pinnacle® II Columns: 3µm or 5µm particles; 110Å pore size

Silica manufactured at Restek, for total control of quality and reproducibility. Excellent replacement for the original Hypersil® material. Physical and chromatographic properties similar to our original Pinnacle® materials, but with greater lot-to-lot uniformity.

Pinnacle® II C18 Columns (USP L1)

Chromatographic Properties:

Excellent choice as a general purpose C18 column. Intermediate carbon loading and surface area, suitable for a wide range of acidic to neutral hydrophobic compounds. Replaces Hypersil® ODS and Pinnacle® C18.

	1.0mm ID		2.1mm ID		3.2mm ID		4.0mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price	cat.#	price
3µm Columns										
30mm	9214331		9214332		9214333				9214335	
50mm	9214351		9214352		9214353				9214355	
100mm	9214311		9214312		9214313				9214315	
5µm Columns										
30mm	9214531		9214532		9214533				9214535	
50mm	9214551		9214552		9214553				9214555	
100mm	9214511		9214512		9214513		9214514		9214515	
150mm	9214561		9214562		9214563		9214564		9214565	
200mm	9214521		9214522		9214523				9214525	
250mm	9214571		9214572		9214573				9214575	

3.0mm ID available on request for 3µm particle applications above 4,000 psi (275 Bar).

Restek manufactured silica

Physical Characteristics:

particle size: 3µm or 5µm, spherical
pore size: 110Å
carbon load: 13%
endcap: fully endcapped
pH range: 2.5 to 8
temperature limit: 80°C

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allicin 730
capsaicinoids 728
morphine sulfate 738
phenolic antioxidants 727, 730

Pinnacle® II C18 Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Pinnacle II C18 Guard Cartridge	921450212	921450210	921450222	921450220	

Pinnacle® II C18 HPLC Prep Columns

	10mm ID		21.2mm ID		30mm ID		50mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
50mm	9214557		9214558		9214559		9214550	
100mm	9214517		9214518		9214519		9214510	
150mm	9214567		9214568		9214569		9214560	
250mm	9214577		9214578		9214579		9214570	

Restek manufactured silica

Physical Characteristics:

particle size: 4µm, spherical
pore size: 110Å
endcap: fully endcapped
pH range: 2.5 to 8
temperature limit: 80°C

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polycyclic aromatic hydrocarbons 717

Pinnacle® II PAH Columns

Chromatographic Properties:

Developed specifically for challenging analyses of polycyclic aromatic hydrocarbons. The Pinnacle® II PAH stationary phase incorporates a proprietary C18 bonding that enables unique shape selectivity to resolve to baseline all 16 PAHs listed in US EPA Method 610. Every lot of Pinnacle® II PAH bonded phase material is tested to ensure baseline resolution of the Method 610 PAHs, using a simple water/acetonitrile mobile phase gradient. Further, because we make Pinnacle® II PAH columns using our own silica, we have greater control over quality and reproducibility. Replaces Pinnacle® PAH columns. If you are analyzing PAHs, Pinnacle® II PAH columns are a reliable, cost-effective choice.

	2.1mm ID		3.2mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price
4µm Columns						
50mm	9219452		9219453		9219455	
100mm	9219412		9219413		9219415	
150mm	9219462		9219463		9219465	
200mm	9219422		9219423		9219425	
250mm	9219472		9219473		9219475	

Pinnacle® II PAH Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Pinnacle II PAH Guard Cartridge	921950212	921950210	921950222	921950220	

Restek manufactured silica

Physical Characteristics:

particle size: 3µm or 5µm, spherical
pore size: 110Å
carbon load: 7%
endcap: fully endcapped
pH range: 2.5 to 8
temperature limit: 80°C

Pinnacle® II C8 Columns (USP L7)

Chromatographic Properties:

Reliable performance and symmetric peaks for neutral to acidic compounds. Provides shorter retention times for hydrophobic compounds, compared to C18 phases. Replaces Hypersil® C8 and Pinnacle® C8.

	1.0mm ID		2.1mm ID		3.2mm ID		4.0mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price	cat.#	price
3µm Columns										
30mm	9213331		9213332		9213333				9213335	
50mm	9213351		9213352		9213353				9213355	
100mm	9213311		9213312		9213313				9213315	
5µm Columns										
30mm	9213531		9213532		9213533				9213535	
50mm	9213551		9213552		9213553				9213555	
100mm	9213511		9213512		9213513		9213514		9213515	
150mm	9213561		9213562		9213563		9213564		9213565	
200mm	9213521		9213522		9213523				9213525	
250mm	9213571		9213572		9213573				9213575	

3.0mm ID available on request for 3µm particle applications above 4,000 psi (275 Bar).

Pinnacle® II C8 Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Pinnacle II C8 Guard Cartridge	921350212	921350210	921350222	921350220	

Pinnacle® II C8 HPLC Prep Columns

	10mm ID		21.2mm ID		30mm ID		50mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
50mm	9213557		9213558		9213559		9213550	
100mm	9213517		9213518		9213519		9213510	
150mm	9213567		9213568		9213569		9213560	
250mm	9213577		9213578		9213579		9213570	

Pinnacle® II Cyano Columns (USP L10)

Chromatographic Properties:

Can be used in either reversed phase or normal phase mode. More rugged than bare silica for normal phase applications. Replaces Hypersil® Cyano and Pinnacle® CN.

Restek manufactured silica

Physical Characteristics:

particle size: 3µm or 5µm, spherical
pore size: 110Å
carbon load: 4%
endcap: fully endcapped
pH range: 2.5 to 8
temperature limit: 80°C

Length	1.0mm ID cat.#	price	2.1mm ID cat.#	price	3.2mm ID cat.#	price	4.6mm ID cat.#	price
3µm Columns								
30mm	9216331		9216332		9216333		9216335	
50mm	9216351		9216352		9216353		9216355	
100mm	9216311		9216312		9216313		9216315	
5µm Columns								
30mm	9216531		9216532		9216533		9216535	
50mm	9216551		9216552		9216553		9216555	
100mm	9216511		9216512		9216513		9216515	
150mm	9216561		9216562		9216563		9216565	
200mm	9216521		9216522		9216523		9216525	
250mm	9216571		9216572		9216573		9216575	

3.0mm ID available on request for 3µm particle applications above 4,000 psi (275 Bar).

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Pinnacle® II Cyano Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Pinnacle II Cyano Guard Cartridge	921650212	921650210	921650222	921650220	$148

Pinnacle® II Cyano HPLC Prep Columns

Length	10mm ID cat.#	price	21.2mm ID cat.#	price	30mm ID cat.#	price	50mm ID cat.#	price
5µm Columns								
50mm	9216557		9216558		9216559		9216550	
100mm	9216517		9216518		9216519		9216510	
150mm	9216567		9216568		9216569		9216560	
250mm	9216577		9216578		9216579		9216570	

also **available**

Bulk Packing Materials
See page 194.

Pinnacle® II Phenyl Columns (USP L11)

Chromatographic Properties:

The Pinnacle® II Phenyl phase offers unique selectivity versus traditional alkyl chain phases, especially for aromatic compounds. Replaces Hypersil® Phenyl and Pinnacle® Phenyl.

Restek manufactured silica

Physical Characteristics:

particle size: 3µm or 5µm, spherical
pore size: 110Å
carbon load: 6%
endcap: fully endcapped
pH range: 2.5 to 8
temperature limit: 80°C

Length	1.0mm ID cat.#	price	2.1mm ID cat.#	price	3.2mm ID cat.#	price	4.6mm ID cat.#	price
3µm Columns								
30mm	9215331		9215332		9215333		9215335	
50mm	9215351		9215352		9215353		9215355	
100mm	9215311		9215312		9215313		9215315	
5µm Columns								
30mm	9215531		9215532		9215533		9215535	
50mm	9215551		9215552		9215553		9215555	
100mm	9215511		9215512		9215513		9215515	
150mm	9215561		9215562		9215563		9215565	
200mm	9215521		9215522		9215523		9215525	
250mm	9215571		9215572		9215573		9215575	

3.0mm ID available on request for 3µm particle applications above 4,000 psi (275 Bar).

Pinnacle® II Phenyl Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Pinnacle II Phenyl Guard Cartridge	921550212	921550210	921550222	921550220	

Pinnacle® II Amino Columns (USP L8)

Restek manufactured silica

Physical Characteristics:

particle size: 3µm or 5µm, spherical
pore size: 110Å
carbon load: 2%
endcap: no
pH range: 2.5 to 8
temperature limit: 80°C

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lactulose concentrate 743
sugars 727

Chromatographic Properties:

HPLC analysis using an amino-based stationary phase is the most popular technique for routine analyses of simple sugars, using isocratic elution (e.g., acetonitrile:water, 75:25) and a refractive index detector (RID) or an evaporative light scattering detector (ELSD). The Pinnacle® II Amino column is ideal for mono- and disaccharide analyses. Replaces Hypersil® Amino and Pinnacle® Amino.

	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
3µm Columns								
30mm	9217331		9217332		9217333		9217335	
50mm	9217351		9217352		9217353		9217355	
100mm	9217311		9217312		9217313		9217315	
5µm Columns								
30mm	9217531		9217532		9217533		9217535	
50mm	9217551		9217552		9217553		9217555	
100mm	9217511		9217512		9217513		9217515	
150mm	9217561		9217562		9217563		9217565	
200mm	9217521		9217522		9217523		9217525	
250mm	9217571		9217572		9217573		9217575	

3.0mm ID available on request for 3µm particle applications above 4,000 psi (275 Bar).

Pinnacle® II Amino Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Pinnacle II Amino Guard Cartridge	921750212	921750210	921750222	921750220	

Pinnacle® II Biphenyl Columns (USP L11)

Restek manufactured silica

Physical Characteristics:

particle size: 5µm, spherical
pore size: 110Å
endcap: yes
pH range: 2.5 to 8
temperature limit: 80°C

Chromatographic Properties:

The Pinnacle® II Biphenyl phase offers alternate selectivity to straight-chain hydrocarbon phases, and enhanced selectivity and retention for unsaturated compounds, compared to traditional phenyl phases. An excellent confirmation column for explosive compounds, as in EPA method 8330.

	4.6mm ID	
Length	cat.#	price
5µm Column		
150mm	9209565	
250mm	9209575	

Pinnacle® II Biphenyl Guard Cartridges

Guard Cartridges	3-pk. (10 x 4.0mm)	2-pk. (20 x 4.0mm)	price
Pinnacle II Biphenyl Guard Cartridge	920950210	920950220	

Pinnacle® II Silica Columns (USP L3)

Chromatographic Properties:

Good general purpose packing for normal phase separations. Moderate surface area. Replaces Hypersil® and Pinnacle® Silica.

Restek manufactured silica

Physical Characteristics:

particle size: 3µm or 5µm, spherical
pore size: 110Å
endcap: no
pH range: 2.5 to 8
temperature limit: 80°C

	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
3µm Columns								
30mm	9210331		9210332		9210333		9210335	
50mm	9210351		9210352		9210353		9210355	
100mm	9210311		9210312		9210313		9210315	
5µm Columns								
30mm	9210531		9210532		9210533		9210535	
50mm	9210551		9210552		9210553		9210555	
100mm	9210511		9210512		9210513		9210515	
150mm	9210561		9210562		9210563		9210565	
200mm	9210521		9210522		9210523		9210525	
250mm	9210571		9210572		9210573		9210575	

3.0mm ID available on request for 3µm particle applications above 4,000 psi (275 Bar).

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hydrocodone bitartrate 738
tocopherols 730

Pinnacle® II Silica Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Pinnacle II Silica Guard Cartridge	921050212	921050210	921050222	921050220	

Pinnacle® II Silica HPLC Prep Columns

	10mm ID		21.2mm ID		30mm ID		50mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
50mm	9210557		9210558		9210559		9210550	
100mm	9210517		9210518		9210519		9210510	
150mm	9210567		9210568		9210569		9210560	
250mm	9210577		9210578		9210579		9210570	

ordering **note**

To order a 2.1mm, 3.2mm, or 4.6mm ID column with a Trident Integral Inlet Fitting, add "-700" to the catalog number for the column.

Nominal additional charge $15.00

Example: 100mm x 4.6mm ID Ultra C18 column with Trident Integral Inlet Fitting: 9174315-700

Also order an XG-XF fitting (10mm: cat.#25026 or 20mm: 25062), see page 196.

also **available**

HPLC Syringes

See pages 346-349.

Allure® Columns: 5µm particles; 60Å pore size

Small pore size in a high-purity, Type B silica provides a large surface area. High carbon loads, highly retentive. An excellent choice for evaporative light scattering (ELSD) and MS detectors, in which more organic solvent in the mobile phase gives better sensitivity.

Allure® C18 Columns (USP L1)

Physical Characteristics:
particle size: 5µm, spherical
pore size: 60Å
carbon load: 27%
endcap: fully endcapped
pH range: 2.5 to 8
temperature limit: 80°C

Chromatographic Properties:
Most retentive of our alkyl stationary phases due to large surface area of the base silica and high-density bondings. Provides excellent peak shapes for a wide range of compounds.

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pesticides 716

	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
30mm	9164531		9164532		9164533		9164535	
50mm	9164551		9164552		9164553		9164555	
100mm	9164511		9164512		9164513		9164515	
150mm	9164561		9164562		9164563		9164565	
200mm	9164521		9164522		9164523		9164525	
250mm	9164571		9164572		9164573		9164575	

Allure® C18 Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Allure C18 Guard Cartridge	916450212	916450210	916450222	916450220	$148

Allure® C18 HPLC Prep Columns

	10mm ID		21.2mm ID		30mm ID		50mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
50mm	9164557		9164558		9164559		9164550	
100mm	9164517		9164518		9164519		9164510	
150mm	9164567		9164568		9164569		9164560	
250mm	9164577		9164578		9164579		9164570	

Allure® Basix Columns (USP L10)

Physical Characteristics:
particle size: 5µm, spherical
pore size: 60Å
carbon load: 12%
endcap: fully endcapped
pH range: 2.5 to 8
temperature limit: 80°C

Chromatographic Properties:
Highly retentive propyl cyano phase. Excellent choice for basic compounds and for analytes containing amine group functionality.

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herbicides 714

	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
30mm	9161531		9161532		9161533		9161535	
50mm	9161551		9161552		9161553		9161555	
100mm	9161511		9161512		9161513		9161515	
150mm	9161561		9161562		9161563		9161565	
200mm	9161521		9161522		9161523		9161525	
250mm	9161571		9161572		9161573		9161575	

Allure® Basix Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Allure Basix Guard Cartridge	916150212	916150210	916150222	916150220	

Allure® Basix HPLC Prep Columns

	10mm ID		21.2mm ID		30mm ID		50mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
50mm	9161557		9161558		9161559		9161550	
100mm	9161517		9161518		9161519		9161510	
150mm	9161567		9161568		9161569		9161560	
250mm	9161577		9161578		9161579		9161570	

also **available**

Bulk Packing Materials
See page 194.

Allure® PFP Propyl Columns (USP L43)

Chromatographic Properties:

A pentafluorophenyl phase with a propyl spacer. Highly retentive for basic analytes. An excellent phase for separating nucleosides, nucleotides, purines, pyrimidines, halogenated compounds, β-blockers, and tricyclic antidepressants.

Physical Characteristics:

particle size: 5µm, spherical
pore size: 60Å
carbon load: 17%
endcap: fully endcapped
pH range: 2.5 to 8
temperature limit: 80°C

	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
30mm	9169531		9169532		9169533		9169535	
50mm	9169551		9169552		9169553		9169555	
100mm	9169511		9169512		9169513		9169515	
150mm	9169561		9169562		9169563		9169565	
200mm	9169521		9169522		9169523		9169525	
250mm	9169571		9169572		9169573		9169575	

Allure® PFP Propyl Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Allure PFP Propyl Guard Cartridge	916950212	916950210	916950222	916950220	

Allure® PFP Propyl HPLC Prep Columns

	10mm ID		21.2mm ID		30mm ID		50mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
50mm	9169557		9169558		9169559		9169550	
100mm	9169517		9169518		9169519		9169510	
150mm	9169567		9169568		9169569		9169560	
250mm	9169577		9169578		9169579		9169570	

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antibiotics 723
benzodiazepines 751
catecholamines 745
cocaine, ecgonine methyl ester 750
nucleic acid bases 744
opiates 748

Allure® Aqueous C18 Columns (USP L1)

Chromatographic Properties:

Highly retentive and selective phase for separating polar analytes, including polar acidic compounds. Compatible with highly aqueous (up to 100%) mobile phases. Highly base deactivated. An excellent choice when analyzing a wide range of compounds, as in LC/MS screening methods.

Physical Characteristics:

particle size: 5µm spherical
pore size: 60Å
endcap: no
pH range: 2.5 to 8
temperature limit: 80°C

	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
30mm	9168531		9168532		9168533		9168535	
50mm	9168551		9168552		9168553		9168555	
100mm	9168511		9168512		9168513		9168515	
150mm	9168561		9168562		9168563		9168565	
200mm	9168521		9168522		9168523		9168525	
250mm	9168571		9168572		9168573		9168575	

Allure® Aqueous C18 Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Allure Aqueous C18 Guard Cartridge	916850212	916850210	916850222	916850220	

Allure® Biphenyl Columns (USP L11)

Physical Characteristics:
particle size: 5µm, spherical
pore size: 60Å
carbon load: 23%
endcap: yes
pH range: 2.5 to 8
temperature limit: 80°C

Chromatographic Properties:
Highly retentive and selective for aromatic and unsaturated compounds. Increased retention and selectivity, compared to phenyl phases. Excellent selectivity for steroids, tetracyclines, explosives, and other unsaturated compounds.

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antibiotics 740
corticosteroids 741
steroids 742

	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
30mm	9166531		9166532		9166533		9166535	
50mm	9166551		9166552		9166553		9166555	
100mm	9166511		9166512		9166513		9166515	
150mm	9166561		9166562		9166563		9166565	
200mm	9166521		9166522		9166523		9166525	
250mm	9166571		9166572		9166573		9166575	

Allure® Biphenyl Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Allure Biphenyl Guard Cartridge	916650212	916650210	916650222	916650220	$148

Allure® Biphenyl HPLC Prep Columns

	10mm ID		21.2mm ID		30mm ID		50mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
50mm	9166557		9166558		9166559		9166550	
100mm	9166517		9166518		9166519		9166510	
150mm	9166567		9166568		9166569		9166560	
250mm	9166577		9166578		9166579		9166570	

Allure® Organic Acids Columns

Physical Characteristics:
particle size: 5µm, spherical
pore size: 60Å
endcap: no
pH range: 2.5 to 8
temperature limit: 80°C

Chromatographic Properties:
Allure® Organic Acids columns provide enhanced retention and selectivity for polar organic acids, allowing the separation to be performed on a single 30cm column. An Allure® Organic Acids column effectively resolves key organic acids such as tartaric and quinic acids, using the chromatographic conditions specified in AOAC method 986.13. Retention is stable and reproducible, even with the 100% aqueous mobile phase specified in the AOAC method.

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fruit juice acids 531

	3.2mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price
5µm Column				
150mm	9165563	$586	9165565	
250mm			9165575	
300mm			9165585	

Note: Other dimensions available on request.

Allure® Organic Acids Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Allure Organic Acids Guard Cartridge	916550212	916550210	916550222	916550220	

Allure® Silica Columns (USP L3)

Chromatographic Properties:

Highly retentive phase for normal phase separations. Very high surface area, Type B silica packing.

Physical Characteristics:

particle size: 5µm, spherical
pore size: 60Å
endcap: no
pH range: 2.5 to 8
temperature limit: 80°C

	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
30mm	9160531		9160532		9160533		9160535	
50mm	9160551		9160552		9160553		9160555	
100mm	9160511		9160512		9160513		9160515	
150mm	9160561		9160562		9160563		9160565	
200mm	9160521		9160522		9160523		9160525	
250mm	9160571		9160572		9160573		9160575	

Allure® Silica Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Allure Silica Guard Cartridge	916050212	916050210	916050222	916050220	

Allure® Silica HPLC Prep Columns

	10mm ID		21.2mm ID		30mm ID		50mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
50mm	9160557		9160558		9160559		9160550	
100mm	9160517		9160518		9160519		9160510	
150mm	9160567		9160568		9160569		9160560	
250mm	9160577		9160578		9160579		9160570	

Allure® AK Columns

Chromatographic Properties:

This highly retentive, highly selective phase, unique to Restek, was developed specifically for the analysis of aldehydes and ketones as DNPH derivatives. Allure® AK is a reversed phase HPLC material that has the unique ability to separate all thirteen carbonyl compounds specified in California Air Resources Board (CARB) Method # 1004, using a simple acetonitrile/water gradient, in less than 15 minutes. Other columns require long analysis times or the use of tetrahydrofuran.

Physical Characteristics:

particle size: 5µm
pore size: 60Å
endcap: yes
pH range: 2.5 to 8
temperature limit: 80°C

	3.2mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price
5µm Columns with Trident Integral Inlet Fittings				
200mm	9159523-700	$601	9159525-700	

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carbonyls 710

Allure® AK Guard Cartridge

Guard Cartridges	3-pk. (10 x 4.0mm)	price
Allure AK Guard Cartridge	915950210	

Carbonyls by CARB Method 1004 on an Allure® AK column.

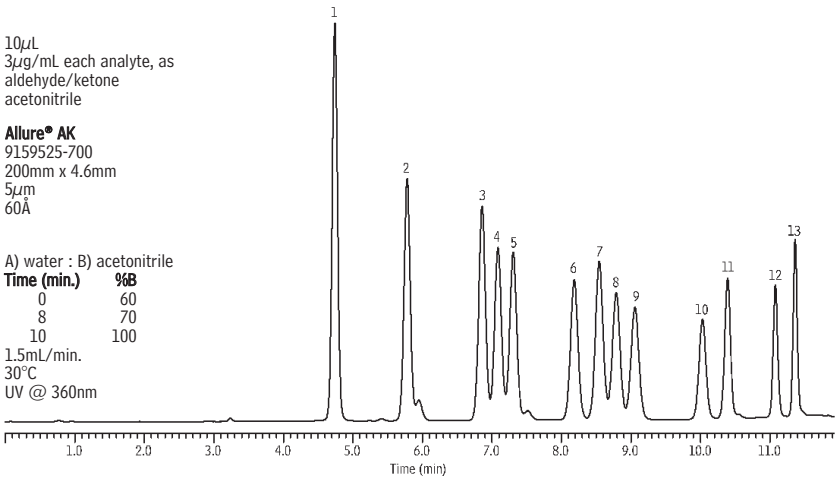
Sample:
Inj.: 10µL
Conc.: 3µg/mL each analyte, as aldehyde/ketone
Sample diluent: acetonitrile

Column: Allure® AK
Cat.#: 9159525-700
Dimensions: 200mm x 4.6mm
Particle size: 5µm
Pore size: 60Å

Conditions:
Mobile phase: A) water : B) acetonitrile

Time (min.)	%B
0	60
8	70
10	100

Flow: 1.5mL/min.
Temp.: 30°C
Det.: UV @ 360nm



LC_EV0393

Peak DNPH derivatives of:	Ret. Time (min.)
1. formaldehyde	4.74
2. acetaldehyde	5.78
3. acrolein	6.86
4. acetone	7.09
5. propionaldehyde	7.31
6. crotonaldehyde	8.19
7. methacrolein	8.55
8. butyraldehyde	8.79
9. methylethylketone	9.06
10. benzaldehyde	10.03
11. valeraldehyde	10.39
12. *m*-tolualdehyde	11.08
13. hexaldehyde	11.36

Ultra Columns: 3µm or 5µm particles; 100Å pore size

Our broadest selection of stationary phases, including unique phases. High density bondings, for maximum retention. High-purity, Type B silica gives excellent peak shapes for a wide range of compounds.

Physical Characteristics:

particle size: 3µm or 5µm, spherical
pore size: 100Å
carbon load: 20%
endcap: fully endcapped
pH range: 2.5 to 8
temperature limit: 80°C

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also available

Capillary HPLC Columns
www.restek.com

- High quality, Restek manufactured packing materials.
- Superior packing technology ensures rugged, reproducible columns.
- Wide range of phases and dimensions available—please inquire.

Ultra C18 Columns (USP L1)

Chromatographic Properties:

A retentive, high-purity packing that exhibits excellent peak shape for a wide range of compounds. Excellent general-purpose reversed phase column.

	1.0mm ID		2.1mm ID		3.2mm ID		4.0mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price	cat.#	price
3µm Columns										
30mm	9174331		9174332		9174333				9174335	
50mm	9174351		9174352		9174353				9174355	
100mm	9174311		9174312		9174313				9174315	
5µm Columns										
30mm	9174531		9174532		9174533				9174535	
50mm	9174551		9174552		9174553				9174555	
100mm	9174511		9174512		9174513		9174514		9174515	
150mm	9174561		9174562		9174563		9174564		9174565	
200mm	9174521		9174522		9174523				9174525	
250mm	9174571		9174572		9174573				9174575	

3.0mm ID available on request for 3µm particle applications above 4,000 psi (275 Bar).

Ultra C18 Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Ultra C18 Guard Cartridge	917450212	917450210	917450222	917450220	$148

Ultra C18 HPLC Prep Columns

	10mm ID		21.2mm ID		30mm ID		50mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
50mm	9174557		9174558		9174559		9174550	
100mm	9174517		9174518		9174519		9174510	
150mm	9174567		9174568		9174569		9174560	
250mm	9174577		9174578		9174579		9174570	

ordering note

To order a 2.1mm, 3.2mm, or 4.6mm ID column with a Trident Integral Inlet Fitting, add "-700" to the catalog number for the column.

Nominal additional charge $15.00

Example: 100mm x 4.6mm ID Ultra C18 column with Trident Integral Inlet Fitting: 9174315-700

Also order an XG-XF fitting (10mm: cat.#25026 or 20mm: 25062), see page 196.

Ultra C8 Columns (USP L7)

Chromatographic Properties:

A retentive, high-purity, base-deactivated reversed phase packing that exhibits excellent peak shape for a wide range of compounds. Less retention for neutral, hydrophobic compounds, compared to the Ultra C18 column.

	1.0mm ID		2.1mm ID		3.2mm ID		4.0mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price	cat.#	price
3µm Columns										
30mm	9103331		9103332		9103333				9103335	
50mm	9103351		9103352		9103353				9103355	
100mm	9103311		9103312		9103313				9103315	
5µm Columns										
30mm	9103531		9103532		9103533				9103535	
50mm	9103551		9103552		9103553				9103555	
100mm	9103511		9103512		9103513		9103514		9103515	
150mm	9103561		9103562		9103563		9103564		9103565	
200mm	9103521		9103522		9103523				9103525	
250mm	9103571		9103572		9103573				9103575	

3.0mm ID available on request for 3µm particle applications above 4,000 psi (275 Bar).

Ultra C8 Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Ultra C8 Guard Cartridge	910350212	910350210	910350222	910350220	

Ultra C8 HPLC Prep Columns

	10mm ID		21.2mm ID		30mm ID		50mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
50mm	9103557		9103558		9103559		9103550	
100mm	9103517		9103518		9103519		9103510	
150mm	9103567		9103568		9103569		9103560	
250mm	9103577		9103578		9103579		9103570	

Physical Characteristics:

particle size: 3µm or 5µm, spherical
pore size: 100Å
carbon load: 12%
endcap: fully endcapped
pH range: 2.5 to 8
temperature limit: 80°C

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oxycodone 738
vanillin & ethyl vanillin 728
vitamins 733

also available

Capillary HPLC Columns

www.restek.com

- High quality, Restek manufactured packing materials.
- Superior packing technology ensures rugged, reproducible columns.
- Wide range of phases and dimensions available—please inquire.

Ultra Aqueous C18 Columns (USP L1)

Chromatographic Properties:

Highly retentive and selective for reversed phase separations of polar analytes. Highly base-deactivated. Compatible with highly aqueous (up to 100%) mobile phases.

	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
3µm Columns								
30mm	9178331		9178332		9178333		9178335	
50mm	9178351		9178352		9178353		9178355	
100mm	9178311		9178312		9178313		9178315	
5µm Columns								
30mm	9178531		9178532		9178533		9178535	
50mm	9178551		9178552		9178553		9178555	
100mm	9178511		9178512		9178513		9178515	
150mm	9178561		9178562		9178563		9178565	
200mm	9178521		9178522		9178523		9178525	
250mm	9178571		9178572		9178573		9178575	

3.0mm ID available on request for 3µm particle applications above 4,000 psi (275 Bar).

Ultra Aqueous C18 Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Ultra Aqueous C18 Guard Cartridge	917850212	917850210	917850222	917850220	$148

Ultra Aqueous C18 HPLC Prep Columns

	10mm ID		21.2mm ID		30mm ID		50mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
50mm	9178557		9178558		9178559		9178550	
100mm	9178517		9178518		9178519		9178510	
150mm	9178567		9178568		9178569		9178560	
250mm	9178577		9178578		9178579		9178570	

Physical Characteristics:

particle size: 3µm or 5µm, spherical
pore size: 100Å
carbon load: 15%
endcap: no
pH range: 2.5 to 8
temperature limit: 80°C

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pesticides 721
phenethyl glucosinolate 730
sudan dyes 722
vitamins 731

Ultra IBD Columns

Physical Characteristics:
particle size: 3µm or 5µm, spherical
pore size: 100Å
carbon load: 12%
endcap: no
pH range: 2.5 to 8
temperature limit: 80°C

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antibiotics 740, 741
diflubenzuron (pesticide) 716
glyburide 741
nucleosides, nucleotides, & nucleic acid bases 744
vitamins 732

Chromatographic Properties:
An intrinsically base-deactivated (IBD) phase, containing a polar group within, or intrinsic to, the hydrocarbon bonded phase. Unique selectivity and a high level of base deactivation, while reducing or eliminating the need for mobile phase additives.

	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
3µm Columns								
30mm	9175331		9175332		9175333		9175335	
50mm	9175351		9175352		9175353		9175355	
100mm	9175311		9175312		9175313		9175315	
5µm Columns								
30mm	9175531		9175532		9175533		9175535	
50mm	9175551		9175552		9175553		9175555	
100mm	9175511		9175512		9175513		9175515	
150mm	9175561		9175562		9175563		9175565	
200mm	9175521		9175522		9175523		9175525	
250mm	9175571		9175572		9175573		9175575	

3.0mm ID available on request for 3µm particle applications above 4,000 psi (275 Bar).

Ultra IBD Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Ultra IBD Guard Cartridge	917550212	917550210	917550222	917550220	$148

Ultra IBD HPLC Prep Columns

	10mm ID		21.2mm ID		30mm ID		50mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
50mm	9175557		9175558		9175559		9175550	
100mm	9175517		9175518		9175519		9175510	
150mm	9175567		9175568		9175569		9175560	
250mm	9175577		9175578		9175579		9175570	

Ultra C4 Columns (USP L26)

Physical Characteristics:
particle size: 3µm or 5µm, spherical
pore size: 100Å
carbon load: 9%
endcap: fully endcapped
pH range: 2.5 to 8
temperature limit: 80°C

Chromatographic Properties:
Exceptionally stable C4 packing, with high bonding coverage and base deactivation. Less retention than C18 or C8 phases.

	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
3µm Columns								
30mm	9102331		9102332		9102333		9102335	
50mm	9102351		9102352		9102353		9102355	
100mm	9102311		9102312		9102313		9102315	
5µm Columns								
30mm	9102531		9102532		9102533		9102535	
50mm	9102551		9102552		9102553		9102555	
100mm	9102511		9102512		9102513		9102515	
150mm	9102561		9102562		9102563		9102565	
200mm	9102521		9102522		9102523		9102525	
250mm	9102571		9102572		9102573		9102575	

3.0mm ID available on request for 3µm particle applications above 4,000 psi (275 Bar).

Ultra C4 Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Ultra C4 Guard Cartridge	910250212	910250210	910250222	910250220	

Ultra C1 Columns (USP L13)

Chromatographic Properties:

Exceptionally stable C1 phase. Least retentive reversed phase hydrocarbon packing.

	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
3µm Columns								
30mm	9101331		9101332		9101333		9101335	
50mm	9101351		9101352		9101353		9101355	
100mm	9101311		9101312		9101313		9101315	
5µm Columns								
30mm	9101531		9101532		9101533		9101535	
50mm	9101551		9101552		9101553		9101555	
100mm	9101511		9101512		9101513		9101515	
150mm	9101561		9101562		9101563		9101565	
200mm	9101521		9101522		9101523		9101525	
250mm	9101571		9101572		9101573		9101575	

3.0mm ID available on request for 3µm particle applications above 4,000 psi (275 Bar).

Ultra C1 Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Ultra C1 Guard Cartridge	910150212	910150210	910150222	910150220	

Physical Characteristics:

particle size: 3µm or 5µm, spherical
pore size: 100Å
carbon load: 5%
pH range: 2.5 to 8
temperature limit: 80°C

also available

HPLC Syringes

See pages 346-349.

Ultra Cyano Columns (USP L10)

Chromatographic Properties:

High-purity cyano phase with few silanol sites. Often a better choice than C18 phases for basic pharmaceuticals, especially regarding peak shape and selectivity. Cyano phases are more rugged than bare silica for normal phase analyses because they are less sensitive to small amounts of water in the mobile phase.

	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
3µm Columns								
30mm	9106331		9106332		9106333		9106335	
50mm	9106351		9106352		9106353		9106355	
100mm	9106311		9106312		9106313		9106315	
5µm Columns								
30mm	9106531		9106532		9106533		9106535	
50mm	9106551		9106552		9106553		9106555	
100mm	9106511		9106512		9106513		9106515	
150mm	9106561		9106562		9106563		9106565	
200mm	9106521		9106522		9106523		9106525	
250mm	9106571		9106572		9106573		9106575	

3.0mm ID available on request for 3µm particle applications above 4,000 psi (275 Bar).

Ultra Cyano Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Ultra Cyano Guard Cartridge	910650212	910650210	910650222	910650220	$148

Ultra Cyano HPLC Prep Columns

	10mm ID		21.2mm ID		30mm ID		50mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
50mm	9106557		9106558		9106559		9106550	
100mm	9106517		9106518		9106519		9106510	
150mm	9106567		9106568		9106569		9106560	
250mm	9106577		9106578		9106579		9106570	

Physical Characteristics:

particle size: 3µm or 5µm, spherical
pore size: 100Å
carbon load: 8%
endcap: fully endcapped
pH range: 2.5 to 8
temperature limit: 80°C

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ordering note

We strongly recommend ordering a semi-prep or prep column only after evaluating the desired separation on an equivalent analytical-scale column. Because we cannot re-use a column or the silica it contains once it has left our facility, we cannot accept returns of large-scale columns (except in cases of our error).

Ultra Phenyl Columns (USP L11)

Physical Characteristics:
particle size: 3µm or 5µm, spherical
pore size: 100Å
carbon load: 10%
endcap: fully endcapped
pH range: 2.5 to 8
temperature limit: 80°C

Chromatographic Properties:
High-purity, highly retentive, base-deactivated phase with alternative selectivity to straight chain hydrocarbon phases, especially for aromatic analytes.

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guaifenesin, codeine 743

	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
3µm Columns								
30mm	9105331		9105332		9105333		9105335	
50mm	9105351		9105352		9105353		9105355	
100mm	9105311		9105312		9105313		9105315	
5µm Columns								
30mm	9105531		9105532		9105533		9105535	
50mm	9105551		9105552		9105553		9105555	
100mm	9105511		9105512		9105513		9105515	
150mm	9105561		9105562		9105563		9105565	
200mm	9105521		9105522		9105523		9105525	
250mm	9105571		9105572		9105573		9105575	

3.0mm ID available on request for 3µm particle applications above 4,000 psi (275 Bar).

Ultra Phenyl Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Ultra Phenyl Guard Cartridge	910550212	910550210	910550222	910550220	

Ultra Phenyl HPLC Prep Columns

	10mm ID		21.2mm ID		30mm ID		50mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
50mm	9105557		9105558		9105559		9105550	
100mm	9105517		9105518		9105519		9105510	
150mm	9105567		9105568		9105569		9105560	
250mm	9105577		9105578		9105579		9105570	

Ultra Amino Columns (USP L8)

Physical Characteristics:
particle size: 3µm or 5µm, spherical
pore size: 100Å
carbon load: 2%
encap: no
pH range: 2.5 to 8
temperature limit: 80°C

Chromatographic Properties:
Recommended for normal phase analyses of mono- and disaccharides, or similar compounds.

	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
3µm Columns								
30mm	9107331		9107332		9107333		9107335	
50mm	9107351		9107352		9107353		9107355	
100mm	9107311		9107312		9107313		9107315	
5µm Columns								
30mm	9107531		9107532		9107533		9107535	
50mm	9107551		9107552		9107553		9107555	
100mm	9107511		9107512		9107513		9107515	
150mm	9107561		9107562		9107563		9107565	
200mm	9107521		9107522		9107523		9107525	
250mm	9107571		9107572		9107573		9107575	

3.0mm ID available on request for 3µm particle applications above 4,000 psi (275 Bar).

Ultra Amino Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Ultra Amino Guard Cartridge	910750212	910750210	910750222	910750220	

also **available**

Bulk Packing Materials
See page 194.

Ultra PFP Columns (USP L43)

Chromatographic Properties:

A pentafluorophenyl phase. Unique selectivity for compounds containing organohalogens or other basic functional groups.

	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
3µm Columns								
30mm	9176331		9176332		9176333		9176335	
50mm	9176351		9176352		9176353		9176355	
100mm	9176311		9176312		9176313		9176315	
5µm Columns								
30mm	9176531		9176532		9176533		9176535	
50mm	9176551		9176552		9176553		9176555	
100mm	9176511		9176512		9176513		9176515	
150mm	9176561		9176562		9176563		9176565	
200mm	9176521		9176522		9176523		9176525	
250mm	9176571		9176572		9176573		9176575	

3.0mm ID available on request for 3µm particle applications above 4,000 psi (275 Bar).

Physical Characteristics:

particle size: 3µm or 5µm, spherical
pore size: 100Å
carbon load: 7%
endcap: fully endcapped
pH range: 2.5 to 8
temperature limit: 80°C

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Ultra PFP Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Ultra PFP Guard Cartridge	917650212	917650210	917650222	917650220	

Ultra PFP HPLC Prep Columns

	10mm ID		21.2mm ID		30mm ID		50mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
50mm	9176557		9176558		9176559		9176550	
100mm	9176517		9176518		9176519		9176510	
150mm	9176567		9176568		9176569		9176560	
250mm	9176577		9176578		9176579		9176570	

ordering **note**

To order a 2.1mm, 3.2mm, or 4.6mm ID column with a Trident Integral Inlet Fitting, add "-700" to the catalog number for the column.

Nominal additional charge $15.00

Example: 100mm x 4.6mm ID Ultra C18 column with Trident Integral Inlet Fitting: 9174315-700

Also order an XG-XF fitting (10mm: cat.#25026 or 20mm: 25062), see page 196.

Physical Characteristics:
particle size: 3µm or 5µm, spherical
pore size: 100Å
endcap: no
pH range: 2.5 to 8
temperature limit: 80°C

also **available**

We also have syringe filters!
See **page 399**.

restek **exclusive**!

Physical Characteristics:
particle size: 3µm or 5µm, spherical
pore size: 100Å
pH range: 2.5 to 8
temperature limit: 80°C

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food contaminants (carbamates) 719

restek **innovation**!

Faster analyses and reduced solvent use!
An Ultra Carbamate column can process as many as 3 to 4 samples per hour, versus less than 2 samples per hour on a general-purpose C18 column.

Ultra Silica Columns (USP L3)

Chromatographic Properties:
High surface area, Type B silica packing.

	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
3µm Columns								
30mm	9100331		9100332		9100333		9100335	
50mm	9100351		9100352		9100353		9100355	
100mm	9100311		9100312		9100313		9100315	
5µm Columns								
30mm	9100531		9100532		9100533		9100535	
50mm	9100551		9100552		9100553		9100555	
100mm	9100511		9100512		9100513		9100515	
150mm	9100561		9100562		9100563		9100565	
200mm	9100521		9100522		9100523		9100525	
250mm	9100571		9100572		9100573		9100575	

3.0mm ID available on request for 3µm particle applications above 4,000 psi (275 Bar).

Ultra Silica Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Ultra Silica Guard Cartridge	910050212	910050210	910050222	910050220	

Ultra Silica HPLC Prep Columns

	10mm ID		21.2mm ID		30mm ID		50mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
50mm	9100557		9100558		9100559		9100550	
100mm	9100517		9100518		9100519		9100510	
150mm	9100567		9100568		9100569		9100560	
250mm	9100577		9100578		9100579		9100570	

Ultra Carbamate Columns

Chromatographic Properties:
Restek chemists developed the Ultra Carbamate column specifically for carbamates analysis. The unique packing separates 10 target carbamates in just over 10 minutes. The column is compatible with fluorescence or LC/MS detection.* An Ultra Carbamate column can process as many as 3 to 4 samples per hour, versus less than 2 samples per hour on a general-purpose C18 column. In addition to increased sample throughput, this much faster analysis will significantly reduce solvent usage—and the costs of disposing of solvent waste.

	1.0mm ID		2.1mm ID		3.2mm ID		4.0mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price	cat.#	price
3µm Columns										
50mm	9177351		9177352		9177353		9177354	$491	9177355	
100mm	9177311		9177312		9177313				9177315	
5µm Columns										
250mm									9177575	$485

3.0mm ID available on request for 3µm particle applications above 4,000 psi (275 Bar).

*For post-column derivatization/fluorescence detection applications using a 4.6mm ID column, the total system dead volume, including the post-column reactor, must be less than 650µL. For standard post-column reactor systems, we recommend a 250mm x 4.6mm, 5µm column. Contact Restek technical service or your Restek representative for more information.

Ultra Carbamate Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Ultra Carbamate Guard Cartridge	917750212	917750210	917750222	917750220	

Ultra Quat Columns

Chromatographic Properties:

A retentive, high-purity, base deactivated reversed phase packing. Ideal for the analysis of paraquat and diquat or other quaternary amines when used with Ultra Quat Reagent Solution mobile phase additive (cat.# 32441).

Length	4.6mm ID cat.#	price
5µm Column		
150mm	9181565	

Ultra Quat Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Ultra Quat Guard Cartridge	918150212	918150210	918150222	918150220	

Ultra Quat Reagent Solution

Use with Ultra Quat HPLC column. Dilute to 1 liter water, per instructions.

In water, 20mL/bottle
cat. # 32441 (ea.) $54

Paraquat & Diquat Calibration Mix

diquat dibromide paraquat dichloride
1,000µg/mL each in water, 1mL/ampul
cat. # 32437 (ea.) $28

restek **innovation**!

An Ultra Quat column and Ultra Quat Reagent Solution eliminate the need for ion pairing reagents in paraquat/diquat analysis.

restek **exclusive**!

Physical Characteristics:

particle size: 5µm, spherical
pore size: 100Å
pH range: 2.5 to 8
temperature limit: 80°C

Page #
paraquat, diquat 715

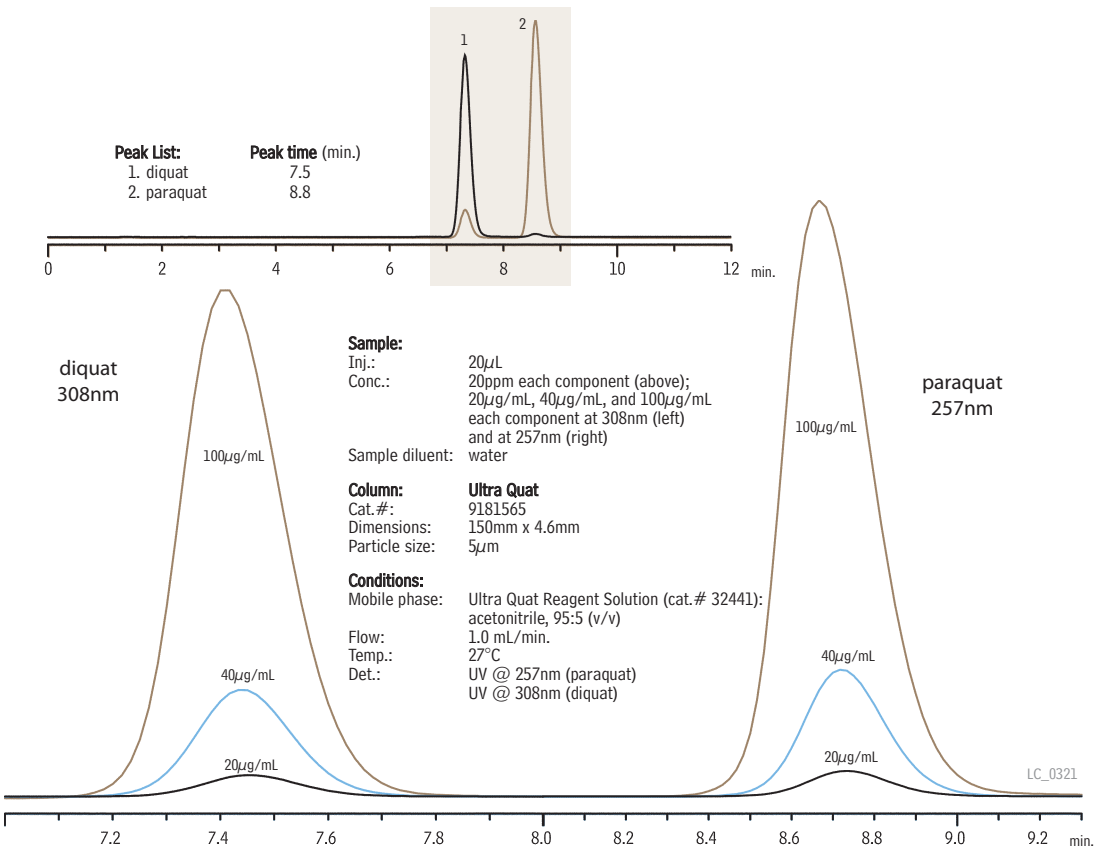
free literature

Simple, Sensitive HPLC/UV Analysis for Paraquat and Diquat

Download your free copy from **www.restek.com**

lit. cat.# 580006

Consistent resolution, retention times, and peak symmetry for paraquat and diquat on an Ultra Quat column.



restek **innovation**!

Viva silica has a narrow distribution around the mean pore size, permitting a larger portion of the silica surface to play a role in the separation of large molecules and biomolecules.

Viva Wide Pore Columns: 3µm or 5µm particles; 300Å pore size

- Excellent for separating peptides or proteins.
- Rugged, spherical particles, with 300Å pore size.
- High proportion of pore/surface area available to large molecules.

Viva columns are based on a wide pore material we designed for optimal large molecule separations. In developing Viva silica, we found that although many commercial wide-pore silicas meet the standard 300Å mean pore size, most have very broad distributions about this mean, with a significant portion of their pore volume falling below 150Å. This means a large portion of the surface area is unavailable to larger molecules. Viva columns have a narrow distribution around the mean pore size, permitting a larger portion of the silica surface to play a role in the separation.

Restek manufactured silica

Physical Characteristics:

particle size: 3µm or 5µm, spherical
pore size: 300Å
carbon load: 9%
endcap: yes
pH range: 2.5 to 8
temperature limit: 80°C

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oxytocin 746
peptides 745
proteins 746

Viva C18 Columns (USP L1)

Chromatographic Properties:

Highly base-deactivated wide pore packing that exhibits excellent peak shape for a wide range of compounds. Excellent general-purpose column for analyzing large molecules and biomolecules.

	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
3µm Columns								
30mm	9514331		9514332		9514333		9514335	
50mm	9514351		9514352		9514353		9514355	
100mm	9514311		9514312		9514313		9514315	
150mm	9514361		9514362		9514363		9514365	
5µm Columns								
30mm	9514531		9514532		9514533		9514535	
50mm	9514551		9514552		9514553		9514555	
100mm	9514511		9514512		9514513		9514515	
150mm	9514561		9514562		9514563		9514565	
200mm	9514521		9514522		9514523		9514525	
250mm	9514571		9514572		9514573		9514575	

3.0mm ID available on request for 3µm particle applications above 4,000 psi (275 Bar).

Viva C18 Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Viva C18 Guard Cartridge	951450212	951450210	951450222	951450220	

Viva C18 HPLC Prep Columns

	10mm ID		21.2mm ID		30mm ID		50mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
50mm	9514557		9514558		9514559		9514550	
100mm	9514517		9514518		9514519		9514510	
150mm	9514567		9514568		9514569		9514560	
250mm	9514577		9514578		9514579		9514570	

also **available**

Capillary HPLC Columns
www.restek.com

- High quality, Restek manufactured packing materials.
- Superior packing technology ensures rugged, reproducible columns.
- Wide range of phases and dimensions available—please inquire.

Viva C8 Columns (USP L7)

Chromatographic Properties:

Highly base-deactivated wide pore packing that exhibits excellent peak shape for a wide range of compounds. Less retention in reversed phase assays than Viva C18.

	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
30mm	9513531		9513532		9513533		9513535	
50mm	9513551		9513552		9513553		9513555	
100mm	9513511		9513512		9513513		9513515	
150mm	9513561		9513562		9513563		9513565	
200mm	9513521		9513522		9513523		9513525	
250mm	9513571		9513572		9513573		9513575	

Viva C8 Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Viva C8 Guard Cartridge	951350212	951350210	951350222	951350220	

Viva C8 HPLC Prep Columns

	10mm ID		21.2mm ID		30mm ID		50mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
50mm	9513557		9513558		9513559		9513550	
100mm	9513517		9513518		9513519		9513510	
150mm	9513567		9513568		9513569		9513560	
250mm	9513577		9513578		9513579		9513570	

Restek manufactured silica

Physical Characteristics:

particle size: 5µm, spherical
pore size: 300Å
carbon load: 5%
endcap: yes
pH range: 2.5 to 8
temperature limit: 80°C

also available

3µm particles are available for all Viva phases—please inquire.

Viva C4 Columns (USP L26)

Chromatographic Properties:

Highly base-deactivated wide pore packing that exhibits excellent peak shape for a wide range of compounds. Less retention in reversed phase assays than Viva C18 or Viva C8.

	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
30mm	9512531		9512532		9512533		9512535	
50mm	9512551		9512552		9512553		9512555	
100mm	9512511		9512512		9512513		9512515	
150mm	9512561		9512562		9512563		9512565	
200mm	9512521		9512522		9512523		9512525	
250mm	9512571		9512572		9512573		9512575	

Viva C4 Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Viva C4 Guard Cartridge	951250212	951250210	951250222	951250220	

Viva C4 HPLC Prep Columns

	10mm ID		21.2mm ID		30mm ID		50mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
50mm	9512557		9512558		9512559		9512550	
100mm	9512517		9512518		9512519		9512510	
150mm	9512567		9512568		9512569		9512560	
250mm	9512577		9512578		9512579		9512570	

Restek manufactured silica

Physical Characteristics:

particle size: 5µm, spherical
pore size: 300Å
carbon load: 3.5%
endcap: yes
pH range: 2.5 to 8
temperature limit: 80°C

ordering note

Other column dimensions and phases are available. Please call for a quote.

free literature

Viva Wide Pore HPLC Columns

Download your free copy from **www.restek.com**

lit. cat# 59939

restek **exclusive**!

Physical Characteristics:

particle size: 5µm
pore size: 300Å
carbon load: 6.7%
endcap: yes
pH range: 2.5 to 8
temperature limit: 80°C

also **available**

3µm particles are available for all Viva phases—please inquire.

Viva Biphenyl Columns (USP L11)

Chromatographic Properties:

Highly base-deactivated wide pore packing that exhibits excellent peak shape for a wide range of compounds; ideal for large molecule and biomolecule assays. Highly retentive and selective phase for aromatic and unsaturated compounds, with increased retention, relative to phenyl phases.

	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
30mm	9516531		9516532		9516533		9516535	
50mm	9516551		9516552		9516553		9516555	
100mm	9516511		9516512		9516513		9516515	
150mm	9516561		9516562		9516563		9516565	
200mm	9516521		9516522		9516523		9516525	
250mm	9516571		9516572		9516573		9516575	

Viva Biphenyl Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Viva Biphenyl Guard Cartridge	951650212	951650210	951650222	951650220	

Restek manufactured silica

Viva PFP Propyl Columns (USP L43)

Chromatographic Properties:

A pentafluorophenyl phase with a propyl spacer. Highly retentive for basic analytes. Highly base-deactivated wide pore packing that exhibits excellent peak shape for a wide range of compounds, including nucleosides, nucleotides, and halogenated compounds.

Physical Characteristics:

particle size: 5µm, spherical
pore size: 300Å
carbon load: 5%
endcap: yes
pH range: 2.5 to 8
temperature limit: 80°C

	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
30mm	9519531		9519532		9519533		9519535	
50mm	9519551		9519552		9519553		9519555	
100mm	9519511		9519512		9519513		9519515	
150mm	9519561		9519562		9519563		9519565	
200mm	9519521		9519522		9519523		9519525	
250mm	9519571		9519572		9519573		9519575	

Viva PFP Propyl Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Viva PFP Propyl Guard Cartridge	951950212	951950210	951950222	951950220	

also **available**

Looking for HPLC syringes?

See pages 346-349.

Viva Silica Columns (USP L3)

Chromatographic Properties:

Highly base-deactivated wide pore packing that exhibits excellent peak shape for a wide range of compounds in normal phase separations.

Restek manufactured silica

Physical Characteristics:

particle size: 5µm, spherical
pore size: 300Å
pH range: 2.5 to 8
temperature limit: 80°C

	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
Length	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
30mm	9510531		9510532		9510533		9510535	
50mm	9510551		9510552		9510553		9510555	
100mm	9510511		9510512		9510513		9510515	
150mm	9510561		9510562		9510563		9510565	
200mm	9510521		9510522		9510523		9510525	
250mm	9510571		9510572		9510573		9510575	

Viva Silica Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Viva Silica Guard Cartridge	951050212	951050210	951050222	951050220	

ordering **note**

To order a 2.1mm, 3.2mm, or 4.6mm ID column with a Trident Integral Inlet Fitting, add "-700" to the catalog number for the column.

Nominal additional charge $15.00

Example: 100mm x 4.6mm ID Ultra C18 column with Trident Integral Inlet Fitting: 9174315-700

Also order an XG-XF fitting (10mm: cat.#25026 or 20mm: 25062), see page 196.

Chromatogram Search Tool

Search by compound name, synonym, CAS # or keyword

www.restek.com/chromatograms

Bulk Packing Materials

Use our bulk packing materials to pack your own columns!

- Prepare your own columns in conventional or custom dimensions.
- Consistent, high-quality materials.

Restek is among the small group of column manufacturers capable of producing their own high purity silica. We offer our Ultra II®, Pinnacle® II and Pinnacle® DB silica and bonded phases in bulk. Pinnacle® II is an excellent replacement for Hypersil® silica. Pinnacle® DB is a highly base-deactivated material for analyses of basic compounds and an excellent alternative to Hypersil® BDS silica. Bonded phases from our Ultra, Allure®, and Viva lines also are available in bulk.

Our extensive QC program ensures the high quality and reproducibility of these silicas. Each lot of material is tested for mean particle size and distribution, pore diameter, surface area, and total metals analysis. You can be confident that you are getting consistent, high-quality product.

Use these materials for easy scale up to preparative scale chromatography, or for packing your own columns.

NEW!

Description	min. qty.	cat.#	5-99 grams	100-499 grams	500-999 grams	≥1000 grams
3µm Ultra II Bulk Packing Materials						
Ultra II C18 Bulk Packing	5g	96043				
Ultra II C8 Bulk Packing	5g	96033				
Ultra II Silica Bulk Packing	5g	96003				
5µm Ultra II Bulk Packing Materials						
Ultra II C18 Bulk Packing	5g	96045				
Ultra II C8 Bulk Packing	5g	96035				
Ultra II Silica Bulk Packing	5g	96005				
5µm Pinnacle DB Bulk Packing Materials						
Pinnacle DB C18 Bulk Packing	5g	94145				
Pinnacle DB C8 Bulk Packing	5g	94135				
Pinnacle DB Cyano Bulk Packing	5g	94165				
Pinnacle DB Silica Bulk Packing	5g	94105				
3µm Pinnacle II Bulk Packing Materials						
Pinnacle II C8 Bulk Packing	5g	92133				
Pinnacle II C18 Bulk Packing	5g	92143				
Pinnacle II Cyano Bulk Packing	5g	92163				
Pinnacle II Phenyl Bulk Packing	5g	92153				
Pinnacle II Silica Bulk Packing	5g	92103				
5µm Pinnacle II Bulk Packing Materials						
Pinnacle II Amino Bulk Packing	5g	92175				
Pinnacle II C8 Bulk Packing	5g	92135				
Pinnacle II C18 Bulk Packing	5g	92145				
Pinnacle II Cyano Bulk Packing	5g	92165				
Pinnacle II Phenyl Bulk Packing	5g	92155				
Pinnacle II Silica Bulk Packing	5g	92105				

Description	qty.	cat.#	1-9 bottles	10-49 bottles	50-99 bottles	≥100 bottles
5µm Ultra Bulk Packing Materials						
Ultra C1 Bulk Packing	10g/btl.	91015				
Ultra C4 Bulk Packing	10g/btl.	91025				
Ultra C8 Bulk Packing	10g/btl.	91035				
Ultra C18 Bulk Packing	10g/btl.	91745				
Ultra Amino Bulk Packing	10g/btl.	91075				
Ultra Cyano Bulk Packing	10g/btl.	91065				
Ultra Phenyl Bulk Packing	10g/btl.	91055				
Ultra Silica Bulk Packing	10g/btl.	91005				

also **available**

Other stationary phases and particle sizes are available; please inquire.

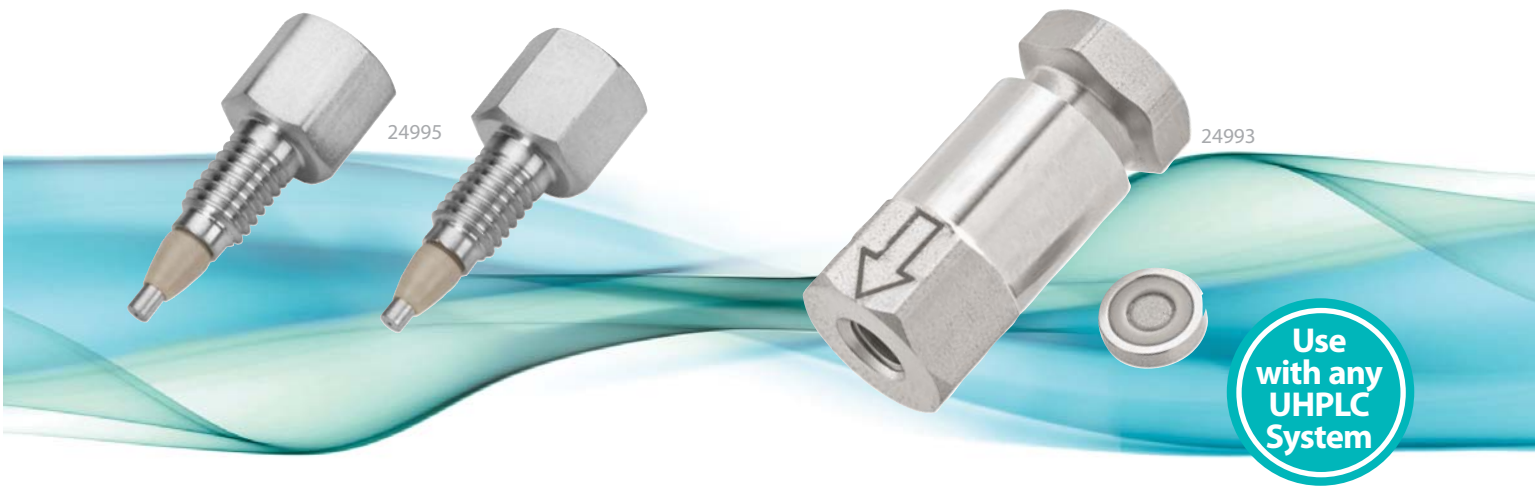
also **available**

Restek Pack in a Box Kit: HPLC Column Packing System
See page 351.

NEW!

Protect your column with UltraShield and UltraLine UHPLC Filters

A cost-effective way to extend the lifetime of any UHPLC column, without sacrificing UHPLC performance.



UltraShield UHPLC PreColumn Filter

- Cost-effective protection for UHPLC systems.
- Reliable way to extend column lifetime.
- Universal fit—connects easily to any brand column.
- Leak-tight to 15,000 psi (1034 bar).
- 0.5 µm titanium filter in stainless steel body with PEEK ferrule.

Specifications:

Inlet/Outlet:	Female/Male 10-32
Port Geometry:	Parker ($^{1}/_{16}$ CPI)
Material:	Stainless Steel, PEEK ferrule
Filter:	0.5 μm Titanium
Pressure Rating:	15,000 psig (1054 bar)
Wrench Flat:	$^{5}/_{16}$"

Description	qty.	cat.#	price
UltraShield UHPLC PreColumn Filter	ea.	24995	$50
UltraShield UHPLC PreColumn Filter	5-pk.	24996	$190
UltraShield UHPLC PreColumn Filter	10-pk.	24997	$360

UltraLine UHPLC In-Line Filter

- In-line design installs easily with standard fittings.
- Cost-effective protection for UHPLC systems.
- Reliable way to extend column lifetime.
- Leak-tight to 15,000 psi (1034 bar).
- Replaceable 0.5 µm stainless steel filter in stainless steel body.

Specifications:

Inlet/Outlet:	Female/Female 10-32
Port Geometry:	Parker ($^{1}/_{16}$ CPI)
Material:	Stainless Steel housing
Filter:	0.5 μm Stainless Steel, 0.125" W x 0.062" T, 5 μL volume
Pressure Rating:	15,000 psig (1054 bar)
Wrench Flat:	$^{3}/_{8}$"

Description	qty.	cat.#	price
UltraLine UHPLC In-Line Filter (In-Line Assembly with Filter)	ea.	24993	$125
UltraLine Replacement Filters	5-pk.	24994	$60

Shannon Rishell, Customer Service

Restek Customer Service

In the U.S.

Call: 800-356-1688 (ext. 3) or 814-353-1300 (ext. 3)

Monday–Friday 8:00 a.m.–6:00 p.m. ET

Fax: 814-353-1309—24-hours a day

Online: www.restek.com—24-hours a day

Outside the U.S.

Contact your Restek representative: Refer to our list on pages 4-5 or visit our website at www.restek.com

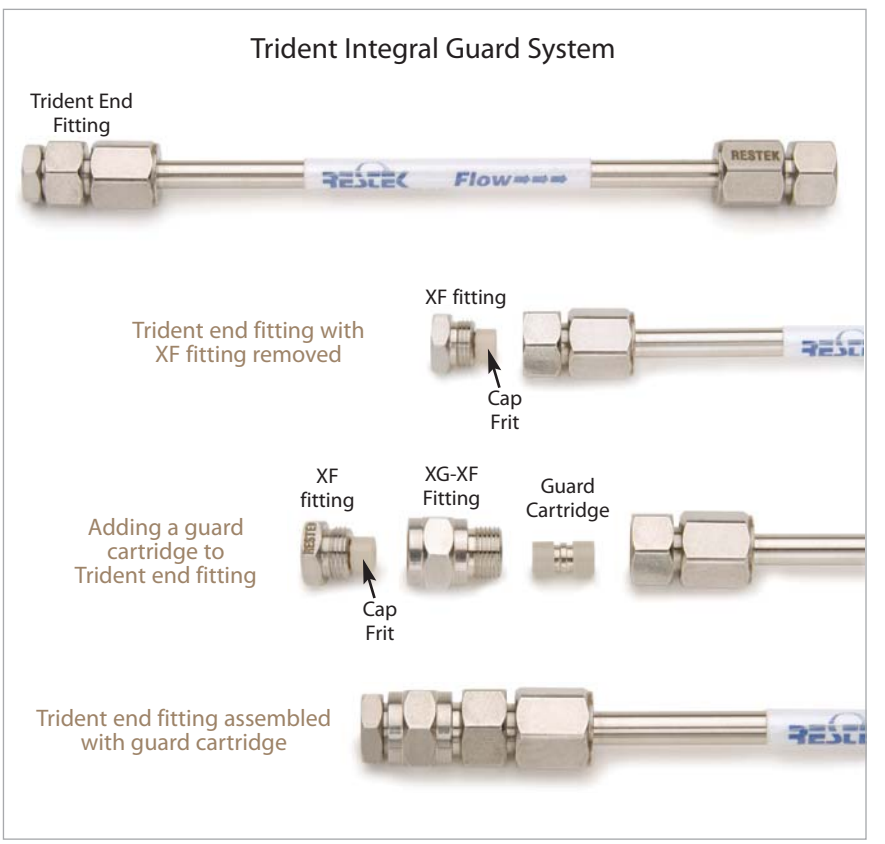
Restek's Exclusive Trident Integral System

- Convenient and economical leak-free guard cartridge system, extremely easy to install.
- Versatile configuration protects against all levels of contamination.
- Integral design eliminates troublesome tubing connections.

The system's foundation consists of the analytical column configured with our exclusive Trident end fitting and XF fitting. This configuration contains the standard internal frit as well as a replaceable cap frit, which easily can be changed without disturbing the packed bed. Changing the external frit can reverse the effects of accumulated particles, such as high backpressure or peak distortion. To obtain this basic configuration, simply order any Restek HPLC column, and add the suffix -700 to the catalog number for the column. (Nominal additional charge.)

For maximum protection against contaminants and particulate matter, the system can be configured with an integral guard cartridge holder (XG-XF), a guard cartridge, and a replaceable external frit. To obtain this configuration, simply order any Restek HPLC column, add the suffix -700 to the catalog number for the column, and order the appropriate XG-XF male fitting (cat.# 25026 or 25062) and Trident guard cartridges. See page 198.

Description	qty.	cat.#	price
XG-XF Fitting for 10mm Guard Cartridge	ea.	25026	
XG-XF Fitting for 20mm Guard Cartridge	ea.	25062	
Replacement XF Filter Fitting	ea.	25024	
Replacement Cap Frits: 4mm 2.0µm	5-pk.	25022	
Replacement Cap Frits: 4mm 0.5µm	5-pk.	25023	
Replacement Cap Frits: 2mm 2.0µm	5-pk.	25057	
Replacement Cap Frits: 2mm 0.5µm	5-pk.	25990	



Trident Direct Guard Cartridge System

Easy to Use, Low Dead Volume—The Ultimate Combination of Convenience and Column Protection

Unlike "one size fits all" guard systems, the Trident Direct system gives you the power to select the right level of protection for your analysis. The system offers three levels of protection and guard cartridges in four dimensions, with a variety of bonded phases to match your analytical column. The economical, leak-free cartridge design provides an unprecedented combination of convenience, economy, and reliability. The foundation of the Trident Direct system is a reusable direct connect holder that easily attaches to any HPLC column using CPI- or Waters-style end fittings.* The system is available in configurations to match different protection level needs: in-line filter, in-line filter with holder for 10mm guard cartridge, and in-line filter with holder for 20mm guard cartridge. The guard cartridges are available in 2.1 and 4.0mm ID and are interchangeable within the appropriate length holder.

25082
Protection against particulate matter.

25084
Protection against particulate matter and moderate protection against irreversibly adsorbed compounds.

25086
Protection against particulate matter and maximum protection against irreversibly adsorbed compounds.

Description	qty.	cat.#	price
High-pressure filter	ea.	25082	
10mm guard cartridge holder without filter	ea.	25083	
10mm guard cartridge holder with filter	ea.	25084	
20mm guard cartridge holder without filter	ea.	25085	
20mm guard cartridge holder with filter	ea.	25086	
Connection tip for Waters-style end fittings	ea.	25088	
PEEK tip standard fittings	ea.	25087	
Replacement Cap Frits: 4mm 2.0µm	5-pk.	25022	
Replacement Cap Frits: 4mm 0.5µm	5-pk.	25023	
Replacement Cap Frits: 2mm 2.0µm	5-pk.	25057	
Replacement Cap Frits: 2mm 0.5µm	5-pk.	25990	

*The standard PEEK tip in Trident Direct systems is compatible with Parker, Upchurch Scientific, Valco, and other CPI-style fittings. To use Trident Direct systems with Waters-style end fittings, replace the tip with cat.# 25088.

Trident Direct 10mm guard cartridge holder with filter

Components

Assembled

Installed onto column

Trident HPLC In-Line Guard Cartridge Holders

A Trident in-line guard cartridge holder can be used with almost any HPLC column by connecting it with a short piece of $^{1}/_{16}$" tubing, appropriate nuts and ferrules, or finger-tight fittings. The system can be used with Restek columns, or with columns from other manufacturers. Holders are available for either 10mm or 20mm guard cartridges. Either size can be purchased with or without a prefilter, which provides added protection against the particles that can shorten the lifetime of the guard cartridge.

25021

25040

25061

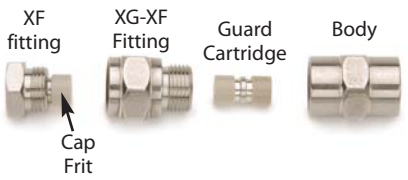
25060

Description	qty.	cat.#	price
Holder for 10mm guard cartridge	ea.	25021	
Holder with filter for 10mm guard cartridge	ea.	25040	
Holder for 20mm guard cartridge	ea.	25061	
Holder with filter for 20mm guard cartridge	ea.	25060	
Replacement Cap Frits: 4mm 2.0µm**	5-pk.	25022	
Replacement Cap Frits: 4mm 0.5µm	5-pk.	25023	
Replacement Cap Frits: 2mm 2.0µm**	5-pk.	25057	
Replacement Cap Frits: 2mm 0.5µm	5-pk.	25990	

**Standard porosity.

Trident In-Line 10mm guard cartridge holder with filter

Components



Assembled

Installed onto column

10 & 20 mm Guard Cartridges

Trident HPLC Guard Cartridges

Guard Cartridges	3-pk. (10 x 2.1mm)	3-pk. (10 x 4.0mm)	2-pk. (20 x 2.1mm)	2-pk. (20 x 4.0mm)	price
Allure AK Guard Cartridge	—	915950210	—	—	
Allure Basix Guard Cartridge	916150212	916150210	916150222	916150220	
Allure C18 Guard Cartridge	916450212	916450210	916450222	916450220	
Allure PFP Propyl Guard Cartridge	916950212	916950210	916950222	916950220	
Allure Silica Guard Cartridge	916050212	916050210	916050222	916050220	
Allure Organic Acids Guard Cartridge	916550212	916550210	916550222	916550220	
Allure Aqueous C18 Guard Cartridge	916850212	916850210	916850222	916850220	
Allure Biphenyl Guard Cartridge	916650212	916650210	916650222	916650220	
Pinnacle II Amino Guard Cartridge	921750212	921750210	921750222	921750220	
Pinnacle II C8 Guard Cartridge	921350212	921350210	921350222	921350220	
Pinnacle II C18 Guard Cartridge	921450212	921450210	921450222	921450220	
Pinnacle II Cyano Guard Cartridge	921650212	921650210	921650222	921650220	
Pinnacle II PAH Guard Cartridge	921950212	921950210	921950222	921950220	
Pinnacle II Phenyl Guard Cartridge	921550212	921550210	921550222	921550220	
Pinnacle II Biphenyl Guard Cartridge	—	920950210	—	920950220	
Pinnacle II Silica Guard Cartridge	921050212	921050210	921050222	921050220	
Pinnacle DB C8 Guard Cartridge	941350212	941350210	941350222	941350220	
Pinnacle DB C18 Guard Cartridge	941450212	941450210	941450222	941450220	
Pinnacle DB Aqueous C18 Guard Cartridge	941850212	941850210	941850222	941850220	
Pinnacle DB Biphenyl Guard Cartridge	940950212	940950210	940950222	940950220	
Pinnacle DB PFP Propyl Guard Cartridge	941950212	941950210	941950222	941950220	
Pinnacle DB Cyano Guard Cartridge	941650212	941650210	941650222	941650220	
Pinnacle DB Phenyl Guard Cartridge	941550212	941550210	941550222	941550220	
Pinnacle DB Silica Guard Cartridge	941050212	941050210	941050222	941050220	
Ultra II Aromax Guard Cartridge	960750212	960750210	960750222	960750220	
Ultra II Biphenyl Guard Cartridge	960950212	960950210	960950222	960950220	
Ultra II C8 Guard Cartridge	960350212	960350210	960350222	960350220	
Ultra II C18 Guard Cartridge	960450212	960450210	960450222	960450220	
Ultra II Aqueous C18 Guard Cartridge	960850212	960850210	960850222	960850220	
Ultra II Carbamate Guard Cartridge	961150212	961150210	961150222	961150220	
Ultra II IBD Guard Cartridge	960550212	960550210	960550222	960550220	
Ultra II PFP Propyl Guard Cartridge	960650212	960650210	960650222	960650220	
Ultra II Silica Guard Cartridge	960050212	960050210	960050222	960050220	
Ultra Amino Guard Cartridge	910750212	910750210	910750222	910750220	
Ultra Aqueous C18 Guard Cartridge	917850212	917850210	917850222	917850220	
Ultra C1 Guard Cartridge	910150212	910150210	910150222	910150220	
Ultra C4 Guard Cartridge	910250212	910250210	910250222	910250220	
Ultra C8 Guard Cartridge	910350212	910350210	910350222	910350220	
Ultra C18 Guard Cartridge	917450212	917450210	917450222	917450220	
Ultra Carbamate Guard Cartridge	917750212	917750210	917750222	917750220	
Ultra Cyano Guard Cartridge	910650212	910650210	910650222	910650220	
Ultra IBD Guard Cartridge	917550212	917550210	917550222	917550220	
Ultra PFP Guard Cartridge	917650212	917650210	917650222	917650220	
Ultra Phenyl Guard Cartridge	910550212	910550210	910550222	910550220	
Ultra Silica Guard Cartridge	910050212	910050210	910050222	910050220	
Ultra Quat Guard Cartridge	918150212	918150210	918150222	918150220	
Viva C18 Guard Cartridge	951450212	951450210	951450222	951450220	
Viva C8 Guard Cartridge	951350212	951350210	951350222	951350220	
Viva C4 Guard Cartridge	951250212	951250210	951250222	951250220	
Viva PFP Propyl Guard Cartridge	951950212	951950210	951950222	951950220	
Viva Biphenyl Guard Cartridge	951650212	951650210	951650222	951650220	
Viva Silica Guard Cartridge	951050212	951050210	951050222	951050220	

HPLC Normal Phase Test Mix #1 (4 components)

Routine analysis using this mix can assist in determining the need to perform column and/or system maintenance.

benzene	1.00mg/mL	benzyl alcohol	3.00
benzaldehyde	0.04	4-methoxybenzyl alcohol	2.00

In hexane, 1mL/ampul

cat. # 35004 (ea.) $33

No data pack available.

HPLC Reversed Phase Test Mix #1 (4 components)

Routine analysis using this mix can assist in determining the need to perform column and/or system maintenance.

benzene	3.00mg/mL	naphthalene	0.50
uracil	0.02	biphenyl	0.06

In methanol:water (75:25), 1mL/ampul

cat. # 35005 (ea.) $33

No data pack available.

HPLC Performance Test Mix (5 components)

The National Institute of Standards and Technology (NIST) has formulated a mixture that is highly effective for characterizing HPLC columns for efficiency, void volume, methylene selectivity, retentiveness, and activity toward chelators and organic bases. Results can be used for column classification, for column selection, for monitoring column performance over time, or for quality control. We test our material against the NIST 870 standard.

amitriptyline hydrochloride	2,800µg/mL	quinizarin	94
		toluene	1,400
ethylbenzene	1,700	uracil	28

In methanol, 1mL/ampul

cat. # 31699 (ea.)

Carbohydrate HPLC Performance Check Mix (5 components)

Performance qualification (PQ) determines the precision of the HPLC system. Our performance check mix for HPLC/RI consists of five simple sugars in varied concentrations. We prepare the reference material in water, lyophilize it, and pack it dry for enhanced stability.

glucose	2.0mg	maltose	4.5
fructose	2.1	sucrose	4.0
lactose	4.4		

Dry components in 4mL screw-cap vial. Reconstitute in 1mL acetonitrile:water (75:25) to 2.0, 2.1, 4.4, 4.5, 4.0mg/mL, respectively.

cat. # 31809 (ea.) $33

No data pack available.

HPLC OQ Linearity Test Mix Kit

Linear detector responses to concentration variations are an important part of operation qualification (OQ) for HPLC instruments. Our kit of five aqueous solutions of caffeine can be used to generate simple plots of UV response versus concentration. Certificate of Analysis includes caffeine concentration, calculated variance in preparing each mixture, a linearity plot, and coefficient of determination (r^2) for the linear plot.

Caffeine at 5, 25, 125, 250, 500µg/mL in water in a five ampul kit.

cat. # 31805 (kit)

kit

No data pack available.
Quantity discounts not available.

Ultra Quat Reagent Solution

Use with Ultra Quat HPLC column. Dilute to 1 liter, per instructions.

In water, 20mL/bottle

cat. # 32441 (ea.)

Rxi® GCColumns

3-IN-1 TECHNOLOGY

Highest Inertness • Lowest Bleed • Exceptional Reproducibility

Lower Detection Limits with Ground-Breaking Column Technology

Rxi® technology unifies outstanding inertness, low bleed, and high reproducibility into a single high performance column line. Take variation out of the equation and get the most consistent results for trace level analysis with Rxi® columns.

Visit us at **www.restek.com/rxi**

phases available

- Rxi®-1ms
- Rxi®-1HT
- Rxi®-5ms
- Rxi®-5Sil MS
- Rxi®-5HT
- Rxi®-XLB
- Rxi®-624Sil MS
- Rxi®-35Sil MS
- Rxi®-17
- Rxi®-17Sil MS
- Rxi® guard/retention gap columns

3-IN-1 TECHNOLOGY

Highest Inertness • Lowest Bleed • Exceptional Reproducibility

Lower Detection Limits with Ground-Breaking Column Technology

Rxi® columns deliver more accurate, reliable trace-level results than any other fused silica column on the market. To ensure the highest level of performance, all Rxi® capillary columns are manufactured and individually tested to meet stringent requirements for exceptional inertness, low bleed, and unsurpassed column-to-column reproducibility.

Highest Inertness

Inertness is one of the most difficult attributes to achieve in an analytical column, but it is one of the most critical as it improves peak shape, response, and retention time stability. Rxi® technology produces the most inert columns available, providing:

- Increased signal-to-noise ratios to improve low-level detection.
- Reproducible retention times for positive identifications.
- Improved response for polar, acidic, and basic compounds.

Increased Signal and Reproducible Retention Times

When capillaries are not sufficiently deactivated, peaks become asymmetric, resulting in reduced signal and unpredictable retention times. As column activity increases, peak tailing becomes more pronounced, reducing peak height and causing retention time to drift (Figure 1). In practice, this means that sensitivity is lost and trace-level analytes cannot be reliably determined. In addition, even compounds at higher concentrations may be misidentified, due to retention time shifting.

A more significant problem for sample analysis is that retention time can vary with analyte concentration if the column is not highly inert. Since the amount of target analyte in samples is unknown, retention times on a poorly deactivated column can easily vary enough to move compounds outside the retention time window (Figure 2). This can result in inaccurate identifications, the need for manual integration, and additional review or analysis before results can be reported. Using inert Rxi® columns ensures that compounds elute with good signal-to-noise ratios at expected retention times, regardless of analyte concentration.

Figure 1 As column activity increases, signal decreases and retention time shifts.

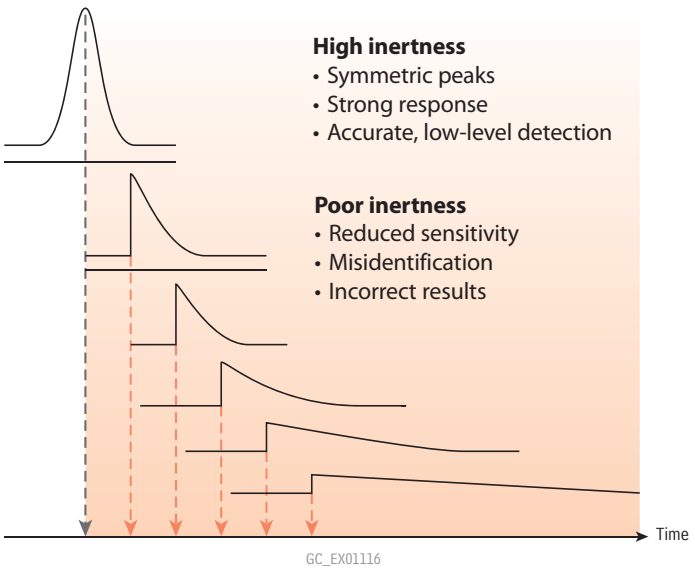
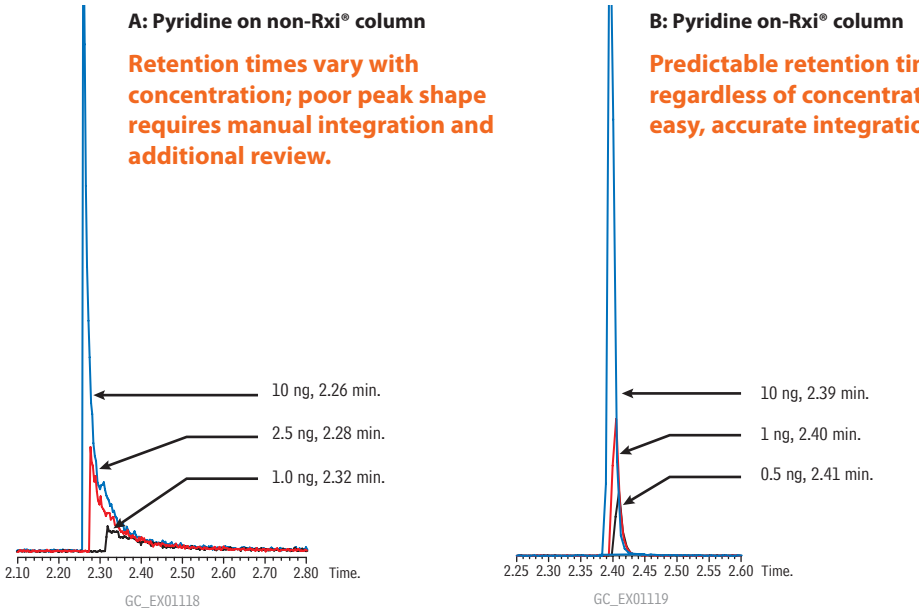


Figure 2 Analyte levels in samples are unknown; only inert columns, which prevent concentration from affecting retention time, can assure accurate results.

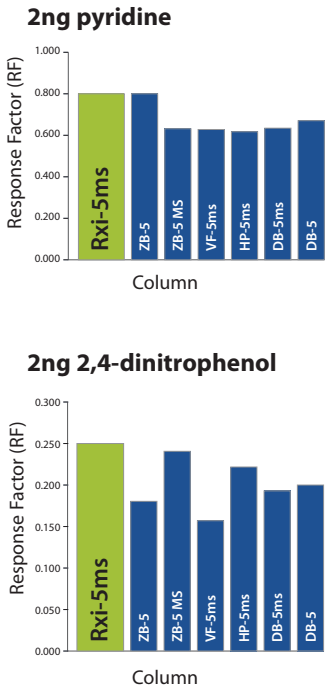


extracted ion chromatogram, m/z 79

Improved Response for Difficult Compounds

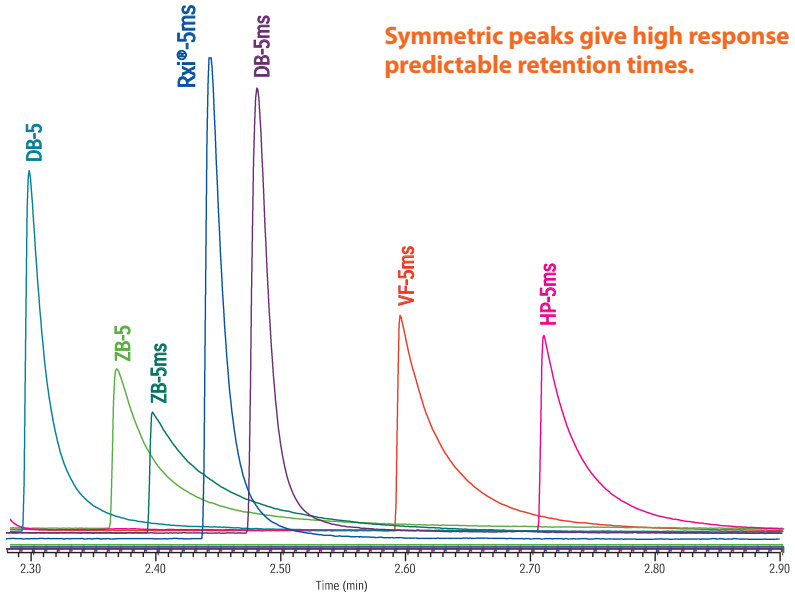
Another reason column inertness is important for trace-level analysis is that many acidic, basic, and polar compounds will tail significantly and become difficult to analyze if the column contains active sites. The remarkable neutrality of Rxi® columns solves this problem and allows a wide range of compounds to be analyzed with high sensitivity, often on a single column. All Rxi® columns are exceptionally inert as demonstrated in Figure 3 by high response factors for both pyridine (basic) and 2,4-dinitrophenol (acidic). Rxi® columns reliably produce highly symmetric peaks and improved responses for difficult compounds, indicating greater inertness than columns produced by other manufacturers (Figure 4).

Figure 3 An Rxi column gives the best overall performance for both basic and acidic compounds.



Comparison of 30m x 0.25mm ID, 0.25µm columns.

Figure 4 Rxi® columns are the most inert columns on the market providing the most symmetric peak shape for basic compounds, such as pyridine.



Comparison of 30m x 0.25mm ID, 0.25µm 5% diphenyl columns, 2ng pyridine on-column, helium carrier gas, Oven temp.: 50°C (3 min.) to 180°C @ 35°C/min. (5 min.), Det.: FID @ 250°C

Innovation & Service

"When my research group needed a GC column for a chiral separation, Restek was the only company that offered to provide us with test columns to evaluate. The willingness of Restek to work with us to find a solution to our separation problem is exceptional."

Joe Dinnocenzo,
Professor of Chemistry
Director, Center for Photoinduced Charge Transfer
University of Rochester

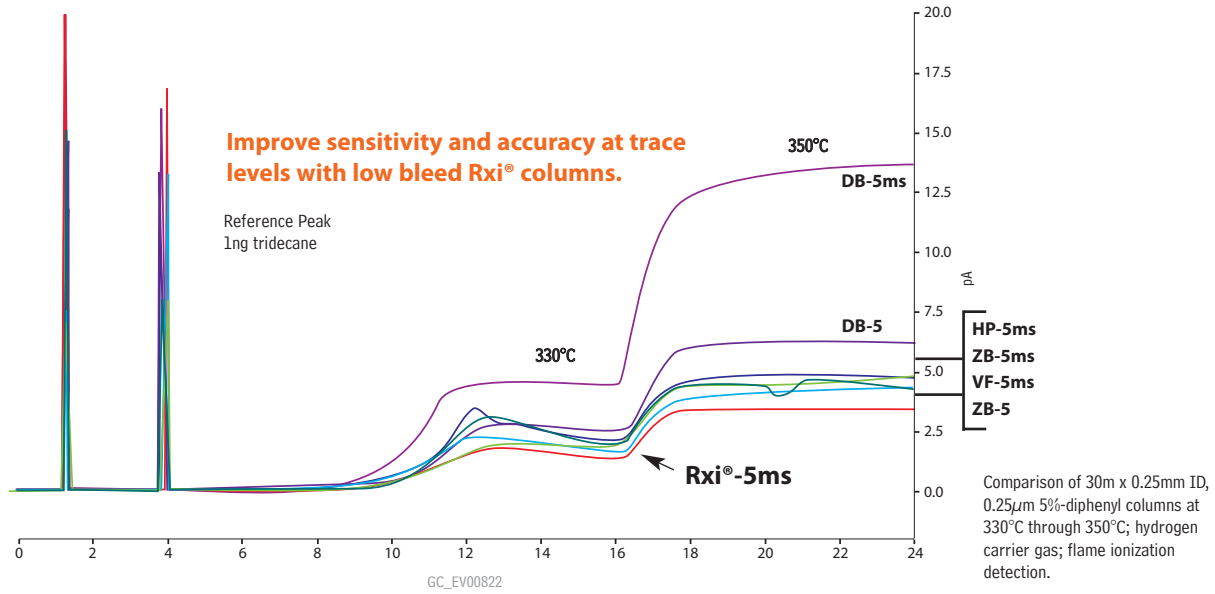
How can we help you today?
Contact support@restek.com or your local Restek representative for helpful, knowledgeable technical support.

Lowest Bleed

Rxi® columns are more stable at high temperatures than any other manufacturer's column, resulting in higher system sensitivity (Figure 5). This low-bleed characteristic is the result of superior stabilization achieved by optimizing polymer cross-linking and surface deactivation technologies. Benefits of using ultra-low bleed Rxi® columns include:

- Increased sensitivity, for lower detection limits and better matches to mass spectral libraries.
- Faster system stabilization.
- Reduced detector contamination results in less downtime for maintenance.

Figure 5 Rxi® columns have the lowest bleed among all major brands of columns.

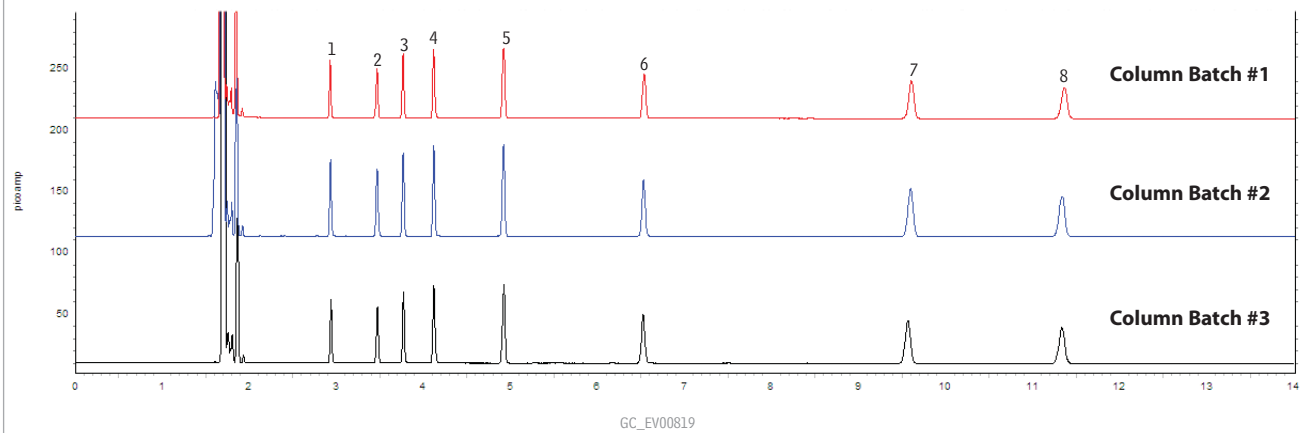


Comparison of 30m x 0.25mm ID, 0.25µm 5%-diphenyl columns at 330°C through 350°C; hydrogen carrier gas; flame ionization detection.

Exceptional Reproducibility

Chromatographers today need to know that every column they receive is going to perform the same way as the column it replaces. Unmatched manufacturing precision and stringent quality control mean Rxi® columns exceed industry standards, resulting in the best column-to-column reproducibility available as measured by efficiency, retention, bleed, and inertness (Figure 6).

Figure 6 Rxi® columns are engineered to assure column-to-column and lot-to-lot reproducibility.



1. 1,6-hexanediol
2. 4-chlorophenol
3. methyl nonanoate
4. 1-decylamine
5. tridecane
6. 1-undecanol
7. acenaphthylene
8. pentadecane

Column:	Rxi®-5ms, 30m, 0.25mm ID, 0.25µm (cat.# 13423)
Sample:	500µg/mL Isothermal Column Test Mix in toluene
Inj.:	1.0µL, split injection (split ratio 1:100), 4mm single gooseneck inlet liner with wool (cat.# 22405)
Inj. temp.:	250°C
Carrier gas:	hydrogen, constant flow
Linear velocity:	38cm/sec. @ 135°C
Oven temp.:	135°C
Det.:	FID @ 330°C

Rxi® Column Family

Rxi®-1ms (fused silica)

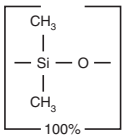
(nonpolar phase, Crossbond® 100% dimethyl polysiloxane)

- General purpose columns for drugs of abuse, essential oils, hydrocarbons, pesticides, PCB congeners or (e.g.) Aroclor mixes, sulfur compounds, amines, solvent impurities, simulated distillation, oxygenates, gasoline range organics (GRO), refinery gases.
- Equivalent to USP G2 phase.

ID	df (µm)	temp. limits	15-Meter	30-Meter	60-Meter
0.25mm	0.25	-60 to 330/350°C	13320	13323	13326
	0.50	-60 to 330/350°C	13335	13338	13341
	1.00	-60 to 330/350°C	13350	13353	13356
0.32mm	0.25	-60 to 330/350°C	13321	13324	13327
	0.50	-60 to 330/350°C	13336	13339	13342
	1.00	-60 to 330/350°C	13351	13354	13357
	4.00	-60 to 330/350°C		13396	
0.53mm	0.50	-60 to 330/350°C	13337	13340	
	1.00	-60 to 330/350°C	13352	13355	
	1.50	-60 to 330/350°C	13367	13370	13373

ID	df (µm)	temp. limits	10-Meter	12-Meter	20-Meter	25-Meter	50-Meter
0.10mm	0.10	-60 to 330/350°C	13301				
0.18mm	0.18	-60 to 330/350°C			13302		
	0.36	-60 to 330/350°C			13311		
0.20mm	0.33	-60 to 330/350°C		13397		13398	13399

Rxi®-1ms Structure



similar phases

DB-1, DB-1ms, HP-1, HP-1ms, Ultra-1, SPB-1, Equity-1, VF-1ms, CP-Sil 5 CB Low Bleed/MS

Rxi®-1HT (fused silica)

(low polarity phase, Crossbond® 100% dimethyl polysiloxane)

Outstanding thermal stability; minimal bleed even at 430°C.

ID	df (µm)	temp. limits*	15-Meter	30-Meter
0.25mm	0.10	-60 to 400°C	13950	13951
	0.25	-60 to 400°C		13952
0.32mm	0.10	-60 to 400°C	13953	13954
	0.25	-60 to 400°C		13955
0.53mm	0.15	-60 to 400°C		13956

*Column may be used up to 430°C, but lifetime will be reduced.

Innovation & Service

"Restek's technical support and preparation of our custom calibration standards, as well as their innovative column technology, have significantly increased the productivity of our GC/MS analyses."

Dan Wright, Lab Director
Shealy Environmental Services, Inc.

How can we help you today?
Contact support@restek.com or your local Restek representative for helpful, knowledgeable technical support.

Rxi®-5ms (fused silica)

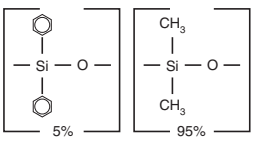
(low polarity phase, Crossbond® 5% diphenyl/95% dimethyl polysiloxane)

- General purpose columns for semivolatiles, phenols, amines, residual solvents, drugs of abuse, pesticides, PCB congeners or (e.g.) Aroclor mixes, solvent impurities.
- Equivalent to USP G27 phase.

ID	df (µm)	temp. limits	15-Meter	30-Meter	60-Meter
0.25mm	0.25	-60 to 330/350°C	13420	13423	13426
	0.40	-60 to 330/350°C		13481	
	0.50	-60 to 330/350°C	13435	13438	13441
	1.00	-60 to 330/350°C	13450	13453	13456
0.32mm	0.25	-60 to 330/350°C	13421	13424	13427
	0.50	-60 to 330/350°C	13436	13439	13442
	1.00	-60 to 330/350°C	13451	13454	13457
0.53mm	0.25	-60 to 330/350°C	13422	13425	
	0.50	-60 to 330/350°C	13437	13440	
	1.00	-60 to 330/350°C	13452	13455	
	1.50	-60 to 330/350°C	13467	13470	

ID	df (µm)	temp. limits	10-Meter	12-Meter	20-Meter	25-Meter	50-Meter
0.10mm	0.10	-60 to 330/350°C	13401				
0.18mm	0.18	-60 to 330/350°C			13402		
	0.30	-60 to 330/350°C			13409		
	0.36	-60 to 330/350°C			13411		
0.20mm	0.33	-60 to 330/350°C		13497		13498	13499

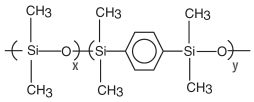
Rxi®-5ms Structure



similar phases

DB-5, HP-5, HP-5ms, Ultra-2, SPB-5, Equity-5, CP-Sil 8, CP-Sil 8 CB

Rxi®-5Sil MS Structure



similar **phases**

DB-5ms, VF-5ms, CP-Sil 8 CB Low-Bleed/MS, DB-5ms UI, BPX-5

Rxi®-5Sil MS (fused silica)

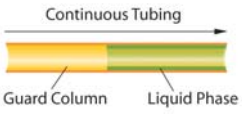
(low polarity, proprietary silarylene phase; similar to 5% diphenyl/95% dimethyl polysiloxane)

- Phenyl groups improve thermal stability, reduce bleed, and make the phase less prone to oxidation.
- Ideal for GC/MS applications requiring high sensitivity, including use in ion trap systems.

ID	df (µm)	temp. limits	15-Meter	30-Meter	60-Meter
0.25mm	0.10	-60 to 330/350°C	13605	13608	
0.25mm	0.25	-60 to 330/350°C	13620	13623	13626
	0.50	-60 to 330/350°C	13635	13638	
	1.00	-60 to 325/350°C	13650	13653	13697
0.32mm	0.25	-60 to 330/350°C	13621	13624	
	0.50	-60 to 330/350°C		13639	
	1.00	-60 to 325/350°C		13654	
0.53mm	1.50	-60 to 310/330°C		13670	

ID	df (µm)	temp. limits	10-Meter	20-Meter
0.10mm	0.10	-60 to 330/350°C	43601	
0.18mm	0.18	-60 to 330/350°C		43602
	0.36	-60 to 330/350°C		43604

Save Time! Eliminate column coupling with Integra-Guard® built-in guard columns



Rxi®-5Sil MS with Integra-Guard®

Extend column lifetime and eliminate leaks with a built-in retention gap.

Description	qty.	cat.#
15-Meter, 0.25mm ID, 0.25µm Rxi-5Sil MS w/10m Integra-Guard Column	ea.	13620-127
30-Meter, 0.25mm ID, 0.25µm Rxi-5Sil MS w/5m Integra-Guard Column	ea.	13623-124
30-Meter, 0.25mm ID, 0.25µm Rxi-5Sil MS w/10m Integra-Guard Column	ea.	13623-127
15-Meter, 0.25mm ID, 0.50µm Rxi-5Sil MS w/5m Integra-Guard Column	ea.	13635-124
30-Meter, 0.25mm ID, 0.50µm Rxi-5Sil MS w/5m Integra-Guard Column	ea.	13638-124
30-Meter, 0.25mm ID, 0.50µm Rxi-5Sil MS w/10m Integra-Guard Column	ea.	13638-127
30-Meter, 0.32mm ID, 0.50µm Rxi-5Sil MS w/5m Integra-Guard Column	ea.	13639-125
30-Meter, 0.32mm ID, 1.00µm Rxi-5Sil MS w/5m Integra-Guard Column	ea.	13654-125

similar **phases**

DB-5HT, VF-5HT, ZB-5HT

Rxi®-5HT (fused silica)

(low polarity phase; 5% diphenyl/95% dimethyl polysiloxane)

- Columns processed for high temperature applications.
- 40% longer lifetime from specially designed fused silica tubing.

ID	df (µm)	temp. limits	15-Meter	30-Meter
0.25mm	0.10	-60 to 400°C	13905	13908
	0.25	-60 to 400°C		13923
0.32mm	0.10	-60 to 400°C	13906	13909
	0.25	-60 to 400°C		13924
0.53mm	0.15	-60 to 400°C		13910

*Column is capable of going to 430°C, but column lifetime will be reduced.

similar **phases**

DB-XLB, VF-Xms

Rxi®-XLB (fused silica)

(low polarity proprietary silarylene phase)

- General purpose columns with unique selectivity and extremely low bleed.
- Ideal for many GC/MS applications—pesticides, semivolatiles, PCB congeners, Aroclor mixes, and PAHs.

ID	df (µm)	temp. limits	15-Meter	30-Meter	60-Meter
0.25mm	0.10	30 to 340/360°C	13705	13708	
	0.25	30 to 340/360°C	13720	13723	13726
	0.50	30 to 340/360°C		13738	
	1.00	30 to 340/360°C	13750	13753	
0.32mm	0.10	30 to 340/360°C		13709	
	0.25	30 to 340/360°C	13721	13724	13727
	0.50	30 to 340/360°C		13739	
	1.00	30 to 340/360°C		13754	
0.53mm	0.50	30 to 340/360°C		13740	
	1.50	30 to 320/340°C	13767	13770	

ID	df (µm)	temp. limits	10-Meter	20-Meter
0.10mm	0.10	30 to 340/360°C	43701	
0.18mm	0.18	30 to 340/360°C		43702

NEW!

Rxi®-624Sil MS (fused silica)

(midpolarity proprietary silarylene phase; similar to 6% cyanopropylphenyl/ 94% dimethyl polysiloxane)

Inert—excellent peak shape for a wide range of analytes, including acidic and basic compounds.

ID	df (µm)	temp. limits	20-Meter	30-Meter	60-Meter
0.18mm	1.00	-60 to 300/320°C	13865		
0.25mm	1.40	-60 to 300/320°C		13868	
0.32mm	1.80	-60 to 300/320°C		13870	13872
0.53mm	3.00	-60 to 280/300°C		13871	

Rxi®-35Sil MS (fused silica)

(midpolarity proprietary silarylene phase; similar to 35% phenyl methylpolysiloxane)

- Excellent inertness for active compounds.
- Very low bleed phase for GC/MS analysis.

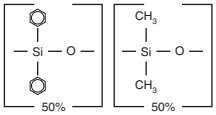
similar **phases** DB-35ms, MR2, VF-35ms

ID	df (µm)	temp. limits	30-Meter
0.25mm	0.25	50 to 340/360°C	13823
0.32mm	0.25	50 to 340/360°C	13824
0.53mm	0.50	50 to 320/340°C	13840

Rxi®-17 (fused silica)

(midpolarity phase; Crossbond® 50% diphenyl/ 50% dimethyl polysiloxane)

General purpose columns for pesticides, herbicides, rosin acids, phthalate esters, triglycerides, sterols.



similar **phases** DB-17, DB-608, CP-Sil 24 CB

ID	df (µm)	temp. limits	15-Meter	30-Meter
0.25mm	0.25	40 to 280/320°C	13520	13523
	0.50	40 to 280/320°C	13535	13538
	1.00	40 to 280/320°C	13550	13553
0.32mm	0.25	40 to 280/320°C	13521	13524
	0.50	40 to 280/320°C	13536	13539
	1.00	40 to 280/320°C	13551	13554
0.53mm	0.25	40 to 280/320°C	13522	13525
	0.50	40 to 280/320°C	13537	13540
	0.83	40 to 280/320°C		13569
	1.00	40 to 280/320°C	13552	13555
	1.50	40 to 280/320°C	13567	13570

ID	df (µm)	temp. limits	10-Meter	20-Meter
0.10mm	0.10	40 to 280/320°C	13501	
0.18mm	0.18	40 to 280/320°C		13502

Rxi®-17Sil MS (fused silica)

(midpolarity proprietary silarylene phase; similar to 50% phenyl methyl polysiloxane)

Low-bleed for use with sensitive detectors and GC/MS.

ID	df (µm)	temp. limits	15-Meter	30-Meter	60-Meter
0.25mm	0.25	40 to 340/360°C	14120	14123	14126
0.32mm	0.25	40 to 340/360°C	14121	14124	

ID	df (µm)	temp. limits	10-Meter	20-Meter
0.10mm	0.10	40 to 340/360°C	14101	
0.18mm	0.18	40 to 340/360°C		14102
	0.36	40 to 340/360°C		14111

Rxi® Guard/Retention Gap Columns

Nominal ID	Nominal OD	5-Meter	5-Meter/6-pk.	10-Meter	10-Meter/6-pk.
0.25mm	0.37 ± 0.04mm	10029	10029-600	10059	10059-600
0.32mm	0.45 ± 0.04mm	10039	10039-600	10064	10064-600
0.53mm	0.69 ± 0.05mm	10054	10054-600	10073	10073-600

Rxi® Column Test Mixes

Rxi® Test Mix (250ppm) (8 components)

acenaphthylene
4-chlorophenol
n-decylamine
1,6-hexanediol
methyl nonanoate (C9:0 FAME)
n-pentadecane (C15)
n-tridecane (C13)
1-undecanol

250µg/mL each in toluene, 1mL/ampul
cat. # 35248 (ea.)

Rxi® Test Mix (500ppm) (8 components)

acenaphthylene
4-chlorophenol
n-decylamine
1,6-hexanediol
methyl nonanoate (C9:0 FAME)
n-pentadecane (C15)
n-tridecane (C13)
1-undecanol

500µg/mL each in toluene, 1mL/ampul
cat. # 35247 (ea.)

Rxi® Test Mix (Rev. A) (8 components)

acenaphthylene
4-chlorophenol
n-decylamine
1,6-hexanediol
methyl nonanoate
n-pentadecane
n-tridecane
1-undecanol

1,000µg/mL each in toluene, 1mL/ampul
cat. # 35241 (ea.)

Rxi®-5Sil MS/XLB Column Test Mix (8 components)

4-chlorophenol
dicyclohexylamine
2-ethylhexanoic acid
1,6-hexanediol
1-methylnaphthalene
n-tetradecane (C14)
n-tridecane (C13)
1-undecanol

350µg/mL each in methylene chloride, 1mL/ampul
cat. # 35226 (ea.)

Column Cross-Reference Table

Rxi® columns produce the same selectivity as competitor columns, but are much more inert, exhibit lower bleed, and offer exceptional reproducibility. For more accurate, reliable trace-level results, choose Rxi® columns.

POLARITY: nonpolar → polar

Restek	Phase Composition	Agilent	Varian/ Chrompack	SGE	Phenomenex	Machery-Nagel	Supelco
Rxi-1ms	100% dimethyl polysiloxane	HP-1ms UI, DB-1ms UI, HP-1, HP-1ms, DB-1 DB-1ms, Ultra-1	VF-1ms CP-Sil 5 CP Sil 5 CB Low Bleed/MS	BP-1	ZB-1 ZB-1ms	Optima-1 Optima-1ms	SPB-1 Equity-1
Rxi-1HT	100% dimethyl polysiloxane	DB-1HT			ZB-1HT		
Rxi-5ms	5% diphenyl/ 95% dimethyl polysiloxane	HP-5ms UI, HP-5, HP-5ms, DB-5, Ultra-2	CP-Sil 8 CP Sil 8 CB	BP-5	ZB-5	Optima-5	SPB-5 Equity-5
Rxi-5Sil MS	5% phenyl, 95% dimethyl arylene siloxane	DB-5ms UI, DB-5ms	VF-5ms CP-Sil 8 CB Low Bleed/MS	BPX-5	ZB-5MS	Optima-5ms	SLB-5
Rxi-5HT	5% diphenyl/95% dimethyl polysiloxane	DB-5HT	VF-5HT		ZB-5HT		
Rxi-XLB	arylene/methyl modified polysiloxane	DB-XLB	VF-Xms				
Rxi-624Sil MS	6% cyanopropylphenyl, 94% dimethyl arylene siloxane	DB-624, HP-624	VF-624ms	BP-624	ZB-624	Optima-624	
Rxi-35Sil MS	35% phenyl, 65% dimethyl arylene siloxane	DB-35ms	VF-35ms		MR2		
Rxi-17	50% diphenyl/50% dimethyl polysiloxane	HP-17, DB-17, DB-608	CP-Sil 24 CB		ZB-50		
Rxi-17Sil MS	50% phenyl, 50% dimethyl arylene siloxane	DB-17ms	VF-17ms	BPX-50			

Visit **www.restek.com/rxi** for detailed comparisons and to learn how exceptional Rxi® inertness, bleed, and reproducibility can improve your data.

RESTEK

ISO 9001:2000 cert.# FM80397

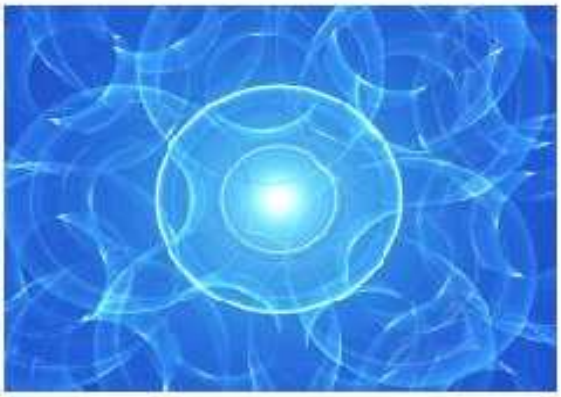
Lit. Cat.# GNFL1173

ChromaNik HPLC Columns

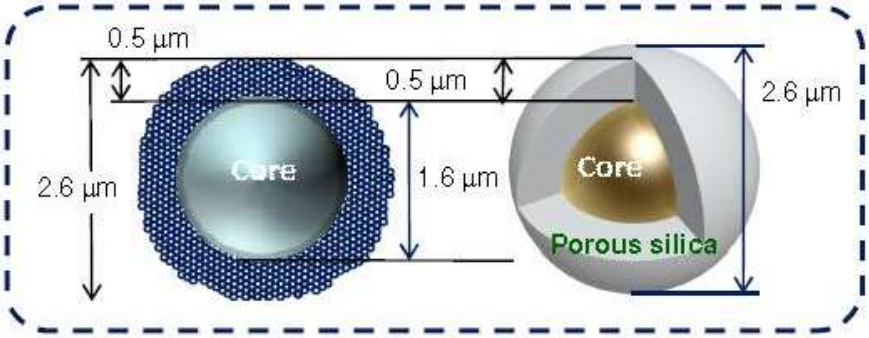
HPLC column C18 C8 PFP

SunShell

C18, C8, PFP



Core Shell Particle



- **u-HPLC Performance on standard HPLCs**

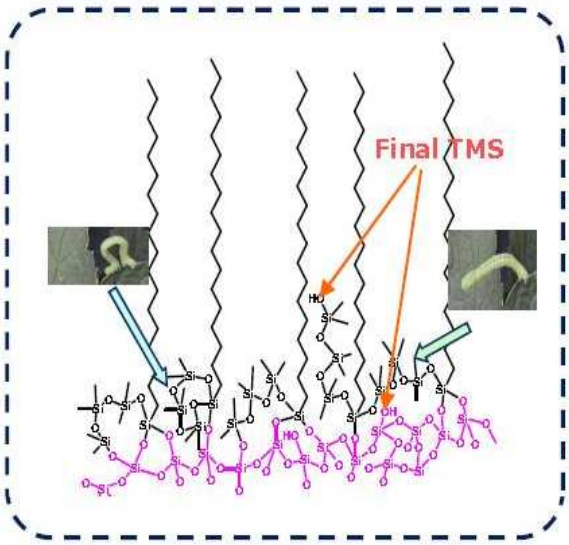
without need for ultra high Cost equipment

253,000 plates/m

- similar efficiency to u-HPLC at 1/2 Pressure Drop

1/3 analysis time of 5um columns

- Unique Deactivation – silanol activity control / Full end capping (patent pending)



C18 80 degC max and pH 1-10 Stability
ID : 2.1, 3.0, 4.6mm
Length : 20, 30, 50, 75, 100, 150mm

Sunniest HPLC Columns – Porous Silica

C18, RP-AQUA, C8 : 3, 5um

IDmm : 2.0, (50, 75, 100, 150mm)
3.0,(150, 250mm)
4.6mmID (20, 30, 50, 75, 100, 150, 250mm)
10.0, 20.0mm (250mm) PREP

- Stability under acids and basic pH
- Reproducibility under 100% aqueous
- ultra Low Bleed for LC/MS

***ALL* Highly INERT**

NEW **Sunniest C18-HT, 2um;** 2.1, 3.0mmID; 30, 50, 75, 100mm

Sunrise C18, C28, PhE 3, 5um; 2.0, 4.6,(50, 75, 100, 150mm (10, 20mmx250mm)

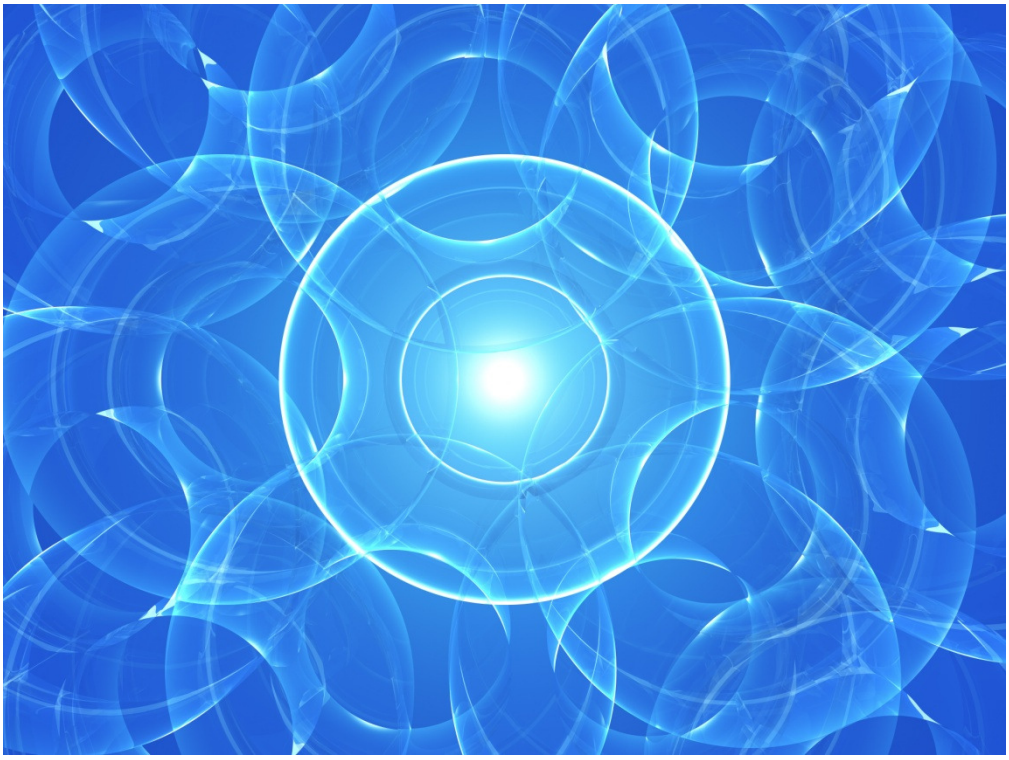
HROMalytic +61(0)3 9762 2034
ECHnology Pty Ltd

ChromaNik Technologies Inc.

BIOTECH

HPLC column C18 C8 PFP

SunShell



Core Shell Particle

ChromaNik Technologies Inc.

Website : www.chromtech.net.au E-mail : info@chromtech.net.au TelNo : 03 9762 2034 . . . in AUSTRALIA

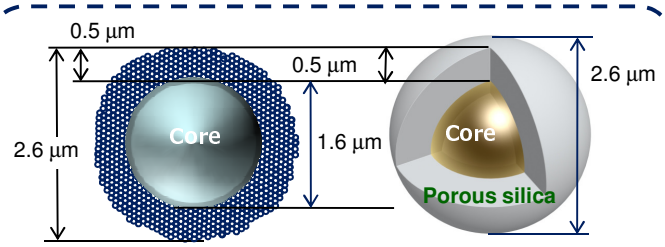
"SunShell " is a core shell silica column made by ChromaNik Technologies.

The next generation to Core Shell particle

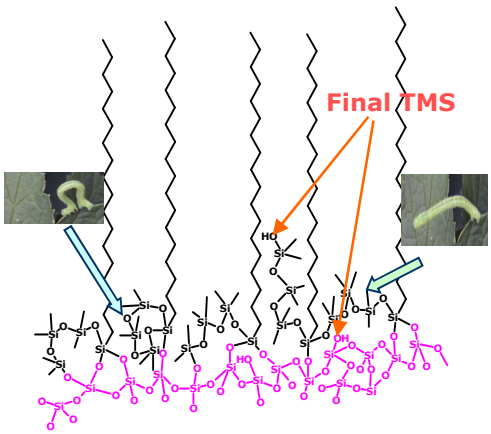
Superficially porous silica

Features of SunShell

*1.6 µm of core and 0.5 µm of superficially porous silica layer
*Same efficiency and high throughput as a Sub 2µm particle
*Same pressure as a 3 µm particle (less than a half then a sub 2µm particle)
*Same chemistry as Sunniest technology (reference figure 1)
*Good peak shape for all compounds such as basic, acidic and chelating compounds
*High stability (pH range for SunShell C18, 1.5 to 10)
* Low breeding



Schematic diagram of a core shell silica particle

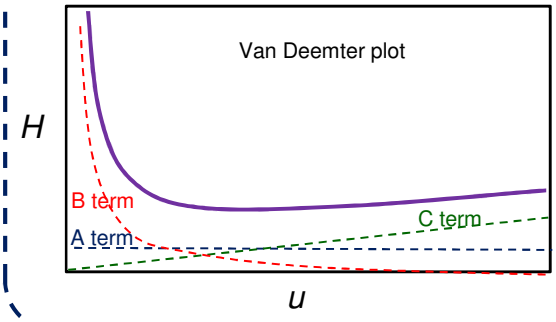


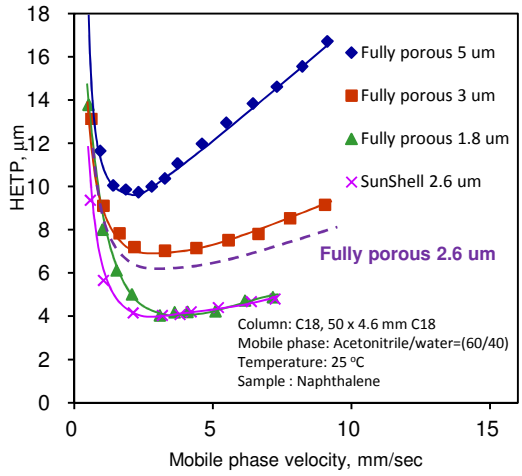
Schematic diagram of bonding of SunShell C18

Van Deemter Equation

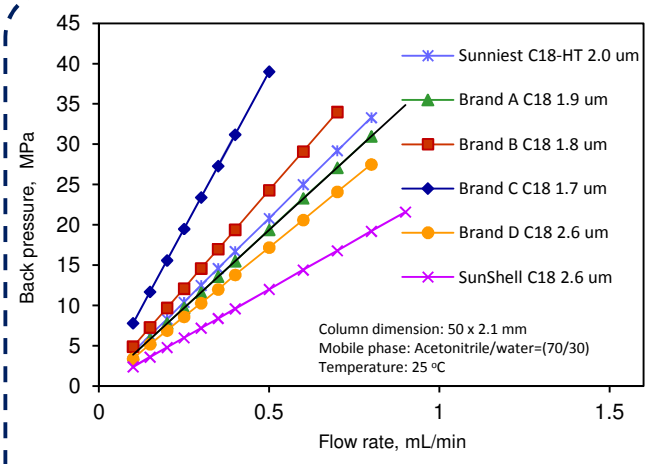
$$H = Ad_p + B\frac{D_m}{u} + C\frac{d_p^2}{D_m}u$$

A term : Eddy diffusion(dp is particle diameter)
B term : Longitudinal diffusion
(Dm is diffusion coefficient)
C term : Mass transfer





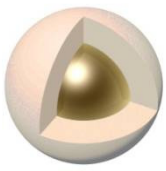
Comparison of plate height plots



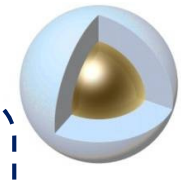
Comparison of back pressure for high throughput columns

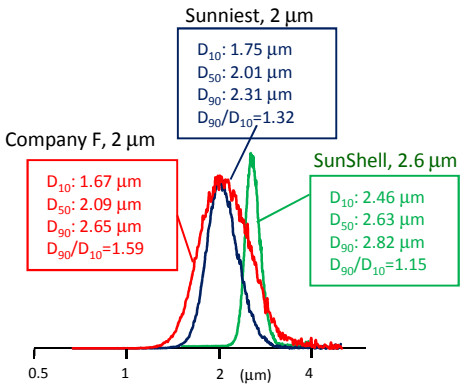
SunShell C18 shows same efficiency as a sub 2 µm C18. In comparison between fully porous 2.6 µm and core shell 2.6 µm (SunShell), SunShell shows lower values for A term, B term and C term of Van Deemter equation. The core shell structure leads higher performance to compare with the fully porous structure.

Furthermore back pressure of SunShell C18 is less than a half to compare with sub-2 µm C18s.

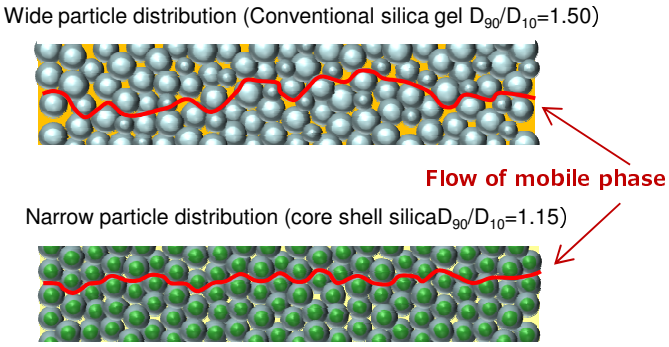


Why does a 2.6 μm core shell particle show the same performance as a sub 2 μm particle?



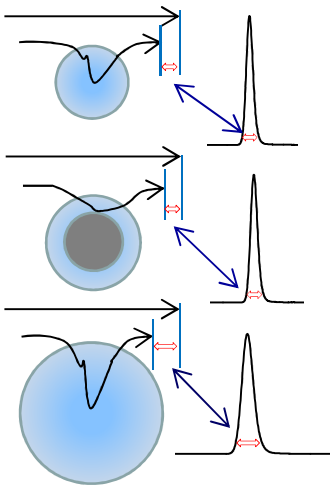


Comparison of Particle Size Distribution



Packing state of core shell and fully porous silica

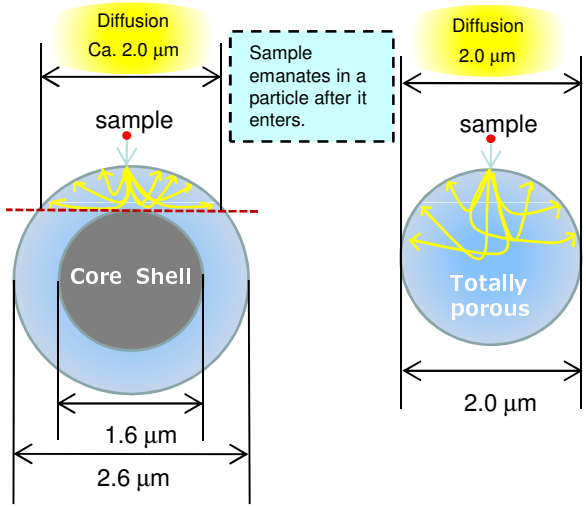
The size distribution of a core shell (SunShell) particle is much narrower than that of a conventional fully porous particle, so that the space among particles in the column reduces and efficiency increases by reducing Eddy Diffusion (multi-path diffusion) as the A term in Van Deemter Equation.



Comparison of diffusion path

As shown in the left figure, a core shell particle has a core so that the diffusion path of samples shortens and mass transfer becomes fast. This means that the C term in Van Deemter Equation reduces. In other words, HETP (theoretical plate) is kept even if flow rate increases. A 2.6 μm core shell particle shows as same column efficiency as a fully porous sub-2 μm particle.

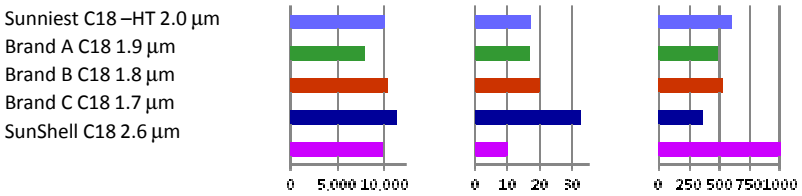
The right figure shows that a diffusion width of a sample in a 2.6 μm core shell particle and a 2 μm fully porous particle. Both diffusion widths are almost same. The 2.6 μm core shell particle is superficially porous, so that the diffusion width becomes narrower than particle size. Same diffusion means same efficiency.



Diffusion of sample in core shell and fully porous silica

Comparison of Performance by Plate/Pressure

	Plate	Back press. (MPa)	Plate/back press.
Sunniest C18 –HT 2.0 μm	9,900	16.7	593
Brand A C18 1.9 μm	7,660	16.3	470
Brand B C18 1.8 μm	10,100	19.6	515
Brand C C18 1.7 μm	11,140	32.0	348
SunShell C18 2.6 μm	9,600	9.7	990

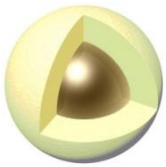


Column: 50 x 2.1 mm C18, Mobile phase: Acetonitrile/water=(70/30), Temperature: 25 °C

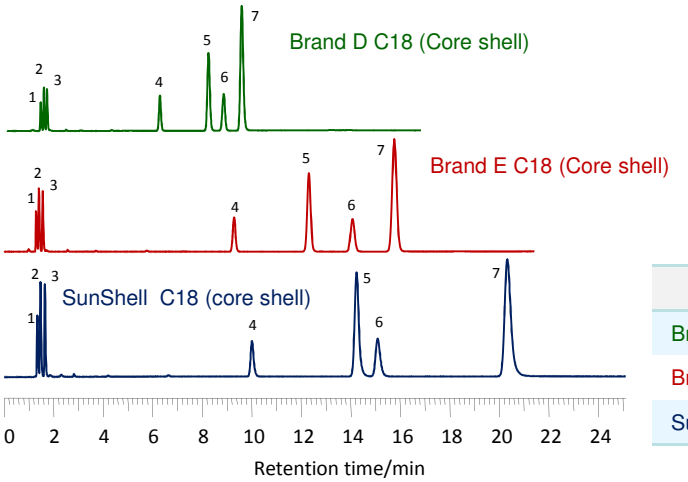
Under a constant back pressure condition, SunShell C18 showed more than 2 times higher performance to compare with fully sub-2μm porous C18s.

Characteristics of SunShell C18

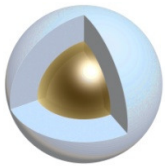
	Core shell silica			C18			
	Particle size (µm)	Pore diameter (nm)	Specific surface area (m^2/g)	Carbon content (%)	Bonded phase	Maximum operating pressure	Available pH range
SunShell C18	2.6	9	150	7	C18	60 MPa or 8,570 psi	1.5 - 10



Comparison of standard samples between core shell C18s



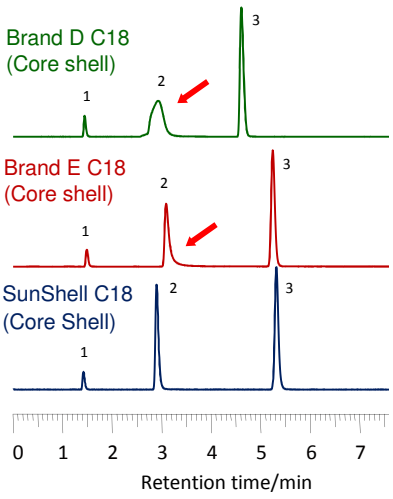
Column:
Brand D C18, 2.6 µm 150 x 4.6 mm (Core shell type)
Brand E C18, 2.7 µm 150 x 4.6 mm (Core shell type)
SunShell C18, 2.6 µm 150 x 4.6 mm
Mobile phase: CH_3OH/H_2O=75/25
Flow rate: 1.0 mL/min
Temperature: 40 ˚C
Sample: 1 = Uracil, 2 = Caffeine, 3 = Phenol, 4 = Butylbenzene
5 = o-Terphenyl, 6 = Amylbenzene, 7 = Triphenylene



	Hydrogen bonding (Caffeine/Phenol)	Hydrophobicity (Amylbenzene/Butylbenzene)	Steric selectivity (Triphenylene/o-Terphenyl)
Brand D C18	0.48	1.54	1.20
Brand E C18	0.44	1.60	1.31
SunShell C18	0.40	1.59	1.47

Retention of standard samples was compared for three kinds of core shell type C18s. Brand D C18 showed only a half retention to compare with SunShell C18. Steric selectivity becomes large when ligand density on the surface is high. SunShell C18 has the largest steric selectivity so that it has the highest ligand density. This leads the longest retention time.

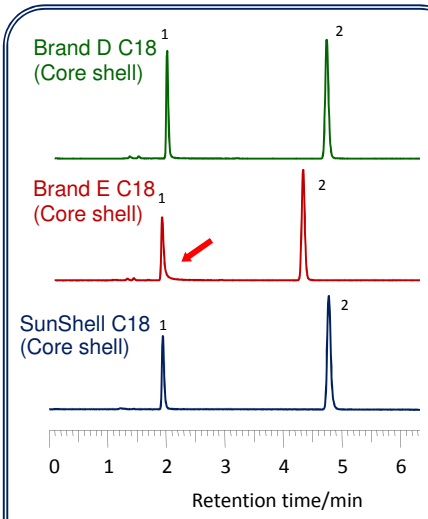
Comparison of pyridine



Column:
Brand D C18, 2.6 µm 150 x 4.6 mm
Brand E C18, 2.7 µm 150 x 4.6 mm
SunShell C18, 2.6 µm 150 x 4.6 mm
Mobile phase: CH_3OH/H_2O=30/70
Flow rate: 1.0 mL/min
Temperature: 40 ºC
Detection: UV@250nm
Sample: 1 = Uracil
2 = Pyridine
3 = Phenol

Residual silanol groups make pyridine be tailing under methanol/water mobile phase condition. Only SunShell C18 shows a sharp peak for pyridine.

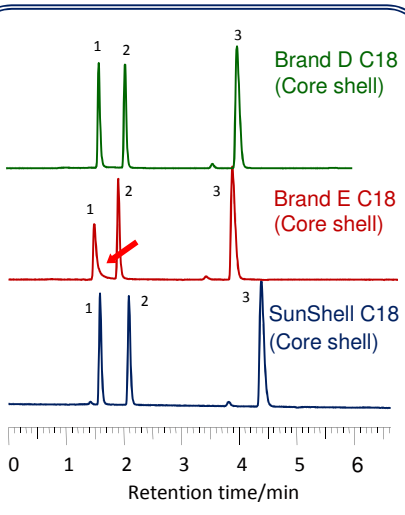
Comparison of Oxine



Column:
Brand D C18, 2.6 µm 150 x 4.6 mm
Brand E C18, 2.7 µm 150 x 4.6 mm
SunShell C18, 2.6 µm 150 x 4.6 mm
Mobile phase: CH_3CN/20mM H_3PO_4=10/90
Flow rate: 1.0 mL/min
Temperature: 40 ºC
Detection: UV@250nm
Sample: 1 = 8-Quinolinol (Oxine)
2 = Caffeine

8-Quinolinol (Oxine) is a metal chelating compound. Metal impurities in the core shell particle leads the tailing for oxine peak.

Comparison of formic acid



Column:
Brand D C18, 2.6 µm 150 x 4.6 mm
Brand E C18, 2.7 µm 150 x 4.6 mm
SunShell C18, 2.6 µm 150 x 4.6 mm
Mobile phase: CH_3CN/0.1% H_3PO_4=2/98
Flow rate: 1.0 mL/min
Temperature: 40 ºC
Detection: UV@210nm
Sample: 1 = Formic acid
2 = Acetic acid
3 = Propionic Acid

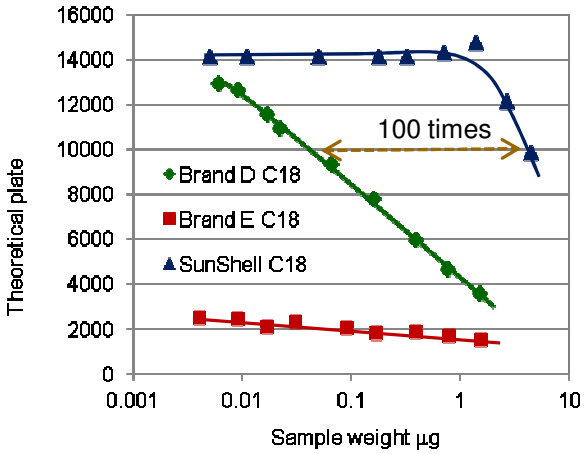
Formic acid is used as an indicator for a acidic inertness. SunShell and brand D C18 show a sharp peak.

Loading capacity of amitriptyline as a basic compound

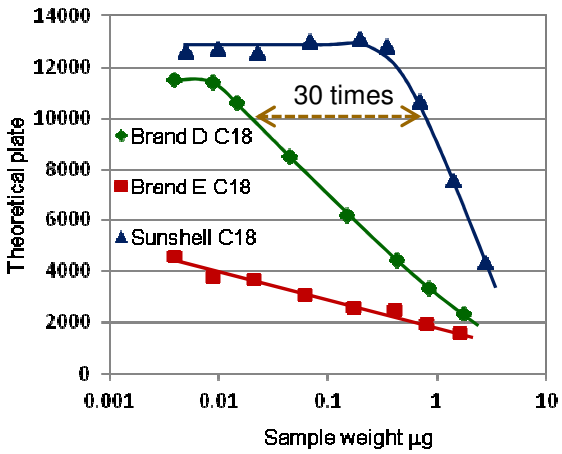
Amitriptyline overlords much more at acetonitrile/buffer mobile phase than methanol/buffer. Three kinds of core shell C18s were compared loading capacity of amitriptyline at three different mobile phases.

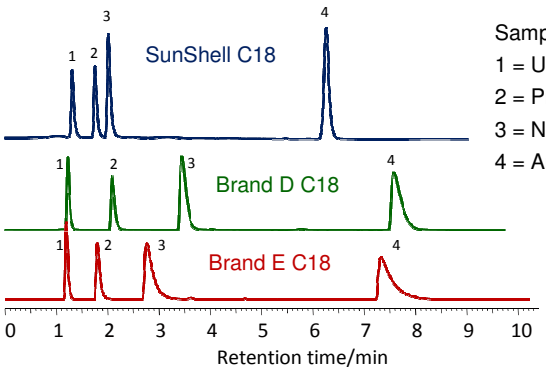
Common condition: Column dimension,150 x 4.6 mm, flow rate; 1.0 mL/min, temperature; 40 °C

Mobile phase: Acetonitrile/**20mM phosphate buffer pH7.0**=(60:40)

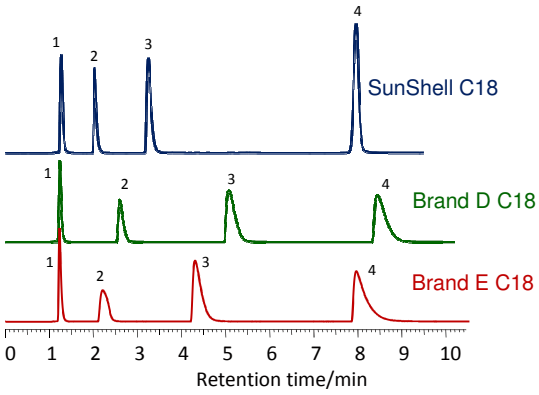


Mobile phase: Acetonitrile/**10mM acetate ammonium pH6.8**=(40:60)

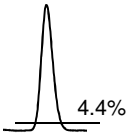




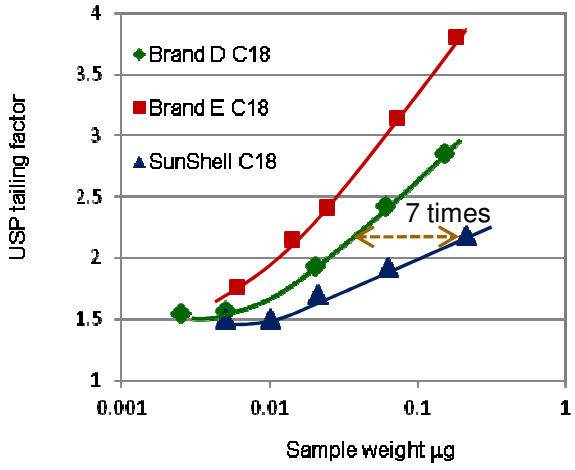
Sample:
1 = Uracil (0.07µg)
2 = Propranolol (1.53µg)
3 = Nortriptyline (0.32µg)
4 = Amitriptyline (0.32µg)



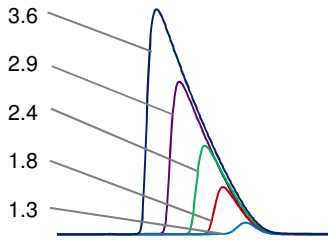
Theoretical plate was calculated by 5σ method using peak width at 4.4% of peak height.



Mobile phase: Acetonitrile/**0.1% formic acid**=(30:70)



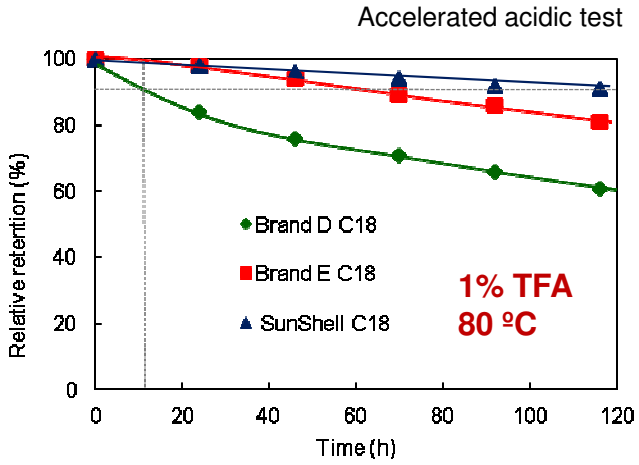
USP tailing factor



Amitriptyline overloads at low weight when acetonitrile/0.1% formic acid mobile phase. A peak is shifted forward under overloading.

Brand D C18 overloaded at more than 0.01 µg of amitriptyline while SunShell C18 overloadsed at more than from 0.3 to 1 µg of amitriptyline. Surprisingly loading capacity of Brand D C18 was only one hundredth to compare with SunShell C18 under acetonitrile/20mM phosphate buffer pH7.0=(60:40) mobile phase. Brand E C18 always showed poor peak of amitriptyline.

◆Evaluation of Stability



Durable test condition

Column size: 50 x 2.1 mm
Mobile phase: CH_3CN/1.0% TFA, pH1=10/90
Flow rate: 0.4 mL/min
Temperature: 80 ºC

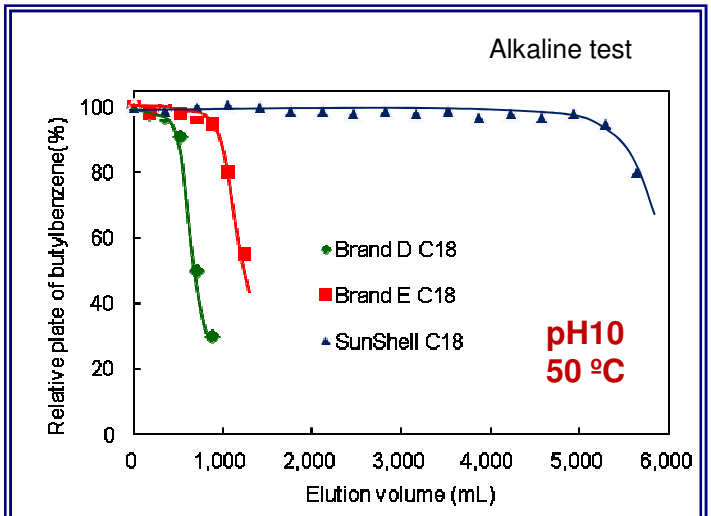
Measurement condition

Column size: 50 x 2.1 mm
Mobile phase: CH_3CN/H_2O=60/40
Flow rate: 0.4 mL/min
Temperature: 40 ºC
Sample: 1 = Uracil (t_0)
2 = Butylbenzene

Stability under acidic pH condition was evaluated at 80 ºC using acetonitrile/1% trifluoroacetic acid solution (10:90) as mobile phase. 100% aqueous mobile phase expels from the pore of packing materials by capillarity and packing materials doesn't deteriorate. 10% acetonitrile in a mobile phase allows an accurate evaluation.[1-3)]

★Sunshell C18 has kept 90% retention for 100 hours under such a severe condition. SunShell C18 is 5 to 10 times more stable than the other core shell C18.

1) N. Nagae, T. Enami and S. Doshi, LC/GC North America October 2002.
2) T. Enami and N. Nagae, American Laboratory October 2004.
3) T. Enami and N. Nagae, BUNSEKI KAGAKU, 53 (2004) 1309.



Durable test condition

Column Size: 50 x 2.1 mm
Mobile phase:
CH_3OH/20mM Sodium borate/10mM NaOH=30/21/49 (pH10)
Flow rate: 0.4 mL/min
Temperature: 50 ºC

Measurement condition

Column Size: 50 x 2.1 mm
Mobile phase: CH_3CN/H_2O=60/40
Flow rate: 0.4 mL/min
Temperature: 40 ºC
Sample: 1 = Butylbenzene

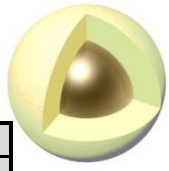
Stability under basic pH condition was evaluated at 50 ºC using methanol/Sodium borate buffer pH 10 (30:70) as mobile phase. Sodium borate is used as a alkaline standard solution for pH meter, so that its buffer capacity is high.

Elevated temperature of 10 ºC makes column life be one third. The other company shows stability test at ambient (room temperature). If room temperature is 25 ºC, column life at room temperature (25 ºC) is sixteen times longer than that at 50 ºC.

★ SunShell C18 is enough stable even if it is used under pH 10 condition. Regarding stability under basic pH condition, there is little C18 column like SunShell C18 except for hybrid type C18. It is considered that our end-capping technique leads high stability.

★ SunShell C18 can be used at the pH range from 1.5 to 10.

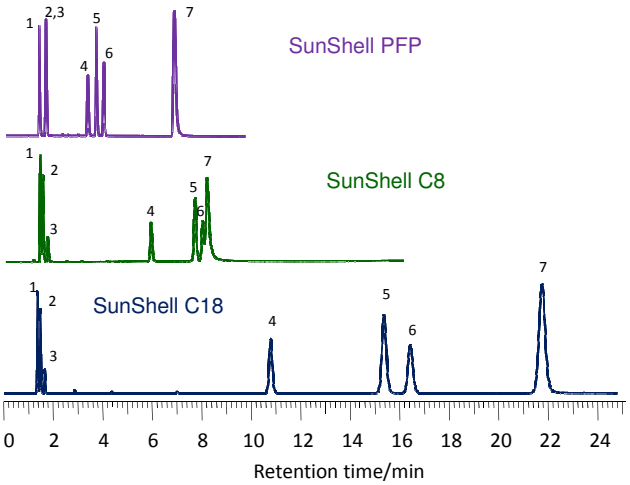
SunShell C8, PFP(Pentafluorophenyl)



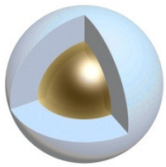
◆ Characteristics of SunShell

	Core shell silica			Bonded phase			
	Particle size (μm)	Pore diameter (nm)	Specific surface area (m^2/g)	Carbon content (%)	Bonded phase	Maximum operating pressure	Available pH range
SunShell C18	2.6	9	150	7	C18	60 MPa or 8,570 psi	1.5 - 10
SunShell C8	2.6	9	150	4.5	C8	60 MPa or 8,570 psi	1.5 - 9
SunShell PFP	2.6	9	150	4.5	Pentafluorophenyl	60 MPa or 8,570 psi	2 - 8

◆ Comparison of standard samples



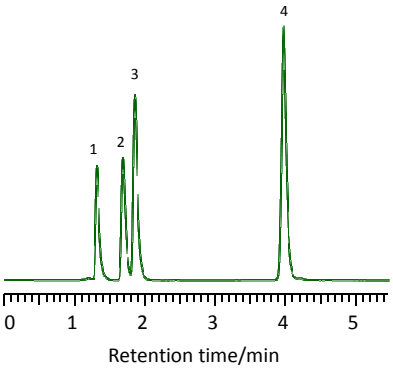
Column:
SunShell PFP, 2.6 μm 150 x 4.6 mm
SunShell C8, 2.6 μm 150 x 4.6 mm
SunShell C18, 2.6 μm 150 x 4.6 mm
Mobile phase: CH_3OH/H_2O=75/25
Flow rate: 1.0 mL/min
Temperature: 40 ºC
Sample: 1 = Uracil, 2 = Caffeine, 3 = Phenol, 4 = Butylbenzene
5 = o-Terphenyl, 6 = Amylbenzene, 7 = Triphenylene



	Hydrogen bonding (Caffeine/Phenol)	Hydrophobicity (Amylbenzene/Butylbenzene)	Steric selectivity (Triphenylene/o-Terphenyl)
SunShell PFP	1.00	1.31	2.38
SunShell C8	0.32	1.46	1.08
SunShell C18	0.39	1.60	1.46

Retention of standard samples was compared for three kinds of phases such as C18, C8 and PFP. C18 showed the highest hydrophobicity and PFP showed both the highest steric selectivity and the highest hydrogen bonding. The feature of PFP phase is to have hydrogen bonding, dipole-dipole interaction, aromatic and pi-pi interactions and hydrophobicity, which causes a different selectivity from a C18 phase.

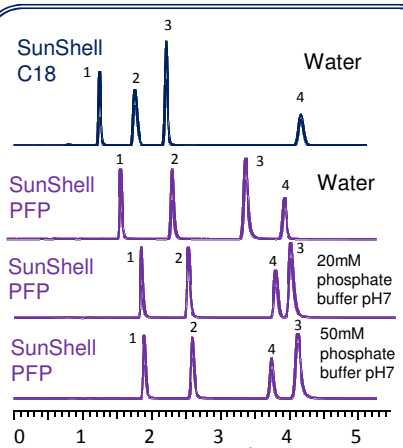
Separation of amitriptyline using C8



SunShell C8, 2.6 μm 150 x 4.6 mm
Mobile phase:
CH_3CN/20mM phosphate buffer H7.0=60/40
Flow rate: 1.0 mL/min
Temperature: 40 ºC
Detection: UV@250nm
Sample: 1 = Uracil
2 = Propranolol
3 = Nortriptyline
4 = Amitriptyline

SunShell C8 showed a sharp peak for amitriptyline a well as SunShell C18.

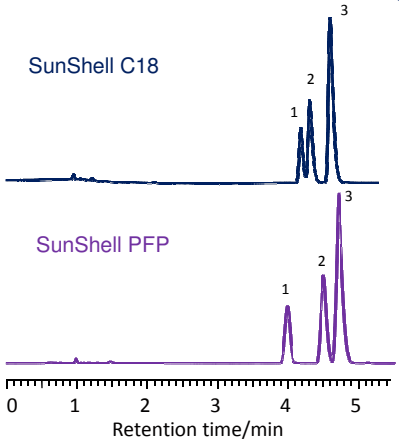
Separation of xanthines



SunShell C18, PFP 2.6 μm 150 x 2.1 mm
Mobile phase: CH_3OH/water or buffer=30/70
Flow rate: 0.3 mL/min
Temperature: 25 ºC
Detection: UV@250nm
Sample: 1 = Theobromine
2 = Theophyline
3 = Caffeine
4 = Phenol

SunShell PFP can retain xanthines more than SunShell C18. The higher the concentration of buffer, the longer the retention time.

Separation of isomers of xylene



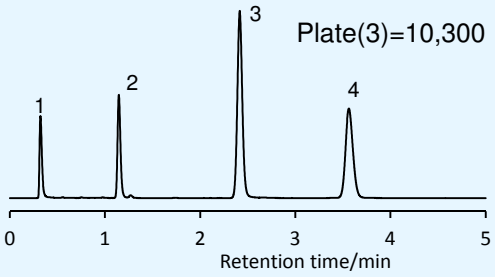
SunShell C18, PFP 2.6 μm 150 x 2.1 mm
Mobile phase:
CH_3OH/water=75:25 for SunShell C18
CH_3OH/water=60:40 for SunShell PFP
Flow rate: 0.3 mL/min
Temperature: 25 ºC
Detection: UV@250nm
Sample: 1 = o-Xylene
2 = m-Xylene
3 = p-Xylene

SunShell PFP showed the different selectivity from SunShell C18.

Efficiency of SunShell C18

UHPLC

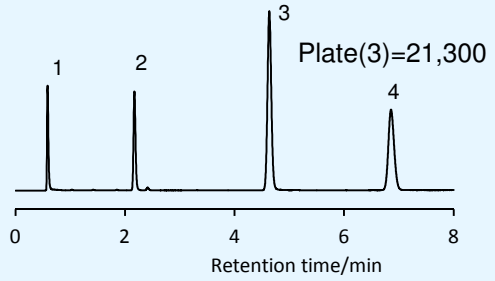
Column: SunShell C18, 50 x 2.1 mm



Column: SunShell C18, 2.6 µm 50 x 2.1 mm
Mobile phase: CH_3CN/H_2O=60/40
Flow rate: 0.3 mL/min
Pressure: 7 MPa
Temperature: 23 °C

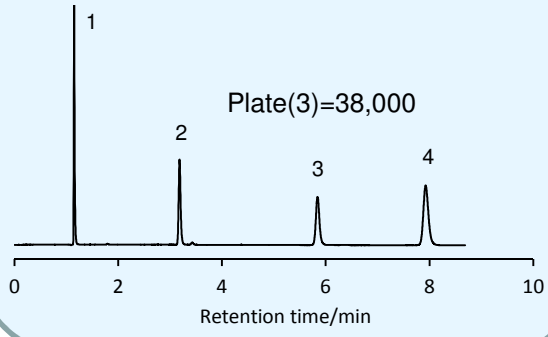
Sample: 1 = Uracil
2 = Toluene
3 = Acenaphthene
4 = Butylbenzene

Column: SunShell C18, 100 x 2.1 mm



Column: SunShell C18, 2.6 µm 100 x 2.1 mm
Mobile phase: CH_3CN/H_2O=60/40
Flow rate: 0.3 mL/min
Pressure: 12.5 MPa
Temperature: 25 °C

Column: SunShell C18,150 x 4.6 mm



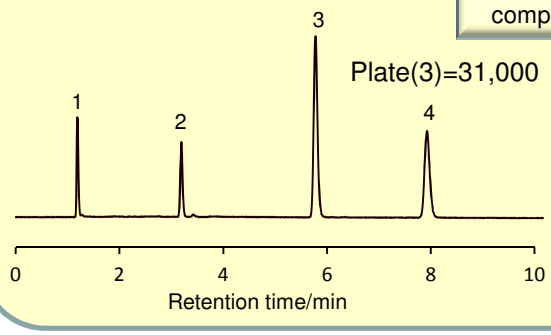
Efficiency=253,000 plate/m

Column: SunShell C18, 2.6 µm 150 x 4.6 mm
SunShell C18, 2.6 µm 100 x 4.6 mm
Mobile phase: CH_3CN/H_2O=70/30
Flow rate: 1.0 mL/min
Pressure: 14.5MPa(UHPLC),13.5 MPa(HPLC) for 150 mm
9.5MPa(HPLC) for 100 mm
Temperature: 25 °C
Sample: 1 = Uracil
2 = Toluene
3 = Acenaphthene
4 = Butylbenzene

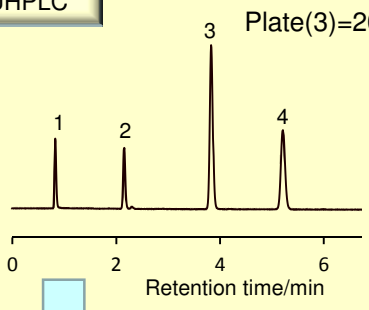
HPLC

80% efficiency to compare with UHPLC

Column: SunShell C18, 150 x 4.6 mm



Column: SunShell C18, 100 x 4.6 mm



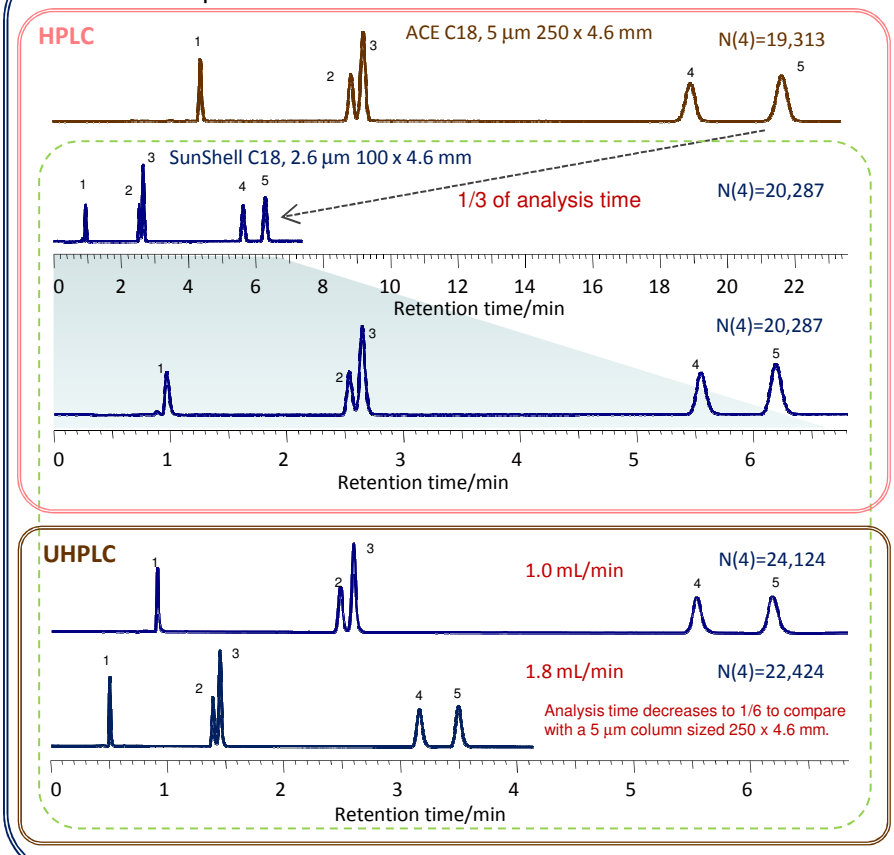
LaChrom ELITE

The same efficiency as 5 µm, 250 x 4.6 mm

Saving 60% for analytical time and consumption of solvent

Examples of transfer from a conventional 5 µm column to SunShell column

Isocratic separation

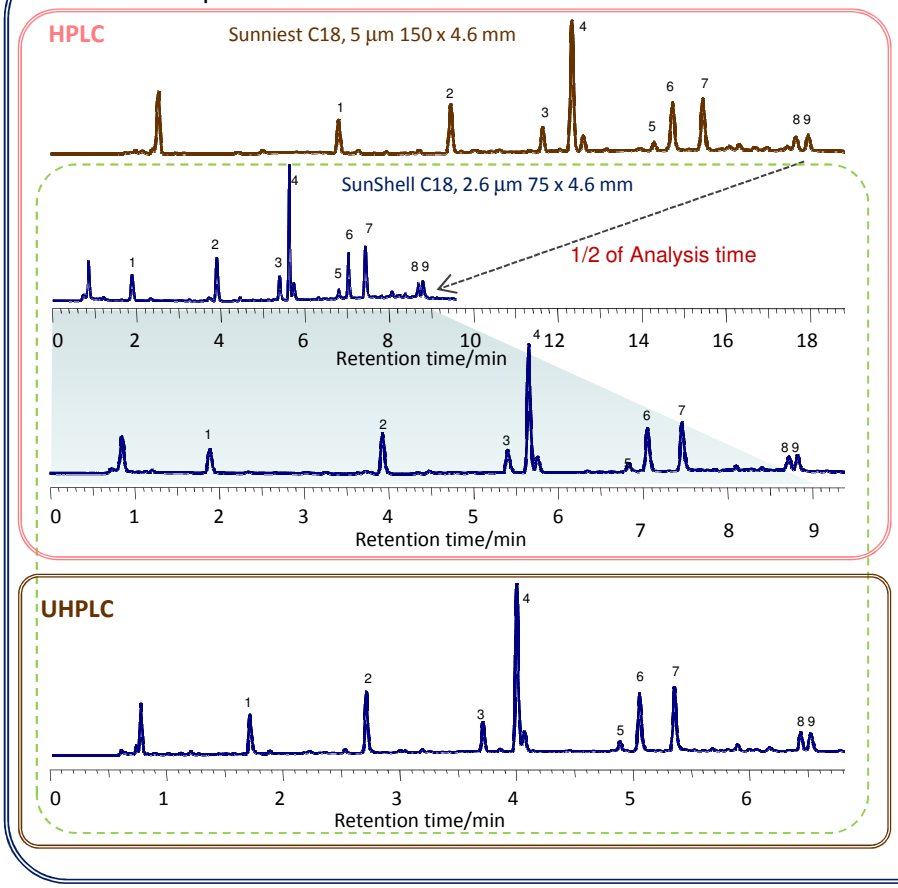


Column:
ACE C18, 5 µm 250 x 4.6 mm
SunShell C18, 2.6 µm 100 x 4.6 mm
Mobile phase:
CH_3CN/20mM Phosphoric acid = 45/55
Flow rate: 1.0 mL/min,
1.8 mL/min at the lowest chromatogram
Temperature: 25 ºC
Pressure: 9.5 MPa for ACE C18 5 µm
13.4 MPa for SunShell C18 2.6 µm
Detection: UV@230 nm

Sample: 1 = Benzydamine
2 = Ketoprofen
3 = Naproxen
4 = Indomethacin
5 = Ibuprofen

HPLC: Hitachi LaChrom ELITE (using 0.25 mm i.d. tubing)
UHPLC: Jasco X-LC

Gradient separation



Column:
Sunniest C18, 5 µm 150 x 4.6 mm
SunShell C18, 2.6 µm 75 x 4.6 mm
Mobile phase:
A) 0.1% Phosphoric acid
B) CH_3CN
Gradient program for Sunniest C18

0 min	15 min	20 min
2%	25%	25%

for SunShell C18

0 min	7.5 min	10 min
2%	25%	25%

Flow rate: 1.0 mL/min,
Temperature: 25 ºC
Detection: UV@250 nm
Sample: Oolong tea
1 = Gallocatechin, 2 = Epigallocatechin,
3 = Catechin, 4 = Caffeine, 5 = Epicatechin,
6 = Epigallocatechin gallate, 7 = Gallocatechin gallate, 8 = Epicatechin gallate, 9 = Catechin gallate

HPLC: Hitachi LaChrom ELITE (using 0.25 mm i.d. tubing)
UHPLC: Jasco X-LC

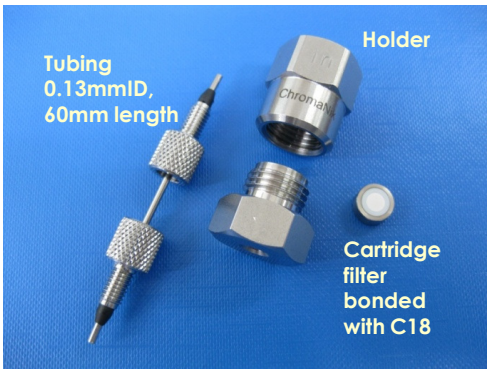
<<Caution>>

There are difference of system time lag between HPLC and UHPLC. UHPLC has much less system time lag than HPLC because of high pressure gradient system for UHPLC and low pressure gradient system for HPLC.

SunShell RP Guard Filter

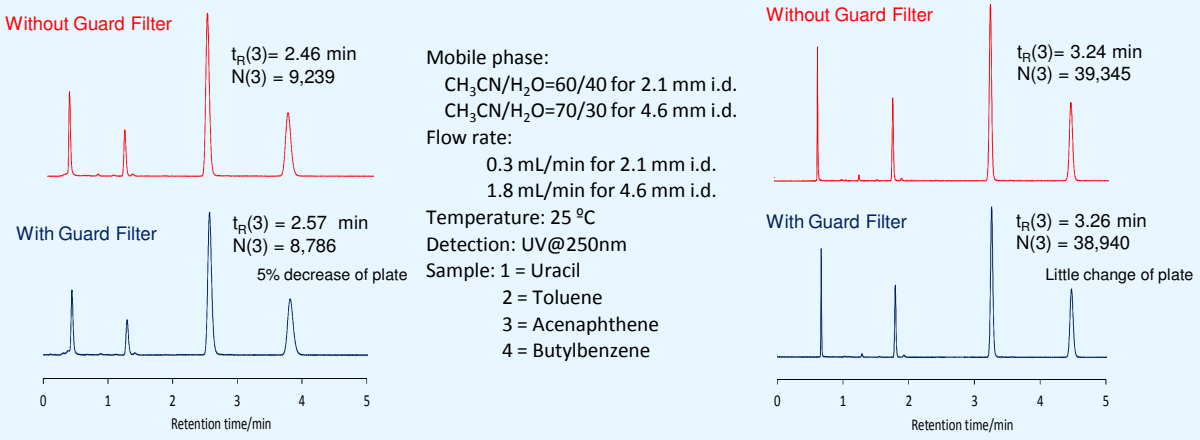
<Cartridge Type, Bonded with C18 and End-Capped with TMS>

Available as a guard column for reversed phase

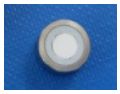
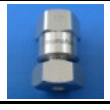


- ✓ The filter is made of porous glass sized 4 mm i.d. and 4 mm thickness.
- ✓ Pore diameter is 2 µm.
- ✓ Low dead volume structure
- ✓ Back pressure on glass filter is ca. 0.1 MPa at 1.0 mL/min of flow rate.
- ✓ Upper pressure limit is more than 60 MPa
- ✓ Available for 2.1 mm i.d to 4.6 mm i.d. column

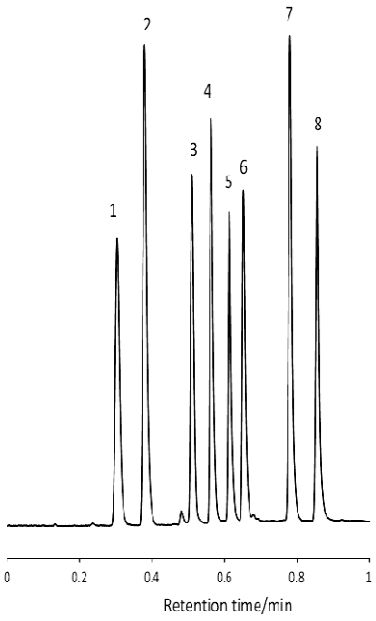
Evaluation of SunShell RP Guard Filter

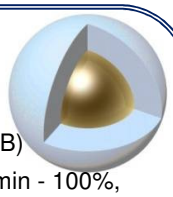


Price of SunShell RP Guard Filter

Name	quantity	Part number	Photo
SunShell RP Guard Filter For exchange	5 pieces	CBGAAC	
SunShell RP Guard Filter Holder	1 piece	CBGAAH	

High-throughput separation





Column: SunShell C18 30 x 3.0 mm. Mobile phase: A) Wtaer, B) Acetonitrile; Gradient (Acetonitorile %), 0.00 min - 35%, 0.40 min - 100%, 0.80 min - 100%, 0.85 min - 35%, 1cycle; 1.8min, (High-pressure gradient). Flow rate: 1.0 mL/min. Temperature: 40 ºC. Injection Volume: 1 µL. Wavelength: 200 - 500nm, CH-9, 215 - 500nm (Max Abs.). Sample: Mixture of ultraviolet absorbers,
1 = 2,2',4,4'-Tetrahydroxybenzophenone,
2 = Ethyl *p*-aminobenzoate, 3 = 2, 4-Dihydroxybenzophenone,
4 = 2,2'-Dihydroxy-4-methoxybenzophenone,
5 = 2,2'-Dihydroxy-4,4'-dimethoxybenzophenone,
6 = 2-Hydroxy-4-methoxybenzophenone,
7 = 2-(2'-Hydroxy-5'-metylphenyl) benzotriazole,
8 = 4-tert-Butylphenyl salicylate.
Courtesy of Jasco.

8 kinds of compounds were separated using SunShell C18 30 x 3.0 mm column in one minute.

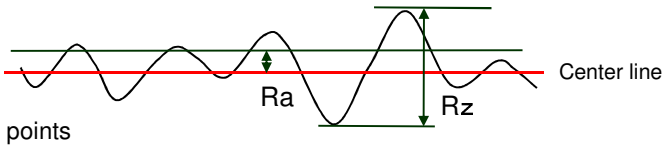
A peak width of just one second!!

Surface Roughness on Inner Surface of Column

Parameter of surface roughness

Ra: Average roughness from center line

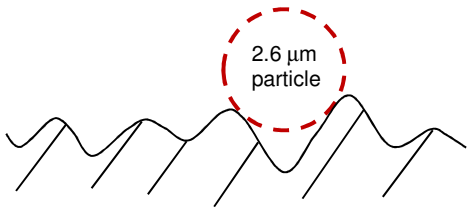
Rz: Roughness calculated from 10 points average (5 points of maximum and 5 points of minimum)



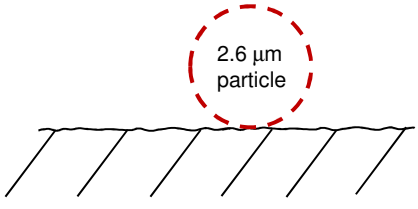
Schematic diagram of surface roughness

	G company	Y company	S1 company	S2 company	W company	ChromaNIk Technologies
Ra	0.34 µm	0.32 µm	0.37 µm	0.03 µm	0.20 µm	0.01 µm
Rz	1.88 µm	1.62 µm	1.91 µm	0.19 µm	0.90 µm	0.10 µm

It is considered that surface roughness affects column performance. Surface asperity of ChromaNik Technologies column with 2.1 mm i.d. and 3.0 mm i.d. is 1/30 to 1/20 to compare with that of GL Sciences, YMC, Shimadzu and Waters columns. ChromaNIk Technologies provides a column with a very smooth surface which is the most suitable for 2.6 µm core shell particle packings.



Inner surface of column of A, B, C companies



Inner surface of column of ChromaNik Technologies

Ordering information

SunShell C18	Inner diameter(mm)	2.1	3.0	4.6
	Length (mm)	Catalog number	Catalog number	Catalog number
	20	CB6921	CB6321	CB6421
	30	CB6931	CB6331	CB6431
	50	CB6941	CB6341	CB6441
	75	CB6951	CB6351	CB6451
	100	CB6961	CB6361	CB6461
	150	CB6971	CB6371	CB6471

SunShell C8	Inner diameter(mm)	2.1	3.0	4.6
	Length (mm)	Catalog number	Catalog number	Catalog number
	20	CC6921	CC6321	CC6421
	30	CC6931	CC6331	CC6431
	50	CC6941	CC6341	CC6441
	75	CC6951	CC6351	CC6451
	100	CC6961	CC6361	CC6461
	150	CC6971	CC6371	CC6471

SunShell PFP	Inner diameter(mm)	2.1	3.0	4.6
	Length (mm)	Catalog number	Catalog number	Catalog number
	20	CF6921	CF6321	CF6421
	30	CF6931	CF6331	CF6431
	50	CF6941	CF6341	CF6441
	75	CF6951	CF6351	CF6451
	100	CF6961	CF6361	CF6461
	150	CF6971	CF6371	CF6471

Next phases, C18-WP (16 nm), RP-AQUA, Phenyl and HILIC-Amide
Coming soon

Global Sales
Biotech AB

Manufacturer
ChromaNik Technologies Inc.

Transfer Guide

from conventional column to SunShell (core-shell) column

1) Choice of column dimension. Terms: same efficiency, same theoretical plate (TP)

In case of using HPLC

C18 5 µm 250 x 4.6 mm, 20,000 plate	SunShell C18 2.6 µm 100 x 4.6 mm, 25,000 plate (UHPC) 20,000 plate (HPLC)
C18 5 µm 150 x 4.6 mm, 12,000 plate	SunShell C18 2.6 µm 75 x 4.6 mm, 15,000 plate (UHPC) 12,000 plate (HPLC) SunShell C18 2.6 µm 50 x 4.6 mm, 12,500 plate (UHPC) 10,000 plate (HPLC)
C18 3 µm 150 x 4.6 mm, 20,000 plate	SunShell C18 2.6 µm 100 x 4.6 mm, 25,000 plate (UHPC) 20,000 plate (HPLC)
C18 3 µm 100 x 4.6 mm, 13,000 plate	SunShell C18 2.6 µm 75 x 4.6 mm, 15,000 plate (UHPC) 12,000 plate (HPLC) SunShell C18 2.6 µm 50 x 4.6 mm, 12,500 plate (UHPC) 10,000 plate (HPLC)

In case of using UHPLC

C18 5 µm 250 x 4.6 mm, 20,000 plate	SunShell C18 2.6 µm 100 x 3.0 mm, 20,000 plate SunShell C18 2.6 µm 100 x 2.1 mm, 20,000 plate
C18 5 µm 150 x 4.6 mm, 12,000 plate	SunShell C18 2.6 µm 75 x 3.0 mm, 12,000 plate SunShell C18 2.6 µm 75 x 2.1 mm, 12,000 plate SunShell C18 2.6 µm 50 x 3.0 mm, 10,0000 plate SunShell C18 2.6 µm 50 x 3.0 mm, 10,0000 plate
C18 3 µm 150 x 4.6 mm, 20,000 plate	SunShell C18 2.6 µm 100 x 3.0 mm, 20,000 plate SunShell C18 2.6 µm 100 x 2.1 mm, 20,000 plate
C18 3 µm 100 x 4.6 mm, 13,000 plate	SunShell C18 2.6 µm 75 x 3.0 mm, 12,000 plate SunShell C18 2.6 µm 75 x 2.1 mm, 12,000 plate SunShell C18 2.6 µm 50 x 3.0 mm, 10,0000 plate SunShell C18 2.6 µm 50 x 3.0 mm, 10,0000 plate

2) Decision of flow rate, injection volume and gradient time program.

$$\text{Flow rate}_{\text{SunShell}} = \text{Flow rate}_{3 \text{ or } 5\ \mu\text{m}} \times \left[\frac{\text{Diameter}_{\text{SunShell}}}{\text{Diameter}_{3 \text{ or } 5\ \mu\text{m}}}\right]^2 \times \text{Coefficient (1.0 – 2.5)}$$

Terms in case of 1.0 of coefficient. (More than 1.5 of coefficient is available for all conditions.)

Molecular weight of sample		Less than 400		More than 400	
Mobile phase		Methanol/water	Acetonitrile/water	Methanol/water	Acetonitrile/water
Temperature	25°C	OK	OK	OK	OK
	40°C	OK	Avoidance	OK	OK

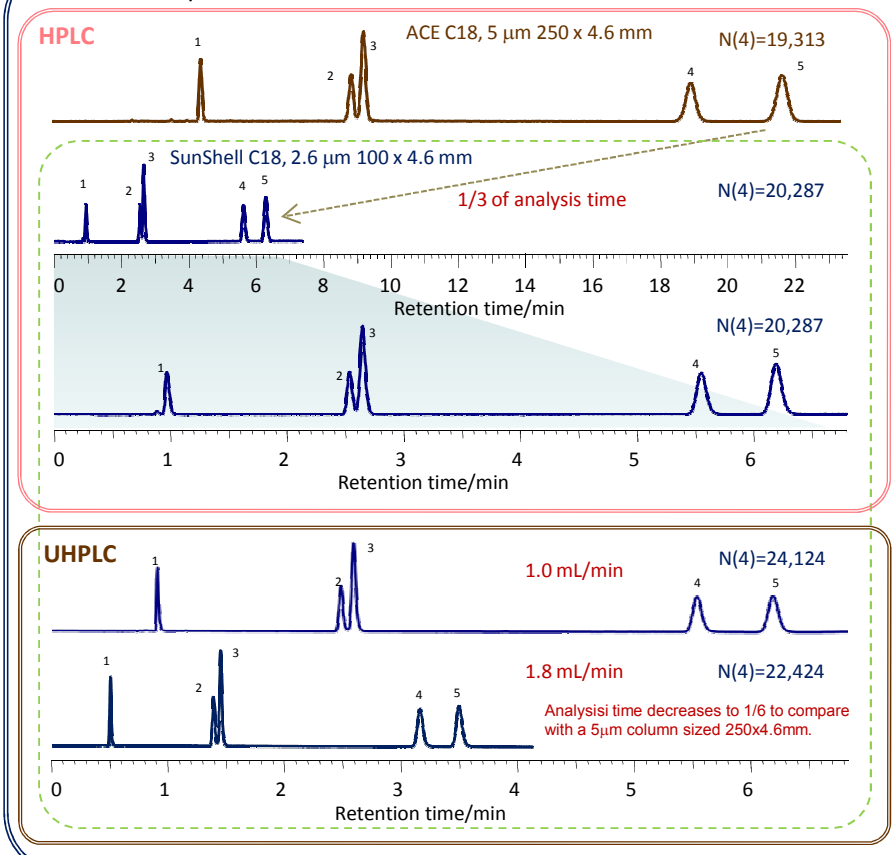
$$\text{Injection volume}_{\text{SunShell}} = \text{Injection volume}_{3 \text{ or } 5\ \mu\text{m}} \times \left[\frac{\text{Diameter}_{\text{SunShell}}}{\text{Diameter}_{3 \text{ or } 5\ \mu\text{m}}}\right]^2 \times \frac{\text{Length}_{\text{SunShell}}}{\text{Length}_{3 \text{ or } 5\mu\text{ m}}}$$

$$\text{Gradient time}_{\text{SunShell}} = \text{Gradient time}_{3 \text{ or } 5\ \mu\text{m}} \times \frac{\text{Flow rate}_{3 \text{ or } 5\ \mu\text{m}}}{\text{Flow rate}_{\text{SunShell}}} \times \left[\frac{\text{Diameter}_{\text{SunShell}}}{\text{Diameter}_{3 \text{ or } 5\ \mu\text{m}}}\right]^2 \times \frac{\text{Length}_{\text{SunShell}}}{\text{Length}_{3 \text{ or } 5\ \mu\text{m}}}$$

* HPLC system time lag of beginning gradient elution should be considered.

Examples of transfer

Isocratic separation

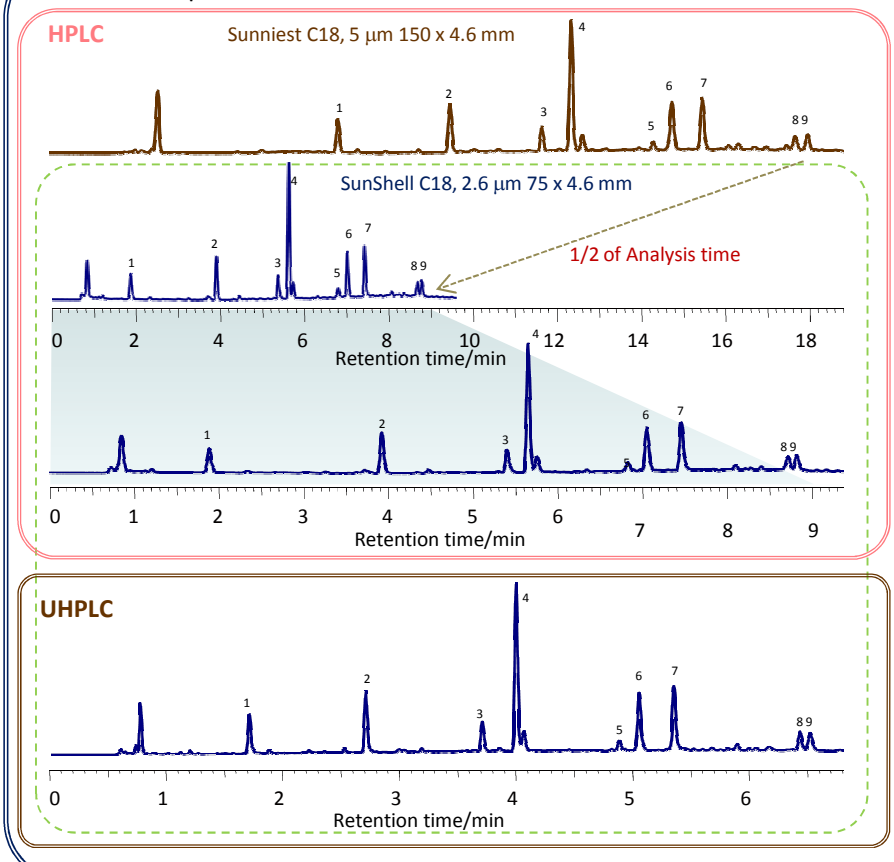


Column:
ACE C18, 5 µm 250 x 4.6 mm
SunShell C18, 2.6 µm 100 x 4.6 mm
Mobile phase:
CH_3CN/20mM Phosphoric acid = 45/55
Flow rate: 1.0 mL/min,
1.8 mL/min at the lowest chromatogram
Temperature: 25 ºC
Pressure: 9.5 MPa for Brand F C18 5 µm
13.4 MPa for SunShell C18 2.6 µm
Detection: UV@230 nm

Sample: 1 = Benzydamine
2 = Ketoprofen
3 = Naproxen
4 = Indomethacin
5 = Ibuprofen

HPLC: Hitachi LaChrom ELITE (using 0.25 mm i.d. tubing)
UHPLC: Jasco X-LC

Gradient separation



Column:
Sunniest C18, 5 µm 150 x 4.6 mm
SunShell C18, 2.6 µm 75 x 4.6 mm
Mobile phase:
A) 0.1% Phosphoric acid
B) CH_3CN
Gradient program for Sunniest C18

0 min	15 min	20 min
2%	25%	25%

for SunShell C18

0 min	7.5 min	10 min
2%	25%	25%

Flow rate: 1.0 mL/min,
Temperature: 25 ºC
Detection: UV@250 nm
Sample: Oolong tea
1 = Gallocatechin, 2 = Epigallocatechin,
3 = Catechin, 4 = Caffeine, 5 = Epicatechin,
6 = Epigallocatechin gallate, 7 = Gallocatechin gallate, 8 = Epicatechin gallate, 9 = Catechin gallate

HPLC: Hitachi LaChrom ELITE (using 0.25 mm i.d. tubing)
UHPLC: Jasco X-LC

<<Caution>>

There are difference of system time lag between HPLC and UHPLC. UHPLC has much less than system time lag than HPLC because of high pressure gradient system for UHPLC and low pressure gradient system for HPLC.

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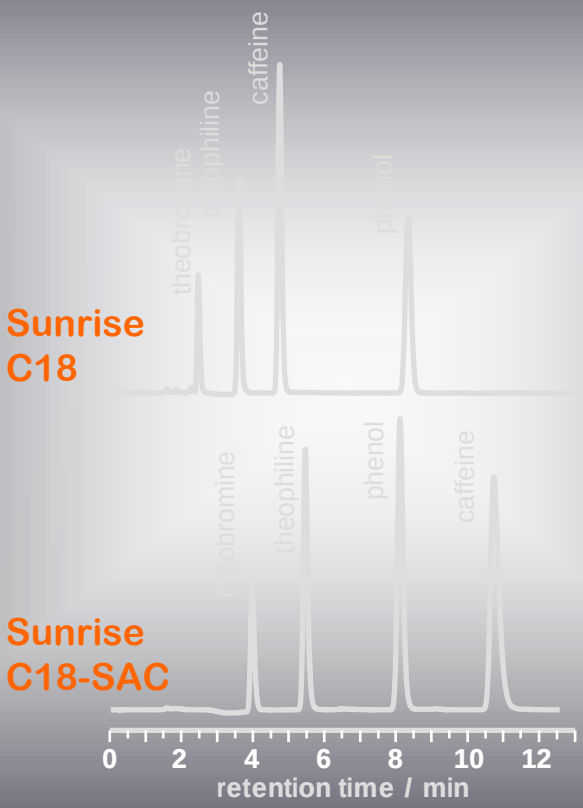
Are Silanol Groups Bad or Good for Basic Compounds?

Sunrise C18
Sunrise C18-SAC

Silanol Activity Controlled C18 Column

New-Type RP Column



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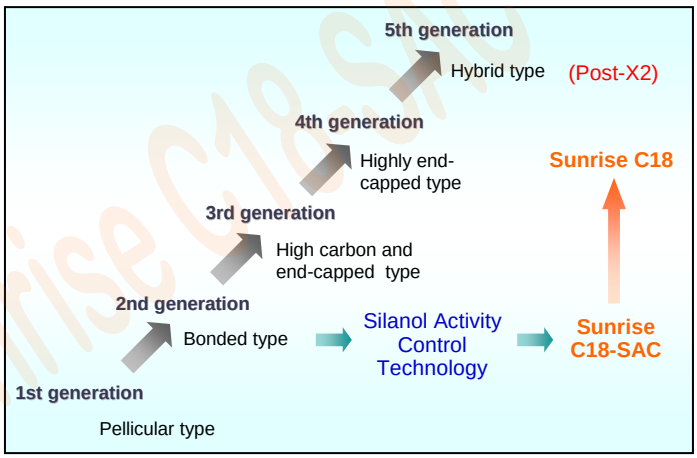
Sunrise C18 and C18-SAC

Silanol Activity Controlled C18 HPLC Column

◆ New generation reversed-phase utilized silanol groups

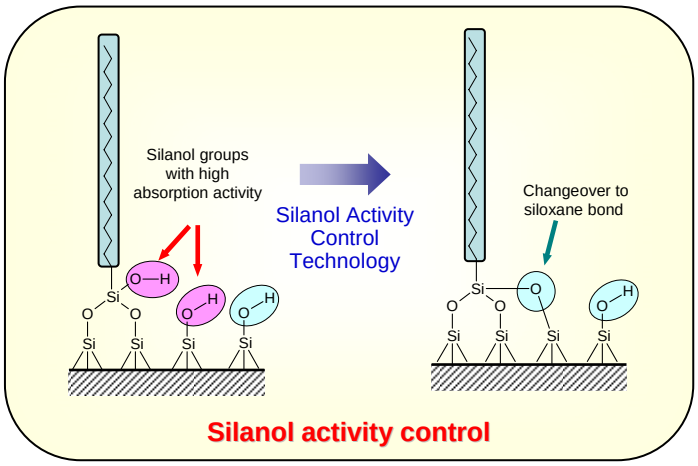
■ Silanol group and peak tailing

It is generally said that residual silanol groups on a stationary phase such as C18 (ODS) causes absorption or peak tailing for a sample. Especially silanol groups near a hydrophobic site don't solvate with water completely, so that they show high absorption for basic compounds. Its peak shows terribly tailing. Several end-capping techniques have been developed to solve these problems for many years.



■ Silanol activity control technology

ChromaNik developed the technique that decreased only silanol groups with high absorption activity to a basic compound and remained effective sailnol groups on the stationary phase. Silanol activity control and no end-capping led the existence of silanol groups with high hydration which created a new and unique reversed-phase separation mode including hydrogen bond and ion-exchange interaction. Furthermore, silanol activity controlling, then end-capping technique improved a peak shape of a basic compound exceedingly.



◆ Feature of Sunrise series

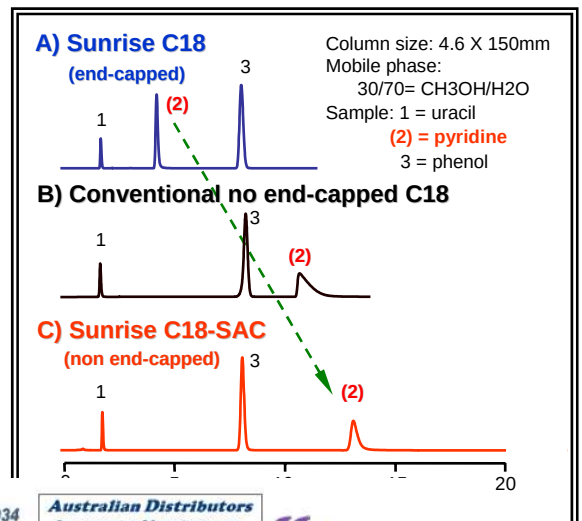
Sunrise C18

- The "1st Choice" column as a fully end-capped C18 column
- Full end-capping after silanol activity control
- Reducing adsorption of a basic compound extremely
- A good peak shape for a metal cheleting compound
- Widely available for general reversed-phase separation

Sunrise C18-SAC

- The "2nd Choice" column which takes advantage of effective silanol groups interaction
- Reducing silanol groups with high adsorption activity
- The new separation mechanism including hydrogen bond and ion-exchange interaction
- Effective for separation of a basic compound and a polar compound
- Different se
changing a

■ **The elution order of pyridine**



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Sunrise C18 and C18-SAC

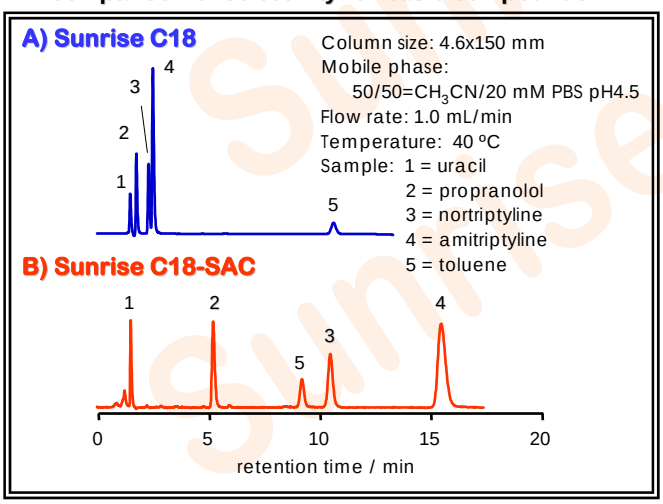
Silanol Activity Controlled C18 HPLC Column

◆ Sunrise series create an unique separation

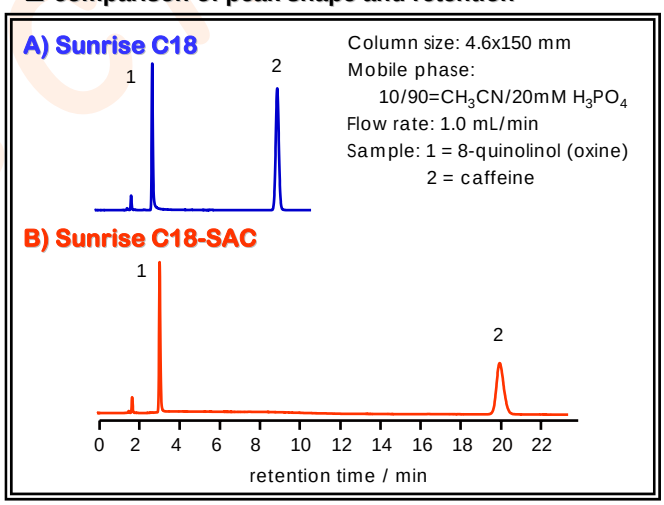
＊ Effectiveness of silanol activity control: Comparison between Sunrise C18 and C18-SAC

Sunrise C18 is the so-called fully end-capped C18 column. It shows the same separation behavior as a conventional C18 column.
On the other hand, Sunrise C18-SAC shows hydrogen bond and ion-exchange interactions based on a residual silanol on the silica support in addition to reversed-phase separation. For example Sunrise C18 column separates a basic compound similarly as a conventional C18, while Sunrise C18-SAC makes retention of a basic compound be large because an ion-exchange interaction works although a non-ionic compound shows the almost same retention on both Sunrise C18 and C18-SAC. Furthermore, Sunrise C18-SAC shows large retention for a polar compound such as caffeine.

■ **comparison of selectivity for basic compounds**



■ **comparison of peak shape and retention**

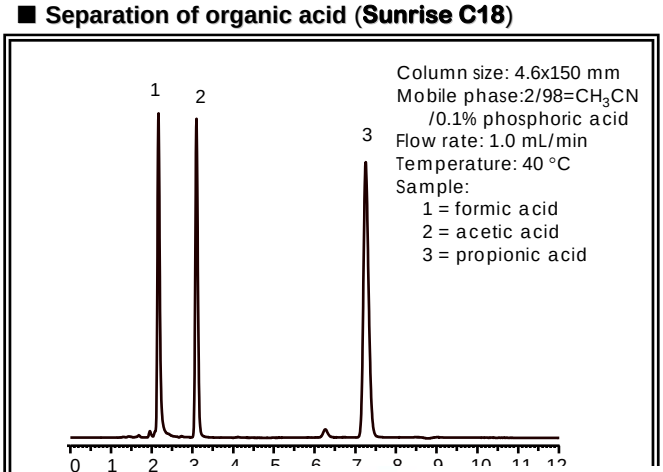


＊ C18 with both silanol activity control and full end-capping is effective in separation of polar compounds.

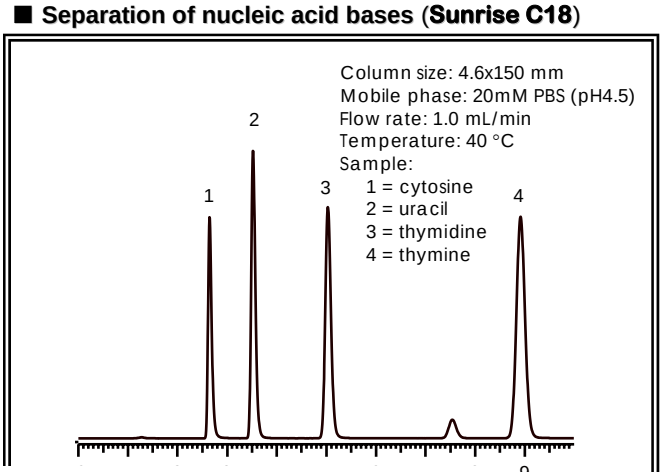
Sunrise C18 is bonded with octadecylsilane on pure silica gel (average pore size: 12nm, specific surface area: 340m^2/g), and end-capped after silanol activity control. Final carbon content of Sunrise C18 is 15%.

Ligand density of Sunrise C18 is intentionally rather low and uniformity of ligands is high, so that it shows enough retention, even if a mobile phase with a low organic solvent content is used, and good peak shape for a polar compound.

■ **Separation of organic acid (Sunrise C18)**



■ **Separation of nucleic acid bases (Sunrise C18)**



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Sunrise C18 and C18-SAC

Silanol Activity Controlled C18 HPLC Column

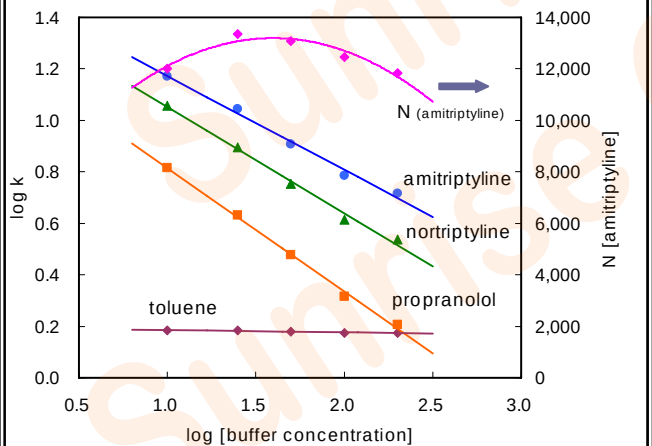
◆ Multiple mode separation is achieved on Sunrise series

＊ Silanol groups controlled its activity functions as ion-exchange groups

Sunrise C18-SAC is bonded with octadecylsilane on a pure silica gel and controlled its silanol activity without end-capping. Its carbon content is 14%.

Separation on Sunrise C18-SAC is done including hydrogen bond and ion-exchange interaction based on silanol groups except for hydrophobic interaction. Control of pH and salt concentration of a mobile phase can regulate retention.

■ **Relationship between buffer concentration and retention(Sunrise C18-SAC)**

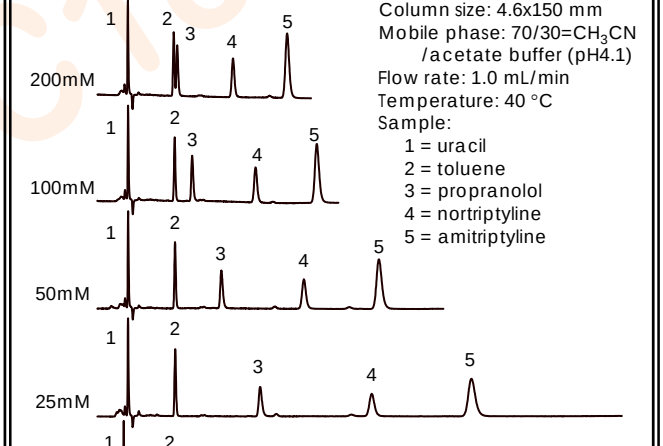


$$\log k = -\frac{z_B}{z_A}\log[A] + \frac{z_B}{z_A}\log[\bar{A}] + \log\frac{V_r}{V_m} + \frac{1}{z_A}\log K_A^B$$

A:ion in eluent, *B*:ion of sample, *k*:retention of *B*, *K*:selection coefficient

ZA, *ZB*:charge, *Vr*, *Vm*:resin volume and mobile phase volume in column

■ **Separation of basic compounds with ammonium acetate: Effect of salt concentration(Sunrise C18-SAC)**



Ordering infomation

Inner diameter	length	Sunrise C18, 5µm	Sunrise C18, 3µm	Sunrise C18-SAC, 5µm	Sunrise C18-SAC, 3µm
[mm]	[mm]	Cat. No.	Cat. No.	Cat. No.	Cat. No.
2.0	50	SB3241	SB2241	SA3241	SA2241
	75	—	SB2251	—	SA2251
	100	SB3261	SB2261	SA3261	SA2261
	150	SB3271	SB2271	SA3271	SA2271
4.6	10	SB3411	SB2411	SA3411	SA2411
	50	SB3441	SB2441	SA3441	SA2441
	75	—	SB2451	—	SA2451
	100	SB3461	SB2461	SA3461	SA2461
	150	SB3471	SB2471	SA3471	SA2471
	250	SB3481	—	SA3481	—
10.0	250	SB3781	—	SA3781	—
20.0	250	SB3881	—	SA3881	—

ChromaNik Technologies Inc.

HPLC column

Sunniest C18

Sunniest RP-AQUA

Sunniest C8

Patent pending

ChromaNik Technologies Inc.

Sunniest C18
Sunniest RP-AQUA
Sunniest C8

A Novel Bonding Technique

(patent pending)

An unique trifunctional silyl-reagent was developed as shown in Fig. 1. This silyl-reagent can bond with any silanol groups on silica surface as shown in Fig.2 because it can expand and contract by itself. This technique can make residual silanol groups on C18 stationary phase to be the least amount.

Finally an end-capping was done with trimethylsilyl-reagent (TMS).

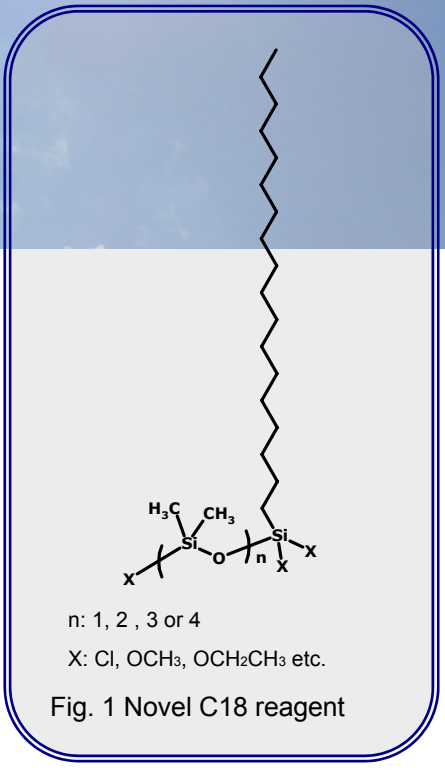


Fig. 1 Novel C18 reagent

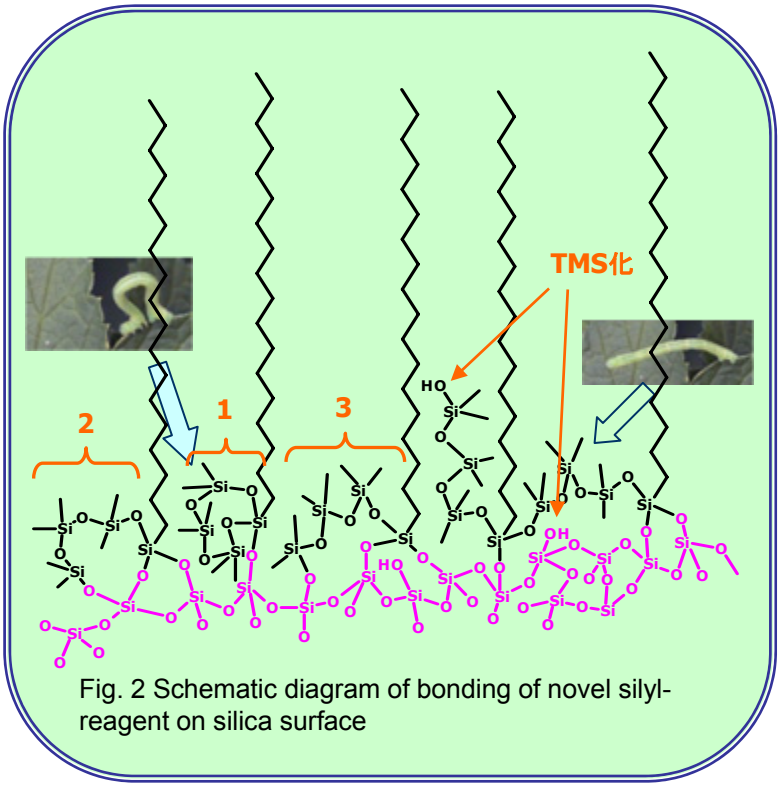


Fig. 2 Schematic diagram of bonding of novel silyl-reagent on silica surface

Features

★ Little residual silanol groups by an unique bonding technique

★Excellent stability, especially under acidic pH conditions

★ Sharp peak shape for acidic, basic and chelating compounds

★RP-AQUA is available under 100% aqueous conditions, and shows enhanced retention of polar compounds.

Characteristics of Sunniest

	Particle size (μm)	Pore diameter (nm)	Specific surface area (m^2/g)	Carbon content (%)	Bonded phase	pH range
Sunniest C18	3 and 5	12	340	16	C18	1.5 - 10
Sunniest RP-AQUA	3 and 5	12	340	16	Near C18	2 - 8
Sunniest C8	3 and 5	12	340	10	C8	1.5 - 9

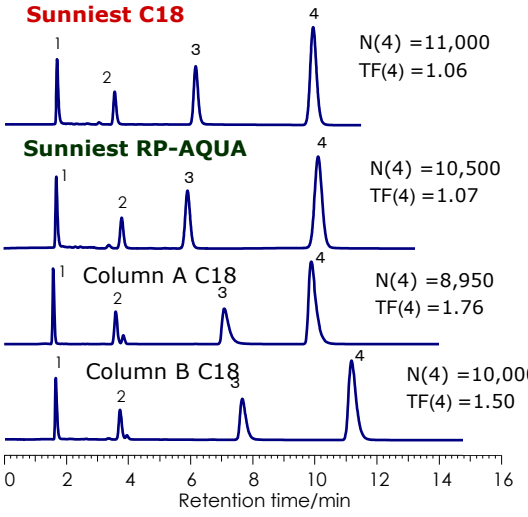
Website : www.chromtech.net.au E-mail : info@chromtech.net.au telNo : 03 9762 2034 . . . in AUSTRALIA

Sunniest C18
Sunniest RP-AQUA
Sunniest C8

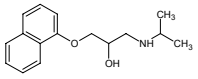
◆Evaluation of End-capping

Comparison of plates number (N) and USP tailing factor (TF) of amitriptyline

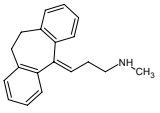
CH_3OH, pH7.5, 40 °C



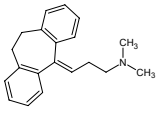
Column size: 150 x 4.6 mm
Particle size: 5µm
Mobile phase:
CH_3OH/20mM Phosphate buffer pH7.5 or 6.0 =80/20
CH_3CN/20mM Phosphate buffer pH7.0 =60/40
Flow rate: 1.0 mL/min
Temperature: 40 °C or 22 °C
Sample: 1 = Uracil
2 = Propranolol



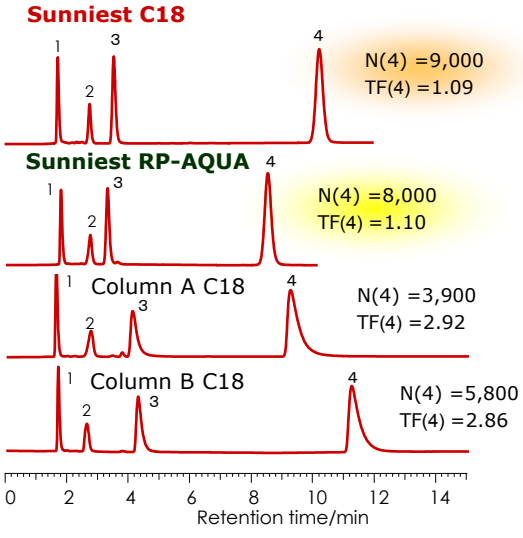
3 = Nortriptyline



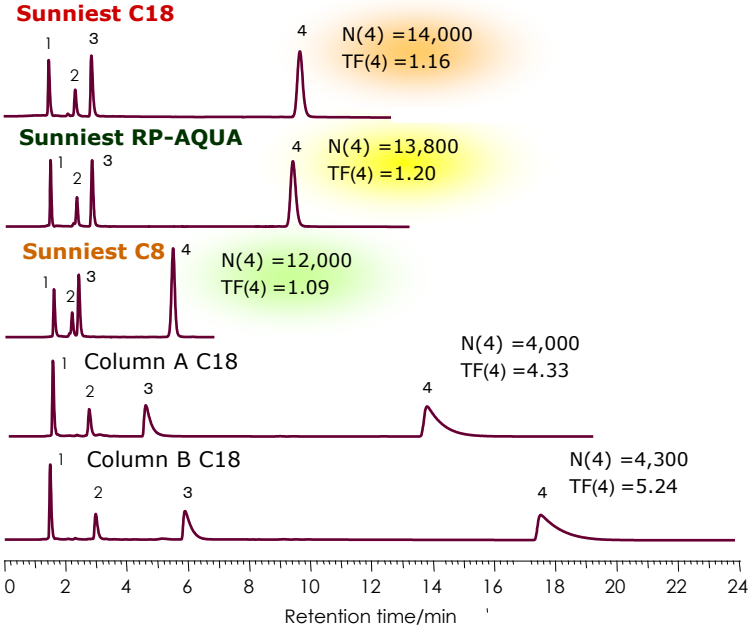
4 = Amitriptyline



CH_3OH, pH6.0, 22 °C



CH_3CN, pH7.0, 40 °C

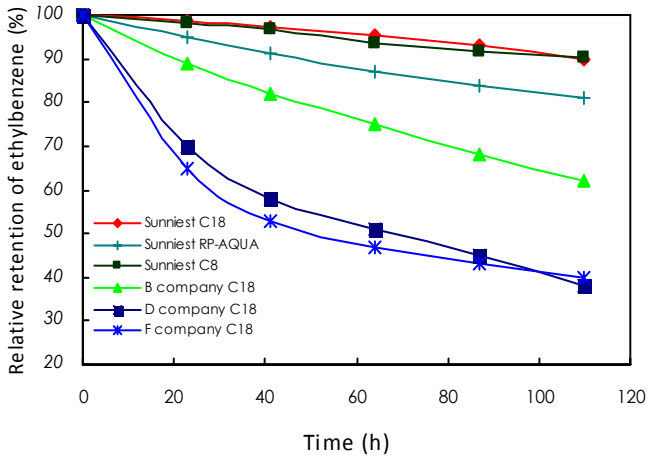


Amitriptyline is widely used to evaluate residual silanol groups on the C18 stationary phase. Peak shape of amitriptyline was compared under 3 kinds of conditions such as methanol/phosphate buffer/40 °C, methanol/phosphate buffer/22 °C and acetonitrile/phosphate buffer/40 °C. Under methanol/phosphate buffer/40 °C conditions which is the most common among HPLC manufacturers, good peak shape was obtained for all columns. There were little difference of a peak shape. Under acetonitrile/phosphate buffer/40 °C, however, Sunniest columns showed a symmetrical peak, while column A and B C18 showed a terribly tailing peak.

Sunniest C18, RP-AQUA and C8 columns allow to use a wide range of mobile phase without peak tailing because of extremely low content of residual silanol groups on the stationary phase.

Sunniest C18
Sunniest RP-AQUA
Sunniest C8

◆Stability under acidic and basic pH conditions

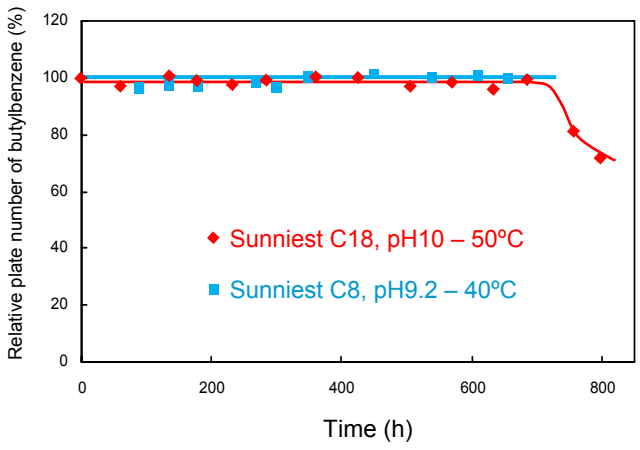


Durable test condition

Column size: 150 x 4.6 mm
Mobile phase: CH_3CN/1.0% TFA (pH1) = 10/90
Flow rate: 1.0 mL/min
Temperature: 80 °C

Measurement condition

Column size: 150 x 4.6 mm
Mobile phase: CH_3CN/H_2O=60/40
Flow rate: 1.0 mL/min
Temperature: 40 °C
Sample: 1 = Uracil
2 = Ethylbenzene



Durable test condition

Column: Sunniest C18, C8, 5 μm 150 x 4.6 mm
Mobile phase:
C18: CH_3OH/20mM Sodium borate/10mM NaOH=30/21/49 (pH10)
C8: CH_3OH/20mM Sodium borate (pH9.2) =30/70
Flow rate: 1.0 mL/min
Temperature: C18 - 50 °C, C8 - 40 °C

Measurement condition

Column: Sunniest C18, C8, 5μm 150 x 4.6 mm
Mobile phase: CH_3CN/H_2O=75/25
Flow rate: 1.0 mL/min
Temperature: 40 °C
Sample: 1 = Butylbenzene

Stability under acidic pH conditions was evaluated at 80 °C using acetonitrile/1% trifluoroacetic acid solution (10:90) as mobile phase. 100% aqueous mobile phase expels from the pore of packing materials by capillarity and packing materials doesn't deteriorate. 10% acetonitrile in a mobile phase allows an accurate evaluation.[1-3)]

★Sunniest C18 has kept 90% retention for 100 hours under such severe conditions.

Our bonding technique can make column life be long.

Sunniest RP-AQUA is less stable than Sunniest C18. However, Sunniest RP-AQUA has more stable than other company C18 columns.

Stability under basic pH conditions was evaluated at 50 °C using methanol/Sodium borate buffer pH 10 (30:70) as mobile phase. Sodium borate is used as a alkaline standard solution for pH meter, so that its buffer capacity is high.

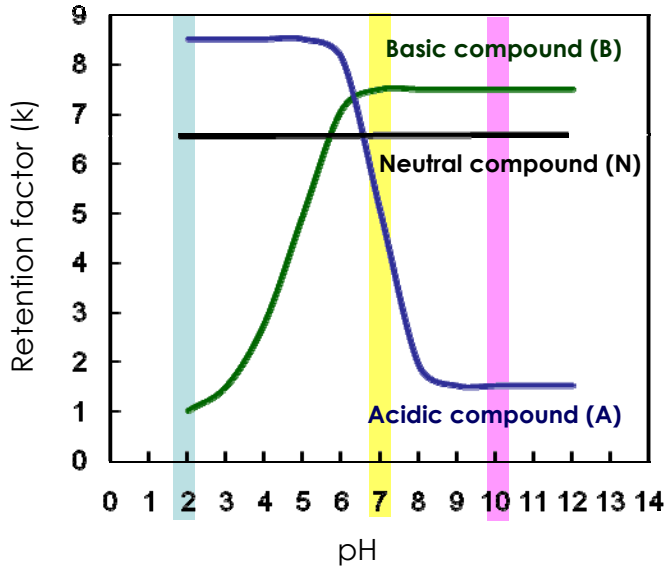
Elevated temperature of 10 °C makes column life be one third. When Sunniest C18 column is used at 40 °C, column life becomes 2,000 hours. Other company shows stability test at ambient (room temperature). If room temperature is 25 °C, column life at room temperature (25 °C) is sixteen times longer than that at 50 °C.

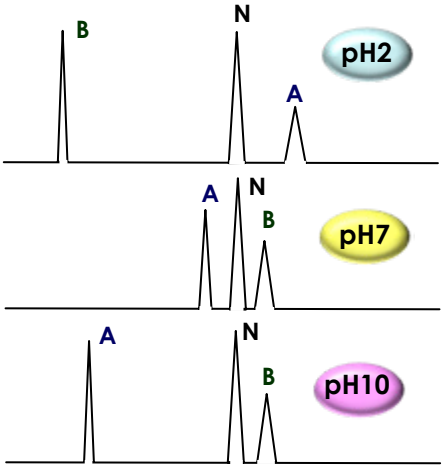
★ Sunniest C18 is enough stable even if it is used under pH 10 condition. Regarding stability under basic pH condition, there is little C18 column like Sunniest C18 except for hybrid type C18. It is considered that our end-capping technique leads high stability.

★ Sunniest C18 can be used at the pH range from 1.5 to 10. Sunniest C8 can be used at the pH range from 1.5 to 9.

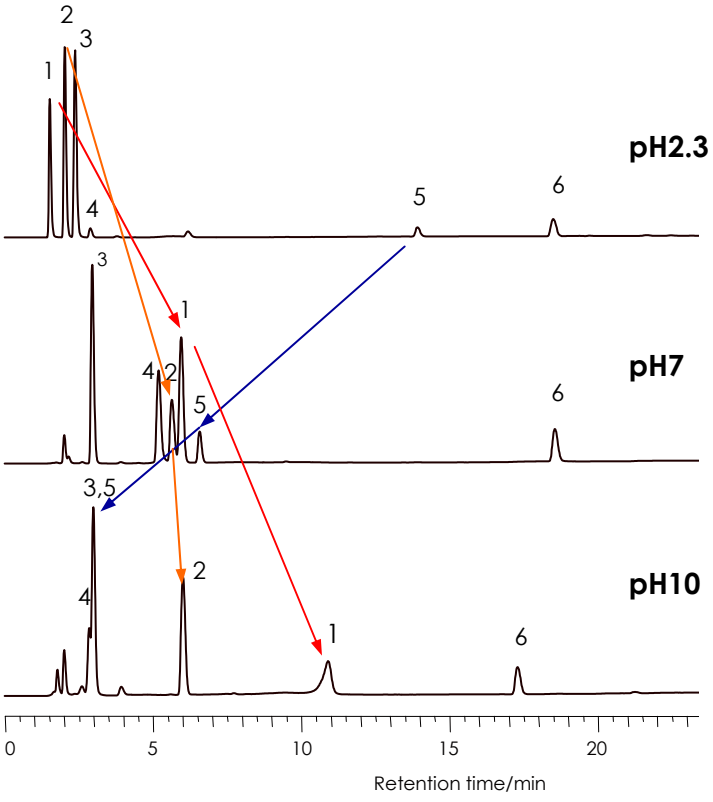
1) N. Nagae, T. Enami and S. Doshi, LC/GC North America October 2002.
2) T. Enami and N. Nagae, American Laboratory October 2004.
3) T. Enami and N. Nagae, BUNSEKI KAGAKU, 53 (2004) 1309.

◆Relationship between pH and retention of acidic, basic and neutral compounds





◆pH selectivity



Column: Sunniest C18, 5 μm 150 x 4.6 mm
Mobile phase:
A1) 20mM Phosphoric acid pH2.3
A2) 20mM Phosphate buffer pH7
A3) 20mM Phosphate buffer pH10
B) Acetonitrile

Time (min)	0	30
%B (%)	2	26

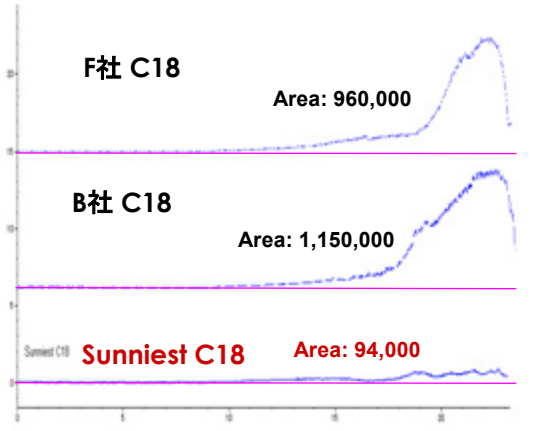
Flow rate: 1.0 mL/min
Temperature: 40 °C
Detection: UV@250 nm
Sample: 1= Thiamine HCl Vitamin B_1
2 = Nicotinamide
3 = Nicotinic acid
4 = Pyridoxine HCl Vitamin B_6
5 = Folic acid
6 = Riboflavin Vitamin B_2

pH of mobile phase can make selectivity of ionic compounds change much. Sunniest C18 can be used at the pH range from 1.5 to 10, so that a suitable analytical method can be created using Sunniest C18.

Sunniest C18
Sunniest RP-AQUA
Sunniest C8

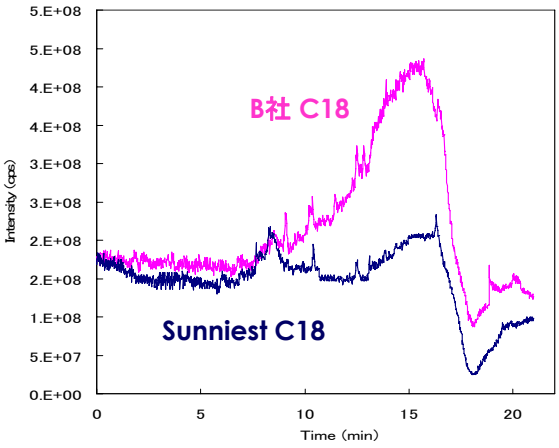
◆Comparison data: Bleeding from column

《Comparison using Corona CAD》



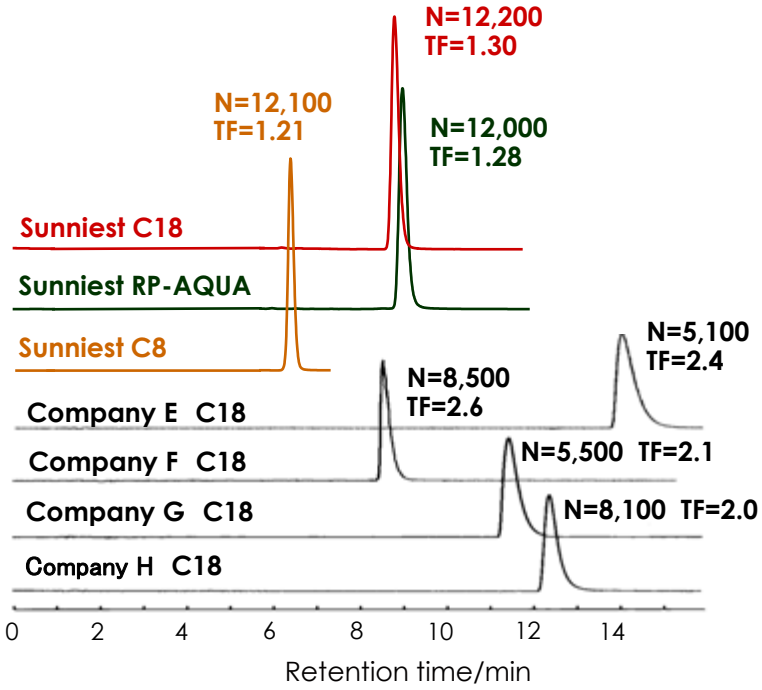
Column size: 150 x 2.0 mm
Mobile phase:
A) 0.1% acetic acid
B) CH_3CN
Gradient:
Time: 0min 3min 14.4min 18min 19min
%B: 5% 5% 100% 100% 5%
Flow rate: 0.2 mL/min
Temperature: 40 °C
Detection: Corona CAD

《Comparison using MS》

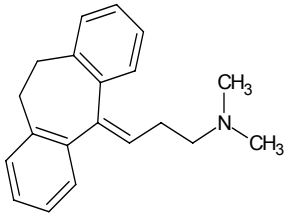


Column size: 150 x 2.0 mm
Mobile phase:
A) 0.1% acetic acid
B) CH_3CN
Gradient: Time: 0min 3min 14.4min 18min 19min
%B: 5% 5% 100% 100% 5%
Flow rate: 0.2 mL/min
Temperature: 40 °C
MS: ABI API-4000
Ionization: Turboionspray (cation)
Measurement mode: Q1 Scan m/z 100-1000

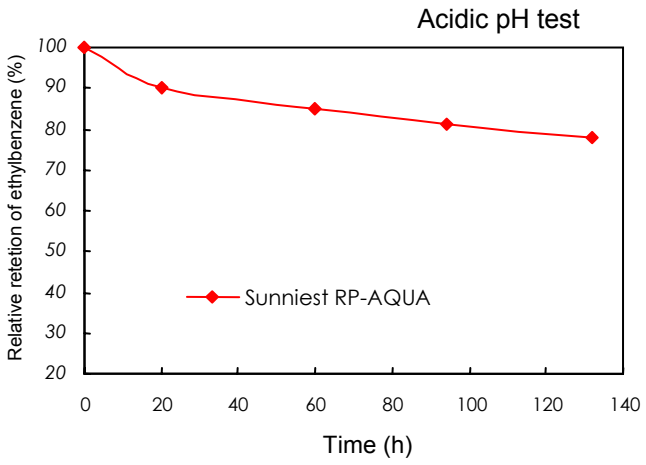
◆Separation of antidepressants using acetonitrile and ammonium acetate for LC/MS



Column size: 150 x 4.6 mm
Particle size: 5μm
Mobile phase: CH_3CN/10mM
Ammonium acetate pH6.8=40/60
Flow rate: 1.0 mL/min
Temperature: 40 °C
Sample: Amitriptyline



◆Stability of Sunniest RP-AQUA under 100% aqueous conditions

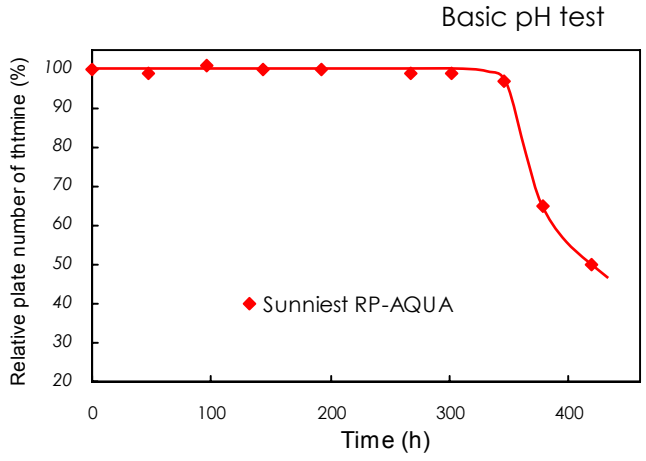


Durable test conditions

Column: Sunniest RP-AQUA, 5µm 150 x 4.6 mm
Mobile phase: 0.5% TFA
Flow rate: 1.0 mL/min
Temperature: 60 °C

Measurement conditions

Column: Sunniest RP-AQUA, 5µm 150 x 4.6 mm
Mobile phase:
CH_3OH/H_2O=75/25
Flow rate: 1.0 mL/min
Temperature: 40 °C
Sample: 1 = Uracil
2 = Amylbenzene



Durable test conditions

Column: Sunniest RP-AQUA, 5µm 150 x 4.6 mm
Mobile phase: 20mM Phosphate buffer pH8.0
Flow rate: 1.0 mL/min
Temperature: 40 °C

Measurement conditions

Column: Sunniest RP-AQUA, 5µm 150 x 4.6 mm
Mobile phase: 10mM Phosphate buffer pH7.0
Flow rate: 1.0 mL/min
Temperature: 40 °C
Sample: 1 = Thymine

It is important that stability is evaluated under 100% aqueous conditions for an AUQA type C18 column because column life becomes longer to increase a content of organic solvent in a mobile phase. Sunniest RP-AQUA can be used under 100% aqueous conditions from pH2 to pH8.

★Sunniest RP-AQUA can be used under 100% aqueous conditions from pH 2 to pH 8. Sunniest RP-AQUA is one of the most stable aqua type column.

Sunniest C18
Sunniest RP-AQUA
Sunniest C8

◆Reproducibility of retention under 100% aqueous conditions

★ C18 and C8 reversed phases exhibit decreased and poorly reproducible retention under more than 98% aqueous conditions as shown in Fig. 1. This problem traditionally has been explained as being the result of ligand collapse or a matting effect. Nagae[1-3] ascertained , however , that the mobile phase was being expelled from the pores of the packing material under 100% aqueous mobile phase conditions, as Fig. 2 shows.

★ When the surface of packing materials isn't wet by water, water used as a mobile phase expels from the pore of the packing material by capillarity. This is a reason why reproducibility in retention is low under 100% aqueous conditions. Reversely pressure around the packing material makes water permeate into the pore of the packing material to overcome a force worked by capillarity.

In other words, the surface of a reversed phase like C18 isn't wet by water anytime even if water permeates into the pore of the packing material or not. So it is wrong that we say " dewetting" when water expel from the pore. Saying " Depermetating" is more suitable.

★ Sunniest RP-AQUA is a reversed stationary phase, so that it is not wet with water. However the contact angle of water on the surface of Sunniest RP-AQUA is less than that of a conventional C18. Expelling force (pressure) acted by capillarity on Sunniest RP-AQUA is less than atmospheric pressure. So, Sunniest RP-AQUA shows reproducible retention under 100% aqueous conditions.

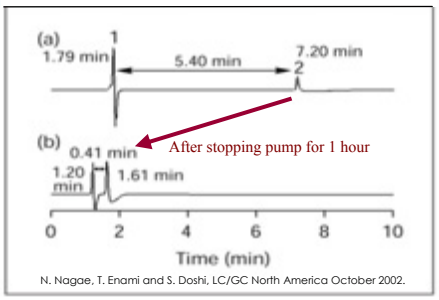


Fig. 1 Retention behavior of a C18 column under 100% aqueous mobile phase conditions

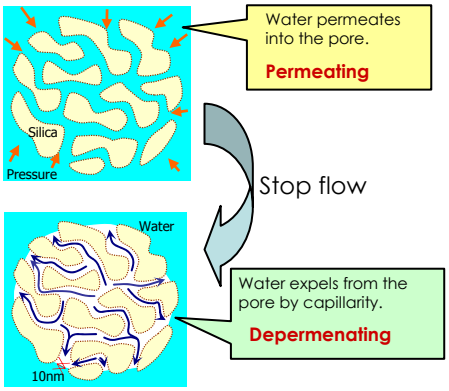
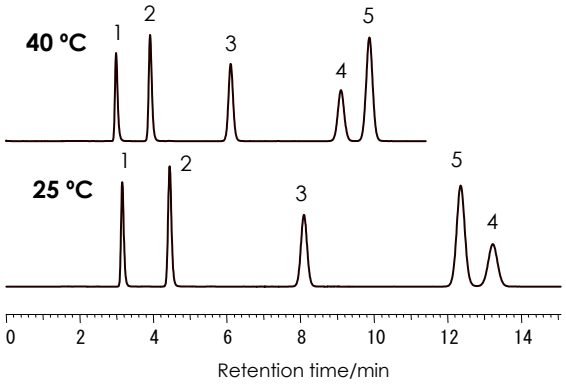


Fig. 2 Schematic diagram of C18 particle

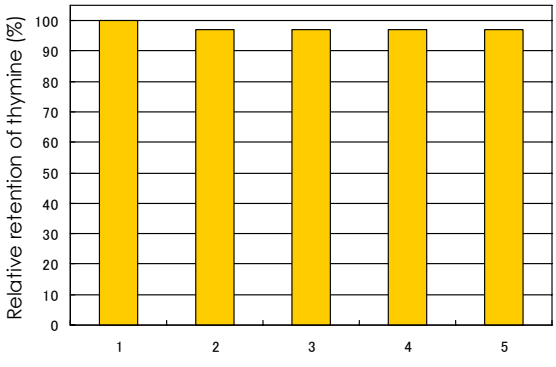
1) N. Nagae, T. Enami and S. Doshi, LC/GC North America October 2002.
2) T. Enami and N. Nagae, American Laboratory October 2004.
3) T. Enami and N. Nagae, BUNSEKI KAGAKU, 53 (2004) 1309.

◆Separation of nucleic acid bases



Column: Sunniest RP-AQUA, 5µm 150 x 4.6 mm
Mobile phase: 10mM Phosphate buffer pH7.0
Flow rate: 1.0 mL/min
Temperature: 40 °C and 25°C
Sample: 1 = Cytosine 2 = Uracil
3 = Thymidine 4 = Uridine
5 = Thymine

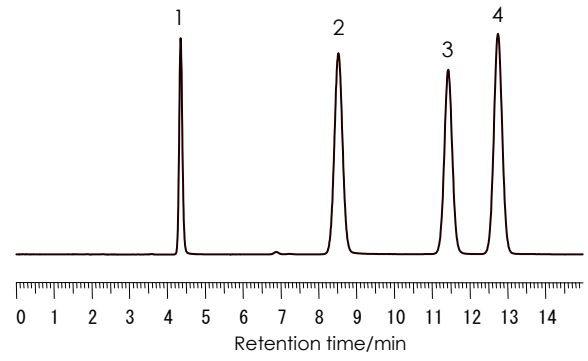
Change of retention of thymine at 40 °C (measurement every stop flow for 1 hour)



Sunniest RP-AQUA showed more than 97% of reproducibility in retention using 100% aqueous buffer as a mobile phase.

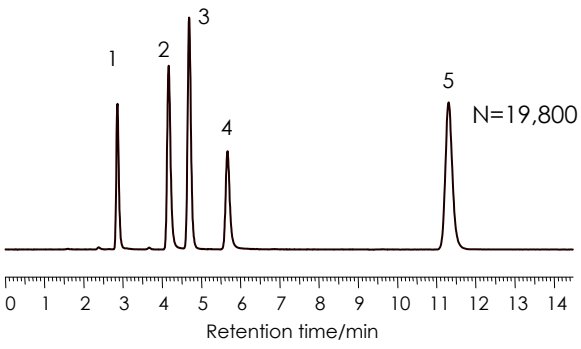
Sunniest C18
Sunniest RP-AQUA
Sunniest C8

◆Separation of water-soluble vitamins



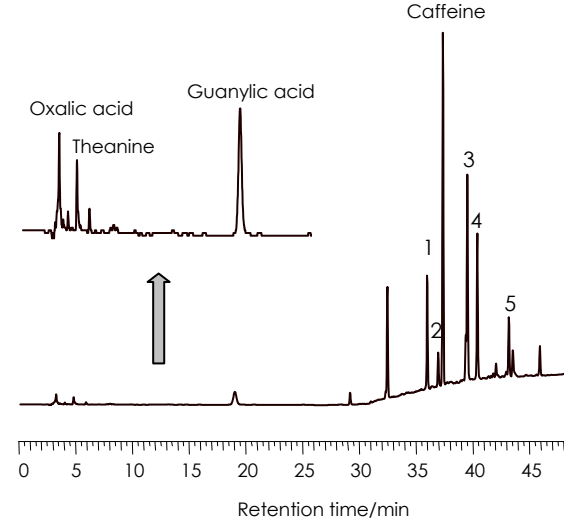
Column: Sunniest RP-AQUA, 5µm 150 x 4.6 mm
Mobile phase: 40mM Phosphate buffer pH6.8
Flow rate: 1.0 mL/min
Temperature: 40 °C
Detection: UV@250nm
Sample: 1 = Nicotinic acid, 2 = Pyridoxal
3 = Pyridoxine, 4 = Nicotinamide

◆Separation of nucleotides



Column: Sunniest RP-AQUA, 3µm 150 x 4.6 mm
Mobile phase: 20mM Phosphate buffer pH6.0
Flow rate: 1.0 mL/min
Temperature: 40 °C
Detection: UV@250nm
Sample: 1 = 5'-GDP, 2 = 5'-GMP, 3 = 5'-ATP, 4 = 5'-ADP,
5 = 5'-AMP

◆separation of Oolong tea

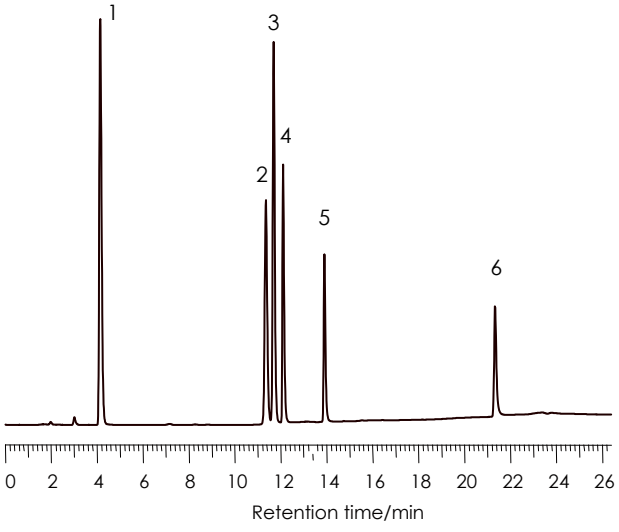


Column: Sunniest RP-AQUA , 5 µm 250 x 4.6 mm
Mobile phase: A) H_2O/H_3PO_4 (99.9:0.1)
B) CH_3CN

Time (min)	0	20	60
%B (%)	0	0	50

Flow rate: 1.0 mL/min
Temperature: 40 °C
Detection: UV@210 nm
Injection volume: 10 µL
Sample: Oolong tea 1 = (-)-Epigallocatechin
2 = (+)-Catechin
3 = (-)-Epigallocatechin gallate
4 = (-)-Epicatechin
5 = (-)-Epicatechin gallate

◆Separation of water-soluble vitamins using mobile phase for LC/MS



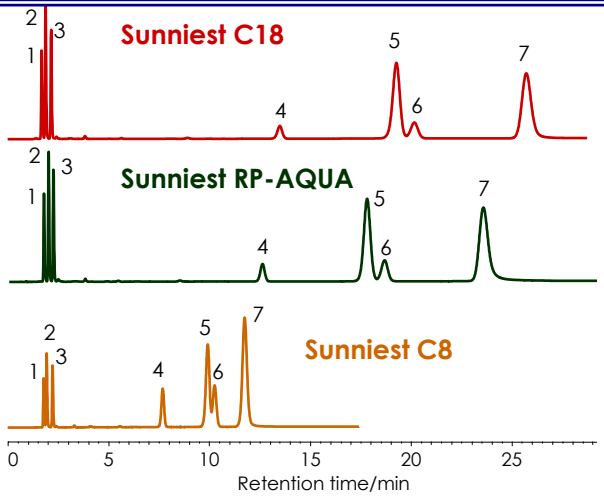
Column: Sunniest RP-AQUA, 5 µm 150 x 4.6 mm
Mobile phase: A) 20mM Ammonium acetate
B) Acetonitrile/ A solution (20:80)

Time (min)	0	5	20	25
%B (%)	0	0	100	100

Flow rate: 1.0 mL/min
Temperature: 40 °C
Detection: UV@250 nm
Sample: 1= Nicotinic acid
2 = Pyridoxine HCl Vitamin B_6
3 = Nicotinamide
4 = Thiamine HCl Vitamin B_1
5 = Folic acid
6 = Riboflavin Vitamin B_2

Sunniest C18
Sunniest RP-AQUA
Sunniest C8

◆Separation of standard samples



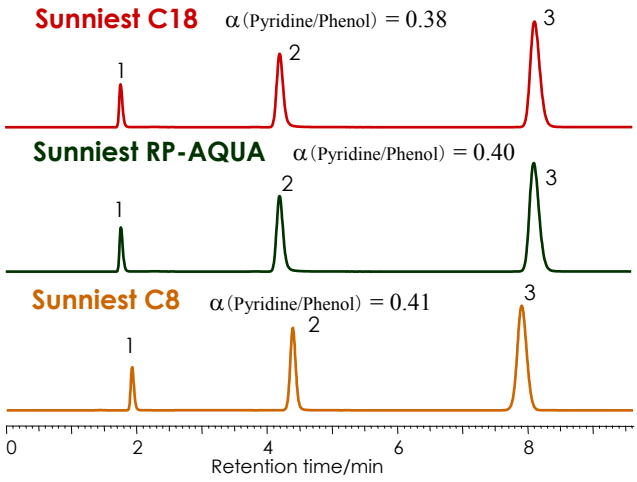
Column: Sunniest C18, 5μm 150 x 4.6 mm
Sunniest RP-AQUA, 5μ m 150 x 4.6 mm
Sunniest C8, 5μm 150 x 4.6 mm
Mobile phase: CH_3OH/H_2O=75/25
Flow rate: 1.0 mL/min
Temperature: 40 °C
Pressure: 5.4 MPa
Sample: 1 = Uracil,
2 = Caffeine,
3 = Phenol,
4 = Butylbenzene, (N=15,700)
5 = o-Terphenyl, (N=15,000)
6 = Amylbenzene, (N=15,300)
7 = Triphenylene, (N=14,500)

N is plate number of the above Sunniest C18.

	C18	RP-AQUA	C8
Hydrophobicity: α(Amylbenzene/Butylbenzene)	1.56	1.56	1.43
Hydrogen bonding capacity: α(Caffeine/Phenol)	0.43	0.49	0.33
Steric selectivity: α(Triphenylene/o-Terphenyl)	1.37	1.36	1.23

Sunniest C18, RP-AQUA and C8 show not only high efficiency but also low column pressure.

◆Separation of pyridine and phenol



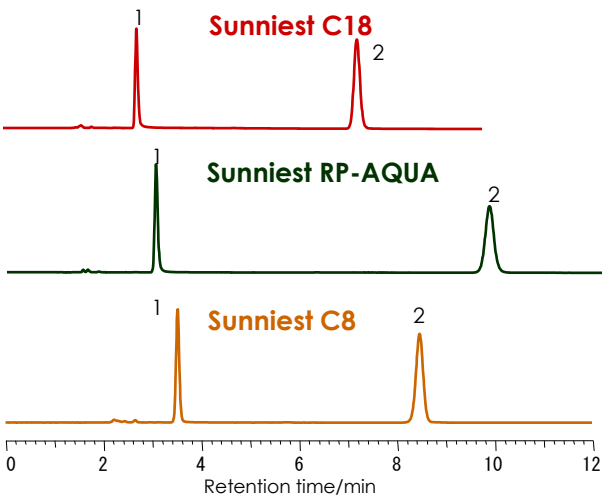
Column: Sunniest C18, 5μm 150 x 4.6 mm
Sunniest RP-AQUA, 5μ m 150 x 4.6 mm
Sunniest C8, 5μm 150 x 4.6 mm
Mobile phase: CH_3OH/H_2O=30/70
Flow rate: 1.0 mL/min
Temperature: 40 °C
Detection: UV@250nm
Sample: 1 = Uracil
2 = Pyridine
3 = Phenol

Separation factor of pyridine and phenol is said to show the amount of residual silanol groups. The lower a value of separation factor, the less an effect of residual silanol groups.

All Sunniest columns show one of the lowest value.

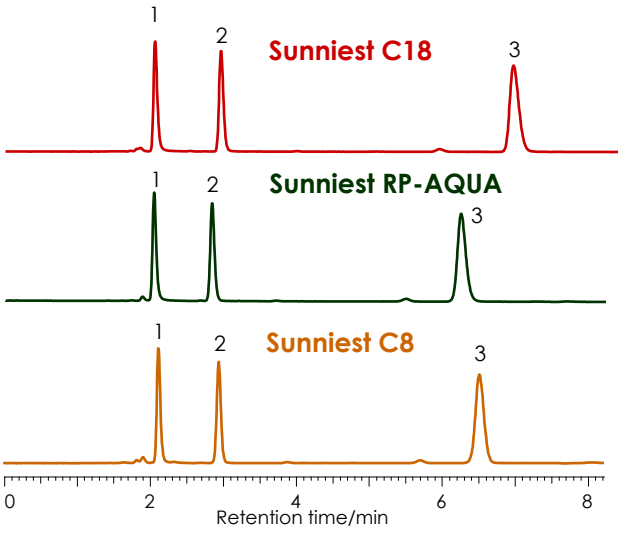
Sunniest C18
Sunniest RP-AQUA
Sunniest C8

◆Separation of a chelating compound



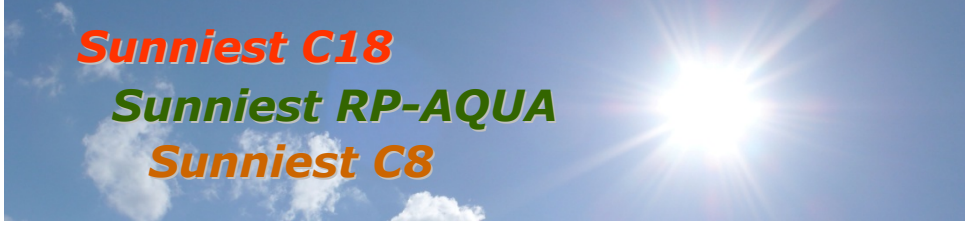
Column: Sunniest C18, 5µm 150 x 4.6 mm
Sunniest RP-AQUA, 5µ m 150 x 4.6 mm
Sunniest C8, 5µm 150 x 4.6 mm
Mobile phase: CH_3CN/20mM H_3PO_4=10/90
Flow rate: 1.0 mL/min
Temperature: 40 °C
Detection: UV@250nm
Sample: 1 = 8-Quinolinol
2 = Caffeine

◆Separation of acidic compounds



Column: Sunniest C18, 5µm 150 x 4.6 mm
Sunniest RP-AQUA, 5µ m 150 x 4.6 mm
Sunniest C8, 5µm 150 x 4.6 mm
Mobile phase: CH_3CN/0.1% H_3PO_4=2/98
Flow rate: 1.0 mL/min
Temperature: 40 °C
Detection: UV@210nm
Sample: 1 = Formic acid
2 = Acetic acid
3 = Propionic Acid

★Sunniest C18, RP-AQUA, C8 are inert for a metal chelating compound and acidic and basic compounds, so that they show symmetrical peaks of each compound.



✻ Sunniest Ordering information

Inner diameter [mm]	Length [mm]	Sunniest C18, 3µm Catalog No.	Sunniest C18, 5µm Catalog No.	Sunniest RP-AQUA, 3µm Catalog No.	Sunniest RP-AQUA, 5µm Catalog No.	SunniestC8, 3µm Catalog No.	Sunniest C8, 5µm Catalog No.
2.0	50	EB2241	EB3241	ER2241	ER3241	EC2241	EC3241
	75	EB2251	—	ER2251	—	EC2251	—
	100	EB2261	EB3261	ER2261	ER3261	EC2261	EC3261
	150	EB2271	EB3271	ER2271	ER3271	EC2271	EC3271
3.0	150	EB2371	EB3371	ER2371	ER3371	EC2371	EC3371
	250	—	EB3381	—	ER3381	—	EC3381
4.6	10	EB2411	EB3411	ER2411	ER3411	EC2411	EC3411
	50	EB2441	EB3441	ER2441	ER3441	EC2441	EC3441
	75	EB2451	—	ER2451	—	EC2451	—
	100	EB2461	EB3461	ER2461	ER3461	EC2461	EC3461
	150	EB2471	EB3471	ER2471	ER3471	EC2471	EC3471
	250	—	EB3481	—	ER3481	—	EC3481
10.0	250	—	EB3781	—	ER3781	—	EC3781
20.0	250	—	EB3881	—	ER3881	—	EC3881

Manufacturer

ChromaNik Technologies Inc.

ChromaNyk
ChromaNik Technologies Inc.

HPLC column

Sunniest

Sunniest C18-HT, 2μm

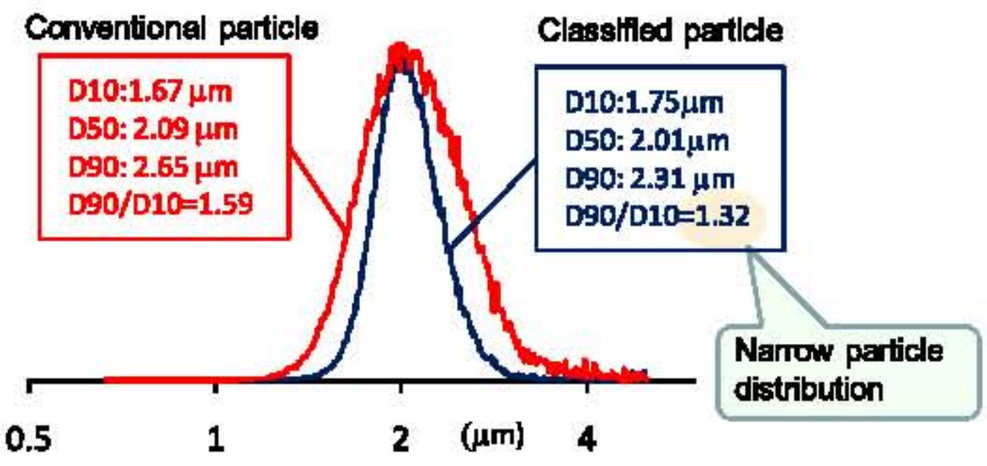
Features

- Low back pressure and high efficiency by precisely classified particle
- High pressure packing (10,000 psi) using hard silica gels with high pressure resistant • leads long column life without any void.
- Unique bonding technique for Sunniest (patent pending)
- The most suitable inner surface of column by special grinding

Sunniest technique to 2μm particle!

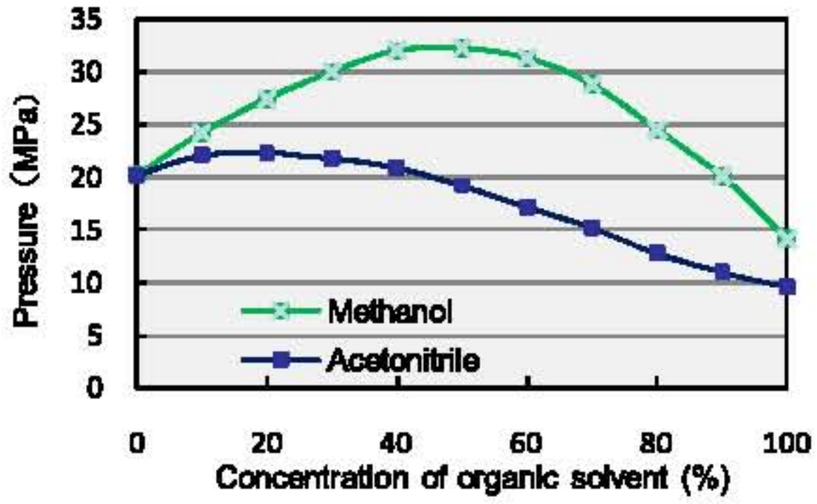
• Narrow Particle Distribution and Low Back Pressure

Measured by Coulter Counter method



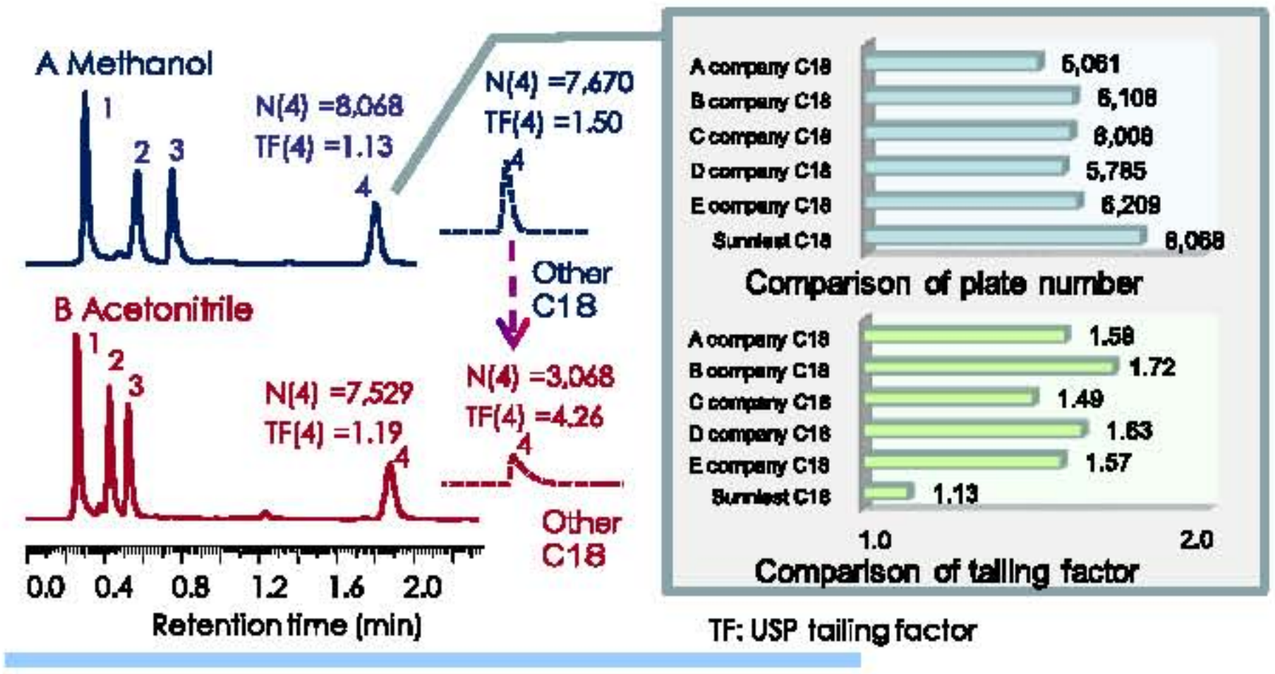
Conventional 2 μm silica gel particle was classified again. 20% volume was cut off from both sides respectively. Consequently column back pressure reduced more than 15%. Our 2 μm silica gel particle shows a half pressure to compare with the other sub-2 μm silica gel particle.

Column pressure using methanol or acetonitrile and water



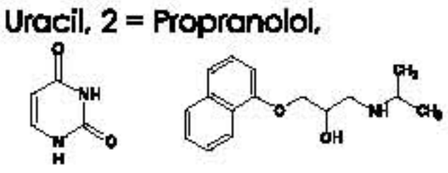
Column: Sunniest C18-HT, 2 μm 50 x 2.1 mm
Mobile phase: CH_3OH/H_2O, CH_3CN/H_2O
Flow rate: 0.5 mL/min
Temperature: 40 °C

• An Unique Modification (Patent Pending as Sunniest series)

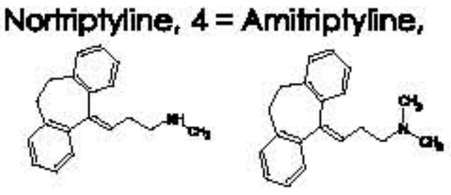


TF: USP tailing factor

Column: Sunniest C18-HT, 2 μm 50 x 2.0 mm
Mobile phase:
A) CH_3OH/20mM Phosphate buffer pH7.5 = 80/20
B) CH_3CN/20mM Phosphate buffer pH7.0 = 60/40
Flow rate: 0.4 mL/min
Pressure: A) 19.5 MPa, B) 13.5 MPa
Temperature: 40 °C
Sample: 1 = Uracil, 2 = Propranolol,

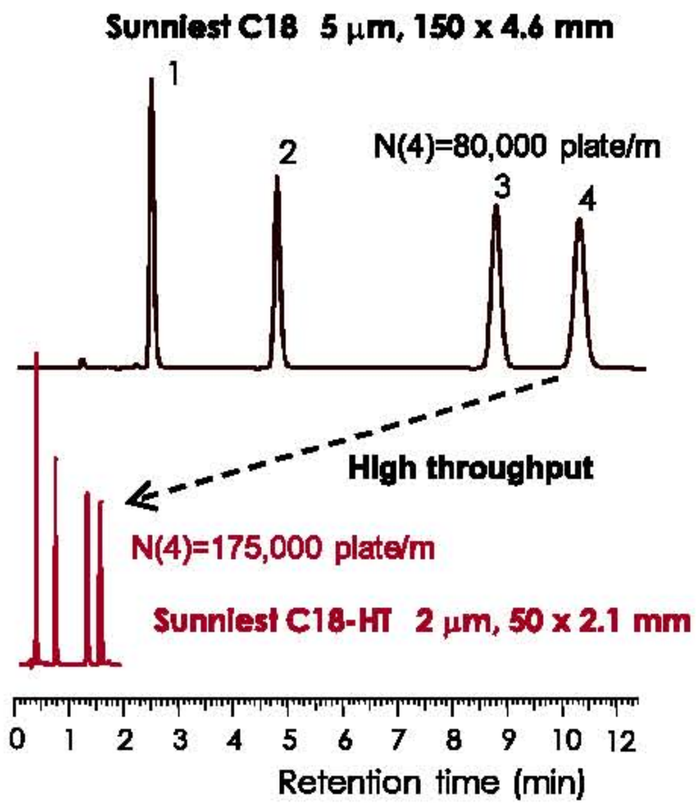


3 = Nortriptyline, 4 = Amitriptyline,

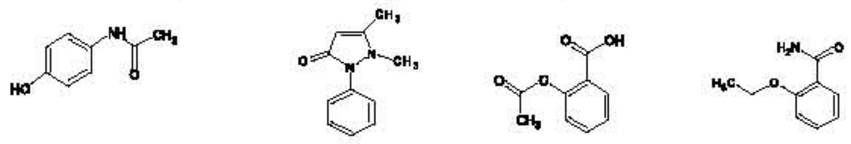


It is difficult to end-cap on sub 2 μm or 2 μm silica gel particle as well as 3 μm or 5 μm silica gel particle. Most sub 2 μm or 2 μm C18 columns show smaller plate number and higher tailing factor than Sunniest C18-HT. Sunniest C18-HT 2 μm shows good peak shape for amitriptyline under not only metahnol/phosphate buffer mobile phase but also acetonitrile/phosphate buffer mobile.

• Separation of Analgesics

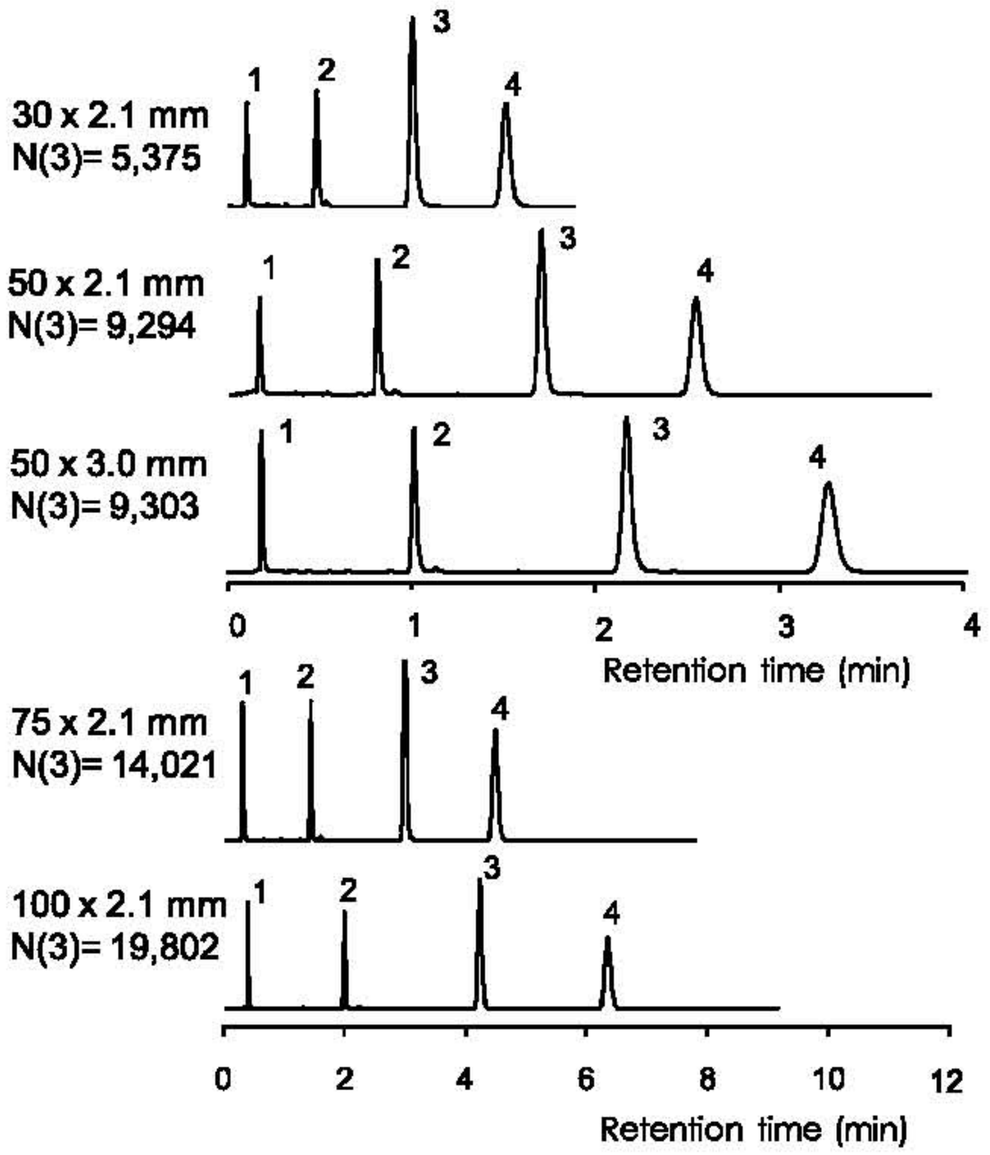


Mobile phase: CH_3CN/0.1% Formic acid = 20/80
Flow rate: 1.0 mL/min for 150 x 4.6 mm
0.6 mL/min for 50 x 2.1 mm
Temperature: 40 °C
Detection: UV@230 nm
Sample:
1=Acetaminophen, 2=Antipyrine, 3=Aspirin, 4=Ethenzamide



2 μm particle allows to reduce retention time because high efficiency is kept under high flow rate conditions. As shown the above chromatograms, analytical time reduced 1/8 without sacrifices of separation by using 2 μm, 50 x 2.1 mm column instead of 5 μm 150 x 4.6 mm column.

• Comparison of Plate Number



Mobile phase: CH_3CN/H_2O = 60/40
Flow rate: 0.6 mL/min for 2.1 x 30 mm and 2.1 x 50 mm
1.0 mL/min for 3.0 x 50 mm
0.4 mL/min for 2.1 x 75 mm and 2.1 x 100 mm
Temperature: 40 °C
Detection: UV@250 nm
Sample: 1=Uracil,
2=Toluene,
3=Acenaphthene,
4=Butylbenzene

• Characteristics of Sunniest C18-HT, 2 μm

Packings	Silica gel support			C18			
	Particle size (μm)	Pore diameter nm)	Specific surface area (m^2/g)	Carbon content (%)	Bonded phase	Maximum operating pressure	Available pH range
Sunniest C18-HT	2.0 (Coulter counter)	10	340	16	C18	70 MPa or 10,000 psi	1.5 - 10

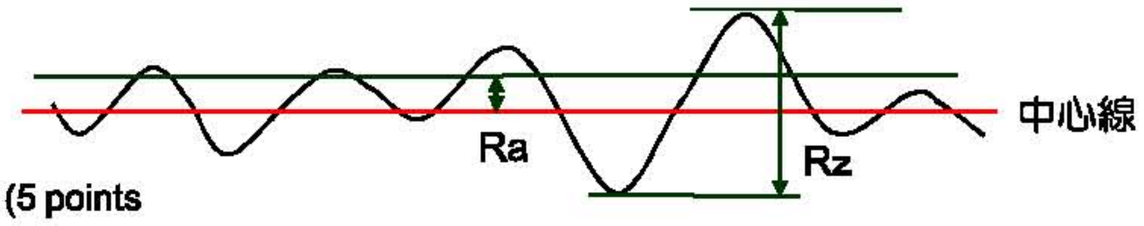
It is very important for 2 mm particle to have a capacity to resist pressure because of high column back pressure. The larger a pore volume of silica gel, the weaker a capacity to resist pressure. The silica gel with 0.85 ml/g of pore volume is used for Sunniest C18-HT, 2 mm, so that it have a high capacity to resist pressure and a high operating pressure.

• Surface Roughness on Inner Surface of Column

Parameter of surface roughness

Ra: Average roughness from center line

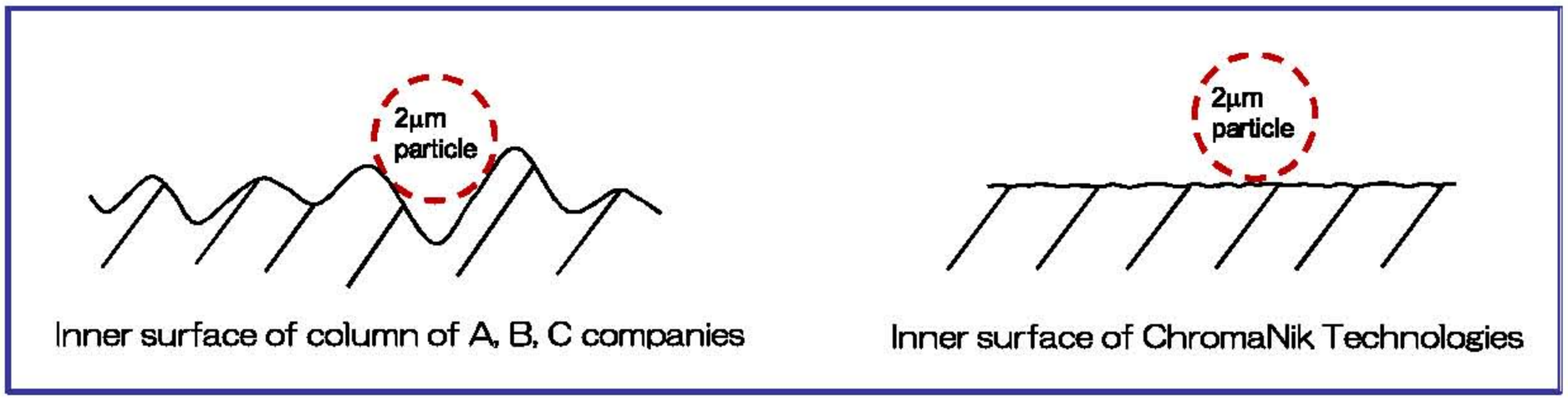
Rz: Roughness calculated from 10 points average (5 points of maximum and 5 points of minimum)



Schematic diagram of surface roughness

	G company	Y company	S1 company	S2 company	W company	ChromaNik Technologies
Ra	0.34 μm	0.32 μm	0.37 μm	0.03 μm	0.20 μm	0.01 μm
Rz	1.88 μm	1.62 μm	1.91 μm	0.19 μm	0.90 μm	0.10 μm

It is considered that surface roughness affects column performance. Surface asperity of ChromaNik Technologies column is 1/30 to 1/20 to compare with that of GL Sciences, YMC, Shimadzu and Waters columns. ChromaNik Technologies provides a column with very smooth surface which is the most suitable for 2 μm particle packing.



Inner surface of column of A, B, C companies

Inner surface of ChromaNik Technologies

• Ordering Information of Sunniest C18-HT, 2 μm

Length (mm)	30	50	75	100
Inner diameter (mm)	Cat. No.	Cat. No	Cat. No	Cat. No
2.1	EB1931	EB1941	EB1951	EB1961
3.0	EB1331	EB1341	EB1351	EB1361

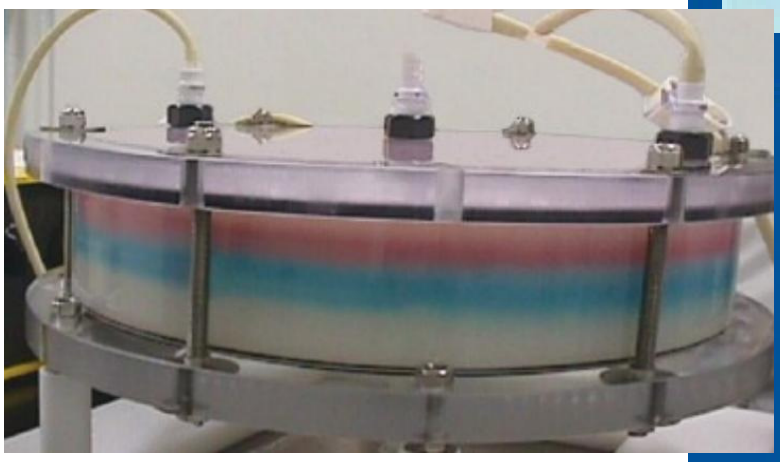
LC Chromatography Columns

analytical / semi Prep to PREP to Huge PREP

Low Pressure to 1500psi

6mm to 50mm to 2.5metre

essentialLife Solutions



Econoline® Columns
Media_Flex® Columns
IsoKrom™ Columns
Upscale® Columns
Glass Series/Acrylic Series
Pumping Systems

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essentialLife Solutions
for preparative chromatography

Versatile High-Performance

Econoline® Laboratory Glass Columns

for ion exchange, size exclusion, normal/reversed phase and affinity chromatography

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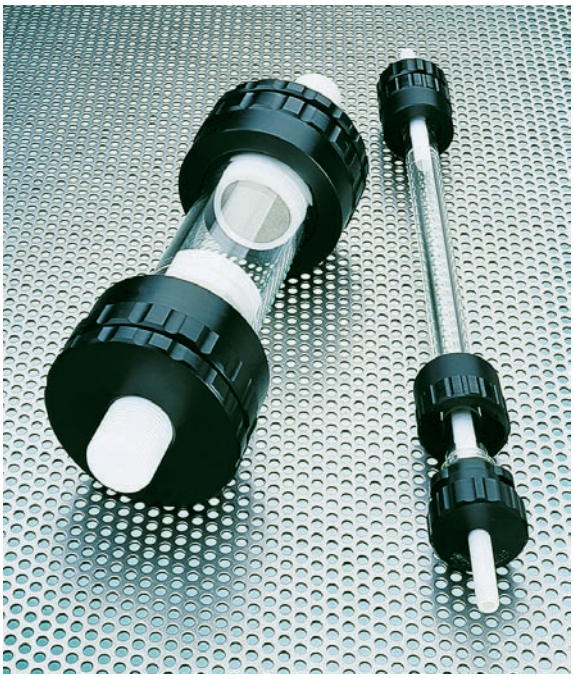
General information:
Any/all information contained within subject to change without notice.

General



Biochromatography is widely applied in high-performance downstream processing techniques that can be used for a range of compounds, such as proteins, peptides or nucleic acids. When using various chromatographic techniques such as ion exchange, affinity or gel permeation chromatography, increasingly high-performance separation media are used and, as a result, higher demands are made on the quality of the column hardware.

Econoline® glass columns meet the highest criteria for professional laboratory use. Particular attention has been paid to the column volume ranges that are as wide as possible (0.4–982 ml) and to the high pressure resistance (up to 80 bar / 1160 psi), so that high flow rates and performance/efficiency can be achieved.
We have selected high-quality, inert materials to make sure Econoline® glass columns are biocompatible and offer the best conditions for high recovery with no loss of bio-activity of your biomolecules. Thanks to the "Quick-Lock" seal and the two adjustable pistons, the columns are fully adjustable and easy to use.

Given the wide range of diameters, frit porosities and lengths available, you can use Econoline® glass columns for the most diverse of applications.

Quick-Lock Fitting

No more than a quarter turn is needed to seal the column.
Piston height adjustment is done by turning the locked "Quick-Lock" fitting.

Advantages of Econoline® Glass Columns

1 HIGHER PRESSURE RATINGS INCORPORATING GLASS CONSTRUCTION

Pressures to 80 Bars (1,160 psig)
Full view of bed unlike stainless steel
Rugged construction for hard lab use

2 LINEAR MOTION OF PISTON

Due to true linear motion of piston there is no torsional load imposed on the packed bed assuring true linear compression.

3 TRUE FRITS

True frit without the use of sock design employed in less expensive columns assure even flow distribution across the bed.

4 ROBUST INLET AND OUTLET CONNECTIONS

Inlet and outlet connections are made at the exterior of the column, which provide a more reliable and visible connection.

5 FINE THREAD ADJUSTMENT

Columns are provided with fine thread adjustment of piston to allow for precise control of piston placement.

6 DOUBLE PISTON ADJUSTMENT

Standard double ended adjustable piston provides flexibility of bed settings and adjustment for settling and packing flexibility.

7 QUICK RELEASE ENDS

Design features our unique quick-disconnect end fittings making column disassembly effortless.

8 PRECISION BORE GLASS TUBE

Minimize "wall effect" due to precise bore.

9 EASY TO INSTALL PACKING ADAPTER

Installs in 5 seconds; user friendly.

"Connectivity and compatibility"

Two of the most frequently asked questions about using ELS glass columns are:

Question 1:

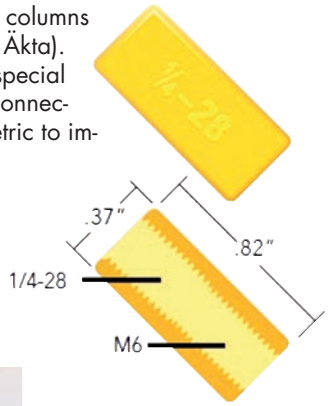
What packing materials can I use in ELS glass columns?

Answer:
In theory you can use any packing material from any manufacturer of your choice!
The only restrictions are those linked to the conditions of use with materials that come into contact with the media, such as the pressure limits of the column and packing material. To accommodate this, ELS offers a wide range of variants and different column versions. Our application laboratory has examples of applications in the fields of ion exchange, size exclusion, gel permeation, normal/reversed phase and affinity chromatography, etc. with an enormous range of phases from various manufacturers, including YMC, GE, Pall, Bio-Rad, Tosoh and others.

Question 2:

Can I link ELS glass columns to any LC system from other manufacturers, or can I only use ELS systems?

Answer:
Of course we would love you to use ELS glass columns as a "package" with ELS LC systems – but of course there are no restrictions! The accessory package included in ELS laboratory glass columns contains connectors and adaptors to link our columns to all current LC systems (e.g. GE Äkta). As an option, we can supply special components such as "yellow" connection adaptors to convert from metric to imperial systems (M6 at 1/4-28).

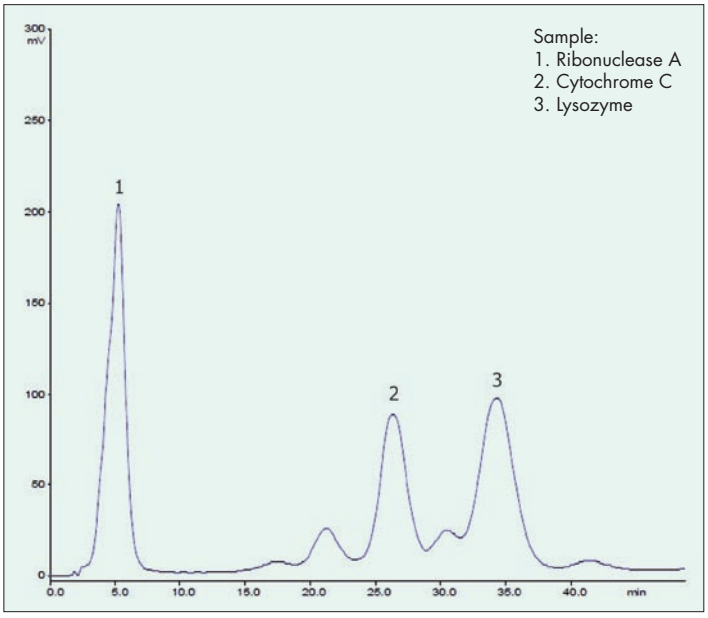


ELS laboratory glass columns in a "multi-purpose" application laboratory

Application Examples

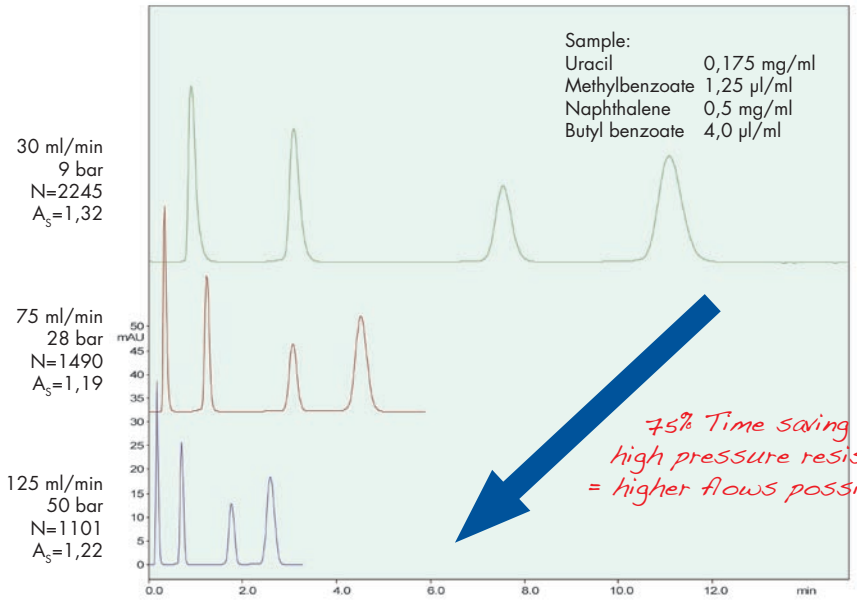
In reversed phase and adsorption chromatography, the possibilities for using glass columns are often limited due to high back pressures generated by small particles. The high pressure resistance of the Econoline® glass columns allow you to achieve high flow rates for demanding separations. The example shows that this enables a considerable acceleration of the separation, which means that you can achieve significant time savings.

Separation of a standard test mixture of proteins



Column:	ELS Econoline® 250 x 15 mm ID
Stationary phase:	YMC-BioPro SP, 30 µm (bed length 170 mm)
Mobile phase:	A) 20 mM KH_2PO_4*K_2HPO_4 (pH 6.8)
	B) 20 mM KH_2PO_4*K_2HPO_4 (pH 6.8) containing 0.5 M NaCl
Gradient:	40-80% B
Flow rate:	6 ml/min
Temperature:	25°C
Detection:	UV at 220 nm
Injection:	100 µl

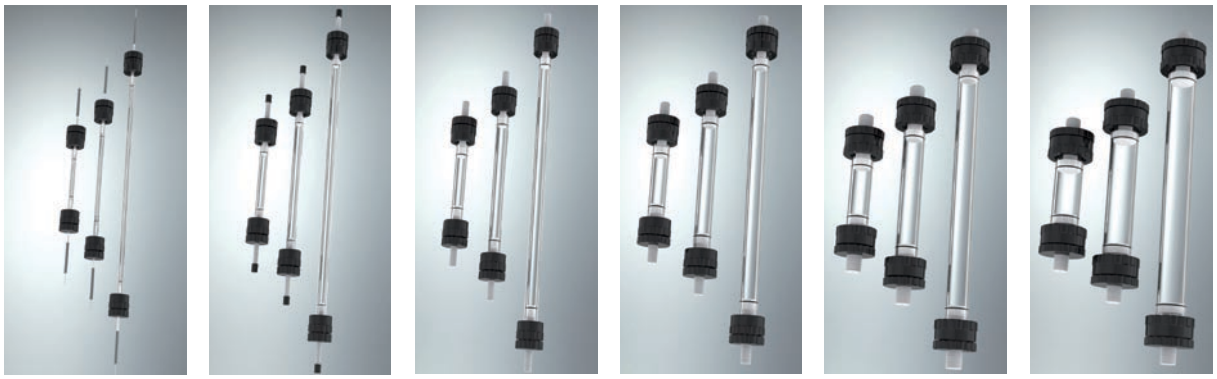
Example of application with reversed phase media



Column:	ELS Econoline® 125 x 25 mm ID
Stationary phase:	YMC-Pack ODS-AQ, 10 µm, 12 nm, 8 cm bed length
Flow rate:	30 ml/min - 75 ml/min - 125 ml/min
Mobile phase:	ACN/H_2O (50:50)
Injection:	500 µl
Detection:	UV at 254 nm

Product options

Econoline® laboratory glass columns are routinely available in three different lengths (125, 250, 500 mm) and three combinations of pistons (Short, Short/long, Long) in order to accommodate different volume configurations.

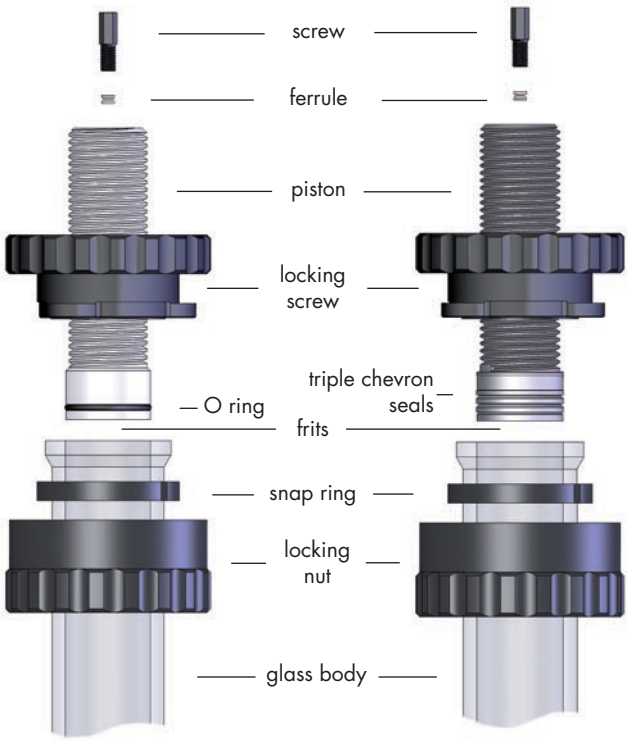


5 mm ID | 10 mm ID | 15 mm ID | 25 mm ID | 35 mm ID | 50 mm ID

The modular construction allows for a range of piston variations to provide the ideal column volume.

Standard Version for aqueous buffers (AB)

Optional Version Solvant Resistant (SR)



Econoline® glass columns are multi-purpose columns for all liquid chromatography applications (with pressure limits of 30 to 80 bar (435 to 1160 psi) - depending on column diameter as shown in the table on page 6). Econoline® glass columns are available in two versions:

Standard-Version (AB = Aqueous Buffer) for aqueous buffers and applications in cold rooms.

Optional-Version (SR = Solvent Resistant) for normal and reversed phase chromatography.

The height-adjustable pistons (standard) at each end of the Econoline® glass column with Teflon ribs (SR-version) are suitable for the entire spectrum of normal phase and reversed phase chromatography as well as biochromatography above ambient temperature.

All Econoline® glass columns are made with high-precision CNC machines and undergo several rigorous quality controls before they are delivered.

Specifications

Aqueous buffer (AB) - version

Temperature range	4 - 40 °C
Plunger	PE (polyethylene)
Sealing	O-ring, EPDM (ethylene propylene diene monomer rubber)
Frit	PE (polyethylene)
Height adjustment	short plungers, short/long plunger, long plungers (see table)
Connections	1/4"-28G female screw thread

Solvent resistant (SR) - version

Temperature range	16 - 40 °C
Plunger	PTFE (polytetrafluorethylene)
Sealing	PTFE triple chevrons
Frit	ID 5 - 15 mm: sintered glass ID 25 - 50 mm: stainless steel
Height adjustment	short plungers, short/long plunger, long plungers (see table)
Connections	1/4"-28G female screw thread

Bed length / Volume

ID [mm]	Pressure limit [bar]	short plungers		short/long plunger		long plungers	
		Bed length [mm]	Volume [ml]	Bed length [mm]	Volume [ml]	Bed length [mm]	Volume [ml]
5	AB = 80 SR = 80	22 - 125 147 - 250 397 - 500	0,4 - 2,5 2,9 - 4,9 7,8 - 9,8	0 - 125 67 - 250 317 - 500	0 - 2,5 1,3 - 4,9 6,2 - 9,8	0 - 125 0 - 250 237 - 500	0 - 2,5 0 - 4,9 4,7 - 9,8
10	AB = 80 SR = 50	32 - 125 157 - 250 407 - 500	2,5 - 9,8 12 - 20 32 - 39	0 - 125 77 - 250 327 - 500	0 - 9,8 6,0 - 20 26 - 39	0 - 125 0 - 250 247 - 500	0 - 9,8 0 - 20 19 - 39
15	AB = 70 SR = 50	24 - 125 149 - 250 399 - 500	4,2 - 22 26 - 44 71 - 88	0 - 125 69 - 250 319 - 500	0 - 22 12 - 44 56 - 88	0 - 125 0 - 250 239 - 500	0 - 22 0 - 44 42 - 88
25	AB = 50 SR = 50	28 - 125 153 - 250 403 - 500	14 - 61 75 - 123 198 - 245	0 - 125 73 - 250 323 - 500	0 - 61 36 - 123 159 - 245	0 - 125 0 - 250 243 - 500	0 - 61 0 - 123 119 - 245
35	AB = 40 SR = 40	30 - 125 155 - 250 405 - 500	29 - 120 149 - 241 390 - 481	0 - 125 75 - 250 325 - 500	0 - 120 72 - 241 313 - 481	0 - 125 0 - 250 245 - 500	0 - 120 0 - 241 236 - 481
50	AB = 30 SR = 25	36 - 125 161 - 250 410 - 500	71 - 245 316 - 491 805 - 982	0 - 125 81 - 250 331 - 500	0 - 245 159 - 491 650 - 982	0 - 125 0 - 250 250 - 500	0 - 245 0 - 491 491 - 982

Econoline® Series Glass Columns, AB-version, short/short plungers

Temperature range	4 - 40 °C
Plunger	PE (polyethylene)
Sealing	O-ring, EPDM
Frit	ID 5 - 50 mm: polyethylene (10 µm or 5 µm)
Height adjustment	short plungers

	Part No.	ID [mm]	Pressure limit [bar]	Bed length [mm]	Volume [ml]	Frit material	Frit porosity [µm]
5 mm ID	TAC05/125SSPE0-AB-2	5	80	22 - 125	0.4 - 2.5	polyethylene	10
	TAC05/250SSPE0-AB-2	5	80	147 - 250	2.9 - 4.9	polyethylene	10
	TAC05/500SSPE0-AB-2	5	80	397 - 500	7.8 - 9.8	polyethylene	10
	TAC05/125SSPE5-AB-2	5	80	22 - 125	0.4 - 2.5	polyethylene	5
	TAC05/250SSPE5-AB-2	5	80	147 - 250	2.9 - 4.9	polyethylene	5
	TAC05/500SSPE-AB-2	5	80	397 - 500	7.8 - 9.8	polyethylene	5
10 mm ID	TAC10/125SSPE0-AB-2	10	80	32 - 125	2.5 - 9.8	polyethylene	10
	TAC10/250SSPE0-AB-2	10	80	157 - 250	12 - 20	polyethylene	10
	TAC10/500SSPE0-AB-2	10	80	407 - 500	32 - 39	polyethylene	10
	TAC10/125SSPE5-AB-2	10	80	32 - 125	2.5 - 9.8	polyethylene	5
	TAC10/250SSPE5-AB-2	10	80	157 - 250	12 - 20	Polyethylene	5
	TAC10/500SSPE5-AB-2	10	80	407 - 500	32 - 39	Polyethylene	5
15 mm ID	TAC15/125SSPE0-AB-2	15	70	24 - 125	4.2 - 22	polyethylene	10
	TAC15/250SSPE0-AB-2	15	70	149 - 250	26 - 44	polyethylene	10
	TAC15/500SSPE0-AB-2	15	70	399 - 500	71 - 88	polyethylene	10
	TAC15/125SSPE5-AB-2	15	70	24 - 125	4.2 - 22	polyethylene	5
	TAC15/250SSPE5-AB-2	15	70	149 - 250	26 - 44	polyethylene	5
	TAC15/500SSPE5-AB-2	15	70	399 - 500	71 - 88	polyethylene	5
25 mm ID	TAC25/125SSPE0-AB-2	25	50	28 - 125	14 - 61	polyethylene	10
	TAC25/250SSPE0-AB-2	25	50	153 - 250	75 - 123	polyethylene	10
	TAC25/500SSPE0-AB-2	25	50	403 - 500	198 - 245	polyethylene	10
	TAC25/125SSPE5-AB-2	25	50	28 - 125	14 - 61	polyethylene	5
	TAC25/250SSPE5-AB-2	25	50	153 - 250	75 - 123	polyethylene	5
	TAC25/500SSPE5-AB-2	25	50	403 - 500	198 - 245	polyethylene	5
35 mm ID	TAC35/125SSPE0-AB-2	35	40	30 - 125	29 - 120	polyethylene	10
	TAC35/250SSPE0-AB-2	35	40	155 - 250	149 - 241	polyethylene	10
	TAC35/500SSPE0-AB-2	35	40	405 - 500	390 - 481	polyethylene	10
	TAC35/125SSPE5-AB-2	35	40	30 - 125	29 - 120	polyethylene	5
	TAC35/250SSPE5-AB-2	35	40	155 - 250	149 - 241	polyethylene	5
	TAC35/500SSPE5-AB-2	35	40	405 - 500	390 - 481	polyethylene	5
50 mm ID	TAC50/125SSPE0-AB-2	50	30	36 - 125	71 - 245	polyethylene	10
	TAC50/250SSPE0-AB-2	50	30	161 - 250	316 - 491	polyethylene	10
	TAC50/500SSPE0-AB-2	50	30	410 - 500	805 - 982	polyethylene	10
	TAC50/125SSPE5-AB-2	50	30	36 - 125	71 - 245	polyethylene	5
	TAC50/250SSPE5-AB-2	50	30	161 - 250	316 - 491	polyethylene	5
	TAC50/500SSPE5-AB-2	50	30	410 - 500	805 - 982	polyethylene	5

Econoline® Series Glass Columns, AB-version, short/long plunger

Temperature range	4 - 40 °C
Plunger	PE (polyethylene)
Sealing	O-ring, EPDM
Frit	ID 5 - 50 mm: polyethylene (10 µm or 5 µm)
Height adjustment	short / long plunger

	Part No.	ID [mm]	Pressure limit [bar]	Bed length [mm]	Volume [ml]	Frit material	Frit porosity [µm]
5 mm ID	TAC05/125SLPE0-AB-2	5	80	0 - 125	0 - 2.5	polyethylene	10
	TAC05/250SLPE0-AB-2	5	80	67 - 250	1.3 - 4.9	polyethylene	10
	TAC05/500SLPE0-AB-2	5	80	317 - 500	6.2 - 9.8	polyethylene	10
	TAC05/125SLPE5-AB-2	5	80	0 - 125	0 - 2.5	polyethylene	5
	TAC05/250SLPE5-AB-2	5	80	67 - 250	1.3 - 4.9	polyethylene	5
	TAC05/500SLPE5-AB-2	5	80	317 - 500	6.2 - 9.8	polyethylene	5
10 mm ID	TAC10/125SLPE0-AB-2	10	80	0 - 125	0 - 9.8	polyethylene	10
	TAC10/250SLPE0-AB-2	10	80	77 - 250	6.0 - 20	polyethylene	10
	TAC10/500SLPE0-AB-2	10	80	327 - 500	26 - 39	polyethylene	10
	TAC10/125SLPE5-AB-2	10	80	0 - 125	0 - 9.8	polyethylene	5
	TAC10/250SLPE5-AB-2	10	80	77 - 250	6.0 - 20	polyethylene	5
	TAC10/500SLPE5-AB-2	10	80	327 - 500	26 - 39	polyethylene	5
15 mm ID	TAC15/125SLPE0-AB-2	15	70	0 - 125	0 - 22	polyethylene	10
	TAC15/250SLPE0-AB-2	15	70	69 - 250	12 - 44	polyethylene	10
	TAC15/500SLPE0-AB-2	15	70	319 - 500	56 - 88	polyethylene	10
	TAC15/125SLPE5-AB-2	15	70	0 - 125	0 - 22	polyethylene	5
	TAC15/250SLPE5-AB-2	15	70	69 - 250	12 - 44	polyethylene	5
	TAC15/500SLPE5-AB-2	15	70	319 - 500	56 - 88	polyethylene	5
25 mm ID	TAC25/125SLPE0-AB-2	25	50	0 - 125	0 - 61	polyethylene	10
	TAC25/250SLPE0-AB-2	25	50	73 - 250	36 - 123	polyethylene	10
	TAC25/500SLPE0-AB-2	25	50	323 - 500	159 - 245	polyethylene	10
	TAC25/125SLPE5-AB-2	25	50	0 - 125	0 - 61	polyethylene	5
	TAC25/250SLPE5-AB-2	25	50	73 - 250	36 - 123	polyethylene	5
	TAC25/500SLPE5-AB-2	25	50	323 - 500	159 - 245	polyethylene	5
35 mm ID	TAC35/125SLPE0-AB-2	35	40	0 - 125	0 - 120	polyethylene	10
	TAC35/250SLPE0-AB-2	35	40	75 - 250	72 - 241	polyethylene	10
	TAC35/500SLPE0-AB-2	35	40	325 - 500	313 - 481	polyethylene	10
	TAC35/125SLPE5-AB-2	35	40	0 - 125	0 - 120	polyethylene	5
	TAC35/250SLPE5-AB-2	35	40	75 - 250	72 - 241	polyethylene	5
	TAC35/500SLPE5-AB-2	35	40	325 - 500	313 - 481	polyethylene	5
50 mm ID	TAC50/125SLPE0-AB-2	50	30	0 - 125	0 - 245	polyethylene	10
	TAC50/250SLPE0-AB-2	50	30	81 - 250	159 - 491	polyethylene	10
	TAC50/500SLPE0-AB-2	50	30	331 - 500	650 - 982	polyethylene	10
	TAC50/125SLPE5-AB-2	50	30	0 - 125	0 - 245	polyethylene	5
	TAC50/250SLPE5-AB-2	50	30	81 - 250	159 - 491	polyethylene	5
	TAC50/500SLPE5-AB-2	50	30	331 - 500	650 - 982	polyethylene	5

Econoline® Series Glass Columns, AB-version, long/long plungers

Temperature range	4 - 40 °C
Plunger	PE (polyethylene)
Sealing	O-ring, EPDM
Frit	ID 5 - 50 mm: polyethylene (10 µm or 5 µm)
Height adjustment	long plungers

	Part No.	ID [mm]	Pressure limit [bar]	Bed length [mm]	Volume [ml]	Frit material	Frit porosity [µm]
5 mm ID	TAC05/125LLPE0-AB-2	5	80	0 - 125	0 - 2.5	polyethylene	10
	TAC05/250LLPE0-AB-2	5	80	0 - 250	0 - 4.9	polyethylene	10
	TAC05/500LLPE0-AB-2	5	80	237 - 500	4.7 - 9.8	Polyethylen	10
	TAC05/125LLPE5-AB-2	5	80	0 - 125	0 - 2.5	polyethylene	5
	TAC05/250LLPE5-AB-2	5	80	0 - 250	0 - 4.9	polyethylene	5
	TAC05/500LLPE5-AB-2	5	80	237 - 500	4.7 - 9.8	polyethylene	5
10 mm ID	TAC10/z-AB-2	10	80	0 - 125	0 - 9.8	polyethylene	10
	TAC10/250LLPE0-AB-2	10	80	0 - 250	0 - 20	polyethylene	10
	TAC10/500LLPE0-AB-2	10	80	247 - 500	19 - 39	polyethylene	10
	TAC10/125LLPE5-AB-2	10	80	0 - 125	0 - 9.8	polyethylene	5
	TAC10/250LLPE5-AB-2	10	80	0 - 250	0 - 20	polyethylene	5
	TAC10/500LLPE5-AB-2	10	80	247 - 500	19 - 39	polyethylene	5
15 mm ID	TAC15/125LLPE0-AB-2	15	70	0 - 125	0 - 22	polyethylene	10
	TAC15/250LLPE0-AB-2	15	70	0 - 250	0 - 44	polyethylene	10
	TAC15/500LLPE0-AB-2	15	70	239 - 500	42 - 88	polyethylene	10
	TAC15/125LLPE5-AB-2	15	70	0 - 125	0 - 22	polyethylene	5
	TAC15/250LLPE5-AB-2	15	70	0 - 250	0 - 44	polyethylene	5
	TAC15/500LLPE5-AB-2	15	70	239 - 500	42 - 88	polyethylene	5
25 mm ID	TAC25/125LLPE0-AB-2	25	50	0 - 125	0 - 61	polyethylene	10
	TAC25/250LLPE0-AB-2	25	50	0 - 250	0 - 123	polyethylene	10
	TAC25/500LLPE0-AB-2	25	50	243 - 500	119 - 245	polyethylene	10
	TAC25/125LLPE5-AB-2	25	50	0 - 125	0 - 61	polyethylene	5
	TAC25/250LLPE5-AB-2	25	50	0 - 250	0 - 123	polyethylene	5
	TAC25/500LLPE5-AB-2	25	50	243 - 500	119 - 245	polyethylene	5
35 mm ID	TAC35/125LLPE0-AB-2	35	40	0 - 125	0 - 120	polyethylene	10
	TAC35/250LLPE0-AB-2	35	40	0 - 250	0 - 241	polyethylene	10
	TAC35/500LLPE0-AB-2	35	40	245 - 500	236 - 481	polyethylene	10
	TAC35/125LLPE5-AB-2	35	40	0 - 125	0 - 120	polyethylene	5
	TAC35/250LLPE5-AB-2	35	40	0 - 250	0 - 241	polyethylene	5
	TAC35/500LLPE5-AB-2	35	40	245 - 500	236 - 481	polyethylene	5
50 mm ID	TAC50/125LLPE0-AB-2	50	30	0 - 125	0 - 245	polyethylene	10
	TAC50/250LLPE0-AB-2	50	30	0 - 250	0 - 491	polyethylene	10
	TAC50/500LLPE0-AB-2	50	30	250 - 500	491 - 982	polyethylene	10
	TAC50/125LLPE5-AB-2	50	30	0 - 125	0 - 245	polyethylene	5
	TAC50/250LLPE5-AB-2	50	30	0 - 250	0 - 491	polyethylene	5
	TAC50/500LLPE5-AB-2	50	30	250 - 500	491 - 982	polyethylene	5

Econoline® Series Glass Columns, SR-version, short/short plungers

Temperature range	16 - 40 °C
Plunger	PTFE
Sealing	PTFE triple chevrons
Frit	ID 5 - 15 mm: sintered glass (10 µm or 2 µm) ID 25 - 50 mm:s tainless steel (10 µm or 2 µm)
Height adjustment	short plungers

	Part No.	ID [mm]	Pressure limit [bar]	Bed length [mm]	Volume [ml]	Frit material	Frit porosity [µm]
5 mm ID	TAC05/125SSG0-SR-3	5	80	22 - 125	0.4 - 2.5	sintered glass	10
	TAC05/250SSG0-SR-3	5	80	147 - 250	2.9 - 4.9	sintered glass	10
	TAC05/500SSG0-SR-3	5	80	397 - 500	7.8 - 9.8	sintered glass	10
	TAC05/125SSG2-SR-3	5	80	22 - 125	0.4 - 2.5	sintered glass	2
	TAC05/250SSG2-SR-3	5	80	147 - 250	2.9 - 4.9	sintered glass	2
	TAC05/500SSG2-SR-3	5	80	397 - 500	7.8 - 9.8	sintered glass	2
10 mm ID	TAC10/125SSG0-SR-3	10	50	32 - 125	2.5 - 9.8	sintered glass	10
	TAC10/250SSG0-SR-3	10	50	157 - 250	12 - 20	sintered glass	10
	TAC10/500SSG0-SR-3	10	50	407 - 500	32 - 39	sintered glass	10
	TAC10/125SSG2-SR-3	10	50	32 - 125	2.5 - 9.8	sintered glass	2
	TAC10/250SSG2-SR-3	10	50	157 - 250	12 - 20	sintered glass	2
	TAC10/500SSG2-SR-3	10	50	407 - 500	32 - 39	sintered glass	2
15 mm ID	TAC15/125SSG0-SR-3	15	50	24 - 125	4.2 - 22	sintered glass	10
	TAC15/250SSG0-SR-3	15	50	149 - 250	26 - 44	sintered glass	10
	TAC15/500SSG0-SR-3	15	50	399 - 500	71 - 88	sintered glass	10
	TAC15/125SSG2-SR-3	15	50	24 - 125	4.2 - 22	sintered glass	2
	TAC15/250SSG2-SR-3	15	50	149 - 250	26 - 44	sintered glass	2
	TAC15/500SSG2-SR-3	15	50	399 - 500	71 - 88	sintered glass	2
25 mm ID	TAC25/125SSS0-SR-3	25	50	28 - 125	14 - 61	stainless steel	10
	TAC25/250SSS0-SR-3	25	50	153 - 250	75 - 123	stainless steel	10
	TAC25/500SSS0-SR-3	25	50	403 - 500	198 - 245	stainless steel	10
	TAC25/125SSS2-SR-3	25	50	28 - 125	14 - 61	stainless steel	2
	TAC25/250SSS2-SR-3	25	50	153 - 250	75 - 123	stainless steel	2
	TAC25/500SSS2-SR-3	25	50	403 - 500	198 - 245	stainless steel	2
35 mm ID	TAC35/125SSS0-SR-3	35	40	30 - 125	29 - 120	stainless steel	10
	TAC35/250SSS0-SR-3	35	40	155 - 250	149 - 241	stainless steel	10
	TAC35/500SSS0-SR-3	35	40	405 - 500	390 - 481	stainless steel	10
	TAC35/125SSS2-SR-3	35	40	30 - 125	29 - 120	stainless steel	2
	TAC35/250SSS2-SR-3	35	40	155 - 250	149 - 241	stainless steel	2
	TAC35/500SSS2-SR-3	35	40	405 - 500	390 - 481	stainless steel	2
50 mm ID	TAC50/125SSS0-SR-3	50	25	36 - 125	71 - 245	stainless steel	10
	TAC50/250SSS0-SR-3	50	25	161 - 250	316 - 491	stainless steel	10
	TAC50/500SSS0-SR-3	50	25	410 - 500	805 - 982	stainless steel	10
	TAC50/125SSS2-SR-3	50	25	36 - 125	71 - 245	stainless steel	2
	TAC50/250SSS2-SR-3	50	25	161 - 250	316 - 491	stainless steel	2
	TAC50/500SSS2-SR-3	50	25	410 - 500	805 - 982	stainless steel	2

Econoline® Series Glass Columns, SR-version, short/long plunger

Temperature range	16 - 40 °C
Plunger	PTFE
Sealing	PTFE triple chevrons
Frit	ID 5 - 15 mm: sintered glass (10 µm or 2 µm) ID 25 - 50 mm: stainless steel (10 µm or 2 µm)
Height adjustment	short / long plunger

	Part No.	ID [mm]	Pressure limit [bar]	Bed length [mm]	Volume [ml]	Frit material	Frit porosity [µm]
5 mm ID	TAC05/125SLG0-SR-3	5	80	0 - 125	0 - 2.5	sintered glass	10
	TAC05/250SLG0-SR-3	5	80	67 - 250	1.3 - 4.9	sintered glass	10
	TAC05/500SLG0-SR-3	5	80	317 - 500	6.2 - 9.8	sintered glass	10
	TAC05/125SLG2-SR-3	5	80	0 - 125	0 - 2.5	sintered glass	2
	TAC05/250SLG2-SR-3	5	80	67 - 250	1.3 - 4.9	sintered glass	2
	TAC05/500SLG2-SR-3	5	80	317 - 500	6.2 - 9.8	sintered glass	2
10 mm ID	TAC10/125SLG0-SR-3	10	50	0 - 125	0 - 9.8	sintered glass	10
	TAC10/250SLG0-SR-3	10	50	77 - 250	6.0 - 20	sintered glass	10
	TAC10/500SLG0-SR-3	10	50	327 - 500	26 - 39	sintered glass	10
	TAC10/125SLG2-SR-3	10	50	0 - 125	0 - 9.8	sintered glass	2
	TAC10/250SLG2-SR-3	10	50	77 - 250	6.0 - 20	sintered glass	2
	TAC10/500SLG2-SR-3	10	50	327 - 500	26 - 39	sintered glass	2
15 mm ID	TAC15/125SLG0-SR-3	15	50	0 - 125	0 - 22	sintered glass	10
	TAC15/250SLG0-SR-3	15	50	69 - 250	12 - 44	sintered glass	10
	TAC15/500SLG0-SR-3	15	50	319 - 500	56 - 88	sintered glass	10
	TAC15/125SLG2-SR-3	15	50	0 - 125	0 - 22	sintered glass	2
	TAC15/250SLG2-SR-3	15	50	69 - 250	12 - 44	sintered glass	2
	TAC15/500SLG2-SR-3	15	50	319 - 500	56 - 88	sintered glass	2
25 mm ID	TAC25/125SLS0-SR-3	25	50	0 - 125	0 - 61	stainless steel	10
	TAC25/250SLS0-SR-3	25	50	73 - 250	36 - 123	stainless steel	10
	TAC25/500SLS0-SR-3	25	50	323 - 500	159 - 245	stainless steel	10
	TAC25/125SLS2-SR-3	25	50	0 - 125	0 - 61	stainless steel	2
	TAC25/250SLS2-SR-3	25	50	73 - 250	36 - 123	stainless steel	2
	TAC25/500SLS2-SR-3	25	50	323 - 500	159 - 245	stainless steel	2
35 mm ID	TAC35/125SLS0-SR-3	35	40	0 - 125	0 - 120	stainless steel	10
	TAC35/250SLS0-SR-3	35	40	75 - 250	72 - 241	stainless steel	10
	TAC35/500SLS0-SR-3	35	40	325 - 500	313 - 481	stainless steel	10
	TAC35/125SLS2-SR-3	35	40	0 - 125	0 - 120	stainless steel	2
	TAC35/250SLS2-SR-3	35	40	75 - 250	72 - 241	stainless steel	2
	TAC35/500SLS2-SR-3	35	40	325 - 500	313 - 481	stainless steel	2
50 mm ID	TAC50/125SLS0-SR-3	50	25	0 - 125	0 - 245	stainless steel	10
	TAC50/250SLS0-SR-3	50	25	81 - 250	159 - 491	stainless steel	10
	TAC50/500SLS0-SR-3	50	25	331 - 500	650 - 982	stainless steel	10
	TAC50/125SLS2-SR-3	50	25	0 - 125	0 - 245	stainless steel	2
	TAC50/250SLS2-SR-3	50	25	81 - 250	159 - 491	stainless steel	2
	TAC50/500SLS2-SR-3	50	25	331 - 500	650 - 982	stainless steel	2

Econoline® Series Glass Columns, SR-version, long/long plungers

Temperature range	16 - 40 °C
Plunger	PTFE
Sealing	PTFE triple chevrons
Frit	ID 5 - 15 mm: sintered glass (10 µm or 2 µm) ID 25 - 50 mm: stainless steel (10 µm or 2 µm)
Height adjustment	long plungers

	Part No.	ID [mm]	Pressure limit [bar]	Bed length [mm]	Volume [ml]	Frit material	Frit porosity [µm]
5 mm ID	TAC05/125LLG0-SR-3	5	80	0 - 125	0 - 2.5	sintered glass	10
	TAC05/250LLG0-SR-3	5	80	0 - 250	0 - 4.9	sintered glass	10
	TAC05/500LLG0-SR-3	5	80	237 - 500	4.7 - 9.8	sintered glass	10
	TAC05/125LLG2-SR-3	5	80	0 - 125	0 - 2.5	sintered glass	2
	TAC05/250LLG2-SR-3	5	80	0 - 250	0 - 4.9	sintered glass	2
	TAC05/500LLG2-SR-3	5	80	237 - 500	4.7 - 9.8	sintered glass	2
10 mm ID	TAC10/125LLG0-SR-3	10	50	0 - 125	0 - 9.8	sintered glass	10
	TAC10/250LLG0-SR-3	10	50	0 - 250	0 - 20	sintered glass	10
	TAC10/500LLG0-SR-3	10	50	247 - 500	19 - 39	sintered glass	10
	TAC10/125LLG2-SR-3	10	50	0 - 125	0 - 9.8	sintered glass	2
	TAC10/250LLG2-SR-3	10	50	0 - 250	0 - 20	sintered glass	2
	TAC10/500LLG2-SR-3	10	50	247 - 500	19 - 39	sintered glass	2
15 mm ID	TAC15/125LLG0-SR-3	15	50	0 - 125	0 - 22	sintered glass	10
	TAC15/250LLG0-SR-3	15	50	0 - 250	0 - 44	sintered glass	10
	TAC15/500LLG0-SR-3	15	50	239 - 500	42 - 88	sintered glass	10
	TAC15/125LLG2-SR-3	15	50	0 - 125	0 - 22	sintered glass	2
	TAC15/250LLG2-SR-3	15	50	0 - 250	0 - 44	sintered glass	2
	TAC15/500LLG2-SR-3	15	50	239 - 500	42 - 88	sintered glass	2
25 mm ID	TAC25/125LLS0-SR-3	25	50	0 - 125	0 - 61	stainless steel	10
	TAC25/250LLS0-SR-3	25	50	0 - 250	0 - 123	stainless steel	10
	TAC25/500LLS0-SR-3	25	50	243 - 500	119 - 245	stainless steel	10
	TAC25/125LLS2-SR-3	25	50	0 - 125	0 - 61	stainless steel	2
	TAC25/250LLS2-SR-3	25	50	0 - 250	0 - 123	stainless steel	2
	TAC25/500LLS2-SR-3	25	50	243 - 500	119 - 245	stainless steel	2
35 mm ID	TAC35/125LLS0-SR-3	35	40	0 - 125	0 - 120	stainless steel	10
	TAC35/250LLS0-SR-3	35	40	0 - 250	0 - 241	stainless steel	10
	TAC35/500LLS0-SR-3	35	40	245 - 500	236 - 481	stainless steel	10
	TAC35/125LLS2-SR-3	35	40	0 - 125	0 - 120	stainless steel	2
	TAC35/250LLS2-SR-3	35	40	0 - 250	0 - 241	stainless steel	2
	TAC35/500LLS2-SR-3	35	40	245 - 500	236 - 481	stainless steel	2
50 mm ID	TAC50/125LLS0-SR-3	50	25	0 - 125	0 - 245	stainless steel	10
	TAC50/250LLS0-SR-3	50	25	0 - 250	0 - 491	stainless steel	10
	TAC50/500LLS0-SR-3	50	25	250 - 500	491 - 982	stainless steel	10
	TAC50/125LLS2-SR-3	50	25	0 - 125	0 - 245	stainless steel	2
	TAC50/250LLS2-SR-3	50	25	0 - 250	0 - 491	stainless steel	2
	TAC50/500LLS2-SR-3	50	25	250 - 500	491 - 982	stainless steel	

Columns supplied with:

for ID 5 mm:
1x 1 m Tefzel tubing 1/16". pre-attached
4x 1/4"-28G nut and ferrule for 1/16" tubing
2x M6 nut and ferrule for 1/16" tubing
2x 10-32 nut/ferrule for 1/16" tubing
2x plugs, PTFE (1/4"-28G)

for ID 10 - 15 mm:
1x 1 m 1/16" FEP tubing (0.8 x 1.6 mm)
4x 1/4"-28G nut and ferrule for 1/16" tubing
2x M6 nut and ferrule for 1/16" tubing
2x 10-32 nut/ferrule for 1/16" tubing
1x frit removal tool
2x plugs, PTFE (1/4"-28G)

for ID 25 - 50 mm:
1x 1 m 1/8" FEP tubing (1.6 x 3.2 mm)
4x 1/4"-28G nut and 4x ferrule for 1/8" tubing
2x M6 nut and ferrule for 1/8" tubing
1x frit removal tool
2x plugs, PTFE (1/4"-28G)

Tubing should be connected to the Econoline® Glass Columns with following screws:

for tubing with 1/16" outer diameter:

ELS-R-55050	Nut 1/4"-28 G
ELS-JR-CFL-CB1KF-S	Ferrule, collapsible 1/16"

for tubing with 1/8" outer diameter:

ELS-JR-55051	Nut 1/4"-28 G
ELS-JR-CFL-CB2KF-S	Ferrule, collapsible 1/8"

IMPORTANT!
2 Screws with metric threads are also supplied with the accessories packages (ELS-K.P207 / ELS-K.P200N oder ELS-K.P307 / ELS-K.P300N). These screws are not suitable for connection to the glass columns as they will damage the thread in the pistons!
They are to allow the columns to be connected to pumps, etc. fitted with metric threads.

Packing Adapters for Econoline® Glass Columns

These consist of a coupling unit and glass body of same column ID as column to be packed

Coupling units consiting of:
- **Econoline®** coupling unit assembly with PTFE insert
- Counter screw (thread) with retaining ring
- Counter screw (bayonet) with retaining ring
- AB-version with two sets (4 pieces) Viton O-rings
- SR-version with two Kalrez® O-rings

Packing Adapters AB-version

Part No.	for column ID [mm]
PAK05/125-AB	5
PAK05/250-AB	5
PAK05/500-AB	5
PAK10/125-AB	10
PAK10/250-AB	10
PAK10/500-AB	10
PAK15/125-AB	15
PAK15/250-AB	15
PAK15/500-AB	15
PAK25/125-AB	25
PAK25/250-AB	25
PAK25/500-AB	25
PAK35/125-AB	35
PAK35/250-AB	35
PAK35/500-AB	35
PAK50/125-AB	50
PAK50/250-AB	50
PAK50/500-AB	50

Packing Adapters SR-version

Part No.	for column ID [mm]
PAK05/125-SR	5
PAK05/250-SR	5
PAK05/500-SR	5
PAK10/125-SR	10
PAK10/250-SR	10
PAK10/500-SR	10
PAK15/125-SR	15
PAK15/250-SR	15
PAK15/500-SR	15
PAK25/125-SR	25
PAK25/250-SR	25
PAK25/500-SR	25
PAK35/125-SR	35
PAK35/250-SR	35
PAK35/500-SR	35
PAK50/125-SR	50
PAK50/250-SR	50
PAK50/500-SR	50

Coupling units AB-version

Part No.	for column ID [mm]
TAC05KU-AB	5
TAC10KU-AB	10
TAC15KU-AB	15
TAC25KU-AB	25
TAC35KU-AB	35
TAC50KU-AB	50

Coupling units SR-version

Part No.	for column ID [mm]
TAC05KU-SR	5
TAC10KU-SR	10
TAC15KU-SR	15
TAC25KU-SR	25
TAC35KU-SR	35
TAC50KU-SR	50

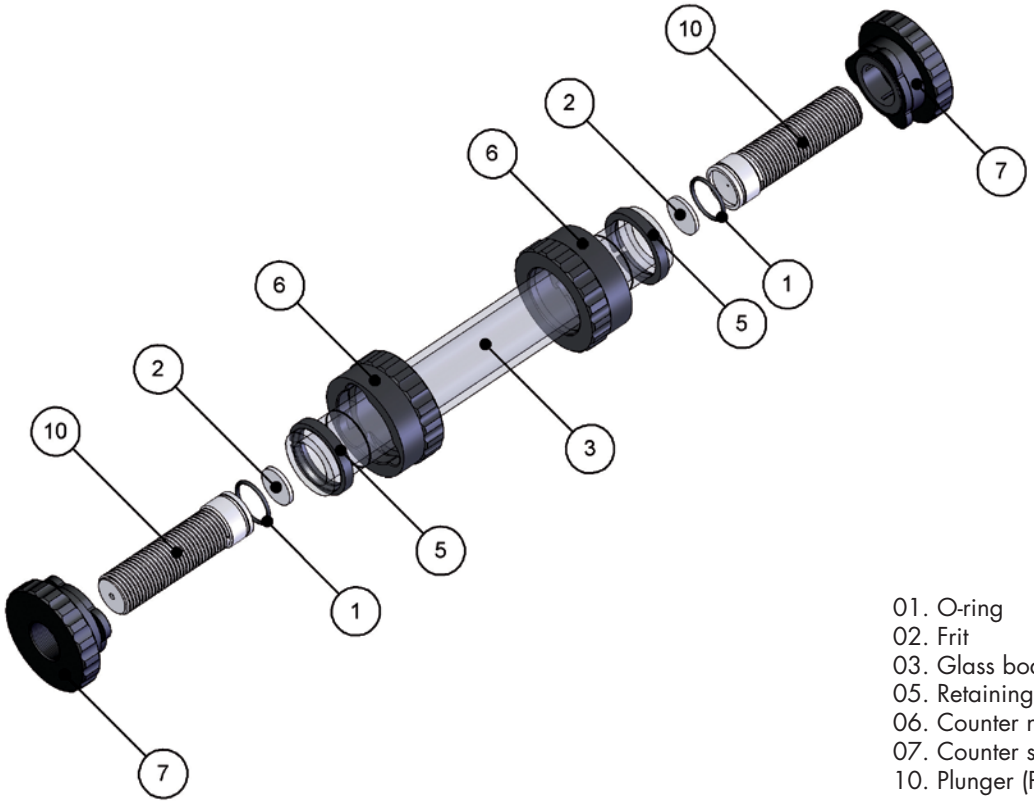
O-ring (Viton) for coupling units AB-version, pack of 2

Part No.	for column ID [mm]
TAC05KU03V/P2	5
TAC10KU03V/P2	10
TAC15KU03V/P2	15
TAC25KU03V/P2	25
TAC35KU03V/P2	35
TAC50KU03V/P2	50

O-ring (Kalrez®) for coupling units SR-version, pack of 2

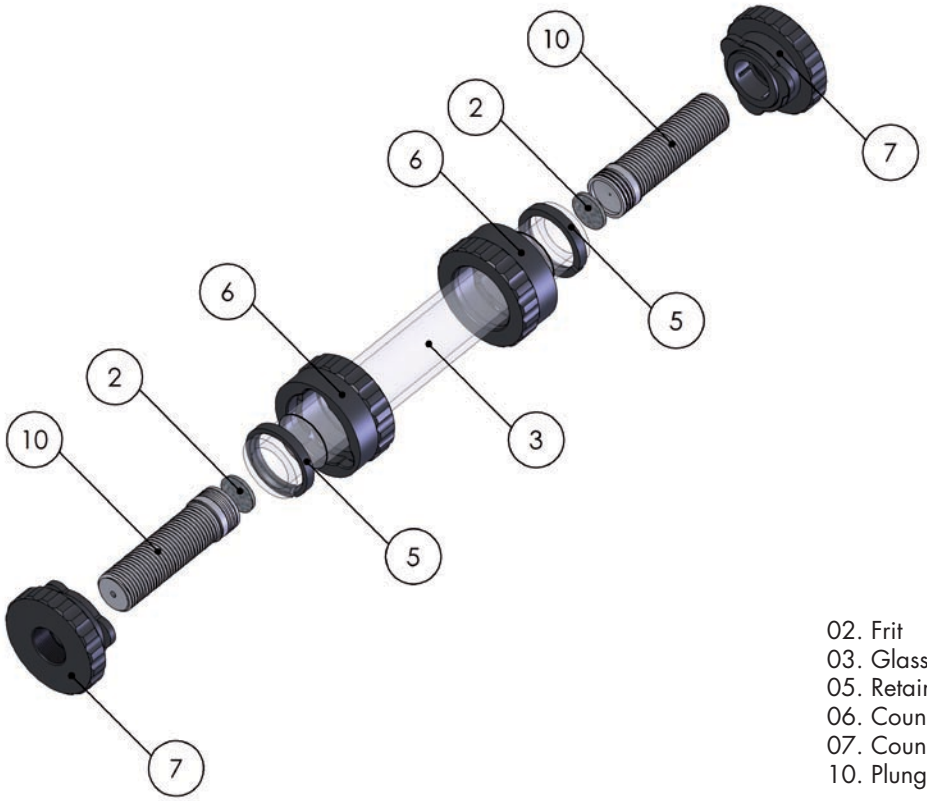
Part No.	for column ID [mm]
TAC05KU03K/P2	5
TAC10KU03K/P2	10
TAC15KU03K/P2	15
TAC25KU03K/P2	25
TAC35KU03K/P2	35
TAC50KU03K/P2	50

Econoline® AB-version



01. O-ring
02. Frit
03. Glass body
05. Retaining ring
06. Counter nut
07. Counter screw
10. Plunger (PE)

Econoline® SR-version



02. Frit
03. Glass body
05. Retaining ring
06. Counter nut
07. Counter screw
10. Plunger (PTFE)

Econoline® glass bodies

Part No.	ID [mm]	max. bed length [mm]
TAC05/125-2	5	125
TAC05/250-2	5	250
TAC05/500-2	5	500
TAC10/125-2	10	125
TAC10/250-2	10	250
TAC10/500-2	10	500
TAC15/125-2	15	125
TAC15/250-2	15	250
TAC15/500-2	15	500
TAC25/125-2	25	125
TAC25/250-2	25	250
TAC25/500-2	25	500
TAC35/125-2	35	125
TAC35/250-2	35	250
TAC35/500-2	35	500
TAC50/125-2	50	125
TAC50/250-2	50	250
TAC50/500-2	50	500

Econoline® column sealing O-ring, EPDM, for AB-version, pack of 2

Part No.	ID [mm]
TAC05/04E/P2	5
TAC10/04E/P2	10
TAC15/04E/P2	15
TAC25/04E/P2	25
TAC35/04E/P2	35
TAC50/04E/P2	50

Plungers, polyethylene, for AB-version (incl. O-ring, w/o frit)

Part No.	for column ID [mm]	adj. bed length [mm]
Short		
TAC05/03STS-AB-2	5	
TAC10/03STS-AB-2	10	
TAC15/03STS-AB-2	15	see
TAC25/03STS-AB-2	25	table page 3
TAC35/03STS-AB-2	35	
TAC50/03STS-AB-2	50	
Long		
TAC05/03STL-AB-2	5	
TAC10/03STL-AB-2	10	
TAC15/03STL-AB-2	15	see
TAC25/03STL-AB-2	25	table page 3
TAC35/03STL-AB-2	35	
TAC50/03STL-AB-2	50	

Plungers, PTFE, for SR-version (w/o frit)

Part No.	for column ID [mm]	adj. bed length [mm]
Short		
TAC05/03STS-3	5	
TAC10/03STS-3	10	
TAC15/03STS-3	15	see
TAC25/03STS-3	25	table page 3
TAC35/03STS-3	35	
TAC50/03STS-3	50	
Long		
TAC05/03STL-3	5	
TAC10/03STL-3	10	
TAC15/03STL-3	15	see
TAC25/03STL-3	25	table page 3
TAC35/03STL-3	35	
TAC50/03STL-3	50	

Frits, pack of 2

Part No.	for column ID [mm]	Porosity [µm]
Polyethylene		
TAC05PE10/P2	5	10
TAC05PE5/P2	5	5
TAC10PE10-2/P2	10	10
TAC10PE5-2/P2	10	5
TAC15PE10-2/P2	15	10
TAC15PE5-2/P2	15	5
TAC25PE10-2/P2	25	10
TAC25PE5-2/P2	25	5
TAC35PE10-2/P2	35	10
TAC35PE5-2/P2	35	5
TAC50PE10-2/P2	50	10
TAC50PE5-2/P2	50	5

Part No.	for column ID [mm]	Porosity [µm]
Sintered glass		
TAC05G10/P2	5	10
TAC05G2/P2	5	2
TAC10G10-2/P2	10	10
TAC10G2-2/P2	10	2
TAC15G10-2/P2	15	10
TAC15G2-2/P2	15	2
Stainless steel		
TAC25S10-2/P2	25	10
TAC25S2-2/P2	25	2
TAC35S10-2/P2	35	10
TAC35S2-2/P2	35	2
TAC50S10-2/P2	50	10
TAC50S2-2/P2	50	2

Additional spare parts

Part No.	Description
ELS-FRT	Frit removal tool
ELS-K.P316-5	Plug PTFE (1/4"-28G), pack of 5
ELS-K.P620-5	Female connector (both ends threaded 1/4"-28G), pack of 5
ELS-K.P621-5	Adaptor 1/4"-28G to M6, pack of 5
ELS-K.P627	Adaptor 10-32 to 1/4"-28G (incl. 1 F-300 fitting for 1/16" tubing)

Tubing

Part No.	Description
ELS-PT0.8FE1.6/M5	FEP tubing, 0.8 x 1.6 mm OD (1/16" OD), pack of 5 metres
ELS-PT1.6FE3.2/M5	FEP tubing, 1.6 x 3.2 mm OD (1/8" OD), pack of 5 metres
ELS-JR-T-082-M3	Tefzel tubing, 0.5 x 1.6 mm OD (1/16" OD), pack of 3 metres

Fittings (nuts and ferrules)

Part No.	Description [€]
ELS-JR-55050-10	Nut, 1/4"-28, PPS, for collapsible ferrule for 1/16" tubing, pack of 10
ELS-JR-CFL-CB1KF	Ferrule, collapsible, for 1/16" tubing, pack of 10
ELS-K.P201X	Nut 1/4"-28G for 1/16" tubing, pack of 10
ELS-K.P200NX	Flangeless ferrule for 1/16" tubing, pack of 10
ELS-K.P207X	M6 nut for 1/16" tubing, pack of 10
ELS-K.P200NX	Flangeless ferrule for 1/16" tubing, pack of 10
ELS-JR-55051-10	FNut, 1/4"-28, PPS, for collapsible ferrule for 1/8" tubing, pack of 10
ELS-JR-CFL-CB2KF-10	Ferrule, collapsible, for 1/8" tubing, pack of 10
ELS-K.P301X	Nut 1/4"-28G for 1/8" tubing, pack of 10
ELS-K.P300NX	Ferrule for 1/8" tubing, pack of 10
ELS-K.P307X	M6 nut, for 1/8" tubing, pack of 10
ELS-K.P300NX	Ferrule for 1/8" tubing, pack of 10

Part No.	Description
ELS-JR-58000-5	10-32 nut/ferrule (one-piece-fitting) for 1/16" tubing (pack of 5)

Additional spare parts are available at request.

essentialLife Solutions

EconolineLP® Columns

Low Pressure, Low Price

HIGHLIGHTS:

- Biocompatible
- Universal Application
- Height Adjustment Plunger at One End
- Ease of Use
- Jacketed Version Available

Advantages of EconolineLP® Columns

1 LINEAR MOTION OF PISTON

Due to true linear motion of piston there is no torsional load imposed on the packed bed assuring true linear compression.

2 TRUE FRITS

True frit without the use of sock design employed in less expensive columns assure even flow distribution across the bed.

3 ROBUST INLET AND OUTLET CONNECTIONS

Inlet and outlet connections are made at the exterior of the column, which provide a more reliable and visible connection.

4 FINE THREAD ADJUSTMENT

Columns are provided with fine thread adjustment of piston to allow for precise control of piston placement.

5 EASY OPEN ENDS

Design features our unique easily removable threaded end fittings making column disassembly effortless.

6 SEAL ADJUSTMENT

Easily adjustable O-ring seals.

7 PACKING ADAPTER

User-friendly packing adapters available.

Pressure Limits:
10 - 30 Bars

Connections:
ID 10mm - 25mm
Two (2) 1/4"-28 fittings
for 1/16" capillaries

ID 32mm - 50 mm
Two (2) 1/4"-28 fittings
for 1/8" capillaries

Height Adjustment:
Multi-variable plunger at one end, 120 mm adjustment. Double piston configuration available upon request.

Accessories:
User-friendly packing adapters

EconolineLP® Columns

MATERIALS OF CONSTRUCTION

- Tube:Borosilicate Glass
- Temperature Range: 4°- 40° C
- Plunger: POM (Delrin®)
- Seal: Viton O-ring
- Frit: Porous Glass

INCLUDED SPARE PARTS

I.D. 10-25mm:
- 2 pcs. Nut 1/16"
- 2 pcs. Ferrule 1/16"
- 0.5mm FEP-Tubing I.D. 0.8mm, O.D. 1.6mm
- 1 pc. frit removel tool

I.D. 32-50mm:
- 2 pcs. Nut 1/8"
- 2 pcs. Ferrule 1/8"
- 0.5mm FEP-Tubing I.D. 1.6mm, O.D. 3.2 mm
- 1 pc. frit removel tool

EconolineLP® Columns

EconolineLP® **Column** with piston removed.

ID (mm)	Bed Length min-max (mm)	Volume min-max (ml)	Pressure Limit (bar)	Frit Porosity (um)	ELS Part No
10	0-120	0-9.42	30	16-40	ECO10/120V3V
10	80-200	6.28-15.71	30	16-40	ECO10/200V3V
10	330-450	25.92-35.34	30	16-40	ECO10/450V3V
10	630-750	49.48-58.90	30	16-40	ECO10/750V3V
10	880-1000	69.11-78.54	30	16-40	ECO10/999V3V
10	0-120	0-9.42	30	40-100	ECO10/120V4V
10	80-200	6.28-15.71	30	40-100	ECO10/200V4V
10	330-450	25.92-35.34	30	40-100	ECO10/450V4V
10	630-750	49.48-58.90	30	40-100	ECO10/750V4V
10	880-1000	69.11-78.54	30	40-100	ECO10/999V4V
15	0-120	0-21.21	25	16-40	ECO15/120V3V
15	80-200	14.14-35.34	25	16-40	ECO15/200V3V
15	330-450	58.32-79.52	25	16-40	ECO15/450V3V
15	630-750	111.33-132.54	25	16-40	ECO15/750V3V
15	880-1000	155.51-176.71	25	16-40	ECO15/999V3V
15	0-120	0-21.21	25	40-100	ECO15/120V4V
15	80-200	14.14-35.34	25	40-100	ECO15/200V4V
15	330-450	58.32-79.52	25	40-100	ECO15/450V4V
15	630-750	111.33-132.54	25	40-100	ECO15/750V4V
15	880-1000	155.51-176.71	25	40-100	ECO15/999V4V
20	0-120	0-37.70	20	16-40	ECO20/120V3V
20	80-200	25.13-62.83	20	16-40	ECO20/200V3V
20	330-450	103.67-141.37	20	16-40	ECO20/450V3V
20	630-750	197.92-235.62	20	16-40	ECO20/750V3V
20	880-1000	276.46-314.16	20	16-40	ECO20/999V3V
20	0-120	0-37.70	20	40-100	ECO20/120V4V
20	80-200	25.13-62.83	20	40-100	ECO20/200V4V
20	330-450	103.67-141.37	20	40-100	ECO20/450V4V
20	630-750	197.92-235.62	20	40-100	ECO20/750V4V
20	880-1000	276.46-314.16	20	40-100	ECO20/999V4V

We now accept Major Credit Cards.

Glass Tempering **Jacket** / Double **Piston** Configuration

User-friendly
PACKING ADAPTER
Available

ID (mm)	Bed Length min-max (mm)	Volume min-max (ml)	Pressure Limit (bar)	Frit Porosity (um)	ELS Part No
25	0-120	0-58.90	15	16-40	ECO25/120M3V-K
25	0-200	0-98.17	15	16-40	ECO25/200M3V-K
25	210-450	103.08-220.89	15	16-40	ECO25/450M3V-K
25	510-750	250.35-368.16	15	16-40	ECO25/750M3V-K
25	760-1000	373.06-490.87	15	16-40	ECO25/999M3V-K
25	0-120	0-58.90	15	40-100	ECO25/120M4V-K
25	0-200	0-98.17	15	40-100	ECO25/200M4V-K
25	210-450	103.08-220.89	15	40-100	ECO25/450M4V-K
25	510-750	250.35-368.16	15	40-100	ECO25/750M4V-K
25	760-1000	373.06-490.87	15	40-100	ECO25/999M4V-K
32	0-120	0-96.51	10	16-40	ECO32/120M3V-K
32	0-200	0-160.85	10	16-40	ECO32/200M3V-K
32	210-450	168.89-361.91	10	16-40	ECO32/450M3V-K
32	510-750	410.17-603.19	10	16-40	ECO32/750M3V-K
32	760-1000	611.23-804.25	10	16-40	ECO32/999M3V-K
32	0-120	0-96.51	10	40-100	ECO32/120M4V-K
32	0-200	0-160.85	10	40-100	ECO32/200M4V-K
32	210-450	168.89-361.91	10	40-100	ECO32/450M4V-K
32	510-750	410.17-603.19	10	40-100	ECO32/750M4V-K
32	760-1000	611.23-804.25	10	40-100	ECO32/999M4V-K
50	0-120	0-235.62	10	16-40	ECO50/120M3V-K
50	0-200	0-392.70	10	16-40	ECO50/200M3V-K
50	210-450	412.33-883.57	10	16-40	ECO50/450M3V-K
50	510-750	1001.38-1472.62	10	16-40	ECO50/750M3V-K
50	760-1000	1492.26-1963.49	10	16-40	ECO50/999M3V-K
50	0-120	0-235.62	10	40-100	ECO50/120M4V-K
50	0-200	0-392.70	10	40-100	ECO50/200M4V-K
50	210-450	412.33-883.57	10	40-100	ECO50/450M4V-K
50	510-750	1001.38-1472.62	10	40-100	ECO50/750M4V-K
50	760-1000	1001.38-1472.62	10	40-100	ECO50/999M4V-K

Glass Tempering **Jacket** / Double **Piston** Configuration

Double Piston EconolineLP® **Column** with Glass Tempering Jacket.

ID (mm)	Bed Length min-max (mm)	Volume min-max (ml)	Pressure Limit (bar)	Frit Porosity (um)	ELS Part No
10	0-120	0-9.42	30	16-40	ECO10/120M3V-K
10	0-200	0-15.71	30	16-40	ECO10/200M3V-K
10	210-450	16.49-35.34	30	16-40	ECO10/450M3V-K
10	510-750	40.06-58.90	30	16-40	ECO10/750M3V-K
10	760-1000	59.69-78.54	30	16-40	ECO10/999M3V-K
10	0-120	0-9.42	30	40-100	ECO10/120M4V-K
10	0-200	0-15.71	30	40-100	ECO10/200M4V-K
10	210-450	16.49-35.34	30	40-100	ECO10/450M4V-K
10	510-750	40.06-58.90	30	40-100	ECO10/750M4V-K
10	760-1000	59.69-78.54	30	40-100	ECO10/999M4V-K
15	0-120	0-21.21	25	16-40	ECO15/120M3V-K
15	0-200	0-35.34	25	16-40	ECO15/200M3V-K
15	210-450	37.11-79.52	25	16-40	ECO15/450M3V-K
15	510-750	90.12-132.54	25	16-40	ECO15/750M3V-K
15	760-1000	144.30-176.71	25	16-40	ECO15/999M3V-K
15	0-120	0-21.21	25	40-100	ECO15/120M4V-K
15	0-200	0-35.34	25	40-100	ECO15/200M4V-K
15	210-450	37.11-79.52	25	40-100	ECO15/450M4V-K
15	510-750	90.12-132.54	25	40-100	ECO15/750M4V-K
15	760-1000	144.30-176.71	25	40-100	ECO15/999M4V-K
20	0-120	0-37.70	20	16-40	ECO20/120M3V-K
20	0-200	0-62.83	20	16-40	ECO20/200M3V-K
20	210-450	65.97-141.37	20	16-40	ECO20/450M3V-K
20	510-750	160.22-235.362	20	16-40	ECO20/750M3V-K
20	760-1000	238.76-314.16	20	16-40	ECO20/999M3V-K
20	0-120	0-37.70	20	40-100	ECO20/120M4V-K
20	0-200	0-62.83	20	40-100	ECO20/200M4V-K
20	210-450	65.97-141.37	20	40-100	ECO20/450M4V-K
20	510-750	160.22-235.362	20	40-100	ECO20/750M4V-K
20	760-1000	238.76-314.16	20	40-100	ECO20/999M4V-K

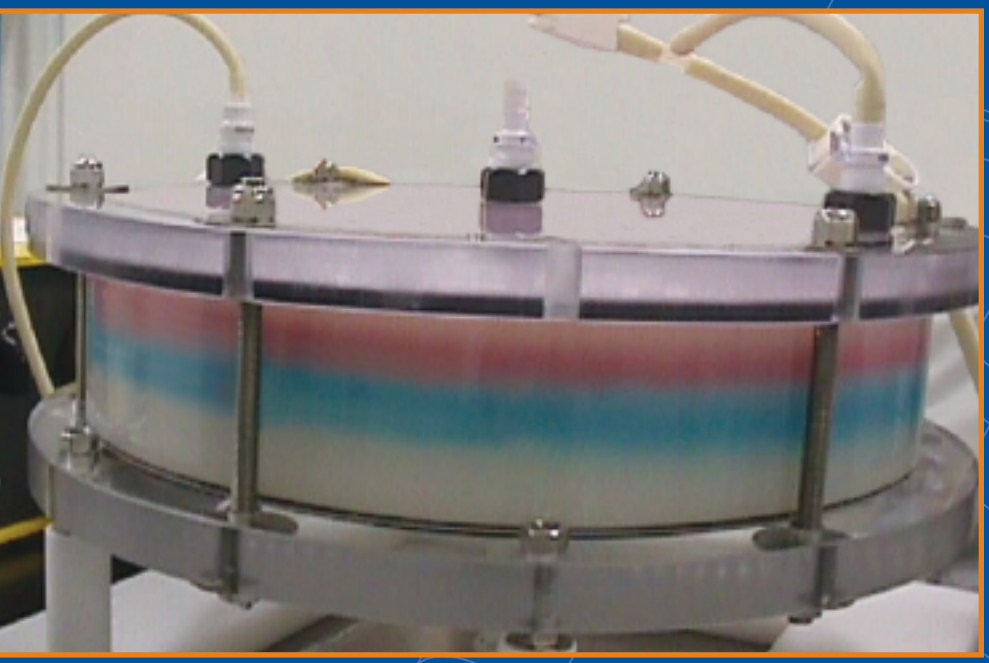
Econoline**LP®** **Column**
with frit removal tool.

ID (mm)	Bed Length min-max (mm)	Volume min-max (ml)	Pressure Limit (bar)	Frit Porosity (um)	ELS Part No
25	0-120	0-58.90	15	16-40	ECO25/120V3V
25	80-200	39.27-98.17	15	16-40	ECO25/200V3V
25	330-450	161.99-220.89	15	16-40	ECO25/450V3V
25	630-750	309.25-368.16	15	16-40	ECO25/750V3V
25	880-1000	431.97-490.87	15	16-40	ECO25/999V3V
25	0-120	0-58.90	15	40-100	ECO25/120V4V
25	80-200	39.27-98.17	15	40-100	ECO25/200V4V
25	330-450	161.99-220.89	15	40-100	ECO25/450V4V
25	630-750	309.25-368.16	15	40-100	ECO25/750V4V
25	880-1000	431.97-490.87	15	40-100	ECO25/999V4V
32	0-120	0-96.51	10	16-40	ECO32/120V3V
32	80-200	64.34-160.85	10	16-40	ECO32/200V3V
32	330-450	265.40-361.91	10	16-40	ECO32/450V3V
32	630-750	506.68-603.19	10	16-40	ECO32/750V3V
32	880-1000	707.74-804.25	10	16-40	ECO32/999V3V
32	0-120	0-96.51	10	40-100	ECO32/120V4V
32	80-200	64.34-160.85	10	40-100	ECO32/200V4V
32	330-450	265.40-361.91	10	40-100	ECO32/450V4V
32	630-750	506.68-603.19	10	40-100	ECO32/750V4V
32	880-1000	707.74-804.25	10	40-100	ECO32/999V4V
50	0-120	0-235.62	10	16-40	ECO50/120V3V
50	80-200	157.08-392.70	10	16-40	ECO50/200V3V
50	330-450	647.95-883.57	10	16-40	ECO50/450V3V
50	630-750	1237.00-1472.62	10	16-40	ECO50/750V3V
50	880-1000	1727.87-1963.49	10	16-40	ECO50/999V3V
50	0-120	0-235.62	10	40-100	ECO50/120V4V
50	80-200	157.08-392.70	10	40-100	ECO50/200V4V
50	330-450	647.95-883.57	10	40-100	ECO50/450V4V
50	630-750	1237.00-1472.62	10	40-100	ECO50/750V4V
50	880-1000	1727.87-1963.49	10	40-100	ECO50/999V4V

essentialLife Solutions

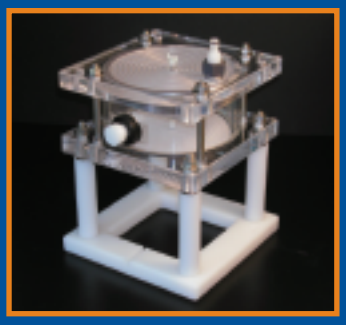
IsoKrom™ Columns

Economical/Sanitary
Process Scale Technology



HIGHLIGHTS:

- All wetted parts are either autoclavable, disposable and/or can be completely taken apart for thorough cleaning.
- Fixed volume, packing through the wall.
- Reduced dead-space by volume (V) and length (L).
- Simple & Robust - IsoKrom™ is designed around standard industrial parts, which lowers the price and assures quality.
- No metal parts contact the solution.



"In a multi-product environment, we install new mesh for each new product run to prevent carry-over contamination. In contrast to IsoKrom, frit replacement in other large columns is expensive, laborious and/or requires factory service".

J. Burton Lee, President,
Lee BioSolutions Inc., MO

"Processes have never been this robust with other systems...[IsoKrom] allows a much faster cycle time for a column run. Production personnel really appreciate when different operators, on different days and with different batches, can consistently reproduce the performance".

Fred Drewe, Ph.D, President,
Drewe Browning Strickler, TX

AVAILABLE STANDARD SIZES*

Tube ID (cm)	Volume (L) at 20-cm bed
9.5	1.4
13.3	2.8
22.9	8.2
33.0	17.1
47.0	34.7
66.0	68.5
79.0	98.0
102.9	166.2
177.8	496.6
238.8	895.5

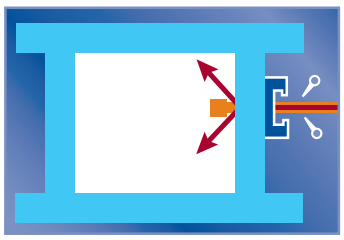
*Custom sizes available upon request.

IsoKrom™ Columns

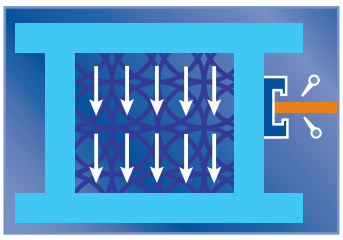
Acrylic columns for preparative low-medium pressure bio-chromatography available from ISO 9000 certified manufacturer

- Improved column sanitation with a packed bed in (CIP) as well as in a disassembled state.
- Inexpensive mesh replacement eliminates potential carry-over of sorbent and contaminants.
- No packing valves blocking the mesh, no stagnant pockets. Uniform unobstructed flow through the entire bed.
- Shorter dead-space translates into reduced clearance time (=L^2), and/or a more thorough CIP.
- Shortended time for column order delivery. Standard parts (Acrylic tube, Nylon mesh, etc.) are available on short notice.
- Due to lower column cost, each purification step can afford a separate dedicated column, with no need to clean and validate re-packing.
- No issues with rusting at low pH and/or at high Chloride, EDTA and Citrate concentration.

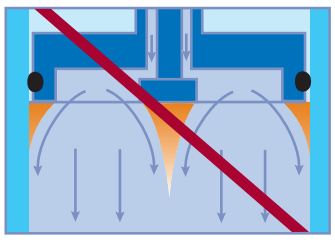
IsoKrom™ Columns



Pack sorbent slurry into precise fixed volume using sidepacking valve.



Packing valve is retracted flush with the wall eliminating dead volume in column.



Other columns employ center packing valve which creates dead volume.

- All wetted parts are either autoclavable, replaceable and/or can be completely taken apart for thorough cleaning.
- No metal parts contact the solution: no issues with rusting at low pH and/or at high NaCl concentration.

essentialLife Solutions

2012 - Now Only Available to Custom Order - 10 sets (each Size) Minimum Order

Media-Flex® **Columns**

"Quick Change" Cartridge Lab Columns

HIGHLIGHTS:

- Pressure to 86 bar
- Low Dead Volume Design
- Fully Visible Bed
- Autoclavable
- Reusable Glass Cartridge
- EPDM Seal for Cold Room Applications

Advantages of Media-Flex® Columns

1 HIGHER PRESSURE RATINGS INCORPORATING GLASS CONSTRUCTION

Pressures to 86 Bars (1,247 psig)
Full view of bed unlike stainless steel
Rugged construction for hard lab use

2 LINEAR MOTION OF PISTON

Due to true linear motion of piston there is no torsional load imposed on the packed bed assuring true linear compression.

3 TRUE FRITS

True frit without the use of sock design employed in less expensive columns assure even flow distribution across the bed.

4 ROBUST INLET AND OUTLET CONNECTIONS

Inlet and outlet connections are made at the exterior of the column, which provide a more reliable and visible connection.

5 FINE THREAD ADJUSTMENT

Columns are provided with fine thread adjustment of piston to allow for precise control of piston placement.

6 QUICK RELEASE ENDS

Design features our unique quick-disconnect end fittings making column disassembly and cartridge removal effortless.

7 UNIQUE CARTRIDGE DESIGN

Media-flex® offers the benefit in that the cartridge unit quickly releases from the housing without disturbing the bed or packing allowing for rapid, inexpensive change-out of the column.

Pressure Limits:
28 - 86 Bars

Connections:
Two 1/4" - 28 Fittings (one for 1/16" and one for 1/8" capillaries). The column is supplied with an M6 adapter to allow direct connection to any LC system.

Height Adjustment:
Multi-variable plunger, 6 cm/12 cm adjustment.

Accessories:
Packing adapters
Spare cartridges

MEDIA-FLEX® COLUMN MATERIALS OF CONSTRUCTION

SR (solvent resistant)

- Tube:Borosilicate Glass
- Temperature Range: 18°- 60° C
- Plunger: PTFE
- Seal: PTFE triple chevron
- Frit: ID 5 mm - 15 mm: sinter glass frit
  ID 25 mm - 50 mm: stainless steel

AB (aqueous buffer)

- Tube:Borosilicate Glass
- Temperature Range: 4°- 40° C
- Plunger: Polyethylene
- Seal: EPDM O-ring
- Frit: ID 5 mm - 50 mm: polyethylene

Media-Flex Lab® **Columns**

ID (mm)	Bed Length min-max (mm)	Volume min-max (ml)	Pressure Limit (bar)	Frit Porosity (um)	Frit Type	Column Type (application)	ELS Part No
5	0 - 120	0.00 - 2.36	86.67	10	Porous Glass	Solvent Resistant (SR)	MF-5-120-L-10-SR
5	60 - 120	1.18 - 2.36	86.67	10	Porous Glass	Solvent Resistant (SR)	MF-5-120-S-10-SR
5	140 - 260	2.75 - 5.11	86.67	10	Porous Glass	Solvent Resistant (SR)	MF-5-260-L-10-SR
5	200 - 260	3.93 - 5.11	86.67	10	Porous Glass	Solvent Resistant (SR)	MF-5-260-S-10-SR
5	380 - 500	7.46 - 9.82	86.67	10	Porous Glass	Solvent Resistant (SR)	MF-5-500-L-10-SR
5	440 - 500	8.64 - 9.82	86.67	10	Porous Glass	Solvent Resistant (SR)	MF-5-500-S-10-SR
5	0 - 120	0.00 - 2.36	86.67	2	Porous Glass	Solvent Resistant (SR)	MF-5-120-L-2-SR
5	60 - 120	1.18 - 2.36	86.67	2	Porous Glass	Solvent Resistant (SR)	MF-5-120-S-2-SR
5	140 - 260	2.75 - 5.11	86.67	2	Porous Glass	Solvent Resistant (SR)	MF-5-260-L-2-SR
5	200 - 260	3.93 - 5.11	86.67	2	Porous Glass	Solvent Resistant (SR)	MF-5-260-S-2-SR
5	380 - 500	7.46 - 9.82	86.67	2	Porous Glass	Solvent Resistant (SR)	MF-5-500-L-2-SR
5	440 - 500	8.64 - 9.82	86.67	2	Porous Glass	Solvent Resistant (SR)	MF-5-500-S-2-SR
10	0 - 120	0.00 - 9.42	80	10	Porous Glass	Solvent Resistant (SR)	MF-10-120-L-10-SR
10	60 - 120	4.71 - 9.42	80	10	Porous Glass	Solvent Resistant (SR)	MF-10-120-S-10-SR
10	140 - 260	11.00 - 20.42	80	10	Porous Glass	Solvent Resistant (SR)	MF-10-260-L-10-SR
10	200 - 260	15.71 - 20.42	80	10	Porous Glass	Solvent Resistant (SR)	MF-10-260-S-10-SR
10	380 - 500	29.85 - 39.27	80	10	Porous Glass	Solvent Resistant (SR)	MF-10-500-L-10-SR
10	440 - 500	34.56 - 39.27	80	10	Porous Glass	Solvent Resistant (SR)	MF-10-500-S-10-SR
10	0 - 120	0.00 - 9.42	80	2	Porous Glass	Solvent Resistant (SR)	MF-10-120-L-2-SR
10	60 - 120	4.71 - 9.42	80	2	Porous Glass	Solvent Resistant (SR)	MF-10-120-S-2-SR
10	140 - 260	11.00 - 20.42	80	2	Porous Glass	Solvent Resistant (SR)	MF-10-260-L-2-SR
10	200 - 260	15.71 - 20.42	80	2	Porous Glass	Solvent Resistant (SR)	MF-10-260-S-2-SR
10	380 - 500	29.85 - 39.27	80	2	Porous Glass	Solvent Resistant (SR)	MF-10-500-L-2-SR
10	440 - 500	34.56 - 39.27	80	2	Porous Glass	Solvent Resistant (SR)	MF-10-500-S-2-SR
15	0 - 120	0.00 - 21.21	66.67	10	Porous Glass	Solvent Resistant (SR)	MF-15-120-L-10-SR
15	60 - 120	10.60 - 21.21	66.67	10	Porous Glass	Solvent Resistant (SR)	MF-15-120-S-10-SR
15	140 - 260	24.74 - 45.95	66.67	10	Porous Glass	Solvent Resistant (SR)	MF-15-260-L-10-SR
15	200 - 260	35.34 - 45.95	66.67	10	Porous Glass	Solvent Resistant (SR)	MF-15-260-S-10-SR
15	380 - 500	67.15 - 88.36	66.67	10	Porous Glass	Solvent Resistant (SR)	MF-15-500-L-10-SR
15	440 - 500	77.75 - 88.36	66.67	10	Porous Glass	Solvent Resistant (SR)	MF-15-500-S-10-SR
15	0 - 120	0.00 - 21.21	66.67	2	Porous Glass	Solvent Resistant (SR)	MF-15-120-L-2-SR
15	60 - 120	10.60 - 21.21	66.67	2	Porous Glass	Solvent Resistant (SR)	MF-15-120-S-2-SR
15	140 - 260	24.74 - 45.95	66.67	2	Porous Glass	Solvent Resistant (SR)	MF-15-260-L-2-SR
15	200 - 260	35.34 - 45.95	66.67	2	Porous Glass	Solvent Resistant (SR)	MF-15-260-S-2-SR
15	380 - 500	67.15 - 88.36	66.67	2	Porous Glass	Solvent Resistant (SR)	MF-15-500-L-2-SR
15	440 - 500	77.75 - 88.36	66.67	2	Porous Glass	Solvent Resistant (SR)	MF-15-500-S-2-SR

ID (mm)	Bed Length min-max (mm)	Volume min-max (ml)	Pressure Limit (bar)	Frit Porosity (um)	Frit Type	Column Type (application)	ELS Part No
20	0 - 120	0.00 - 37.70	60	10	Stainless Steel	Solvent Resistant (SR)	MF-20-120-L-10-SR
20	60 - 120	18.85 - 37.70	60	10	Stainless Steel	Solvent Resistant (SR)	MF-20-120-S-10-SR
20	140 - 260	43.98 - 81.86	60	10	Stainless Steel	Solvent Resistant (SR)	MF-20-260-L-10-SR
20	200 - 260	62.83 -81.86	60	10	Stainless Steel	Solvent Resistant (SR)	MF-20-260-S-10-SR
20	380 - 500	119.38 - 157.08	60	10	Stainless Steel	Solvent Resistant (SR)	MF-20-500-L-10-SR
20	440 - 500	138.23 - 157.08	60	10	Stainless Steel	Solvent Resistant (SR)	MF-20-500-S-10-SR
20	0 - 120	0.00 - 37.70	60	2	Stainless Steel	Solvent Resistant (SR)	MF-20-120-L-2-SR
20	60 - 120	18.85 - 37.70	60	2	Stainless Steel	Solvent Resistant (SR)	MF-20-120-S-2-SR
20	140 - 260	43.98 - 81.86	60	2	Stainless Steel	Solvent Resistant (SR)	MF-20-260-L-2-SR
20	200 - 260	62.83 -81.86	60	2	Stainless Steel	Solvent Resistant (SR)	MF-20-260-S-2-SR
20	380 - 500	119.38 - 157.08	60	2	Stainless Steel	Solvent Resistant (SR)	MF-20-500-L-2-SR
20	440 - 500	138.23 - 157.08	60	2	Stainless Steel	Solvent Resistant (SR)	MF-20-500-S-2-SR
25	0 - 120	0.00 - 58.90	50	10	Stainless Steel	Solvent Resistant (SR)	MF-25-120-L-10-SR
25	60 - 120	29.45 - 58.90	50	10	Stainless Steel	Solvent Resistant (SR)	MF-25-120-S-10-SR
25	140 - 260	68.72 - 127.63	50	10	Stainless Steel	Solvent Resistant (SR)	MF-25-260-L-10-SR
25	200 - 260	98.17 - 127.63	50	10	Stainless Steel	Solvent Resistant (SR)	MF-25-260-S-10-SR
25	380 - 500	186.53 - 245.44	50	10	Stainless Steel	Solvent Resistant (SR)	MF-25-500-L-10-SR
25	440 - 500	215.98 - 245.44	50	10	Stainless Steel	Solvent Resistant (SR)	MF-25-500-S-10-SR
25	0 - 120	0.00 - 58.90	50	2	Stainless Steel	Solvent Resistant (SR)	MF-25-120-L-2-SR
25	60 - 120	29.45 - 58.90	50	2	Stainless Steel	Solvent Resistant (SR)	MF-25-120-S-2-SR
25	140 - 260	68.72 - 127.63	50	2	Stainless Steel	Solvent Resistant (SR)	MF-25-260-L-2-SR
25	200 - 260	98.17 - 127.63	50	2	Stainless Steel	Solvent Resistant (SR)	MF-25-260-S-2-SR
25	380 - 500	186.53 - 245.44	50	2	Stainless Steel	Solvent Resistant (SR)	MF-25-500-L-2-SR
25	440 - 500	215.98 - 245.44	50	2	Stainless Steel	Solvent Resistant (SR)	MF-25-500-S-2-SR
50	0 - 120	0.00 - 235.62	28	10	Stainless Steel	Solvent Resistant (SR)	MF-50-120-L-10-SR
50	60 - 120	117.81 - 235.62	28	10	Stainless Steel	Solvent Resistant (SR)	MF-50-120-S-10-SR
50	140 - 260	274.89 - 510.51	28	10	Stainless Steel	Solvent Resistant (SR)	MF-50-260-L-10-SR
50	200 - 260	392.70 - 510.51	28	10	Stainless Steel	Solvent Resistant (SR)	MF-50-260-S-10-SR
50	380 - 500	746.13 - 981.75	28	10	Stainless Steel	Solvent Resistant (SR)	MF-50-500-L-10-SR
50	440 - 500	863.94 - 981.75	28	10	Stainless Steel	Solvent Resistant (SR)	MF-50-500-S-10-SR
50	0 - 120	0.00 - 235.62	28	2	Stainless Steel	Solvent Resistant (SR)	MF-50-120-L-2-SR
50	60 - 120	117.81 - 235.62	28	2	Stainless Steel	Solvent Resistant (SR)	MF-50-120-S-2-SR
50	140 - 260	274.89 - 510.51	28	2	Stainless Steel	Solvent Resistant (SR)	MF-50-260-L-2-SR
50	200 - 260	392.70 - 510.51	28	2	Stainless Steel	Solvent Resistant (SR)	MF-50-260-S-2-SR
50	380 - 500	746.13 - 981.75	28	2	Stainless Steel	Solvent Resistant (SR)	MF-50-500-L-2-SR
50	440 - 500	863.94 - 981.75	28	2	Stainless Steel	Solvent Resistant (SR)	MF-50-500-S-2-SR

Media-Flex Lab® **Columns**

ID (mm)	Bed Length min-max (mm)	Volume min-max (ml)	Pressure Limit (bar)	Frit Porosity (um)	Frit Type	Column Type (application)	ELS Part No
5	0 - 120	0.00 - 2.36	86.67	10	Polyethylene	Aqueous Buffer (AB)	MF-5-120-L-10-AB
5	60 - 120	1.18 - 2.36	86.67	10	Polyethylene	Aqueous Buffer (AB)	MF-5-120-S-10-AB
5	140 - 260	2.75 - 5.11	86.67	10	Polyethylene	Aqueous Buffer (AB)	MF-5-260-L-10-AB
5	200 - 260	3.93 - 5.11	86.67	10	Polyethylene	Aqueous Buffer (AB)	MF-5-260-S-10-AB
5	380 - 500	7.46 - 9.82	86.67	10	Polyethylene	Aqueous Buffer (AB)	MF-5-500-L-10-AB
5	440 - 500	8.64 - 9.82	86.67	10	Polyethylene	Aqueous Buffer (AB)	MF-5-500-S-10-AB
5	0 - 120	0.00 - 2.36	86.67	5	Polyethylene	Aqueous Buffer (AB)	MF-5-120-L-5-AB
5	60 - 120	1.18 - 2.36	86.67	5	Polyethylene	Aqueous Buffer (AB)	MF-5-120-S-5-AB
5	140 - 260	2.75 - 5.11	86.67	5	Polyethylene	Aqueous Buffer (AB)	MF-5-260-L-5-AB
5	200 - 260	3.93 - 5.11	86.67	5	Polyethylene	Aqueous Buffer (AB)	MF-5-260-S-5-AB
5	380 - 500	7.46 - 9.82	86.67	5	Polyethylene	Aqueous Buffer (AB)	MF-5-500-L-5-AB
5	440 - 500	8.64 - 9.82	86.67	5	Polyethylene	Aqueous Buffer (AB)	MF-5-500-S-5-AB
10	0 - 120	0.00 - 9.42	80	10	Polyethylene	Aqueous Buffer (AB)	MF-10-120-L-10-AB
10	60 - 120	4.71 - 9.42	80	10	Polyethylene	Aqueous Buffer (AB)	MF-10-120-S-10-AB
10	140 - 260	11.00 - 20.42	80	10	Polyethylene	Aqueous Buffer (AB)	MF-10-260-L-10-AB
10	200 - 260	15.71 - 20.42	80	10	Polyethylene	Aqueous Buffer (AB)	MF-10-260-S-10-AB
10	380 - 500	29.85 - 39.27	80	10	Polyethylene	Aqueous Buffer (AB)	MF-10-500-L-10-AB
10	440 - 500	34.56 - 39.27	80	10	Polyethylene	Aqueous Buffer (AB)	MF-10-500-S-10-AB
10	0 - 120	0.00 - 9.42	80	5	Polyethylene	Aqueous Buffer (AB)	MF-10-120-L-5-AB
10	60 - 120	4.71 - 9.42	80	5	Polyethylene	Aqueous Buffer (AB)	MF-10-120-S-5-AB
10	140 - 260	11.00 - 20.42	80	5	Polyethylene	Aqueous Buffer (AB)	MF-10-260-L-5-AB
10	200 - 260	15.71 - 20.42	80	5	Polyethylene	Aqueous Buffer (AB)	MF-10-260-S-5-AB
10	380 - 500	29.85 - 39.27	80	5	Polyethylene	Aqueous Buffer (AB)	MF-10-500-L-5-AB
10	440 - 500	34.56 - 39.27	80	5	Polyethylene	Aqueous Buffer (AB)	MF-10-500-S-5-AB
15	0 - 120	0.00 - 21.21	66.67	10	Polyethylene	Aqueous Buffer (AB)	MF-15-120-L-10-AB
15	60 - 120	10.60 - 21.21	66.67	10	Polyethylene	Aqueous Buffer (AB)	MF-15-120-S-10-AB
15	140 - 260	24.74 - 45.95	66.67	10	Polyethylene	Aqueous Buffer (AB)	MF-15-260-L-10-AB
15	200 - 260	35.34 - 45.95	66.67	10	Polyethylene	Aqueous Buffer (AB)	MF-15-260-S-10-AB
15	380 - 500	67.15 - 88.36	66.67	10	Polyethylene	Aqueous Buffer (AB)	MF-15-500-L-10-AB
15	440 - 500	77.75 - 88.36	66.67	10	Polyethylene	Aqueous Buffer (AB)	MF-15-500-S-10-AB
15	0 - 120	0.00 - 21.21	66.67	5	Polyethylene	Aqueous Buffer (AB)	MF-15-120-L-5-AB
15	60 - 120	10.60 - 21.21	66.67	5	Polyethylene	Aqueous Buffer (AB)	MF-15-120-S-5-AB
15	140 - 260	24.74 - 45.95	66.67	5	Polyethylene	Aqueous Buffer (AB)	MF-15-260-L-5-AB
15	200 - 260	35.34 - 45.95	66.67	5	Polyethylene	Aqueous Buffer (AB)	MF-15-260-S-5-AB
15	380 - 500	67.15 - 88.36	66.67	5	Polyethylene	Aqueous Buffer (AB)	MF-15-500-L-5-AB
15	440 - 500	77.75 - 88.36	66.67	5	Polyethylene	Aqueous Buffer (AB)	MF-15-500-S-5-AB