

Chromatography Columns

MEGA[®]
improve your GC analysis

CUSTOM DEDICATED COLUMNS

GC-MS
columns

dex xeb
chiral columns

maga 2D[™]
columns

FAST-GC
solutions

MegaHT
High Temperature Columns

since 1980

GC products 2014



general purpose

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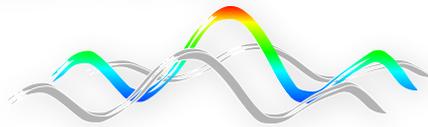
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COLUMNS

GC-MS
columns

dex xeb
chiral columns

mega^{2D}[™]
columns



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solutions

MegaHT
High Temperature Columns

general purpose

GC products
2014

since
1980



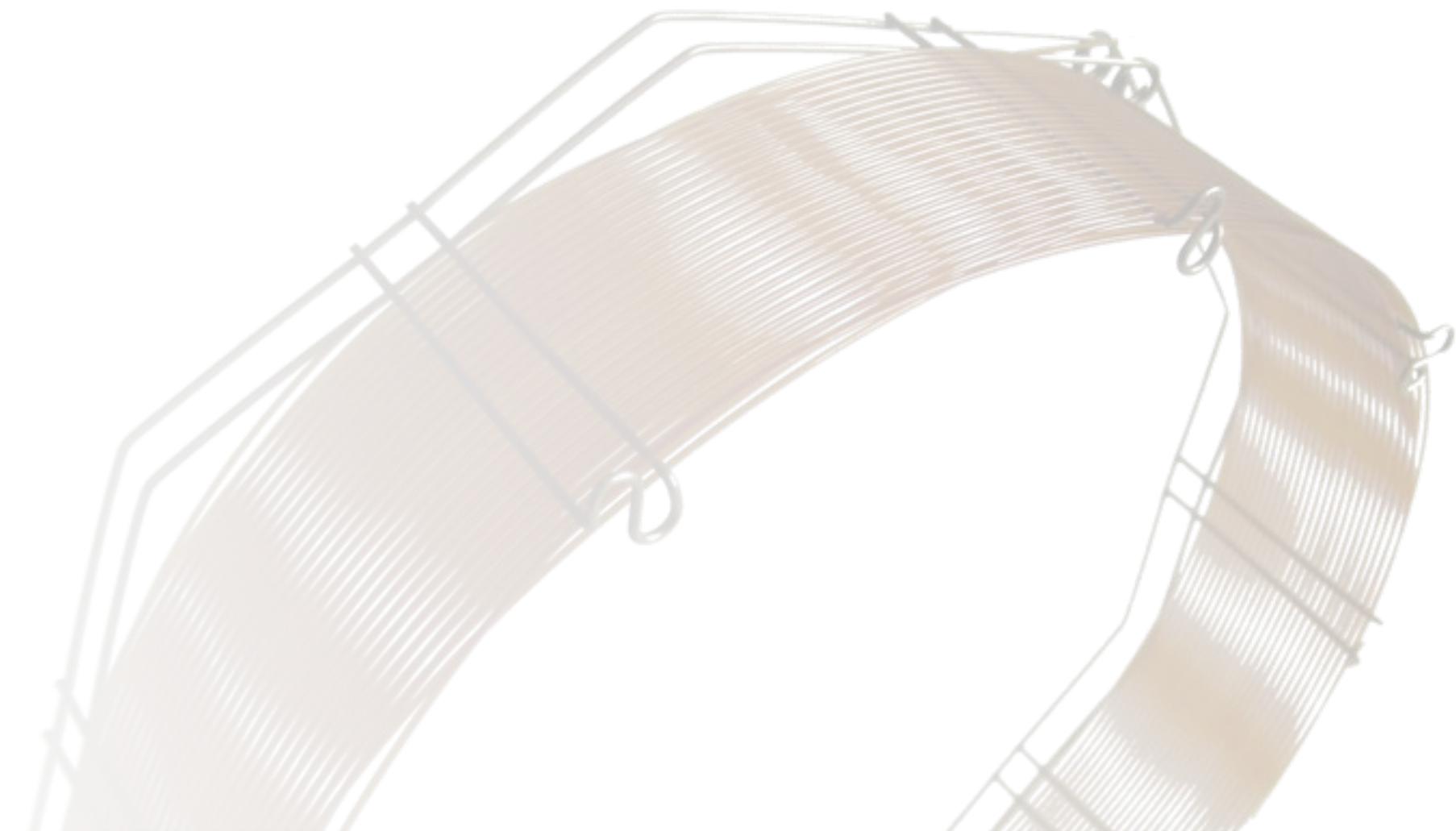
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Since 1980 we offer:

- the most complete range of stationary phases for Conventional-GC, FAST-GC, Wide Bore GC, Chiral-GC, GC-MS
- special and innovative products for Multidimensional-GC (including GCxGC), High Temperature GC and more
- unsurpassed Quality, Efficiency and Inertness, we produce and test each column one-by-one to assure a perfect column-to-column reproducibility
- custom products by request with no additional cost
- support and services for your GC analysis

our experience in Gas Chromatography at Your service

GC Columns Dimensions Available

FAST	I.D.	0.05 mm	0.075 mm	0.10 mm	0.15mm
	Length	from 2 to 5 m	from 2 to 8 m	from 2 to 15 m	from 2.5 to 30 m
	Film Thickness *	from 0.05 to 0.25 μm	from 0.05 to 0.50 μm	from 0.05 to 1.00 μm	from 0.05 to 1.40 μm

CONVENTIONAL	I.D.	0.18 mm	0.20 mm	0.25 mm	0.32mm
	Length	from 5 to 60 m	from 5 to 60 m	from 5 to 100 m	from 5 to 100 m
	Film Thickness *	from 0.05 to 1.50 μm	from 0.05 to 1.50 μm	from 0.05 to 3.00 μm	from 0.05 to 5.00 μm

WIDE BORE	I.D.	0.45 mm	0.53 mm
	Length	from 10 to 75 m	from 10 to 75 m
	Film Thickness *	up to 5.00 μm	up to 5.00 μm

Completely customize your product, selecting all combinations of sizes and also asking for out-of-catalog configurations. Since 1980 we develop ad-hoc solutions for your specific analytical problem. We are able to even tune the selectivity of the stationary phase to respond to particular exigences.

All our stationary phases are available for FAST, Conventional, Wide-Bore and Multidimensional-GC (including GCxGC solutions). Discover moreover our MEGA-DEX chiral columns, our MEGA-HT High Temperature columns and other unique and special products.

New Products Highlight



MEGA-WAX HT column, an unique **PEG stationary phase** able to reach up to **300°C** even in isothermal mode. Especially developed for FAST-GC and GCxGC use. The performances of the MEGA-WAX HT have appeared on LCGC Europe Journal with GCxGC application notes. Click here to go to the webpage that includes the MEGA-WAX HT free literature .



MEGA-5 MS Xil column, a new GC-MS silphenylene-based phase that assures **ultra-low bleeding and unsurpassed inertness and efficiency** for your GC-MS analysis. Click here to open and download free technical literature of the new MEGA-5 MS Xil column.



MEGA-2D single column, a revolutionary **unique tubing column coated with two in series different stationary phases** for GCxGC and MDGC applications. No connections are needed. Contact us to have more information and discover all the advantages of the MEGA-2D technology also applied to conventional-GC.



FAST Chiral MEGA-DEX columns line; today you can speed up your chiral GC separations with **the most complete line of FAST-GC chiral columns.** Contact us to have more info and application notes.

Stationary Phase	T max *	Equivalent to	EPA - USP - Methods **	Applications
MEGA-I 100% methyl polysiloxane	350°C	DB-I, HP-I, AT-I, ZB-I, 007-I, Rtx-I, BP-I, SPB-I, CP Sil 5 CB	EPA: 504.1, 505, 551, 606, 612, 8141A/B, etc.** USP: G1, G2, G9, G38	General purpose column. Solvent impurities, PCBs, simulated distillation, drugs, gases, natural gases, essential oils, semivolatiles, pesticides, phenols, etc.
MEGA-5 5% phenyl, 95% methyl polysiloxane	350°C	DB-5, HP-5, AT-5, ZB-5, 007-5, Rtx-5, BP-5, SPB-5, CP Sil 8 CB	EPA: 506, 611, 604, 607, 608, 8015, 8041, 8082, 8091, etc.** USP: G27, G36, G41	General purpose column. Solvent impurities, PCBs, hydrocarbons, essential oils, semivolatiles, pesticides, etc.
MEGA-SE52 5% phenyl, 95% methyl polysiloxane	350°C	SE52	USP: G27, G36, G41	General purpose column. Solvent impurities, PCBs, hydrocarbons, essential oils, semivolatiles, triglycerides, pesticides, poly-waxes, etc.
MEGA-SE54 5% phenyl, 1% vinyl, 94% methyl polysiloxane	350°C	SE54	-	General purpose column. Solvent impurities, PCBs, hydrocarbons, essential oils, semivolatiles, allergens, pesticides, etc.
MEGA-I701 14% cyanopropylphenyl, 86% methyl polysiloxane	280°C	DB-I701, HP-I701, AT-I701, ZB-I701, 007-I701, Rtx-I701, BP-I0, SPB-I701, CP Sil 19 CB	EPA: 513, 515.2, 552.2, 607, 619, 622, 8091, 8121, etc.** USP: G46	General purpose column. Residual solvents, PCBs, alcohols, oxygenates, pesticides, etc. Ideal as confirmation column and GCxGC use.
MEGA-I7 50% phenyl, 50% methyl polysiloxane	340°C	DB-I7, DB-608, HP-I7, AT-50, ZB-50, 007-I7, Rtx-I7, BPX-50, SPB-50, CP Sil 24 CB	EPA: 604, 608, 619, 8060, 8081 USP: G3, G17	General purpose column. Phthalate esters, herbicides, pharmaceuticals, etc. Ideal as confirmation column and GCxGC use.
MEGA-WAX polyethylene glycol (PEG)	250°C	DB-Wax, HP-Wax, InnoWax AT-Wax, ZB-Wax, 007-CW, Rtx-Wax, BP-20, CP Wax 52 CB	EPA: 602, 603, 619, 8015C USP 467 (OVIs), etc.** USP: G14, G15, G16, etc.	General purpose column. FAMEs, flavor compounds, essential oils, BTEX aromatics, solvents, alcohols, etc. Tune your Wax column polarity! Ask us for more info.
MEGA-I MS low bleeding 100% methyl polysiloxane	350°C	DB-I ms (UI), HP-I ms, ZB-I ms, Rtx-I ms, BPX-I, Equity-I, CP Sil 5 CB ms	EPA: 504.1, 505, 606, etc.** USP: G1, G2, G9, G38	General purpose column for GC-MS use. See MEGA-I phase.
MEGA-5 MS low bleeding 5% phenyl, 95% methyl polysiloxane	350°C	DB-5 ms (UI), HP-5 ms, AT-5 ms, ZB-5 ms, 007-5 ms, Rtx-5 ms, BPX-5, Equity-5	EPA: 513, 528, 552, 610, 613, 1625, 8100, 8141A/B, etc.** USP: G27, G36, G41	General purpose column for GC-MS use. See MEGA-5 phase.

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Stationary Phase	T max *	Equivalent to	EPA - USP - Methods **	Applications
MEGA-5 MS XiI low bleeding silphenylene based MS phase	350°C	DB-5 ms (UI), Rtx-5 ms Sil, SLB-5 ms new column	EPA: 515, 521, 529, 552, 604, 610, 625, 1613, 1625, etc.** USP: G27, G36, G41	General purpose column for GC-MS use. Dioxins and furans, herbicides, phthalate esters POCs, chlorinated acids, etc.
MEGA-35 MS low bleeding 35% phenyl, 65% methyl polysiloxane	340°C	DB-35 ms, BPX-35, BPX-608, MR2, Rtx-35 Sil ms	EPA: 507, 508, 552, 614, 615, 622, etc.** USP: G28, G32, G42	General purpose column for GC-MS use. See MEGA-35 phase.
MEGA-17 MS low bleeding 50% phenyl, 50% methyl polysiloxane	340°C	DB-17 ms, Rtx-17 Sil ms	EPA: 505, 610, 619, 614, 8040, 8041, etc.** USP: G3, G17	General purpose column for GC-MS use. See MEGA-17 phase.
MEGA-225 MS low bleeding 25% cyanopropyl, 25% phenyl, 50% methyl polysiloxane	260°C	unique column	EPA: 8095 USP: G7, G19	General purpose column for GC-MS use. See MEGA-225 phase.
MEGA-WAX MS low bleeding polyethylene glycol (PEG)	250°C	Stabilwax, ZB-Wax Plus, InnoWax, VF-Wax ms	EPA: 602, 603, 619, 8015C, 8121, etc.** USP: G14, G15, G16 etc.	General purpose column for GC-MS use. See MEGA-WAX phase.
MEGA-10 100% cyanopropyl polysiloxane	260°C	HP-88, AT-Silar, Silar 10 Rtx-2560, SP-2560 BPX-70, CP Sil 88	EPA: 613, 1613, 8290B USP: G5, G8, G48	High polarity column ideal for <i>cis/trans</i> FAMEs and dioxins isomers analysis.
MEGA-101 100% methyl polysiloxane	350°C	OV-101	USP: G1, G2, G9, G38	General purpose apolar column.
MEGA-13 13% phenyl, 87% methyl polysiloxane	340°C	CP Sil 13 CB	EPA: 601, 602, 624	General purpose column, ideal as confirmation column.
MEGA-20 20% phenyl, 80% methyl polysiloxane	340°C	AT-20, 007-7, Rtx-20, SPB-20	USP: G28, G32	General purpose column, ideal as confirmation column.

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MEGA-200 trifluoropropyl methyl polysiloxane	300°C	DB-200, DB-210, AT-210 007-210, Rtx-200, SP-2401, VF-200 ms	EPA: 551, 612, 625, 8095, etc.** USP: G6	Unique selectivity column. Freon fluorocarbons, ketones, alcohols, organophosphorus pesticides, etc.
MEGA-225 25% cyanopropyl, 25% phenyl, 50% methyl polysiloxane	260°C	DB-225, HP-225, AT-225, 007-225, Rtx-225, BP-225, CP Sil 43 CB	EPA: 8095 USP: G7, G19	Mid-to-high polarity phase. Carbohydrates, sterols, flavor compounds, etc.
MEGA-35 35% phenyl, 65% methyl polysiloxane	340°C	DB-35, HP-35, AT-35, ZB-35, 007-11, MR2 Rtx-35, SPB-35, SPB-608	EPA: 507, 508, 513, 551.1, 615, 622, etc.** USP: G28, G32, G42	General purpose column. Pesticides, PCBs, substituted polar compounds, phenols, etc. Ideal as confirmation column.
MEGA-50 50% cyanopropyl, 50% methyl polysiloxane	260°C	DB-23, Silar 5, Rtx-2330, SP-2330	USP: G8	Mid-to-high polarity phase. Carbohydrates, sterols, FAMES, flavor compounds, etc. Confirmation column.
MEGA-624 6% cyanopropylphenyl, 94% methyl polysiloxane	280°C	DB-624, HP-624, AT-624, ZB-624, 007-624, Rtx-624, Vocol, SPB-624, VF-624 ms	EPA: 501.3, 502.1, 502.2, 601, 624, 1624, 8020, 8021, etc.** USP: G43, 467 (OVIs)	General purpose column. Ideal for volatile organic pollutants, purgeable aromatics, purgeable hydrocarbons, VOCs, etc.
MEGA-ACID FFAP acid modified polyethylene glycol (PEG)	250°C	DB-FFAP, AT-1000, 007-FFAP, Stabilwax-DA, BP-21, SPB-1000 Nukol, CP Wax 58 CB	EPA: 8032 USP: G14, G15, G16, G25, G35, G39	General purpose column. Ideal for free acids, FAMES, BTEX aromatics, flavor compounds, alcohols, spirits, polar compounds, etc.
MEGA-ALC 1&2 proprietary phases	n.d.	DB-ALC 1&2, Rtx-BAC 1&2	-	Application-specific columns for blood alcohols testing.
MEGA-BASIC proprietary unique phase for basic compounds	n.d.	unique column	-	Application-specific column for basic compounds analysis (i.e. amines).
MEGA-BIODIESEL phases for biodiesel analysis	370°C (UNI EN ISO 14105)	-	UNI EN ISO 14105 (ASTM 6584), UNI EN ISO 14103	Application-specific columns for free and total glycerine (phase stable up to 370°C) and for FAMES in biodiesel analysis.

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Stationary Phase	T max *	Equivalent to	EPA - USP - Methods **	Applications
MEGA-DAI 1&2 proprietary unique phases for Direct Aqueous Injections	n.d.	unique columns	-	Application-specific columns for the introduction of aqueous samples, thus minimizing preparation.
MEGA-JXR 100% methyl polysiloxane	350°C	no equivalent on the market	USP: G1, G2, G9, G38	General purpose apolar column.
MEGA-LAP proprietary unique phase for Lipid Analysis	370°C	unique column	-	Application-specific column for lipids, sterols and triglycerides analysis.
MEGA-PAH unique phase for Polycyclic Aromatic Hydrocarbons	340°C	unique column	EPA: 610, 8100	Application-specific column for polycyclic aromatic hydrocarbons.
MEGA-PLUS copolymer polyethylene glycol + methyl polysiloxane	n.d.	Agilent DX columns series	EPA: 505	Discover new selectivities! Choose also between MEGA-PLUS 25 (25% PEG), MEGA-PLUS 75 (75% PEG)...and others! Contact us! We can customize this phase as you need!
MEGA-POF 1&2 proprietary phases for pesticides, herbicides and insecticides	n.d.	new columns MRI (MEGA-POF I)	EPA: 622	Application-specific columns developed for pesticides, herbicides, insecticides analysis etc.
MEGA-I PONA PDMS optimized for hydrocarbons analysis	350°C	DB-Petro, HP-Pona, Rtx-I Pona, Petrocol	-	Phase optimized for DHA (Detailed Hydrocarbons Analysis).
MEGA-PS255 1% vinyl, 99% methyl polysiloxane	350°C	no equivalent on the market	-	Phase that is extremely suitable for high film thickness columns to analyze solvents, alcohols, volatiles, etc.
MEGA-PS264 5.8% phenyl, 0.2% vinyl, 94% methyl polysiloxane	350°C	no equivalent on the market	-	Phase that is extremely suitable for high film thickness columns to analyze solvents, alcohols, volatiles, etc.

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Stationary Phase	T max *	Equivalent to	EPA - USP - Methods **	Applications
MEGA-SE30 100% methyl polysiloxane	350°C	SE30	EPA: 504.1, 505, 606, 8141A USP: G1, G2, G9, G38	General purpose apolar column.
MEGA-SOLVE 1&2 proprietary unique phases for complex solvents mix analysis	n.d.	unique columns TCEP (MEGA-SOLVE 2)	-	Application-specific columns developed for complex solvents mixtures analysis. MEGA-SOLVE 2 is ideal for aromatics and oxygenates in gasoline.
MEGA-TNT unique phase	n.d.	unique column	EPA: 8091, 8095	Application-specific column for explosives analysis, nitroaromatics, nitramines, nitrate esters.
MEGA-VOC 1&2 proprietary phases for Volatile Organic Compounds	n.d.	new columns	-	Application-specific columns for volatile organic compounds (OVIs), solvents and purgeable compounds.
MEGA-DEX DAC beta	230°C		chiral-enantiomeric separations	Diacetyl TBS beta cyclodextrin based column. See and download on our website the applications and the table with hundreds of chiral compounds separated on our MEGA-DEX columns.
MEGA-DEX DAC gamma	230°C		chiral-enantiomeric separations	Diacetyl TBS gamma cyclodextrin based column. See and download on our website the applications and the table with hundreds of chiral compounds separated on our MEGA-DEX columns.
MEGA-DEX DET beta	230°C		chiral-enantiomeric separations	Diethyl TBS beta cyclodextrin based column. See and download on our website the applications and the table with hundreds of chiral compounds separated on our MEGA-DEX columns.
MEGA-DEX DET gamma	230°C		chiral-enantiomeric separations	Diethyl TBS gamma cyclodextrin based column. See and download on our website the applications and the table with hundreds of chiral compounds separated on our MEGA-DEX columns.
MEGA-DEX DMP beta	230°C		chiral-enantiomeric separations	Dimethyl-pentyl TBS beta cyclodextrin based column. See and download on our website the applications and the table with hundreds of chiral compounds separated on our MEGA-DEX columns.

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Stationary Phase	T max *	Equivalent to	EPA - USP - Methods **	Applications
MEGA-DEX DMT beta	230°C		chiral-enantiomeric separations	Dimethyl TBS beta cyclodextrin based column. See and download on our website the applications and the table with hundreds of chiral compounds separated on our MEGA-DEX columns.
MEGA-I HT 100% methyl polysiloxane for high temperature	380°C	high temperature column DB-1 ht	-	High temperature general purpose column. See MEGA-I phase.
MEGA-17 HT high temperature 50% phenyl, 50% methyl polysiloxane	370°C	high temperature column DB-17 ht	-	High temperature general purpose column. See MEGA-17 phase.
MEGA-5 HT high temperature 5% phenyl, 95% methyl polysiloxane	380°C	high temperature column DB-5 ht	-	High temperature general purpose column. See MEGA-5 phase.
MEGA-SE54 HT high temperature 5% phenyl, 1% vinyl, 94% methyl polysiloxane	380°C	high temperature unique column	-	High temperature general purpose column. See MEGA-SE54 phase.
MEGA-WAX HT high temperature polyethyleneglycol (PEG)	300°C	high temperature unique column	-	High temperature unique PEG phase. Extend the temperature limits of your FAST-GC and GCxGC analysis while using a polar Wax phase!

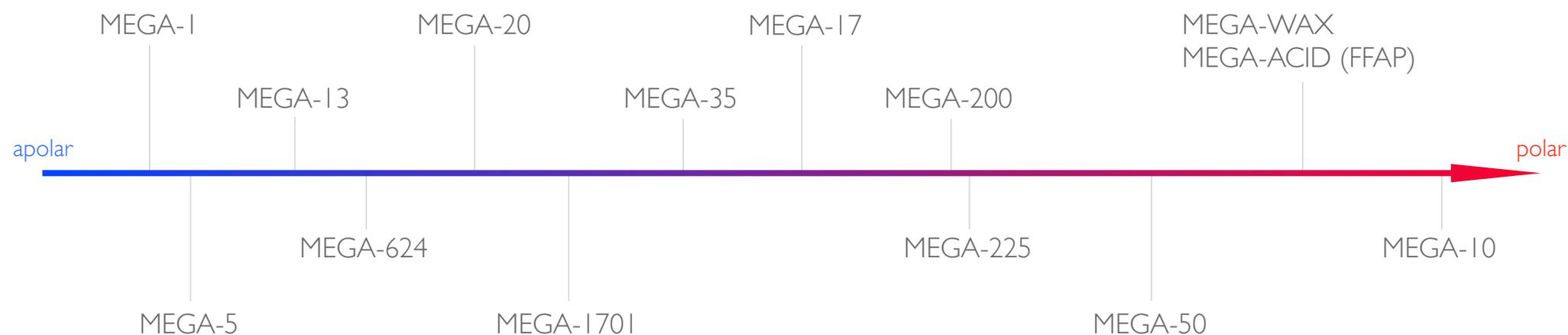
FAST-GC
solutions

All our stationary phases are available for FAST-GC. Contact us to have more details. You can download on mega.mi.it our free guide to FAST-GC with a tons of application notes!

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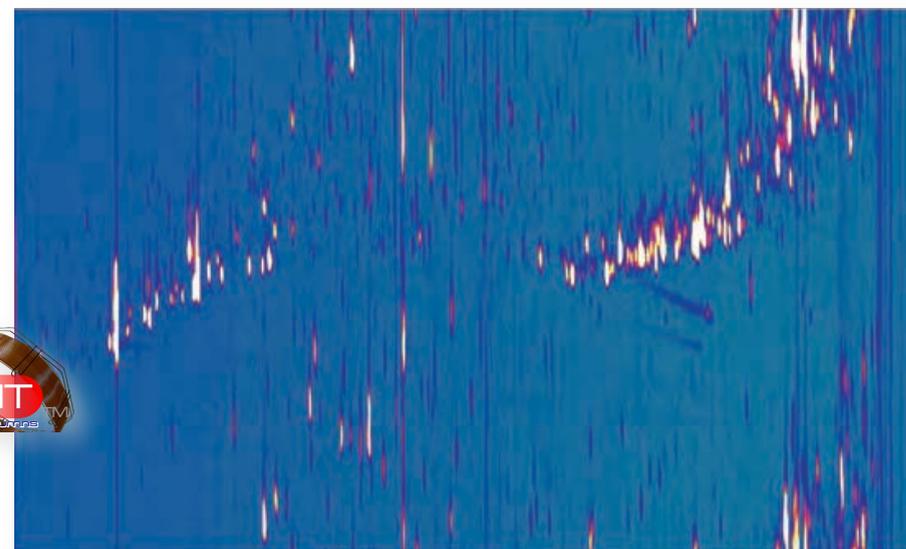


GCxGC Solutions

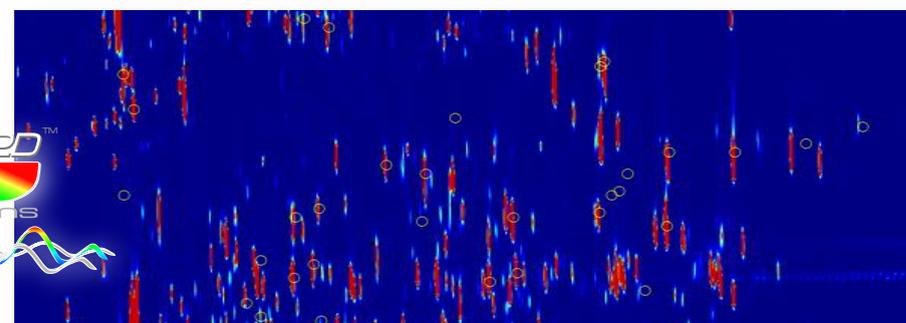
MEGA offers unique and innovative products for your GCxGC analysis.

We can provide completely custom GCxGC solutions, including ready-to-use kits.

Selectivity of the stationary phase plays a fundamental role in GC and this is even more important in GCxGC. Ask us to tune the selectivity of the stationary phase thus to explore new and unique solutions and to optimize the orthogonality and the efficiency of your GCxGC system.



Kunzea essential oil GCxGC analysis using MEGA-WAX HT on 2nd dimension. Courtesy of R. Shellie et al.



MEGA[®]
improve your GC analysis

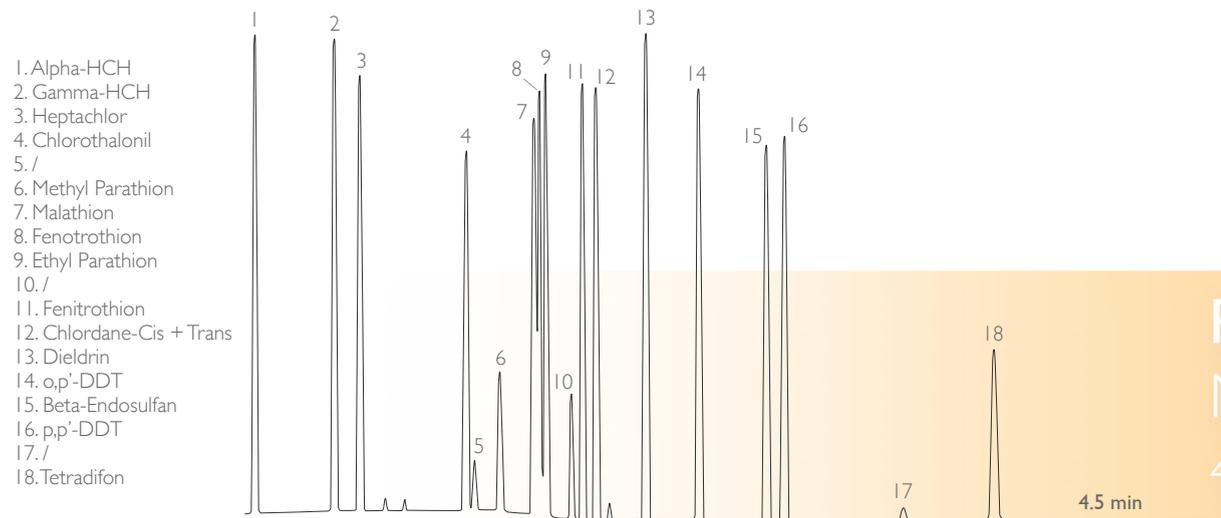
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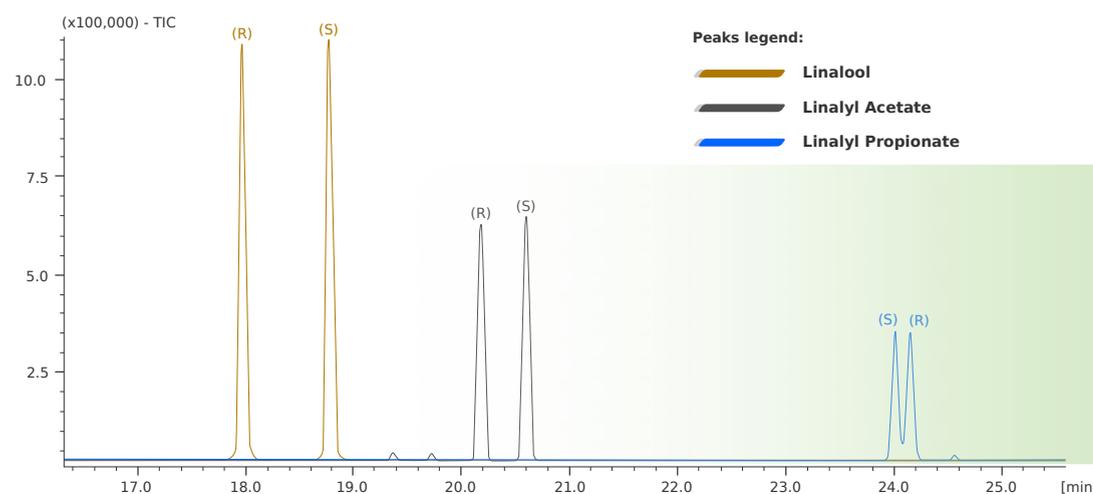
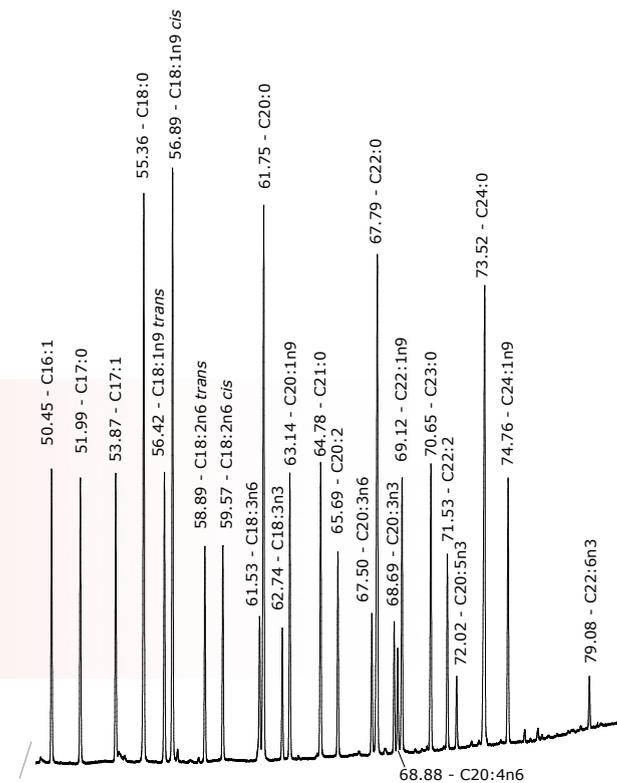


Pesticides mix on
MEGA-1701 FAST column
4.5 min analysis time only

Courtesy of University of Torino - Prof. C. Bicchi et al.

CUSTOM
DEDICATED
COLUMNS

cis/trans FAMES isomers
on MEGA-10 column



dex xeb
chiral columns

Linalool - Linalyl Acetate
enantiomeric separation
on MEGA-DEX DET Beta
chiral column

Courtesy of University of Torino - Prof. C. Bicchi et al.

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PRESS-FIT connectors

- easy to handle

- a simple pressure to
assure a perfect seal

- easy to install

MEGA Press-Fit connectors allow you to simply connect, with a tight seal, different columns or Retention Gaps together in many ways. Our Press-Fit connectors are custom-made to fit any tubing size and to ensure the minimal dead volume. Visit our website to download the free guide "Press-Fit Connectors Tips" and discover how easy is to use our Press-Fit connectors.

Press-Fit Union linear connectors, ideal to connect two columns or a Retention Gap to the analytical column.

Press-Fit "Y" three ways connectors, ideal to connect two analytical columns to a single injector port or split the exit of one column to a dual detector GC system. Many other configurations are possible using MEGA "Y" Press-Fit.

MEGA produces also personalized **Multiways Press-Fit connectors** for advanced analytical system configurations as MDGC and other custom settings.



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- easy to handle

- exceptional inertness

- easy to install

Retention Gaps deactivated for any purpose: our Retention Gaps are suitable for any analytical needs (use with polar solvents, apolar solvents and for general use) and available in any internal diameter size (0.05, 0.075, 0.10, 0.15, 0.18, 0.20, 0.25, 0.32, 0.45, and 0.53mm I.D.). Any length is available, also in pre-cut pieces individually packaged and ready to use.

MEGA Retention Gaps have an unsurpassed chemical inertness. Use our Retention Gaps for focusing the sample components when introducing a large (liquid) sample directly into the column and/or to protect the analytical column from contamination. Retention Gaps are also useful as connecting pipes to various part of systems with different configurations.

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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.

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.

Equation 1 The resolution equation defines variables affecting 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

Table I Empirically 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 μ m dp	2.2 μ m dp	3 μ m dp	5 μ m 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 μ m 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 μ m particle size only
Pinnacle II	110	180	2–13	Moderate retention Acidic Type A (not for RP analyses of bases) 3 and 5 μ m particle size only
Pinnacle DB	140	150	4–11	Moderate retention Base deactivated silica 1.9, 3 and 5 μ m 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.

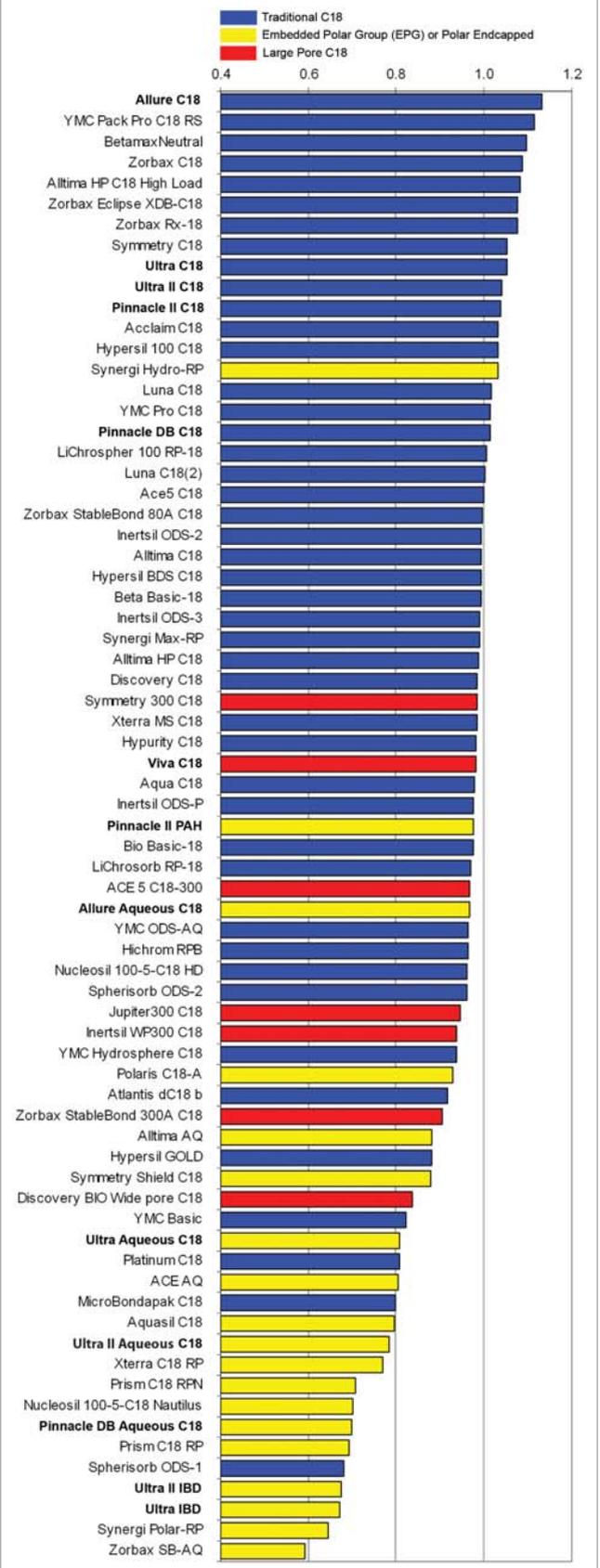
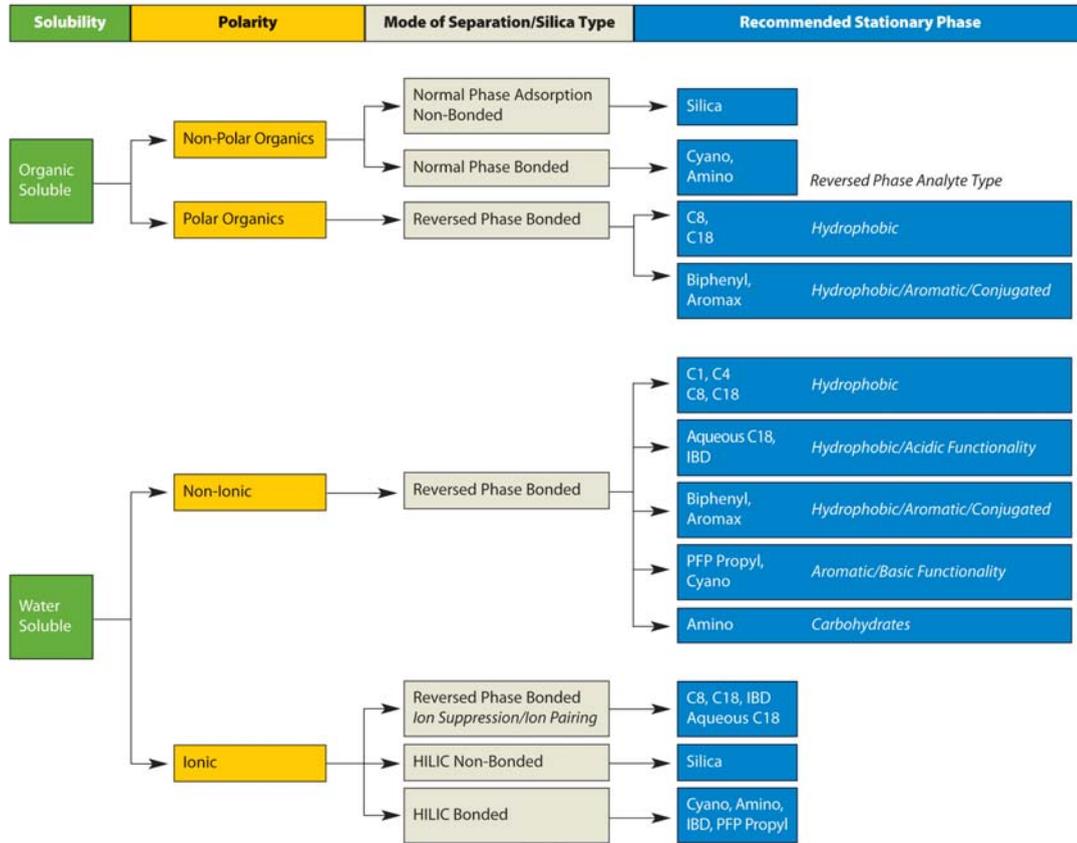


Figure 2 Decision tree for LC mode of separation and column selection.



Solvent Miscibility and Solubility

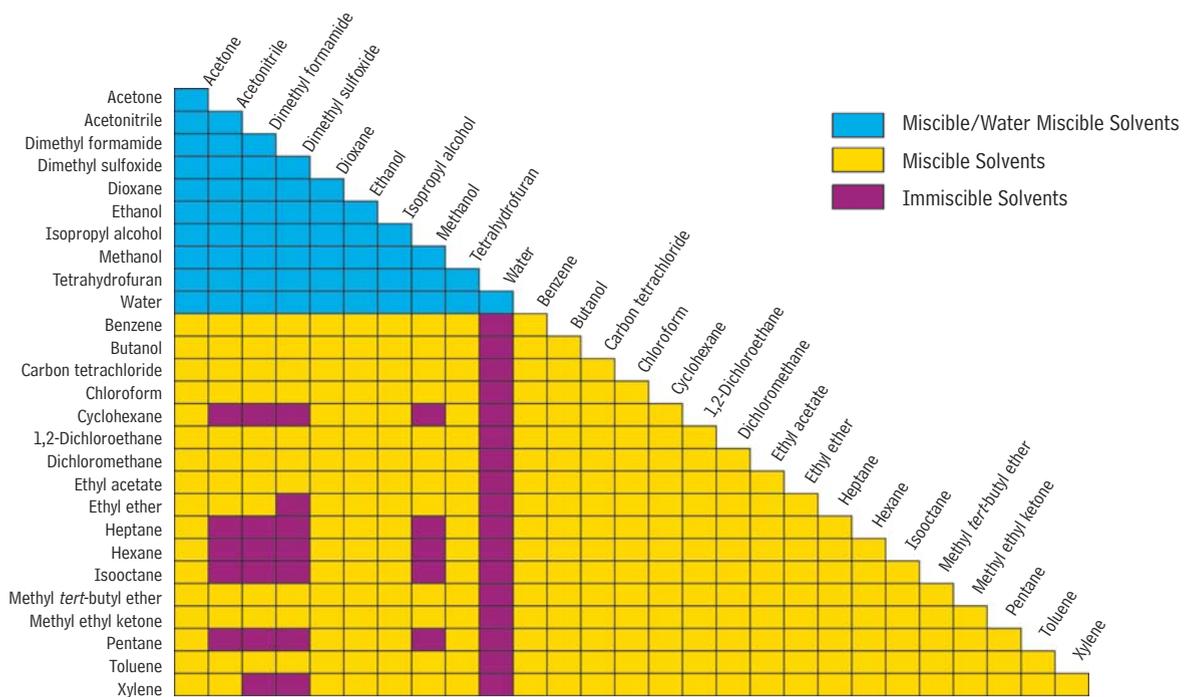
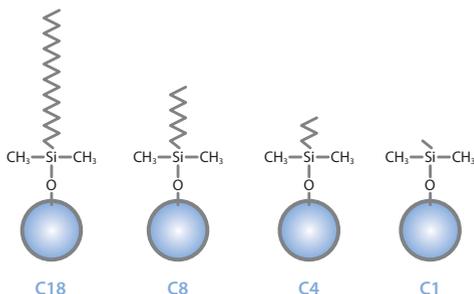


Figure 3 Restek stationary phases and recommended uses.

Alkyl Phases

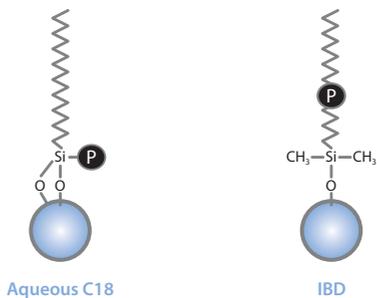
- General purpose reversed phase columns rely on dispersive interaction to separate molecules.
- Elution order is hydrophilic to hydrophobic; increased chain length increases retention.



Non Polar Retention

Modified Alkyl Phases

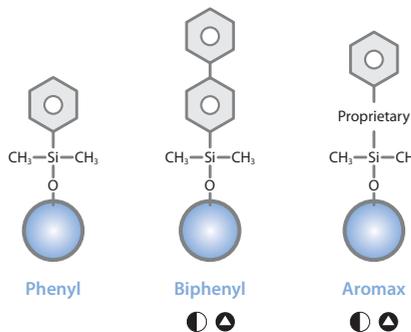
- Alkyl phases with modified bonding chemistry to increase polarity.
- Columns are compatible with 100% aqueous mobile phases.
- Rely on dispersive interaction with additional hydrogen bonding.
- Aqueous columns show balanced retention and are a great starting point for method development.
- Polar embedded 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.



Acidic Retention

Phenyl Phases

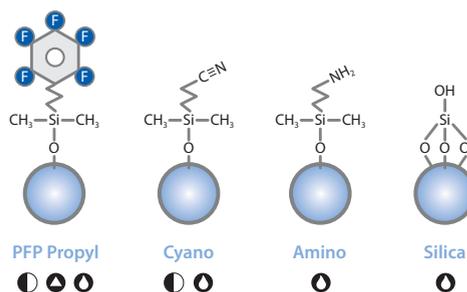
- Phenyl columns rely on dispersive and pi-pi ($\pi-\pi$) interactions.
- Enhanced retention and selectivity are seen with aromatic, conjugated molecules, and compounds containing electron withdrawing ring substituents.
- Biphenyl and Aromax columns show more interaction and greater aromatic retention and selectivity, relative to conventional phenyl and phenyl-hexyl phases.



Aromatic Retention

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/cm ²	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/cm ² =	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

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 PFR, 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 PFR, 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, Synchronapak C18, 208 TP C18	L1	190
Silica manufactured by Restek.	BioBasic 8, Zorbax 300 OSB C8, Synchronapak C8, 208 TP C8	L7	191
Silica manufactured by Restek.	BioBasic 4, Symmetry 300 C4, Jupiter 300 C4, Synchronapak 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. <i>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)</i>
L3	Porous silica particles, 5 to 10µm in diameter. <i>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)</i>
L7	Octylsilane chemically bonded to totally porous silica particles, 1.7 to 10µm in diameter. <i>Ultra II C8 (p. 158), Pinnacle DB C8 (p. 167), Pinnacle II C8 (p. 174), Ultra C8 (p. 183), Viva C8 (p. 191)</i>
L8	An essentially monomolecular layer of aminopropylsilane chemically bonded to totally porous silica gel support, 3 to 10µm in diameter. <i>Pinnacle II Amino (p. 176), Ultra Amino (p. 186)</i>
L10	Nitrile groups chemically bonded to porous silica particles, 3 to 10µm in diameter. <i>Pinnacle DB Cyano (p. 168), Pinnacle II Cyano (p. 175), Allure Basix (p. 178), Ultra Cyano (p. 185)</i>
L11	Phenyl groups chemically bonded to porous silica particles, 1.7 to 10µm in diameter. <i>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)</i>
L13	Trimethylsilane chemically bonded to porous silica particles, 3 to 10µm in diameter. <i>Ultra C1 (p. 185)</i>
L26	Butyl silane chemically bonded to totally porous silica particles, 3 to 10µm in diameter. <i>Ultra C4 (p.184), Viva C4 (p.191)</i>
L43	Pentafluorophenyl groups chemically bonded to silica particles by a propyl spacer, 5 to 10µm in diameter. <i>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)</i>
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. <i>Ultra II IBD (p. 162), Pinnacle DB IBD (p. 171), Ultra IBD (p. 184)</i>

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.

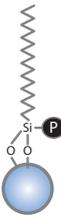
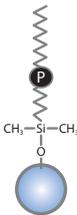
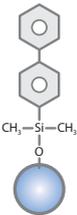
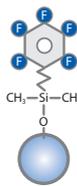
While numerous bonded phases are available for reversed phase chromatography, many are similar and offer only moderate changes in retention (e.g. C8 and C18), rather than significant differences in selectivity. Method development is less laborious and time-consuming when using a full range of column 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.

Equation 1 Selectivity drives resolution—USLC™ considers column selectivity during method development, resulting in fast, effective separations.

$$R = 1/4 \sqrt{N} \times (k'/k'+1) \times (\alpha-1/\alpha)$$

Efficiency Retention capacity Selectivity

Figure 1 Restek offers the widest range of unique column chemistries to aid in fast, easy method development.

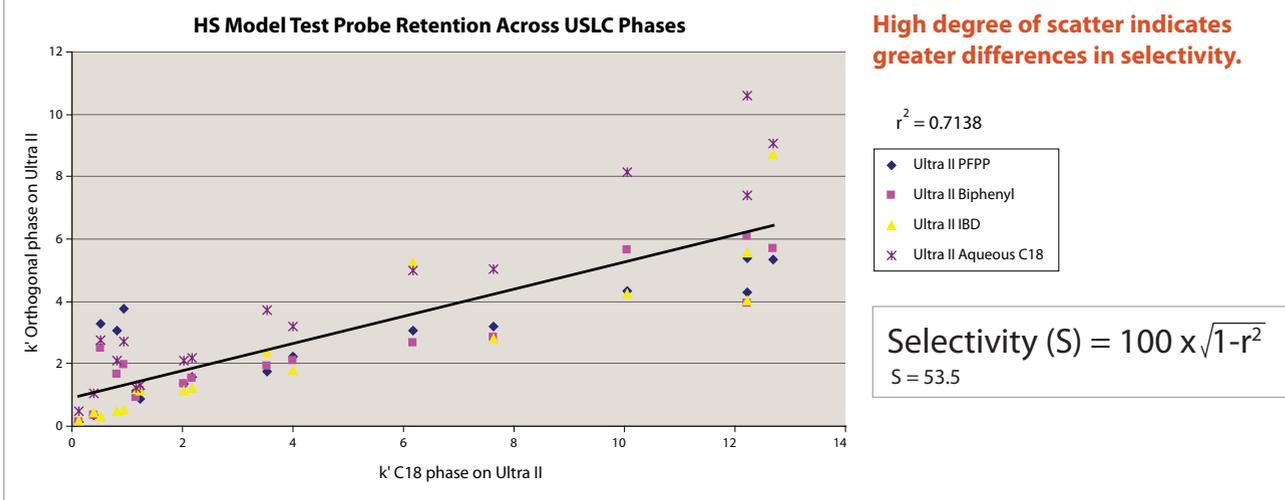
Restek phase (column class)	Aqueous C18 (alkyl)	IBD (polar embedded)	Biphenyl (phenyl)	PPF Propyl (fluorophenyl)
				
Ligand type	Proprietary polar modified and functionally bonded C18	Proprietary polar functional embedded alkyl	Unique Biphenyl	Proprietary end-capped pentafluorophenyl propyl
Characteristics and uses	<ul style="list-style-type: none"> C18 phase for balanced retention of multiple solute types. Compatible with up to 100% aqueous mobile phases. 	<ul style="list-style-type: none"> Enhanced retention of polar acids. Moderate retention of both acidic and basic solutes. 	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> 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.

Common Reversed Phase Column Type	Column Line						
	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



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!

- **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.

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.

Length	1.0mm ID		2.1mm ID		3.0mm ID		4.6mm ID	
	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 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	

Ultra II® C18 HPLC Prep Columns

Length	10mm ID		21.2mm ID		30mm ID		50mm ID	
	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	

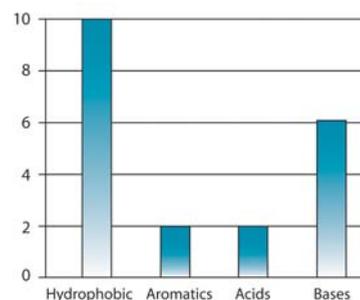
Available in 10µm particle size upon request.



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

Ultra II® C18 Retention Profile



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vitamins733

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

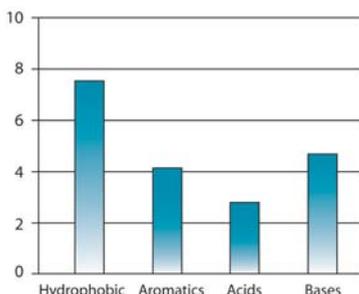
Bulk Packing Materials
See page 194.



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

Ultra II® C8 Retention Profile



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.

Length	1.0mm ID		2.1mm ID		3.0mm ID		4.6mm ID	
	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 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

Length	10mm ID		21.2mm ID		30mm ID		50mm ID	
	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.

Length	1.0mm ID		2.1mm ID		3.0mm ID		4.6mm ID	
	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	

Ultra II® Aqueous C18 Guard Cartridges

Guard Cartridges	3-pk.	3-pk.	2-pk.	2-pk.	price
	(10 x 2.1mm)	(10 x 4.0mm)	(20 x 2.1mm)	(20 x 4.0mm)	
Ultra II Aqueous C18 Guard Cartridge	960850212	960850210	960850222	960850220	\$145

Ultra II® Aqueous C18 HPLC Prep Columns

Length	10mm ID		21.2mm ID		30mm ID		50mm ID	
	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	

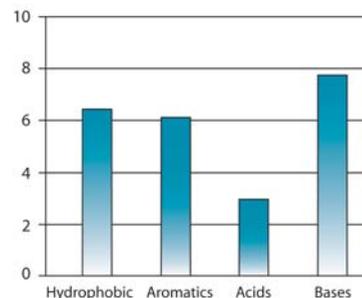
Available in 10µm particle size upon request.



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 Retention Profile



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herbicides	713
melatonin	729
organic acids	729
vitamins	734



Supersize without surprise!

ordering note

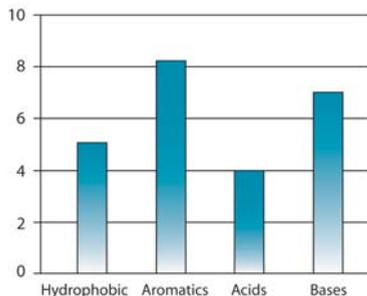
We strongly recommend ordering a semi-prep or prep column only after evaluating the desired separation on an equivalent analytical-scale column. Because we cannot re-use a column or the silica it contains once it has left our facility, we cannot accept returns of large-scale columns (except in cases of our error).



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

Ultra II® Biphenyl Retention Profile



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.

Length	1.0mm ID		2.1mm ID		3.0mm ID		4.6mm ID	
	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 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

Length	10mm ID		21.2mm ID		30mm ID		50mm ID	
	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.

	Page #
alcohol metabolites	.749
amphetamines	.750
antibiotics	.725
diuretics	.749
drug residues	.725
drugs of abuse	.748
NSAIDs	.723
pain management drugs in urine	.747
sulfa drugs	.725
THC & metabolites	.748

Chromatogram Search Tool

Search by compound name, synonym, CAS # or keyword

www.restek.com/chromatograms



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.

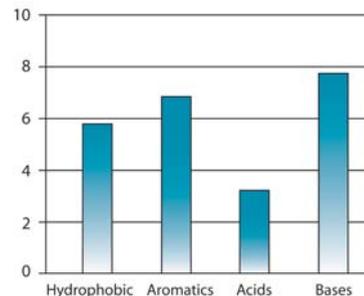
Length	1.0mm ID		2.1mm ID		3.0mm ID		4.6mm ID	
	cat.#	price	cat.#	price	cat.#	price	cat.#	price
1.9µm Columns								
30mm			9607232		960723E			
50mm			9607252		960725E			
100mm			9607212		960721E			
3µm Columns								
30mm	9607331		9607332		960733E		9607335	
50mm	9607351		9607352		960735E		9607355	
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	



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



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

Length	10mm ID		21.2mm ID		30mm ID		50mm ID	
	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.



	Page #
explosives	711
famotidine and USP impurities	736
potential genotoxic impurities	737
vitamins	735

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.



ChromaBLOGraphy

Topical and timely insights from top chromatographers.

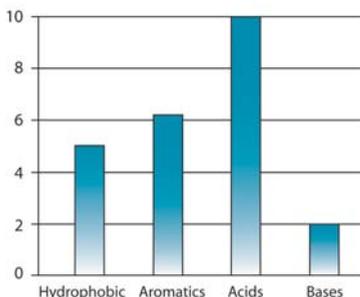
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Physical Characteristics:

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



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.

Length	1.0mm ID		2.1mm ID		3.0mm ID		4.6mm ID	
	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.	3-pk.	2-pk.	2-pk.	price
	(10 x 2.1mm)	(10 x 4.0mm)	(20 x 2.1mm)	(20 x 4.0mm)	
Ultra II IBD Guard Cartridge	960550212	960550210	960550222	960550220	\$145

Ultra II® IBD HPLC Prep Columns

Length	10mm ID		21.2mm ID		30mm ID		50mm ID	
	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.

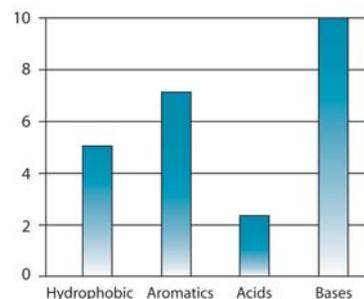
Length	1.0mm ID		2.1mm ID		3.0mm ID		4.6mm ID	
	cat.#	price	cat.#	price	cat.#	price	cat.#	price
1.9µm Columns								
30mm			9606232		960623E			
50mm			9606252		960625E			
100mm			9606212		960621E			
3µm Columns								
30mm	9606331		9606332		960633E		9606335	
50mm	9606351		9606352		960635E		9606355	
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	



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

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

Length	10mm ID		21.2mm ID		30mm ID		50mm ID	
	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.





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

Ultra II® Silica Columns (USP L3)

Chromatographic Properties:

High surface area. Type B silica packing.

Length	1.0mm ID		2.1mm ID		3.0mm ID		4.6mm ID	
	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

Length	10mm ID		21.2mm ID		30mm ID		50mm ID	
	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.

Length	1.0mm ID		2.1mm ID		3.0mm ID		4.6mm ID	
	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	

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

Length	10mm ID		21.2mm ID		30mm ID		50mm ID	
	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).

Length	4.6mm ID	
	cat.#	price
5µm Column		
150mm	9612565	



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



	Page #
food contaminants719
pesticides (carbamates)719

Chromatogram Search Tool

Search by compound name, synonym,
CAS # or keyword

www.restek.com/chromatograms



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.



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



vanilla bean extract727
xanthines743

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.

Length	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
	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

Length	10mm ID		21.2mm ID		30mm ID		50mm ID	
	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.



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

Length	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
	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
	cat.#	price	cat.#	price	cat.#	price	cat.#	price	
Pinnacle DB C8 Guard Cartridge	941350212		941350210		941350222		941350220		\$148

Pinnacle® DB C8 HPLC Prep Columns

Length	10mm ID		21.2mm ID		30mm ID		50mm ID	
	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	

ChromaBLOGraphy

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Anthony Hahn, 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





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



also
available

**Bulk Packing
Materials**
See page 194.



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

Pinnacle® DB Cyano Columns (USP L10)

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.

Length	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
	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	

Pinnacle® DB Cyano Guard Cartridges

Guard Cartridges	3-pk.	3-pk.	2-pk.	2-pk.	price
	(10 x 2.1mm)	(10 x 4.0mm)	(20 x 2.1mm)	(20 x 4.0mm)	
Pinnacle DB Cyano Guard Cartridge	941650212	941650210	941650222	941650220	

Pinnacle® DB Cyano HPLC Prep Columns

Length	10mm ID		21.2mm ID		30mm ID		50mm ID	
	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)

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.

Length	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
	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.	3-pk.	2-pk.	2-pk.	price
	(10 x 2.1mm)	(10 x 4.0mm)	(20 x 2.1mm)	(20 x 4.0mm)	
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.



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

Length	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
	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.	3-pk.	2-pk.	2-pk.	price
	(10 x 2.1mm)	(10 x 4.0mm)	(20 x 2.1mm)	(20 x 4.0mm)	
Pinnacle DB PFP Propyl Guard Cartridge	941950212	941950210	941950222	941950220	

Pinnacle® DB PFP Propyl HPLC Prep Columns

Length	10mm ID		21.2mm ID		30mm ID		50mm ID	
	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	

Chromatogram Search Tool

Search by compound name, synonym,
CAS # or keyword

www.restek.com/chromatograms





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



	Page #
drug residues	.725
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.

Length	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
	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.	3-pk.	2-pk.	2-pk.	price
	(10 x 2.1mm)	(10 x 4.0mm)	(20 x 2.1mm)	(20 x 4.0mm)	
Pinnacle DB Biphenyl Guard Cartridge	940950212	940950210	940950222	940950220	\$148

Pinnacle® DB Biphenyl HPLC Prep Columns

Length	10mm ID		21.2mm ID		30mm ID		50mm ID	
	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.

Length	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
	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).

Pinnacle® DB Aqueous C18 Guard Cartridges

Guard Cartridges	3-pk.	3-pk.	2-pk.	2-pk.	price
	(10 x 2.1mm)	(10 x 4.0mm)	(20 x 2.1mm)	(20 x 4.0mm)	
Pinnacle DB Aqueous C18 Guard Cartridge	941850212	941850210	941850222	941850220	

Pinnacle® DB Aqueous C18 HPLC Prep Columns

Length	10mm ID		21.2mm ID		30mm ID		50mm ID	
	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.

Length	2.1mm ID	
	cat.#	price
1.9µm Columns		
30mm		9425232
50mm		9425252
100mm		9425212

Pinnacle® DB IBD HPLC Prep Columns

Length	10mm ID		21.2mm ID		30mm ID		50mm ID	
	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	



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



food contaminants720, 722
pesticides720, 722



Physical Characteristics:

particle size: 1.9µm
pore size: 140Å
endcap: yes
pH range: 2.5 to 8
temperature limit: 80°C



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.

Length	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
	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.	3-pk.	2-pk.	2-pk.	price
	(10 x 2.1mm)	(10 x 4.0mm)	(20 x 2.1mm)	(20 x 4.0mm)	
Pinnacle DB Silica Guard Cartridge	941050212	941050210	941050222	941050220	

Pinnacle® DB Silica HPLC Prep Columns

Length	10mm ID		21.2mm ID		30mm ID		50mm ID	
	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	

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.

Length	2.1mm ID	
	cat.#	price
1.9µm Columns		
30mm		9470232
50mm		9470252
100mm		9470212



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 hydrocarbons718

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.

Length	1.0mm ID		2.1mm ID		3.2mm ID		4.0mm ID		4.6mm ID	
	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).

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

Length	10mm ID		21.2mm ID		30mm ID		50mm ID	
	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	



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



	Page #
allicin	730
capsaicinoids	728
morphine sulfate	738
phenolic antioxidants	727, 730

Chromatogram Search Tool

Search by compound name, synonym, CAS # or keyword

www.restek.com/chromatograms





Physical Characteristics:

particle size: 4µm, spherical
pore size: 110Å
endcap: fully endcapped
pH range: 2.5 to 8
temperature limit: 80°C



polycyclic aromatic hydrocarbonsPage #

polycyclic aromatic hydrocarbons717



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 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.

Length	2.1mm ID		3.2mm ID		4.6mm ID	
	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	

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.

Length	1.0mm ID		2.1mm ID		3.2mm ID		4.0mm ID		4.6mm ID	
	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

Length	10mm ID		21.2mm ID		30mm ID		50mm ID	
	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.

Length	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
	cat.#	price	cat.#	price	cat.#	price	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).

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		21.2mm ID		30mm ID		50mm ID	
	cat.#	price	cat.#	price	cat.#	price	cat.#	price
5µm Columns								
50mm	9216557		9216558		9216559		9216550	
100mm	9216517		9216518		9216519		9216510	
150mm	9216567		9216568		9216569		9216560	
250mm	9216577		9216578		9216579		9216570	

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.

Length	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
	cat.#	price	cat.#	price	cat.#	price	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	



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



.....Page #
piperine728



also
available

**Bulk Packing
Materials**
See page 194.



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



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



	Page #
lactulose concentrate	.743
sugars	.727

Pinnacle® II Amino Columns (USP L8)

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.

Length	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
	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)

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.

Length	4.6mm ID 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	



Physical Characteristics:

particle size: 5µm, spherical
pore size: 110Å
endcap: yes
pH range: 2.5 to 8
temperature limit: 80°C

ChromaBLOGraphy

Topical and timely insights from top chromatographers.

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Pinnacle® II Silica Columns (USP L3)

Chromatographic Properties:

Good general purpose packing for normal phase separations. Moderate surface area. Replaces Hypersil® and Pinnacle® Silica.

Length	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
	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).



Physical Characteristics:

particle size: 3µm or 5µm, spherical
pore size: 110Å
endcap: no
pH range: 2.5 to 8
temperature limit: 80°C



	Page #
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

Length	10mm ID		21.2mm ID		30mm ID		50mm ID	
	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.





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



.....Page #
herbicides712
pesticides716

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)

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.

Length	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
	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

Length	10mm ID		21.2mm ID		30mm ID		50mm ID	
	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	

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



.....Page #
herbicides714

Allure® Basix Columns (USP L10)

Chromatographic Properties:

Highly retentive propyl cyano phase. Excellent choice for basic compounds and for analytes containing amine group functionality.

Length	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
	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

Length	10mm ID		21.2mm ID		30mm ID		50mm ID	
	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.

Length	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
	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
	cat.#	price	cat.#	price	cat.#	price	cat.#	price	
Allure PFP Propyl Guard Cartridge	916950212		916950210		916950222		916950220		

Allure® PFP Propyl HPLC Prep Columns

Length	10mm ID		21.2mm ID		30mm ID		50mm ID	
	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	

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.

Length	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
	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
	cat.#	price	cat.#	price	cat.#	price	cat.#	price	
Allure Aqueous C18 Guard Cartridge	916850212		916850210		916850222		916850220		

Physical Characteristics:

particle size: 5 μ m, spherical
pore size: 60Å
carbon load: 17%
endcap: fully endcapped
pH range: 2.5 to 8
temperature limit: 80°C



	Page #
antibiotics	.723
benzodiazepines	.751
catecholamines	.745
cocaine, ecgonine methyl ester	.750
nucleic acid bases	.744
opiates	.748

Physical Characteristics:

particle size: 5 μ m spherical
pore size: 60Å
endcap: no
pH range: 2.5 to 8
temperature limit: 80°C

Chromatogram Search Tool

Search by compound name, synonym, CAS # or keyword

www.restek.com/chromatograms





Physical Characteristics:

particle size: 5µm, spherical
pore size: 60Å
carbon load: 23%
endcap: yes
pH range: 2.5 to 8
temperature limit: 80°C



	Page #
antibiotics	740
corticosteroids	741
steroids	742

Allure® Biphenyl Columns (USP L11)

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.

Length	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
	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.	3-pk.	2-pk.	2-pk.	price
	(10 x 2.1mm)	(10 x 4.0mm)	(20 x 2.1mm)	(20 x 4.0mm)	
Allure Biphenyl Guard Cartridge	916650212	916650210	916650222	916650220	\$148

Allure® Biphenyl HPLC Prep Columns

Length	10mm ID		21.2mm ID		30mm ID		50mm ID	
	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	

Physical Characteristics:

particle size: 5µm, spherical
pore size: 60Å
endcap: no
pH range: 2.5 to 8
temperature limit: 80°C



	Page #
fruit juice acids	531

Allure® Organic Acids Columns

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.

Length	3.2mm ID		4.6mm ID	
	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.	3-pk.	2-pk.	2-pk.	price
	(10 x 2.1mm)	(10 x 4.0mm)	(20 x 2.1mm)	(20 x 4.0mm)	
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.

Length	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
	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
	cat.#	price	cat.#	price	cat.#	price	cat.#	price	
Allure Silica Guard Cartridge	916050212		916050210		916050222		916050220		

Allure® Silica HPLC Prep Columns

Length	10mm ID		21.2mm ID		30mm ID		50mm ID	
	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.

Length	3.2mm ID		4.6mm ID	
	cat.#	price	cat.#	price
5µm Columns with Trident Integral Inlet Fittings				
200mm	9159523-700	\$601	9159525-700	

Allure® AK Guard Cartridge

Guard Cartridges	3-pk. (10 x 4.0mm)		price
	cat.#	price	
Allure AK Guard Cartridge	915950210		

Physical Characteristics:

particle size: 5µm, spherical
pore size: 60Å
endcap: no
pH range: 2.5 to 8
temperature limit: 80°C

Physical Characteristics:

particle size: 5µm
pore size: 60Å
endcap: yes
pH range: 2.5 to 8
temperature limit: 80°C



.....	Page #
carbonyls	710

Carbonyls by CARB Method 1004 on an Allure® AK column.

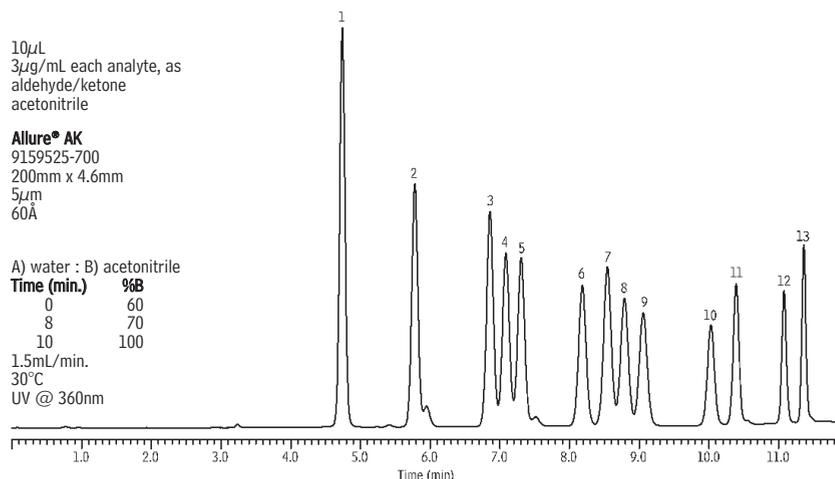
Sample:
Inj.: 10µL
Conc.: 3µg/mL each analyte, as aldehyde/ketone
Sample diluent: acetonitrile

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



Peak	Ret. Time (min.)
DNPH derivatives of:	
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



	Page #
acetaminophen, narcotic analgesics	738
aldehydes, ketones	710
beclomethasone	739
corticosteroids	741
drug residues	724
herbicides	712
hydrocodone bitartrate, acetaminophen	743
nitrofurantol metabolites	724
vitamins (fat soluble)	732

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.

Length	1.0mm ID		2.1mm ID		3.2mm ID		4.0mm ID		4.6mm ID		
	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

Length	10mm ID		21.2mm ID		30mm ID		50mm ID	
	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	

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.

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.

Length	1.0mm ID		2.1mm ID		3.2mm ID		4.0mm ID		4.6mm ID	
	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

Length	10mm ID		21.2mm ID		30mm ID		50mm ID	
	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	

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.

Length	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
	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

Length	10mm ID		21.2mm ID		30mm ID		50mm ID	
	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: 12%
endcap: fully endcapped
pH range: 2.5 to 8
temperature limit: 80°C



	Page #
explosives	711
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.

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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amino acids (aromatics)	745
analgesics	737
carboxylic acids	726
food contaminants	721, 722
herbicides	714
pesticides	721
phenethyl glucosinolate	730
sudan dyes	722
vitamins	731



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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antiarrhythmics	.739
antibiotics	.740, 741
diflubenzuron (pesticide)	.716
glyburide	.741
nucleosides, nucleotides, & nucleic acid bases	.744
vitamins	.732

Ultra 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 a high level of base deactivation, while reducing or eliminating the need for mobile phase additives.

Length	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
	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

Length	10mm ID		21.2mm ID		30mm ID		50mm ID	
	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)

Chromatographic Properties:

Exceptionally stable C4 packing, with high bonding coverage and base deactivation. Less retention than C18 or C8 phases.

Length	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
	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	

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

ChromaBLOGraphy

Topical and timely insights from top chromatographers.

Visit us at blog.restek.com

Ultra C1 Columns (USP L13)

Chromatographic Properties:

Exceptionally stable C1 phase. Least retentive reversed phase hydrocarbon packing.

Length	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
	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
	cat.#	price	cat.#	price	cat.#	price	cat.#	price	
Ultra C1 Guard Cartridge	910150212		910150210		910150222		910150220		

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.

Length	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
	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
	cat.#	price	cat.#	price	cat.#	price	cat.#	price	
Ultra Cyano Guard Cartridge	910650212		910650210		910650222		910650220		\$148

Ultra Cyano HPLC Prep Columns

Length	10mm ID		21.2mm ID		30mm ID		50mm ID	
	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	

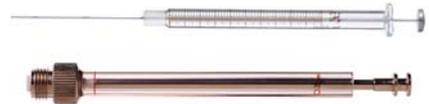
Physical Characteristics:

particle size: 3µm or 5µm, spherical
pore size: 100Å
carbon load: 5%
pH range: 2.5 to 8
temperature limit: 80°C

also available

HPLC Syringes

See pages 346-349.



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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antiarrhythmics739



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).



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



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guaifenesin, codeine	743

Ultra Phenyl Columns (USP L11)

Chromatographic Properties:

High-purity, highly retentive, base-deactivated phase with alternative selectivity to straight chain hydrocarbon phases, especially for aromatic analytes.

Length	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
	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

Length	10mm ID		21.2mm ID		30mm ID		50mm ID	
	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	

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



also
available

**Bulk Packing
Materials**
See page 194.

Ultra Amino Columns (USP L8)

Chromatographic Properties:

Recommended for normal phase analyses of mono- and disaccharides, or similar compounds.

Length	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
	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	

Ultra PFP Columns (USP L43)

Chromatographic Properties:

A pentafluorophenyl phase. Unique selectivity for compounds containing organohalogens or other basic functional groups.

Length	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
	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).

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

Length	10mm ID		21.2mm ID		30mm ID		50mm ID	
	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	

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



.....	Page #
purines, pyrimidines	745



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



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



.....Page #
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.

Length	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
	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
	cat.#	price	cat.#	price	cat.#	price	cat.#	price	
Ultra Silica Guard Cartridge	910050212		910050210		910050222		910050220		

Ultra Silica HPLC Prep Columns

Length	10mm ID		21.2mm ID		30mm ID		50mm ID	
	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.

Length	1.0mm ID		2.1mm ID		3.2mm ID		4.0mm ID		4.6mm ID	
	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
	cat.#	price	cat.#	price	cat.#	price	cat.#	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
5µm Column	cat.# price
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 **exclusive!**

Physical Characteristics:

particle size: 5µm, spherical
pore size: 100Å
pH range: 2.5 to 8
temperature limit: 80°C



.....Page #
paraquat, diquat715

free literature



Simple, Sensitive HPLC/UV Analysis for Paraquat and Diquat

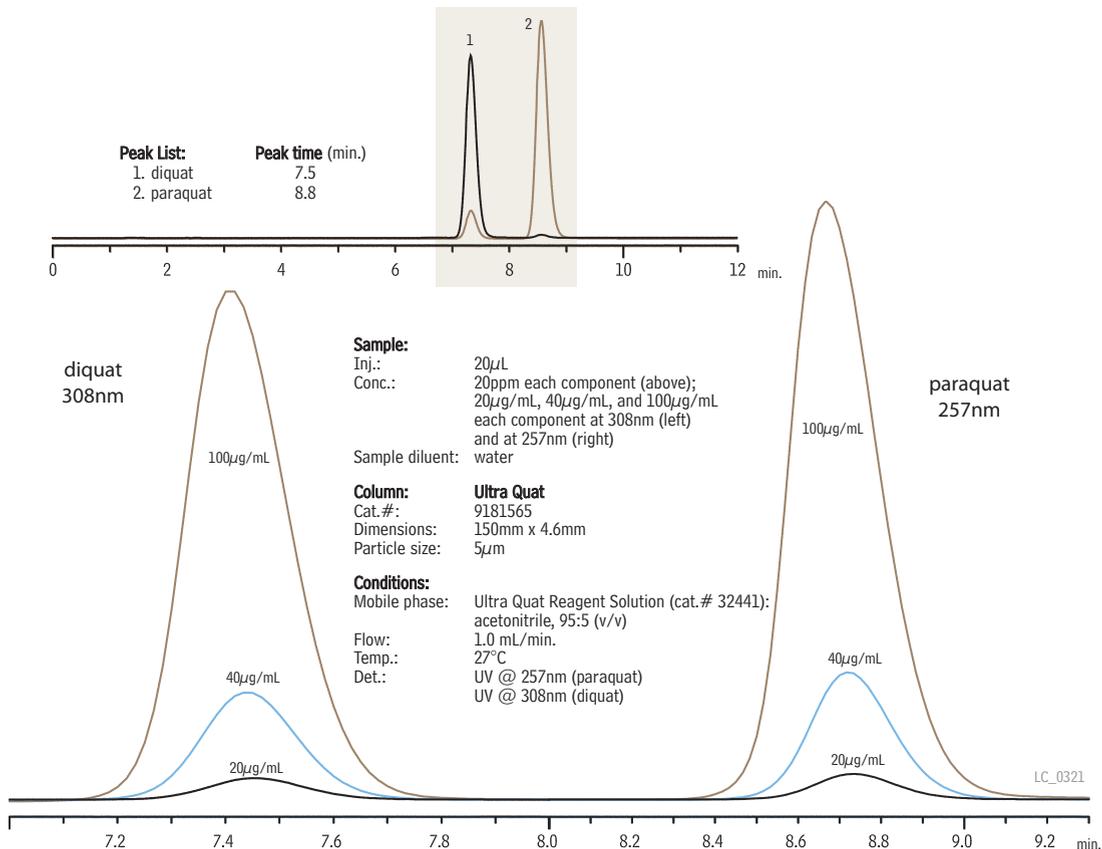
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www.restek.com

lit. cat.# 580006

restek **innovation!**

An Ultra Quat column and Ultra Quat Reagent Solution eliminate the need for ion pairing reagents in paraquat/diquat analysis.

Consistent resolution, retention times, and peak symmetry for paraquat and diquat on an Ultra Quat column.



Australian Distributors
Importers & Manufacturers
www.chromtech.net.au



www.restek.com 189

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.

**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



	Page #
oxytocin746
peptides745
proteins746

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.

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.

Length	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
	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

Length	10mm ID		21.2mm ID		30mm ID		50mm ID	
	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.

Length	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
	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

Length	10mm ID		21.2mm ID		30mm ID		50mm ID	
	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	

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.

Length	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
	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

Length	10mm ID		21.2mm ID		30mm ID		50mm ID	
	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	



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.

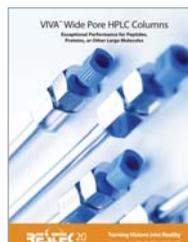


Physical Characteristics:

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

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.

Length	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
	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	

also available

3µm particles are available for all Viva phases—please inquire.

Viva Biphenyl Guard Cartridges

Guard Cartridges	3-pk.	3-pk.	2-pk.	2-pk.	price
	(10 x 2.1mm)	(10 x 4.0mm)	(20 x 2.1mm)	(20 x 4.0mm)	
Viva Biphenyl Guard Cartridge	951650212	951650210	951650222	951650220	

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.

Length	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
	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.	3-pk.	2-pk.	2-pk.	price
	(10 x 2.1mm)	(10 x 4.0mm)	(20 x 2.1mm)	(20 x 4.0mm)	
Viva PFP Propyl Guard Cartridge	951950212	951950210	951950222	951950220	

also available**Looking for HPLC syringes?**

See pages 346-349.

**Physical Characteristics:**

particle size: 5µm, spherical
 pore size: 300Å
 carbon load: 5%
 endcap: yes
 pH range: 2.5 to 8
 temperature limit: 80°C

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.

Length	1.0mm ID		2.1mm ID		3.2mm ID		4.6mm ID	
	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
	cat.#	price	cat.#	price	cat.#	price	cat.#	price	
Viva Silica Guard Cartridge	951050212		951050210		951050222		951050220		



Physical Characteristics:

particle size: 5µm, spherical
pore size: 300Å
pH range: 2.5 to 8
temperature limit: 80°C



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.



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				

also available

**Restek Pack in a Box Kit:
HPLC Column Packing System**
See page 351.



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				

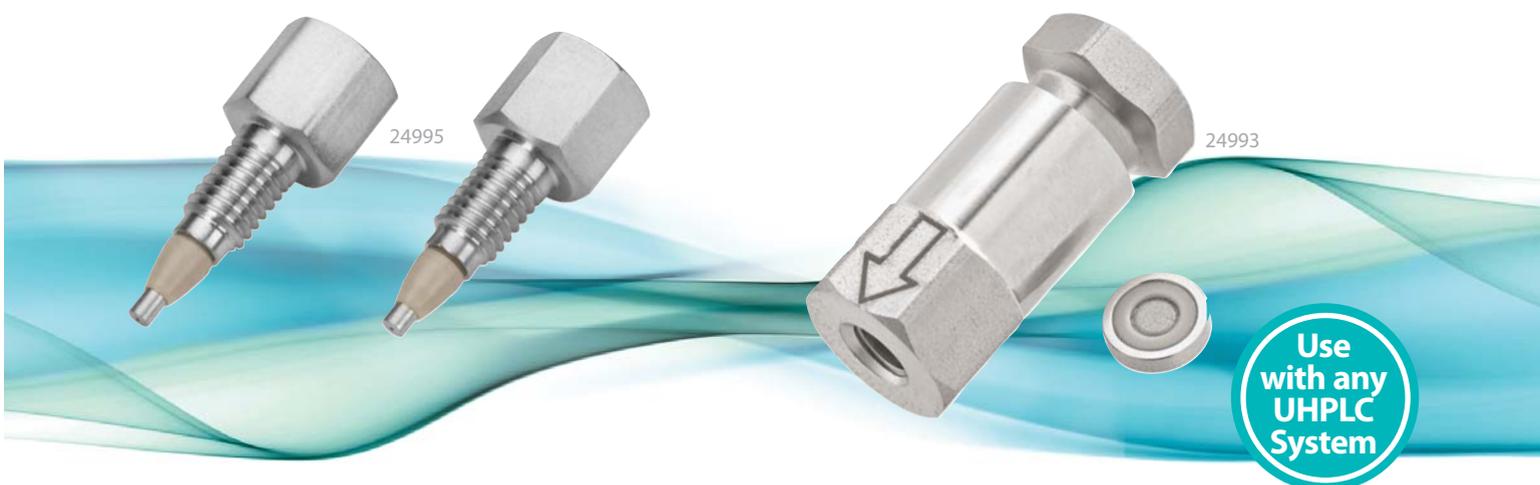
also available

Other stationary phases and particle sizes are available; please inquire.



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.



Use
with any
UHPLC
System

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

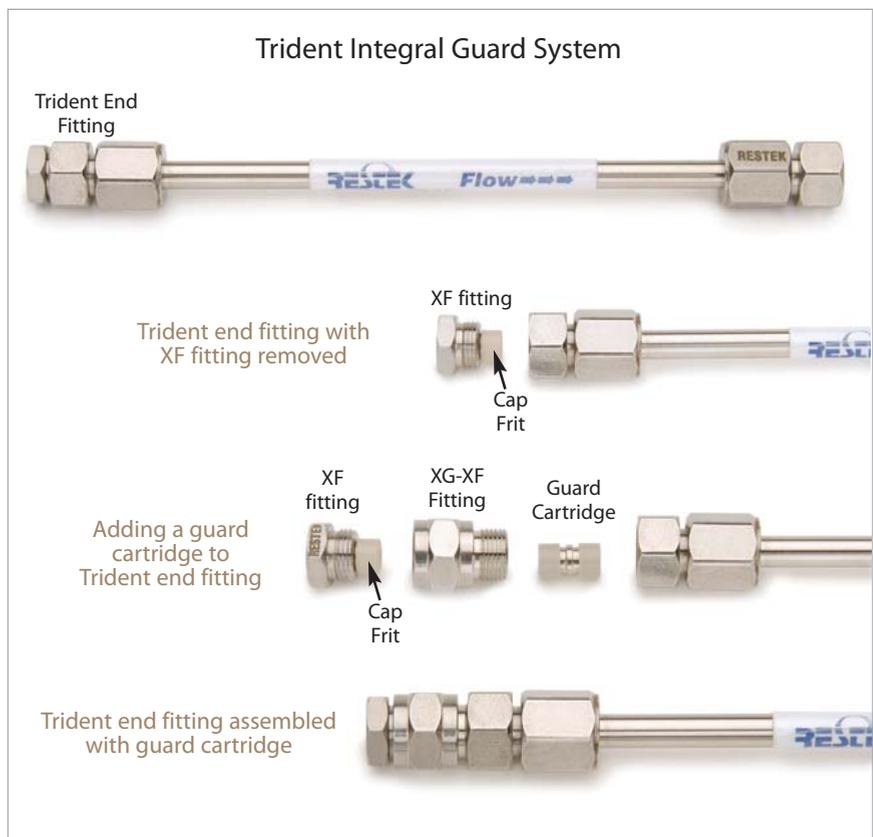
Restek's Exclusive Trident Integral System

- 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 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 Direct 10mm guard cartridge holder with filter

Components



Assembled



Installed onto column



Cap frits

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
ethylbenzene	1,700	toluene	1,400
		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)

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.)



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Rxi, Intermediate-Polarity, Siltek, Polar, Base, Hydroguard Water-Resistant, Integrated

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GC COLUMNS

FUSED SILICA COLUMNS

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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.

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Pro ezGC 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 ezGC 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 μ m and 0.18 mm ID x 0.18 μ m, etc.

Characteristic	Column ID					
	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.*

Column ID	Film Thickness (df) / β Value						
	0.10 μ m	0.25 μ m	0.50 μ m	1.0 μ m	1.5 μ m	3.0 μ m	5.0 μ m
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

* $\beta = r/2df$ (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.



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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

- Review the application section of this catalog or www.restek.com/chromatograms for similar compound list.
- 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

- 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

- Optimize column flow (mL/min.)
- Choose appropriate carrier gas (hydrogen, helium, or nitrogen)
- 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

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.

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.

Chromatogram Search Tool

Search by compound name, synonym, CAS # or keyword

www.restek.com/chromatograms



need **more** help?

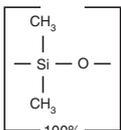
- Call 800-356-1688 or 814-353-1300, ext. 4, or your Restek representative.
- Visit www.restek.com
- Email (U.S.): support@restek.com
Email (outside U.S.): intltechsupp@restek.com

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



Rxi®-1ms, Rxi®-1HT, Rtx®-1

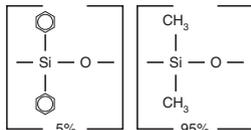
100% dimethyl polysiloxane



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

Rxi®-5ms, Rxi®-5HT, Rtx®-5, Rtx®-5MS

5% diphenyl/95% dimethyl polysiloxane

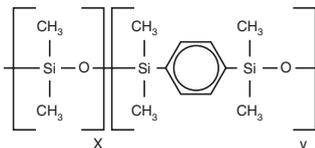


Polarity: slightly polar
Uses: flavors, environmental, aromatic hydrocarbons
[G27]

Rxi®-5Sil MS

5% phenyl

95% dimethyl arylene polysiloxane

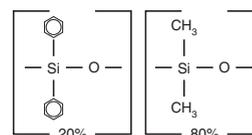


Polarity: slightly polar
Uses: flavors, environmental, pesticides, PCBs, aromatic hydrocarbons

Rtx®-20

20% diphenyl

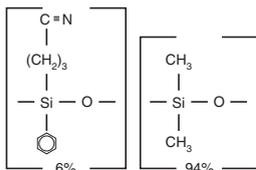
80% dimethyl polysiloxane



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

Rtx®-1301, Rtx®-624, Rtx®-G43

6% cyanopropylphenyl
94% dimethyl polysiloxane

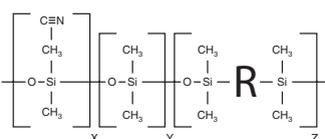


Polarity: slightly polar
Uses: volatile compounds, insecticides, residue solvents in pharmaceutical products
[G43]

Rxi®-624Sil MS

6% cyanopropylphenyl

94% dimethyl arylene polysiloxane

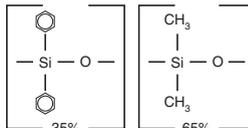


Polarity: intermediately polar
Uses: volatile compounds, insecticides, residue solvents in pharmaceutical products

Rtx®-35

35% diphenyl

65% dimethyl polysiloxane

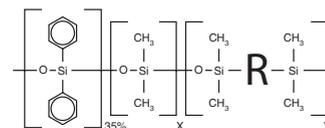


Polarity: intermediately polar
Uses: pesticides, Aroclor PCBs, amines, nitrogen-containing herbicides
[G42]

Rxi®-35Sil MS

35% phenyl

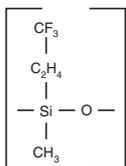
65% dimethyl arylene polysiloxane



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

Rtx®-200

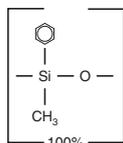
trifluoropropylmethyl polysiloxane



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

Rtx®-50

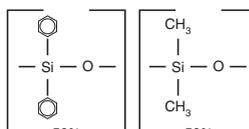
50% phenyl
50% methyl polysiloxane



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

Rxi®-17

50% diphenyl
50% dimethyl polysiloxane

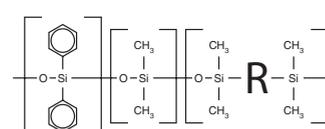


Polarity: intermediately polar
Uses: triglycerides, phthalate esters, steroids, phenols
[G3]

Rxi®-17Sil MS

50% phenyl

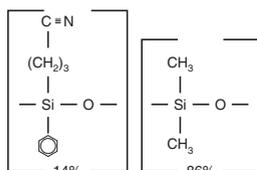
50% dimethyl arylene polysiloxane



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

Rtx®-1701

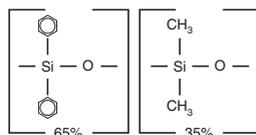
14% cyanopropylphenyl
86% dimethyl polysiloxane



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

Rtx®-65, Rtx®-65TG

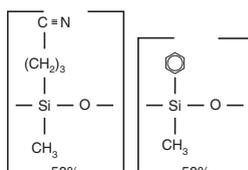
65% diphenyl
35% dimethyl polysiloxane



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

Rtx®-225

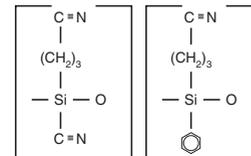
50% cyanopropylmethyl
50% phenylmethyl polysiloxane



Polarity: polar
Uses: FAMES, carbohydrates
[G7]

Rt®-2330

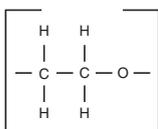
90% biscyanopropyl
10% cyanopropylphenyl polysiloxane



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)	6% cyanopropyl phenyl	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-624 (p. 55)	6% cyanopropyl phenyl	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 ₂ SO ₄ (p. 108) MXF-Alumina BOND/Na ₂ SO ₄	Na ₂ SO ₄ deactivation		GS-Alumina, HP PLOT S	CP-AL ₂ O ₃ / Na ₂ SO ₄				AluminaSulfate- PLOT	AT-Alumina	
Rt-Alumina BOND/KCl (p. 108, 76)	KCl deactivation		GS-Alumina/KCl, HP-PLOT Al ₂ O ₃ /KCl	CP-Al ₂ O ₃ /KCl				AluminaChloride- PLOT		
Rt-Alumina BOND/CFC (p. 108, 74)										
							unique column			
Rt-MSieve 5A (p. 109) MXF-MSieve 5A			GS-MSieve, HP PLOT Molsieve	CP-Molsieve 5A				Molsieve 5A	AT-Molsieve	PLT-5A
Rt-Q-BOND (p. 110) MXF-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) MXFS-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 F

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	
MXF-1HT SimDist (p. 77)	Simulated distillation	DBHT-SimDist				CP-SIMDIST	ZB-1T SimDist
MXF-1 SimDist (p. 79)	Simulated distillation	DBHT-SMD				CP-SIMDIST	Ultimet
MXF-500 SimDist (p. 79)	Simulated distillation	unique column					
Rtx-Biodiesel TG (p. 81)	Triglycerides in biodiesel	unique column					
MXF-Biodiesel TG (p. 81)		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-55il 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-175il 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 µm) 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.



please note

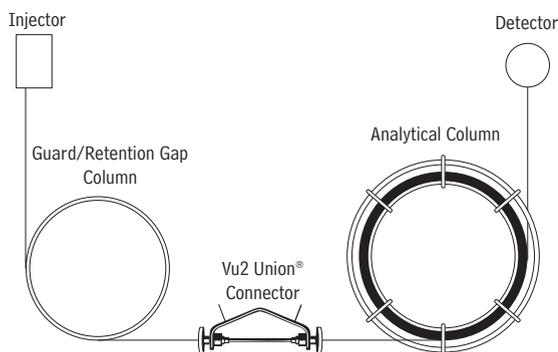
For superior inertness, try our Siltek® guard columns!

See page 33 for details.

Having trouble making a leak-free connection? Try our “built in” Integra-Guard® columns!

See page 35 for details.

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



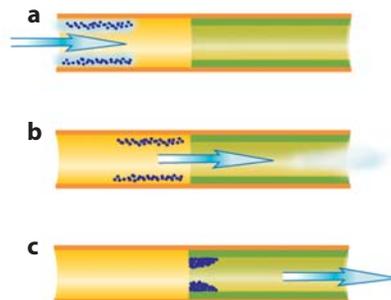
Analyte Focusing

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 split-less 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.

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®-deactivated 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.



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.

also available

Metal MXT® Guard Columns

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

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

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.

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.

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.

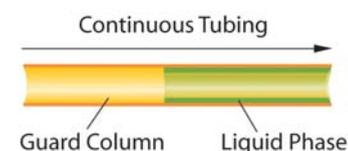
Description	qty.	cat.#	price
Rtx-1			
30m, 0.25mm ID, 0.25 μ m Rtx-1 w/5m Integra-Guard Column	ea.	10123-124	
30m, 0.53mm ID, 1.00 μ m Rtx-1 w/5m Integra-Guard Column	ea.	10155-126	
30m, 0.53mm ID, 5.00 μ m Rtx-1 w/5m Integra-Guard Column	ea.	10179-126	
Rtx-5			
30m, 0.25mm ID, 0.25 μ m Rtx-5 w/5m Integra-Guard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

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.

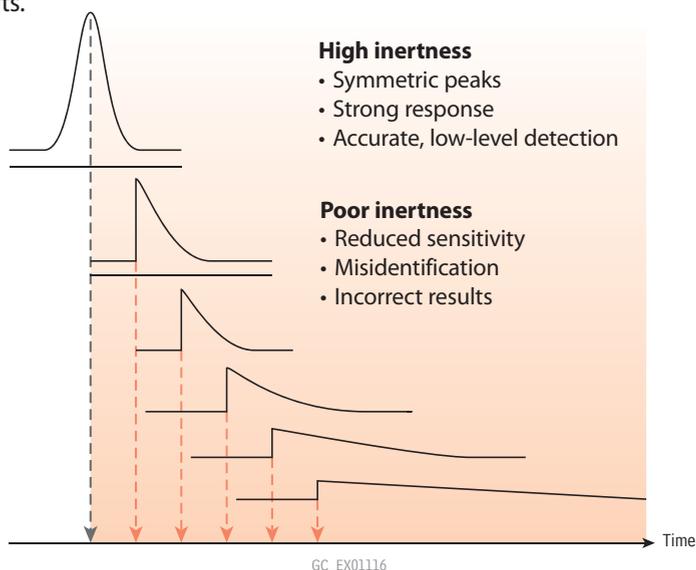
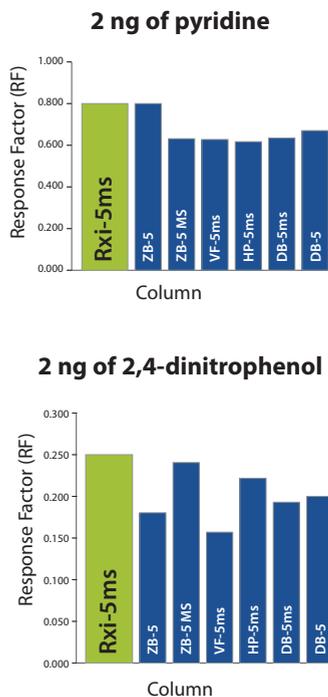
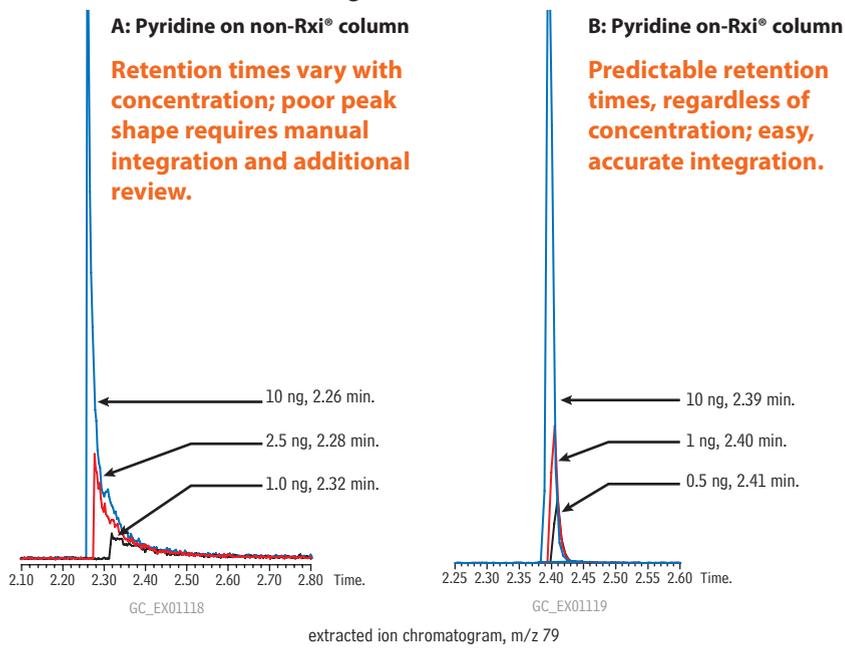


Figure 3 An Rxi®-5ms column gives the highest response for both basic and acidic compounds.



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.



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

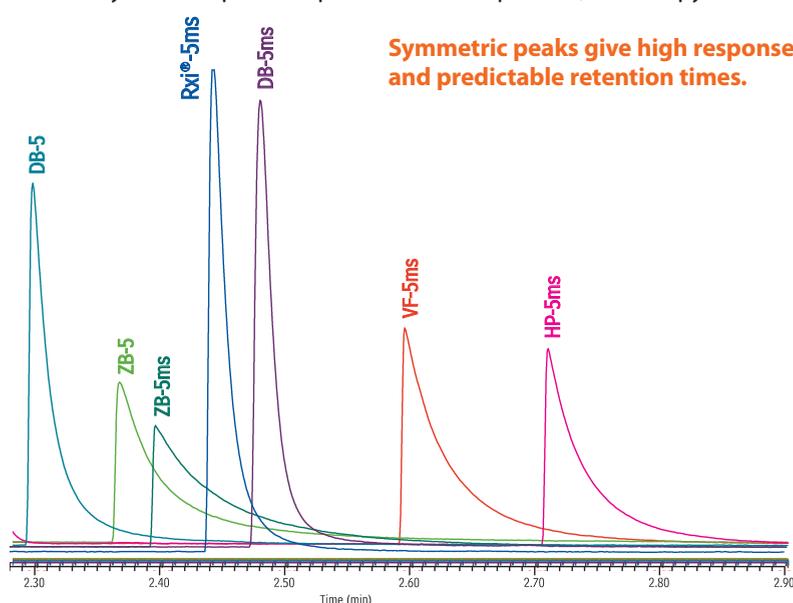
“When my research group needed a GC column for a chiral separation, Restek was the only company that offered to provide us with test columns to evaluate. The willingness of Restek to work with us to find a solution to our separation problem is exceptional.”

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.



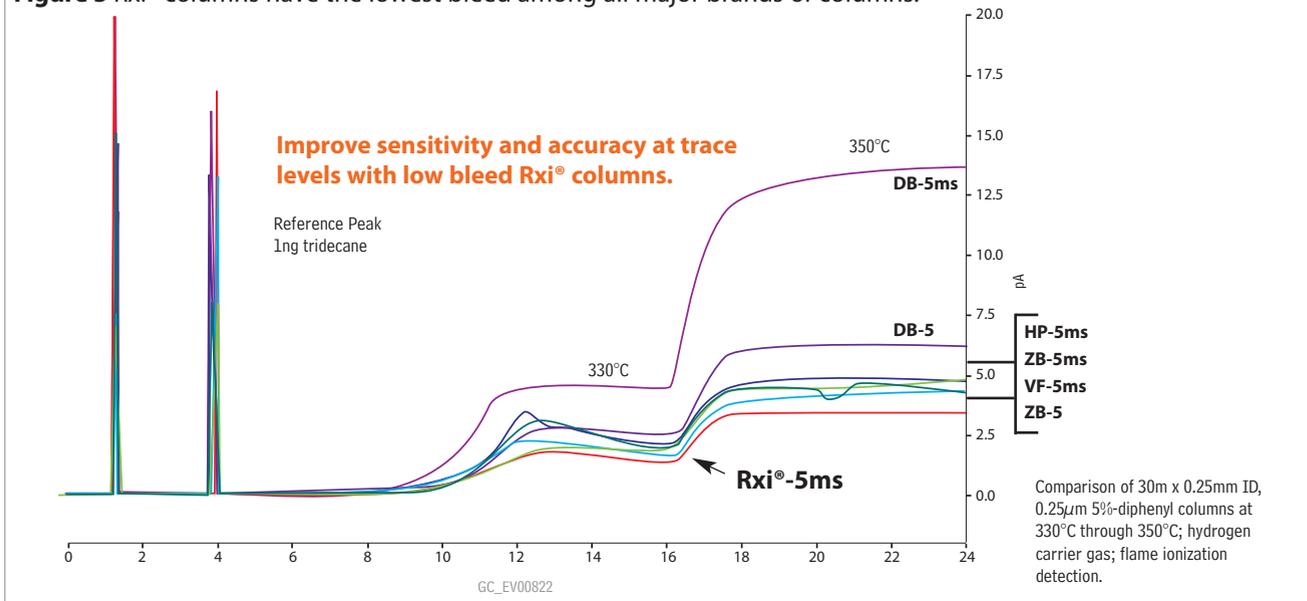
Comparison of 30m x 0.25mm ID, 0.25µm 5% diphenyl columns, 2ng pyridine on-column, helium carrier gas, Oven temp.: 50°C (3 min.) to 180°C @ 35°C/min. (5 min.), Det.: FID @ 250°C

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.

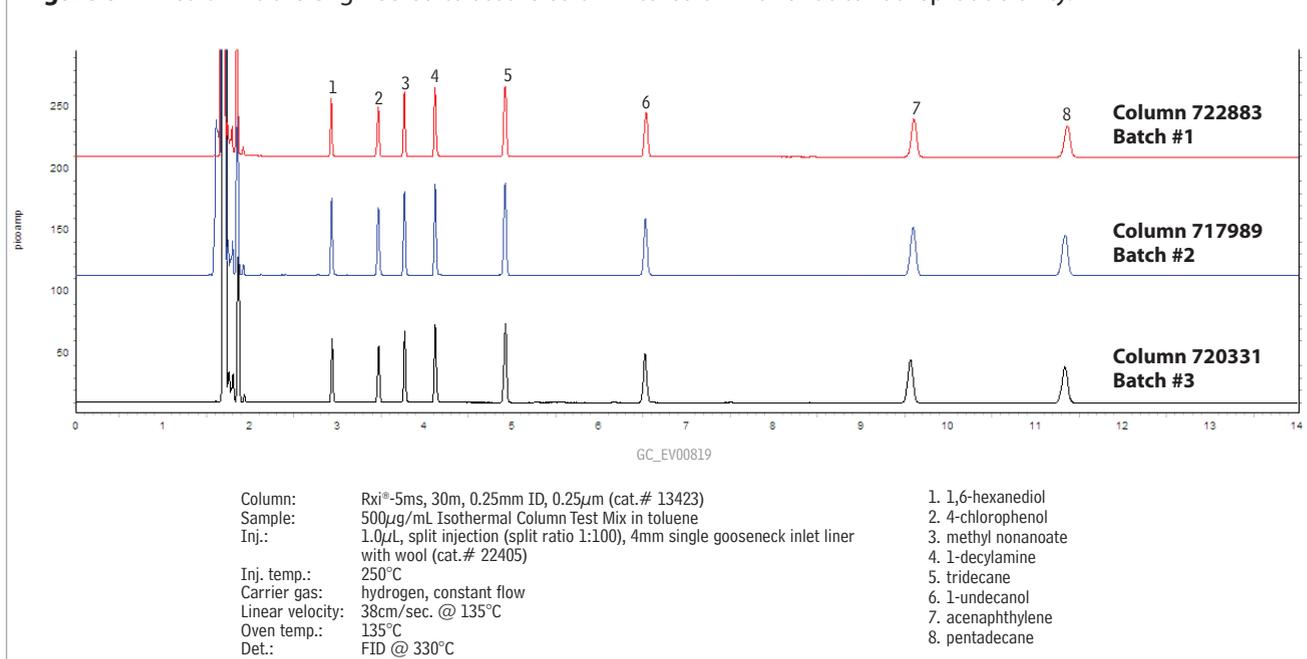
Figure 5 Rxi® columns have the lowest bleed among all major brands of columns.



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 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	Restek	Phase Composition	Agilent	Varian/ Chrompack	SGE	Phenomenex	Machery-Nagel	Supelco
	non-polar	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
	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
POLARITY	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	
+ polar	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®-1 ms 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

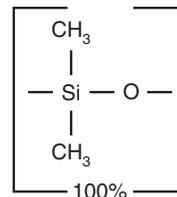
Rxi®-5ms Columns (fused silica)

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

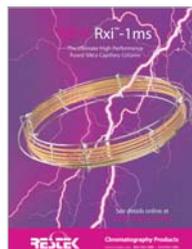
- General purpose columns for semivolatiles, phenols, amines, residual solvents, drugs of abuse, pesticides, PCB congeners (e.g. Aroclor mixes), solvent impurities.
- Most inert column on the market.
- Tested and guaranteed for ultra-low bleed—improved signal-to-noise ratio, for better sensitivity and 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	

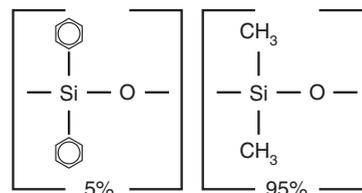
ID	df	temp. limits	10-Meter	12-Meter	20-Meter	25-Meter	50-Meter
0.10mm	0.10µm	-60 to 330/350°C	13401				
0.18mm	0.18µm	-60 to 330/350°C			13402		
	0.30µm	-60 to 330/350°C			13409		
	0.36µm	-60 to 330/350°C			13411		
0.20mm	0.33µm	-60 to 330/350°C		13497		13498	13499

Rxi®-1ms Structure**similar phases**

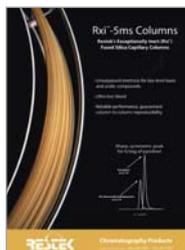
DB-1, DB-1ms, HP-1, HP-1ms, Ultra-1, SPB-1, Equity-1, VF-1ms, CP-Sil 5 CB Low Bleed/MS

free literature**Rxi®-1ms: The Ultimate High Performance Fused Silica Capillary Column**Download your free copy from www.restek.com

lit. cat.# 580075B

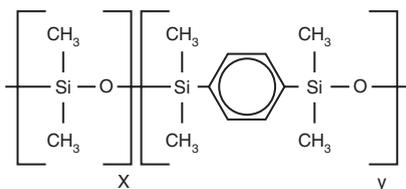
Rxi®-5ms Structure**similar phases**

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



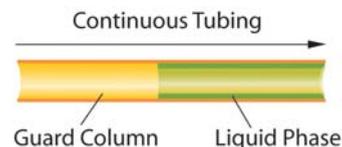
Download your free
copies from
www.restek.com

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.

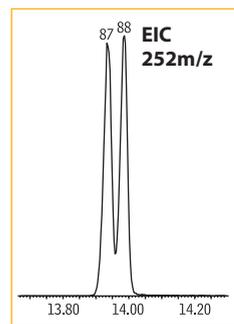
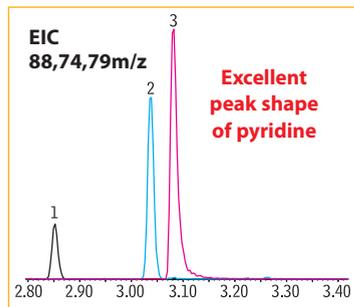
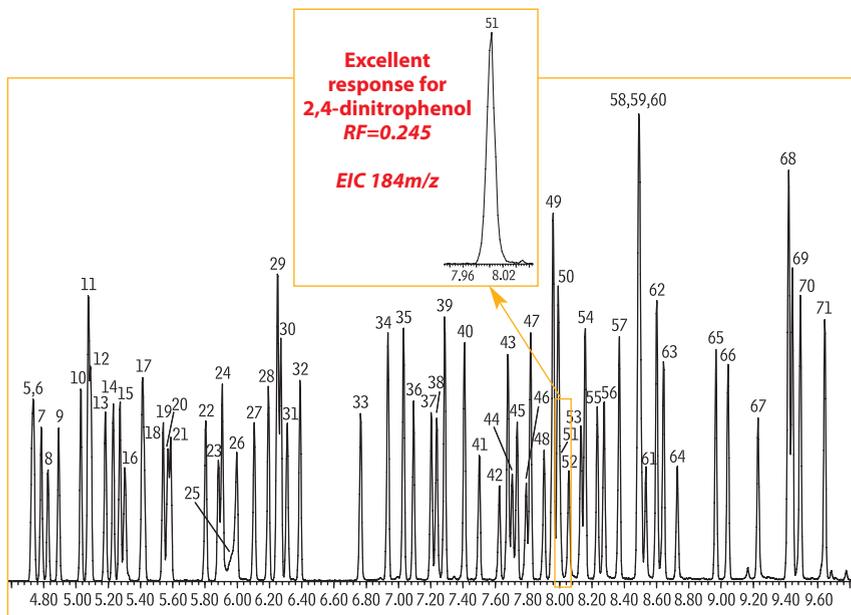
Integra-Guard® built-in guard column



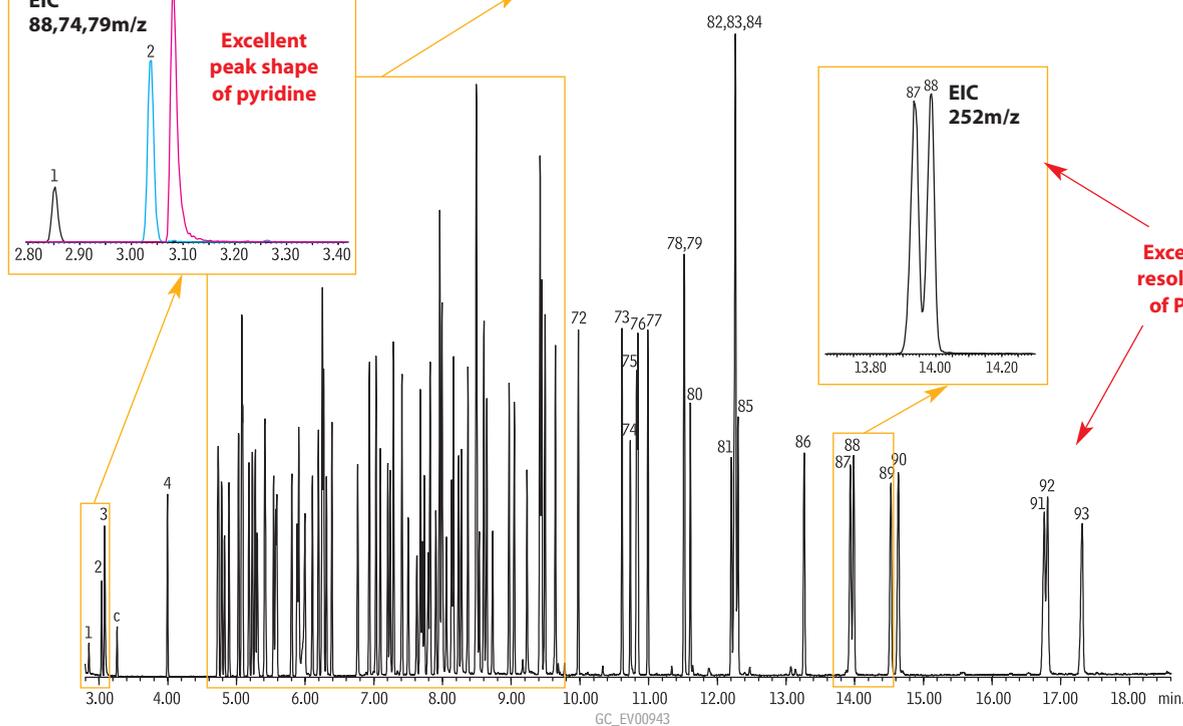
Integra-Guard® columns are available for all phases listed, for columns with 0.25, 0.32 or 0.53mm ID. If you don't see what you need here, contact us.

Semivolatile organics for US EPA Method 8270 on an Rxi®-5Si1 MS column.

Column: Rxi®-5Si1 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



Excellent resolution of PAHs



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

c = contaminant



similar phases

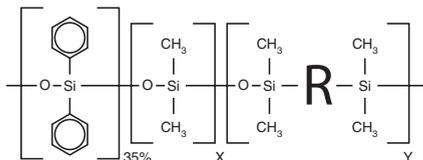
DB-XLB, VF-Xms

i 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.

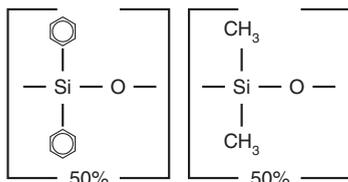
Rxi®-35Si1 MS Structure



similar phases

DB-35ms, MR2, VF-35ms

Rxi®-17 Structure



similar phases

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

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	
0.53mm	0.10µm	30 to 340/360°C		13754	
	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®-35Si1 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



More dimensions are now available!

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.

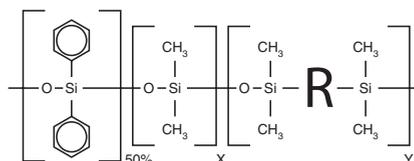
ID	df	temp. limits	15-Meter	30-Meter
0.25mm	0.25µm	40 to 280/320°C	13520	13523
	0.50µm	40 to 280/320°C	13535	13538
	1.00µm	40 to 280/320°C	13550	13553
0.32mm	0.25µm	40 to 280/320°C	13521	13524
	0.50µm	40 to 280/320°C	13536	13539
	1.00µm	40 to 280/320°C	13551	13554
0.53mm	0.25µm	40 to 280/320°C	13522	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®-17Si MS Columns (fused silica)

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

- 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.

**Rxi®-17Si MS Structure****similar phases**

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

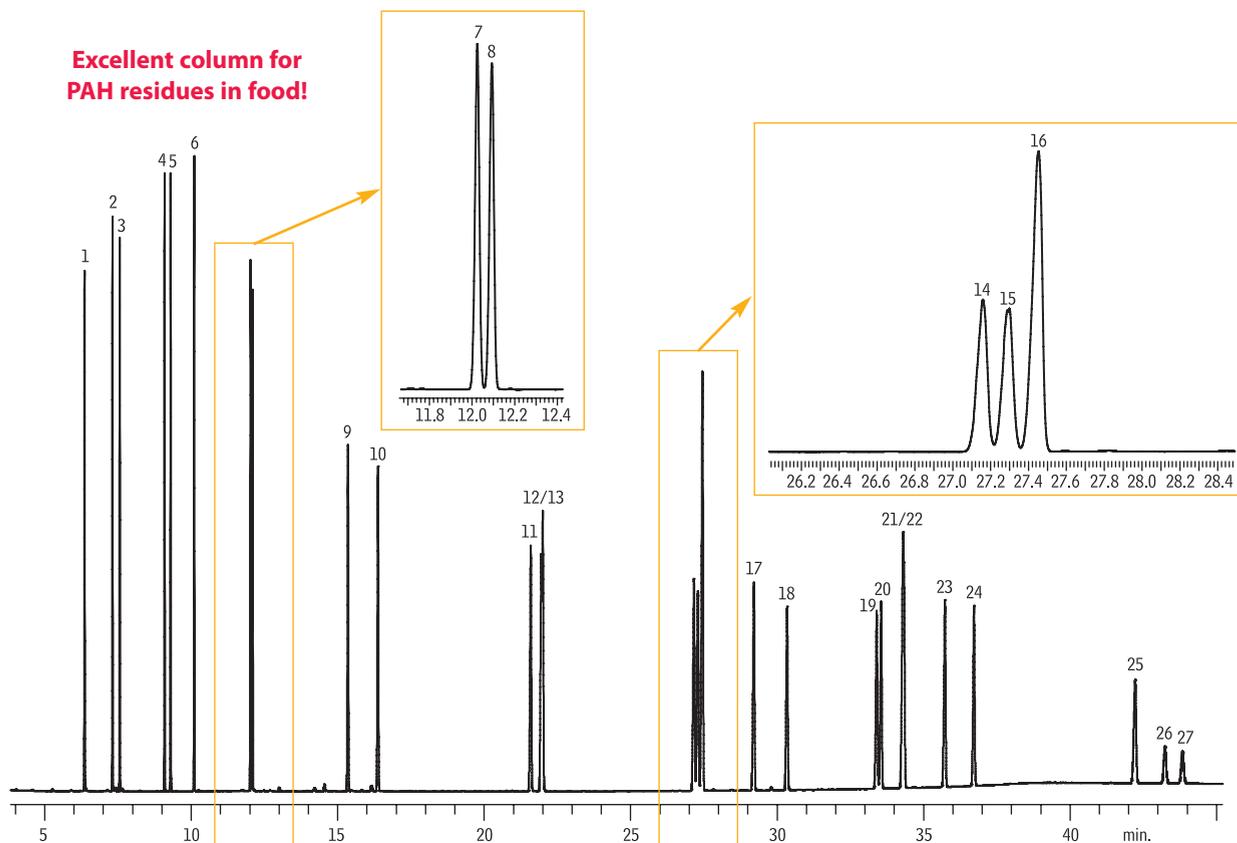
ID	df	temp. limits*	15-Meter	30-Meter	60-Meter
0.25mm	0.25µm	40 to 340/360°C	14120	14123	14126
0.32mm	0.25µm	40 to 340/360°C	14121	14124	

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.

Polycyclic Aromatic Hydrocarbons on Rxi®-17Si MS

Excellent column for
PAH residues in food!



GC_EV1160

- Naphthalene
- 2-Methylnaphthalene
- 1-Methylnaphthalene
- Acenaphthylene
- Acenaphthene
- Fluorene
- Phenanthrene
- Anthracene
- Fluoranthene
- Pyrene
- Benz[*a*]anthracene
- Chrysene
- Triphenylene
- Benzo[*b*]fluoranthene

- Benzo[*k*]fluoranthene
- Benzo[*j*]fluoranthene
- Benzo[*a*]pyrene
- 3-Methylcholanthrene
- Dibenz[*a,h*]acridine
- Dibenz[*a,j*]acridine
- Indeno[1,2,3-*cd*]pyrene
- Dibenz[*a,h*]anthracene
- Benzo[*ghi*]perylene
- 7H-Dibenzo[*c,g*]carbazole
- Dibenzo[*a,e*]pyrene
- Dibenzo[*a,i*]pyrene
- Dibenzo[*a,h*]pyrene

Column Sample

Diluent:
Conc.:
Injection
Inj. Vol.:
Liner:
Inj. Temp.:
Purge Flow:
Oven
Oven Temp:
Carrier Gas
Flow Rate:
Detector
Instrument
Acknowledgement

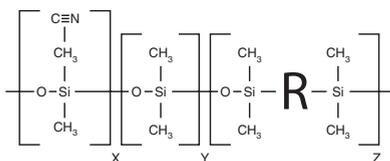
Rxi®-17Si MS, 30 m, 0.25 mm ID, 0.25 µm (cat.# 14123)
SV Calibration Mix #5 / 610 PAH Mix (cat.# 31011)
EPA Method 8310 PAH Mixture (cat.# 31841)
dichloromethane
10 ppm

0.5 µL splitless (hold 1.75 min.)
Auto SYS XL PSS Split/Splitless w/Wool (cat.# 21718)
320 °C
75 mL/min.

65 °C (hold 0.5 min.) to 220 °C at 15 °C/min. to 330 °C at 4 °C/min. (hold 15 min.)
He, constant flow
2.0 mL/min.
FID @ 320 °C
PE Clarus 600 GC
Instrument provided by PerkinElmer



Rxi®-624Sil MS Structure



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	

similar phases

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



free literature

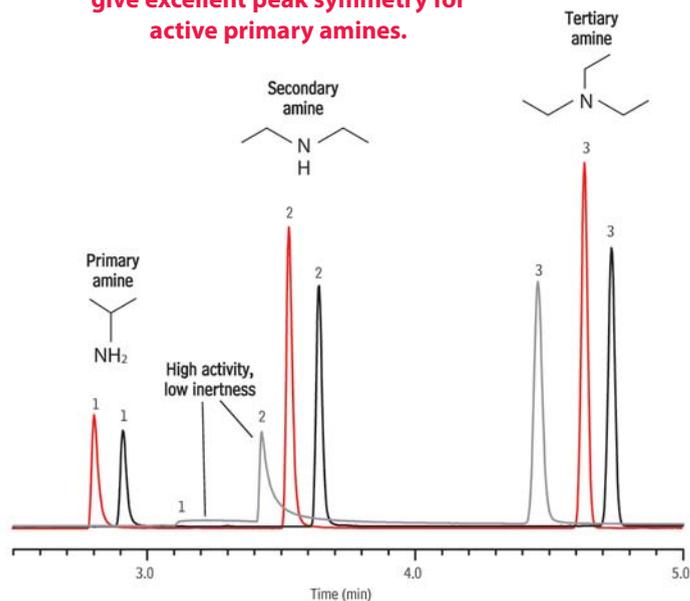
Rxi®-624Sil MS: The "Go To" GC Column for Fast, Effective Volatile Impurities Method Development

Download your free copy from www.restek.com

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

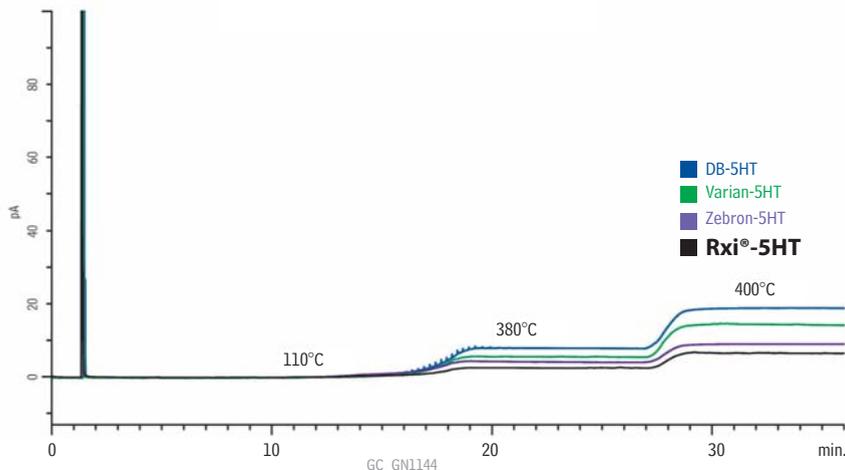
NEW!



Looking for an Inert and Low Bleed High Temp Column?

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	0.10 μm	-60 to 400°C	13905	13908
	0.25 μm	-60 to 400°C		13923
0.32mm	0.10 μm	-60 to 400°C	13906	13909
	0.25 μm	-60 to 400°C		13924
0.53mm	0.15 μm	-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)

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

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

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

RESTEK

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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[®]-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.

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

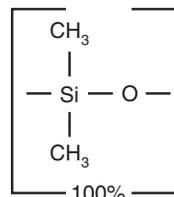
*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

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	

Rtx®-1 Structure**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

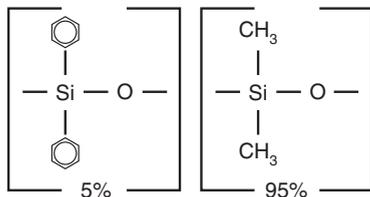
For exceptional inertness, ultra-low bleed, and unsurpassed performance, choose Rxi®-1ms columns! See **pages 36-41**.

crossbond® technology

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

**Catch the Buzz**

Sign up for Restek's e-newsletter, *The Buzz*
www.restek.com/buzz

Rtx[®]-5/Rtx[®]-5MS StructureRtx[®]-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.

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.

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
	3.00µm	-60 to 280/300°C	10281	10284	10287	10290
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 270/290°C	10282	10285	10288	10291
	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		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			

*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	

Integra-Guard[®] built-in guard column

Continuous Tubing

Guard Column Liquid Phase

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**.

Six columns for the price of five!

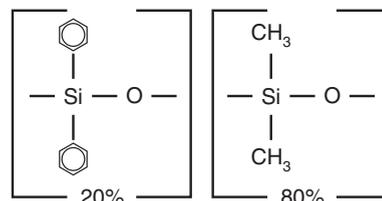
Other phases and configurations available on request.

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.

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

Rtx[®]-20 Structuresimilar **phase**

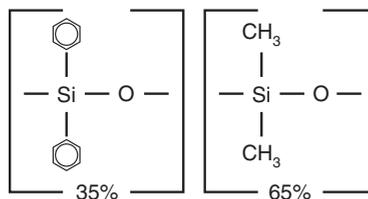
SPB-20, AT-20, 007-7

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.

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

Rtx[®]-35 Structuresimilar **phases**

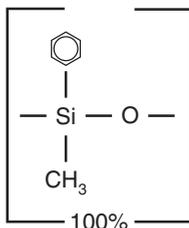
DB-35, HP-35, SPB-35, SPB-608

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 ColumnsSee **page 65**.

Rtx®-50 Structure



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.

similar phases

HP-50, SPB-50, SP-2250

also available

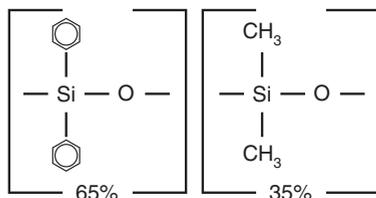
Metal MXT® Columns

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

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



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.

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.

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.

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.

restek **innovation!**

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

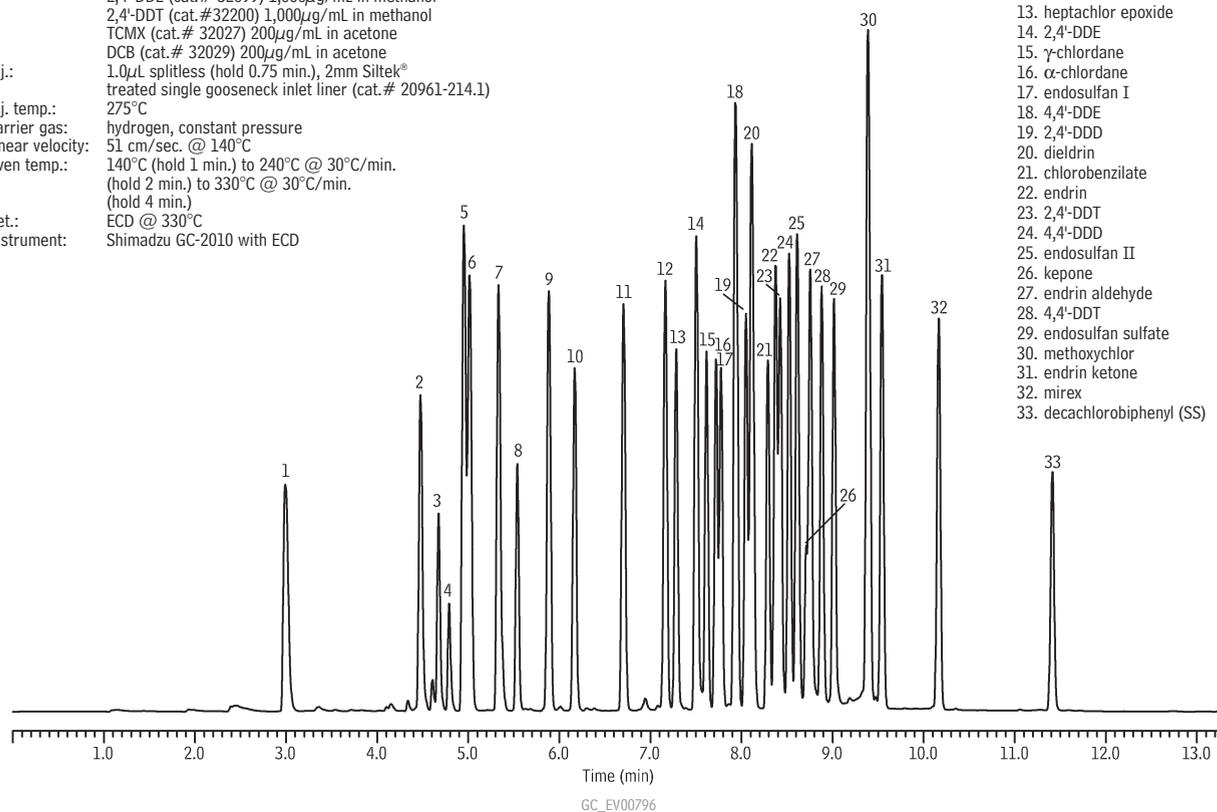
Linear velocity: 51 cm/sec. @ 140°C

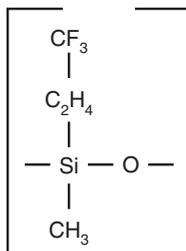
Oven temp.: 140°C (hold 1 min.) to 240°C @ 30°C/min.
(hold 2 min.) to 330°C @ 30°C/min.
(hold 4 min.)

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 life-time, 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®-624 Columns (fused silica)

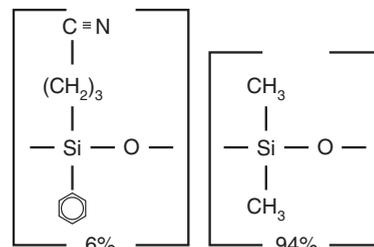
(low to midpolarity phase; Crossbond® 6% cyanopropylphenyl/94% dimethyl polysiloxane)

- 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

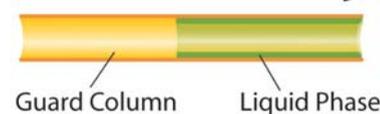
ID	df	temp. limits	20-Meter	40-Meter
0.18mm	1.00µm	-20 to 240°C	40924	40925

Rtx®-1301 Structure**similar phases**

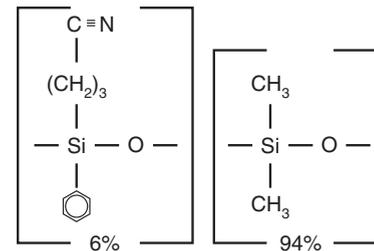
DB-1301, DB-624, HP-1301, HP-624, SPB-1301, SPB-624, VF-1301, VF-624ms, CP-1301, CP-Select 624 CB

Integra-Guard® built-in guard column

Continuous Tubing

**Get the protection without the connection!**

For Rtx®-1301 and Rtx®-624 columns with built-in Integra-Guard® guard columns, see **page 35**.

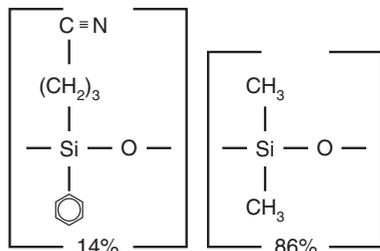
Rtx®-624 Structure**similar phases**

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

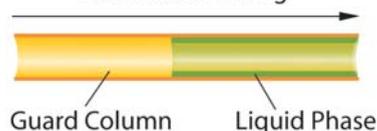


similar phases

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

Integra-Guard® built-in guard column

Continuous Tubing



Get the protection without the connection!

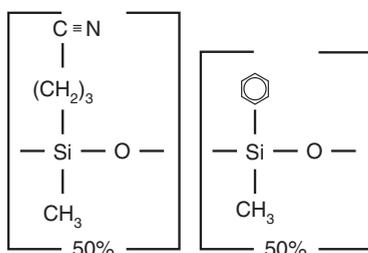
For Rtx®-1701 columns with built-in
Integra-Guard® guard columns,
see page 35.

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.

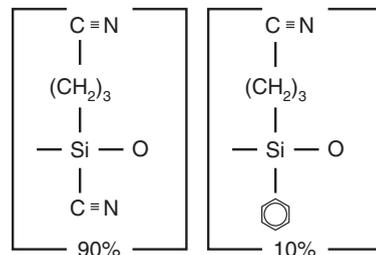
Rt®-2560 Column (fused silica)

(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

Rt®-2330 Structure**similar phases**

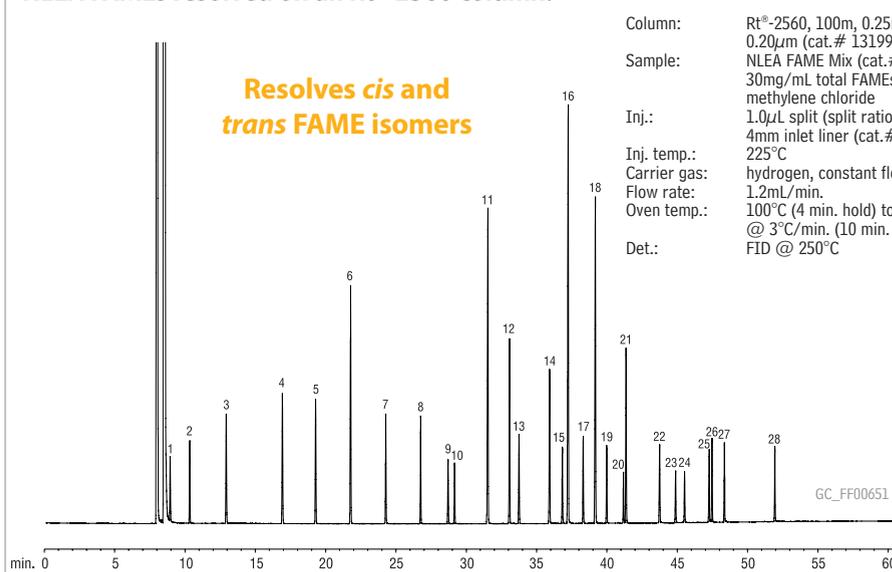
DB-23, HP-23, SP-2330, SP-2380

Doing Dioxin Analysis?

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

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)

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**Selection Guide for
Polar Wax GC
Column Phases**

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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

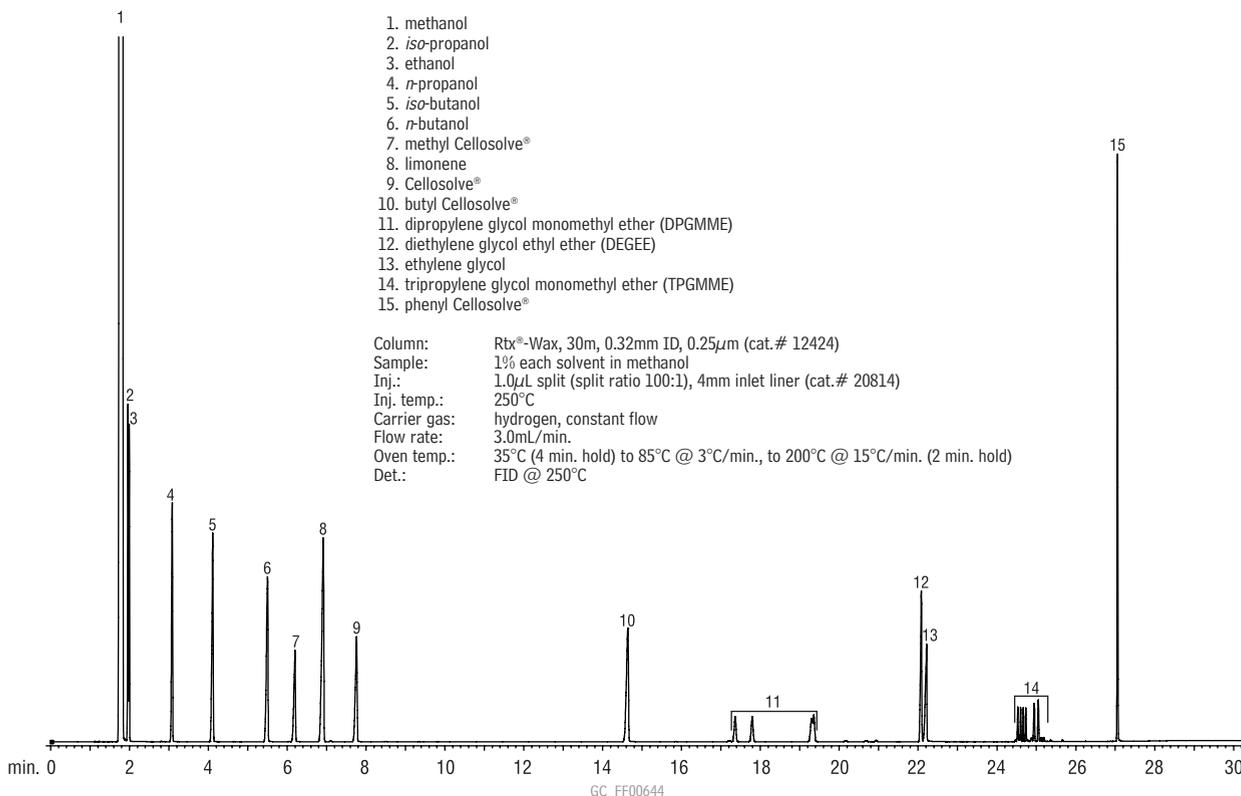
ID	df	temp. limits	10-Meter	20-Meter
0.10mm	0.10µm	20 to 250°C	41601	41602
	0.20µm	20 to 240/250°C	41603	41604

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

similar phases

DB-WAX, HP-Wax

Cleaning solvents on an Rtx®-Wax column.

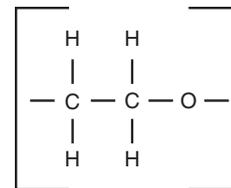


Stabilwax® Columns (fused silica)

(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.

Stabilwax® Structure**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!

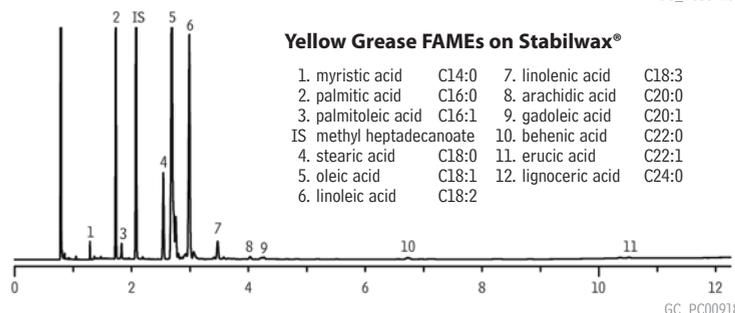
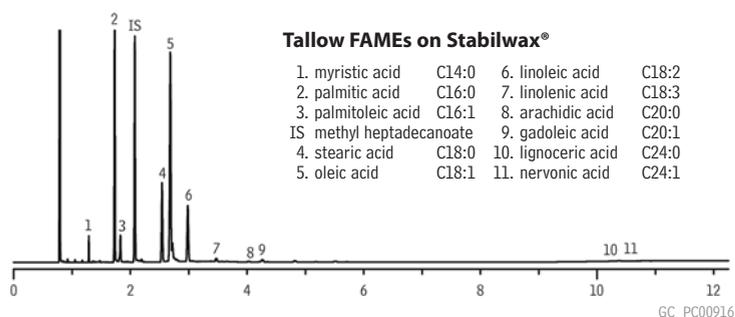
Call 800-356-1688, ext. 4, or your Restek representative for details!

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.

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

FAMES in biodiesel oils on a Stabilwax® column.

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 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	0.10 μ m	-60 to 330/350°C	13301	
0.15mm	0.15 μ m	-60 to 330/350°C	43800	43801
	2.0 μ m	-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	0.10 μ m	-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	0.10 μ m	-60 to 330/350°C	43601	
0.15mm	0.15 μ m	-60 to 330/350°C	43815	\$295 43816
	2.0 μ m	-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	0.10 μ m	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	0.15 μ m	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	0.15 μ m	-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	0.10 μ m	40 to 250/260°C	42601	
0.15mm	0.15 μ m	40 to 250/260°C	43830	43831

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

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

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

Rtx®-CLPesticides for Fast GC (fused silica)

(proprietary Crossbond® phase)

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

**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.

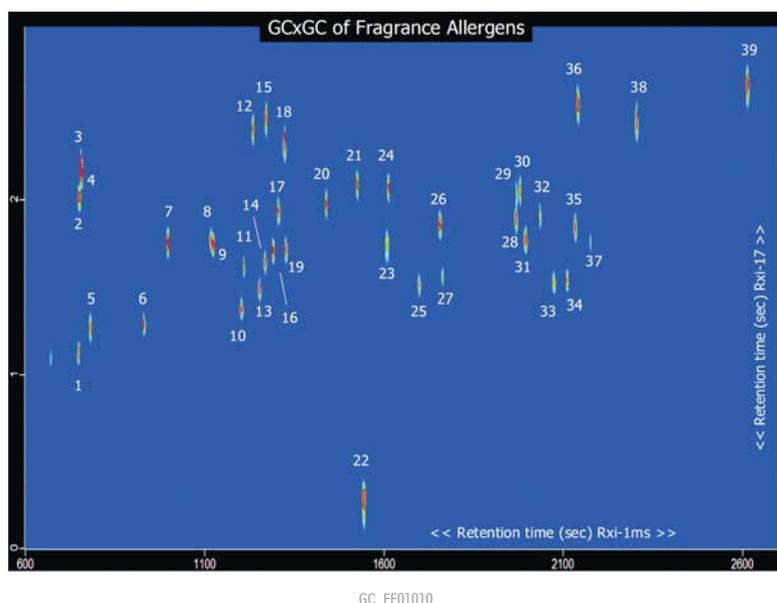
GCxGC Second Dimension Selectivity Kit

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

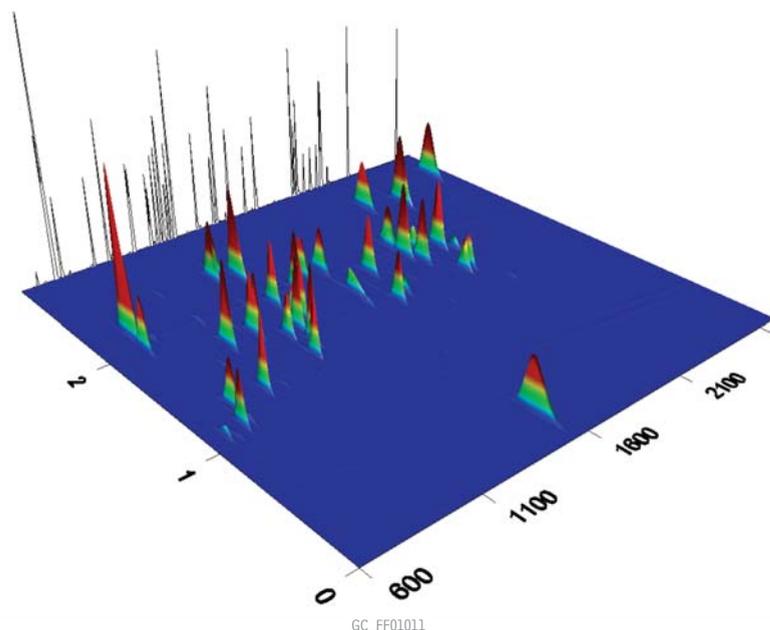
- Rxi®-17, 50% diphenyl dimethylpolysiloxane
- Rtx®-CLPesticides, trifluoropropyl containing polymer
- Stabilwax®, polar polyethylene glycol
- Rt®-LC350, liquid crystalline phase selective for aromatic compounds

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)



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



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.

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- Petroleum & Petrochemical
- Clinical, Forensic & Toxicology
- Pharmaceutical
- Environmental

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



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11/12

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.

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.



similar phases

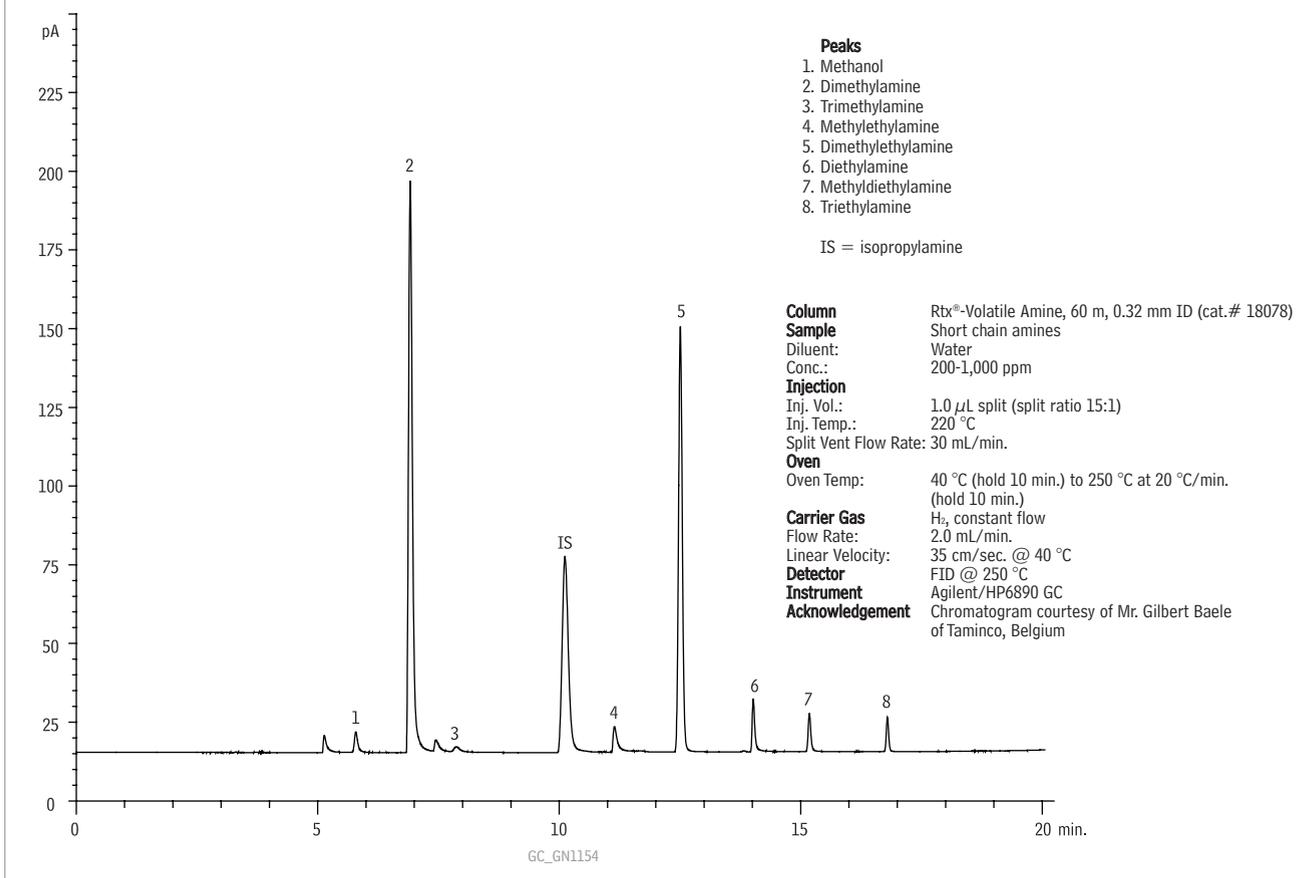
Direct replacement for CP-Volamine, thick-film CP-Sil 8 for amines, and other amine-deactivated columns coated with low polarity polysiloxane phases.

please note

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

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

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





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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.

similar phase

PTA-5, CP-Sil CB

also available

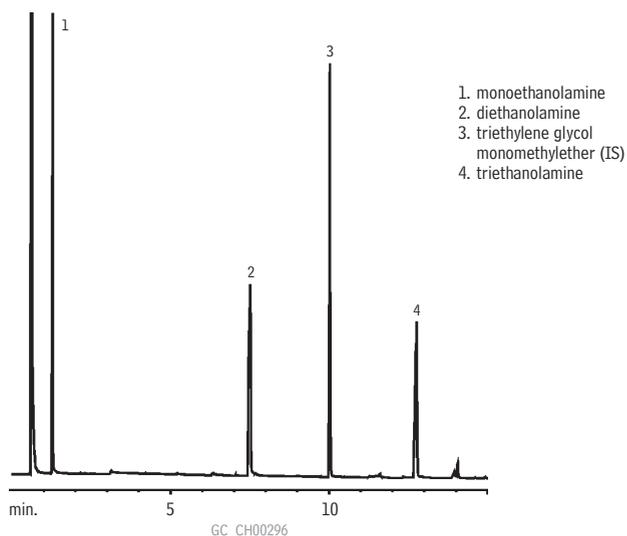
See **page 65** for Rtx®-35 Amine columns.

please note

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

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

Ethanolamines on an Rtx®-5 Amine column.

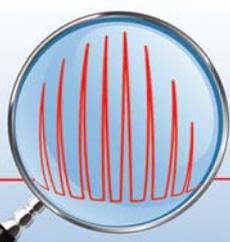


Column: Rtx®-5 Amine, 15m, 0.25mm ID, 0.50µm (cat.# 12335)
 Sample: 1.0µL split injection of ethanolamine mix in methanol
 On-column conc.: 34ng
 Oven temp.: 50°C (hold 2 min.) to 180°C @ 10°C/min. (hold 2 min.)
 Inj./det. temp.: 280°C/300°C
 Carrier gas: hydrogen
 Linear velocity: 43cm/sec. set @ 50°C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

Chromatogram Search Tool

Search by compound name, synonym, CAS # or keyword

www.restek.com/chromatograms



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

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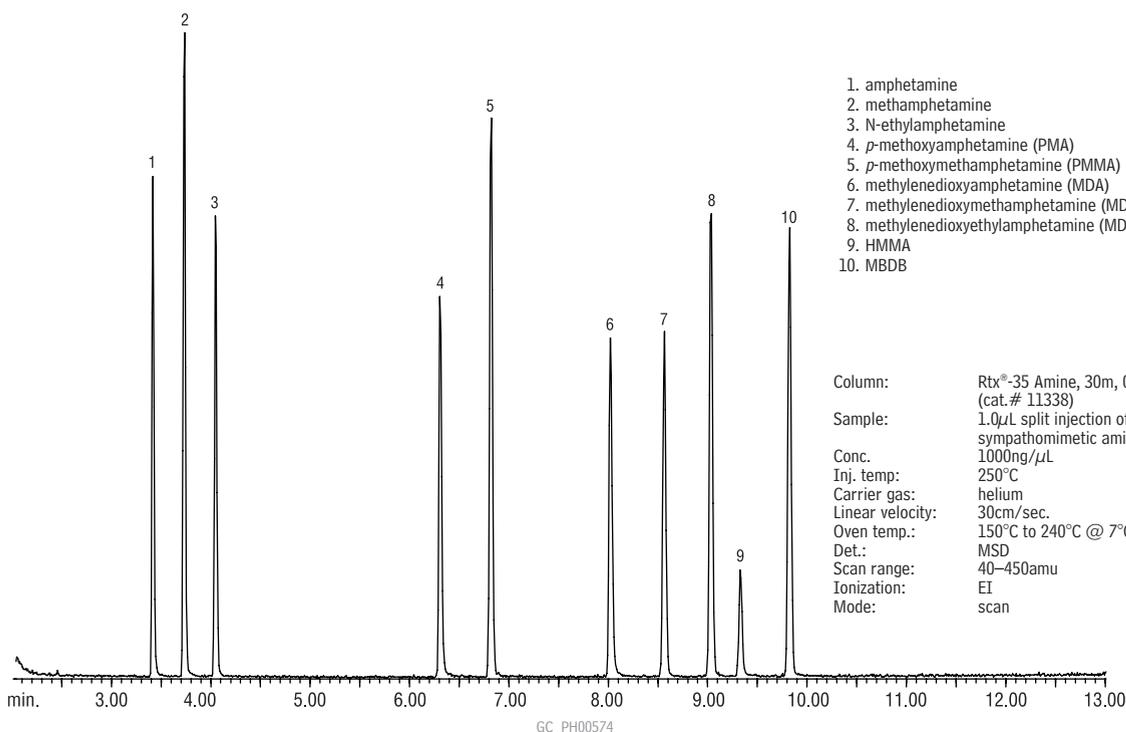
please note

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.



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.

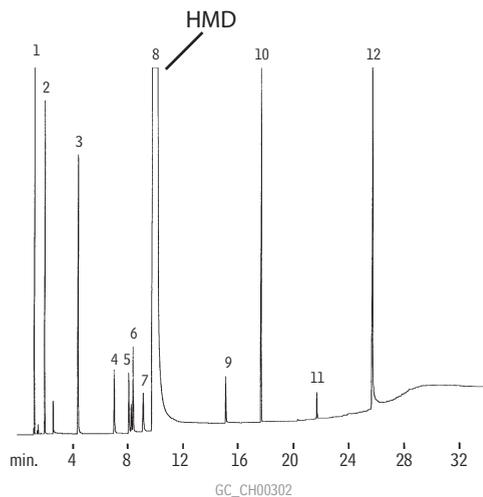
ID	df	temp. limits	15-Meter	30-Meter	60-Meter
0.25mm	0.25µm	40 to 210/220°C	10820	10823	
	0.50µm	40 to 210/220°C		10838	
0.32mm	0.25µm	40 to 210/220°C	10821	10824	
	0.50µm	40 to 210/220°C		10839	
	1.00µm	40 to 210/220°C	10851	10854	10857
0.53mm	0.50µm	40 to 210/220°C		10840	
	1.00µm	40 to 210/220°C	10852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

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



Excellent resolution and peak shape for impurities in HMD!

1. cyclohexane
2. hexamethyleimine
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

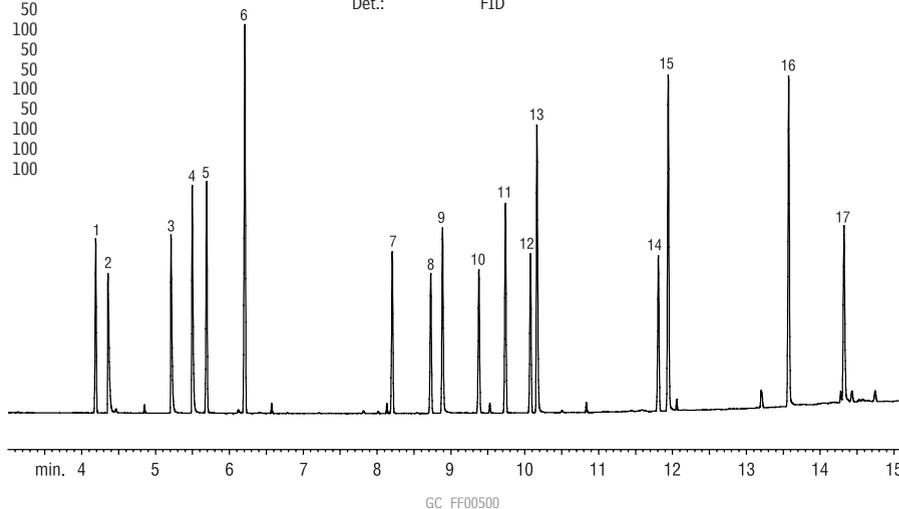
reduces bleed, prolongs column lifetime, and allows rejuvenation through solvent rinsing.

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



Enantiomers Analysis

Cyclodextrin Columns for Analyzing Many Chiral Compounds

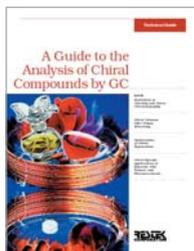
By adding β or γ cyclodextrin to our bonded Rtx®-1701 stationary phase, we greatly enhance overall utility and column lifetime for our chiral columns, compared to columns that have pure cyclodextrin stationary phases. Separations of more than one hundred chiral compounds have been achieved using our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

free literature

A Guide to the Analysis of Chiral Compounds by GC

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lit. cat.# 59889



please note

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

i 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

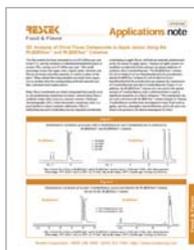
Grape Flavor Analysis, Using an Rt®- γ DEXsa GC Column

lit. cat.# 59553

GC Analysis of Chiral Flavor Compounds in Apple Juices, Using Rt®- β DEXsm and Rt®- β DEXse Columns

lit. cat.# 59546

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Rt®- β DEXm 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	0.25 μ m	40 to 230°C	13100
0.32mm	0.25 μ m	40 to 230°C	13101

Rt®- β DEXsm 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	0.25 μ m	40 to 230°C	13105
0.32mm	0.25 μ m	40 to 230°C	13104

Rt®- β DEXse 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- β DEXsm 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	0.25 μ m	40 to 230°C	13107
0.32mm	0.25 μ m	40 to 230°C	13106

Rt®- β DEXsp 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- β DEXsm column, for complex enantiomeric separations.

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

Rt®- β DEXsa 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	0.25 μ m	40 to 230°C	13109
0.32mm	0.25 μ m	40 to 230°C	13108

Rt®- β DEXcst 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	0.25 μ m	40 to 230°C	13103
0.32mm	0.25 μ m	40 to 230°C	13102

Rt®- γ DEXsa 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	0.25 μ m	40 to 230°C	13113
0.32mm	0.25 μ m	40 to 230°C	13112

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.

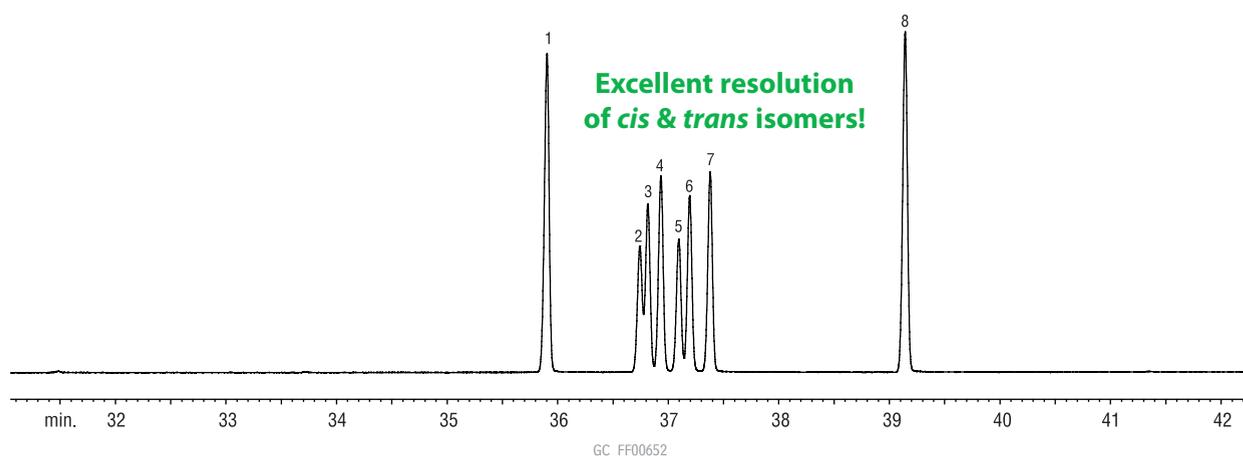
Because the Rt[®]-2560 stationary phase is not bonded, it should not be solvent rinsed.

similar phases

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

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

FAMES (*cis/trans* isomers) on an Rt[®]-2560 column.



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 (<i>trans</i> -6)	8.0
3. C18:1 methyl elaidate (<i>trans</i> -9)	10.0
4. C18:1 methyl transvacenate (<i>trans</i> -11)	12.0
5. C18:1 methyl petroselinate (<i>cis</i> -6)	8.0
6. C18:1 methyl oleate (<i>cis</i> -9)	10.0
7. C18:1 methyl vacenate (<i>cis</i> -11)	12.0
8. C18:2 methyl linoleate (<i>cis</i> -9,12)	20.0



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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

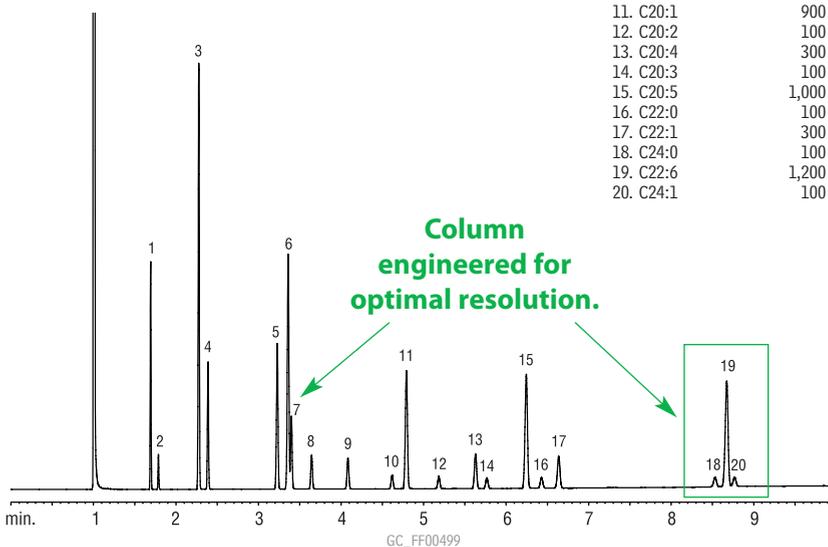
Omegawax

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 isoctane
 (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



Chromatogram Search Tool

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Flavor & Fragrance Compounds 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

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In the U.S.

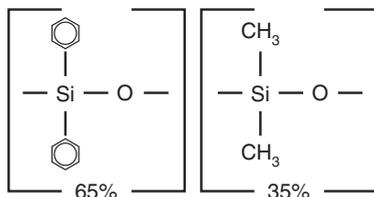
Phone: 1-800-356-1688, ext. 4
Fax: 814-353-1568
e-mail: support@restek.com

Outside the U.S.

Contact your Restek representative.



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)

Triglycerides in Foods Analysis

Rtx®-65TG Columns (fused silica)

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

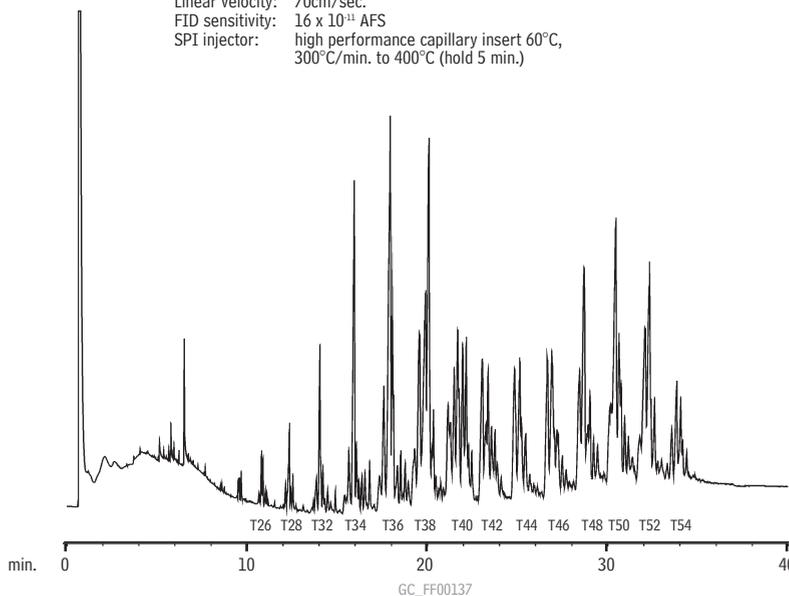
- Application-specific columns, specially tested for triglycerides.
- Stable to 370 °C.

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 10¹¹ AFS
 SPI injector: high performance capillary insert 60°C, 300°C/min. to 400°C (hold 5 min.)



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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.

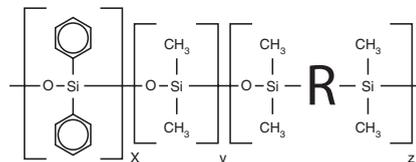
ID	df	temp. limits*	15-Meter	30-Meter	60-Meter
0.25mm	0.25µm	40 to 340/360°C	14120	14123	14126
0.32mm	0.25µm	40 to 340/360°C	14121	14124	

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

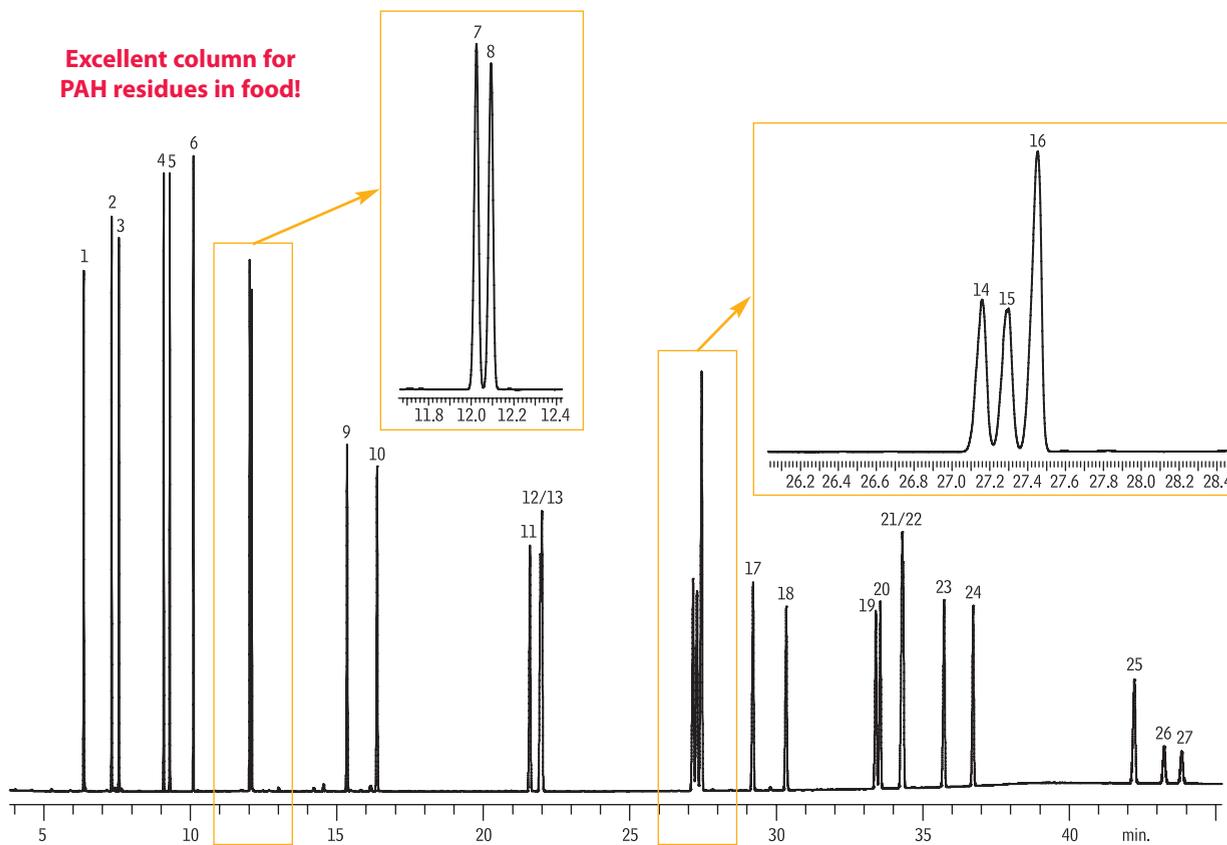


similar phases

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

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

Excellent column for PAH residues in food!



GC_EV1160

- Naphthalene
- 2-Methylnaphthalene
- 1-Methylnaphthalene
- Acenaphthylene
- Acenaphthene
- Fluorene
- Phenanthrene
- Anthracene
- Fluoranthene
- Pyrene
- Benz[a]anthracene
- Chrysene
- Triphenylene
- Benzo[b]fluoranthene

- Benzo[k]fluoranthene
- Benzo(j)fluoranthene
- Benzo[a]pyrene
- 3-Methylcholanthrene
- Dibenz[a,h]acridine
- Dibenz[a,j]acridine
- Indeno[1,2,3-cd]pyrene
- Dibenz[a,h]anthracene
- Benzo[ghi]perylene
- 7H-Dibenzo[c,g]carbazole
- Dibenzo[a,e]pyrene
- Dibenzo[a,i]pyrene
- Dibenzo[a,h]pyrene

Column Sample

Diluent:
Conc.:
Injection
Inj. Vol.:
Liner:
Inj. Temp.:
Purge Flow:
Oven
Oven Temp:
Carrier Gas
Flow Rate:
Detector
Instrument
Acknowledgement

Rxi®-17Sil MS, 30 m, 0.25 mm ID, 0.25 µm (cat.# 14123)
SV Calibration Mix #5 / 610 PAH Mix (cat.# 31011)
EPA Method 8310 PAH Mixture (cat.# 31841)
dichloromethane
10 ppm

0.5 µL splitless (hold 1.75 min.)
Auto SYS XL PSS Split/Splitless w/Wool (cat.# 21718)
320 °C
75 mL/min.

65 °C (hold 0.5 min.) to 220 °C at 15 °C/min. to 330 °C at 4 °C/min. (hold 15 min.)
He, constant flow
2.0 mL/min.
FID @ 320 °C
PE Clarus 600 GC
Instrument provided by PerkinElmer

Chlorinated Fluorocarbons (CFC) Analysis



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

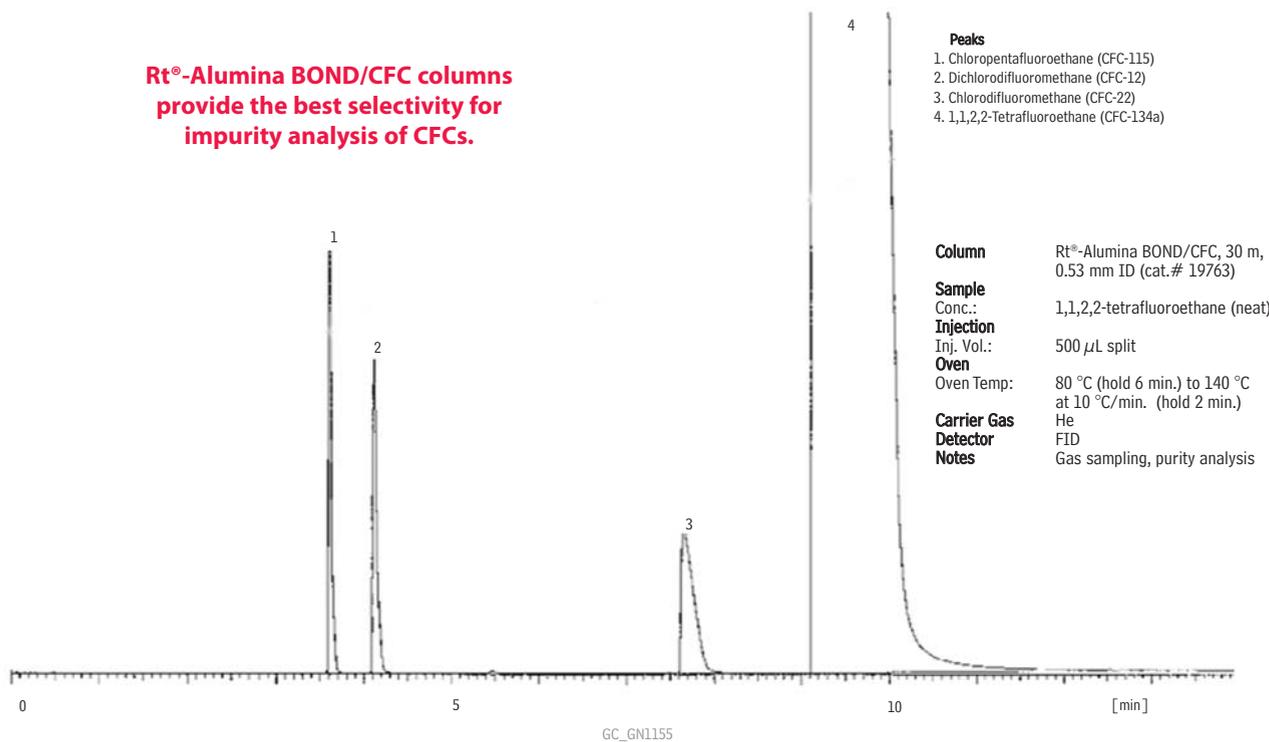
- Improved inertness for halogenated compounds.
- Highly selective alumina-based column, separates most CFCs.
- High retention and capacity for CFCs.

The alumina adsorbent is ideal for retaining halogenated compounds, especially CFC (chlorinated fluorocarbons, 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.



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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.



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

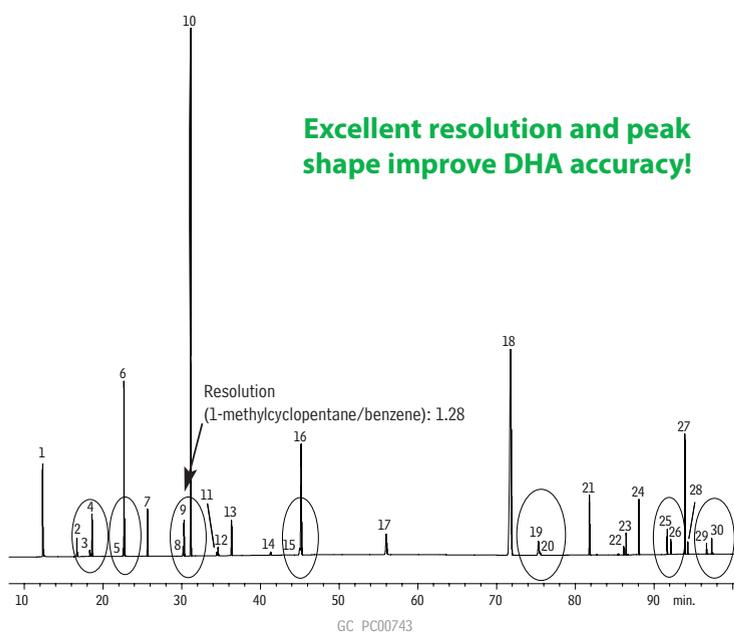
similar phases

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



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

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/Na₂SO₄ columns.

similar phases

GC-Alumina KCl, CP-Al₂O₃/KCl

Light Hydrocarbon Analysis

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.

Rt[®]-Alumina BOND/Na₂SO₄ Columns (fused silica PLOT)

(Na₂SO₄ 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

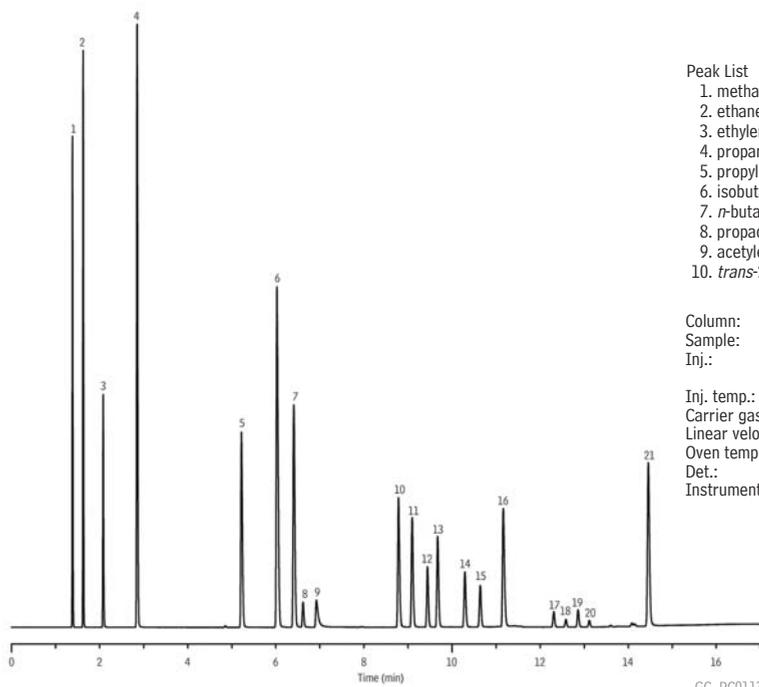
Rt[®]-Alumina BOND/KCl Columns (fused silica PLOT)

(KCl deactivation)

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

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/Na₂SO₄ column.



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

Column: Rt[®]-Alumina BOND/Na₂SO₄, 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)

(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

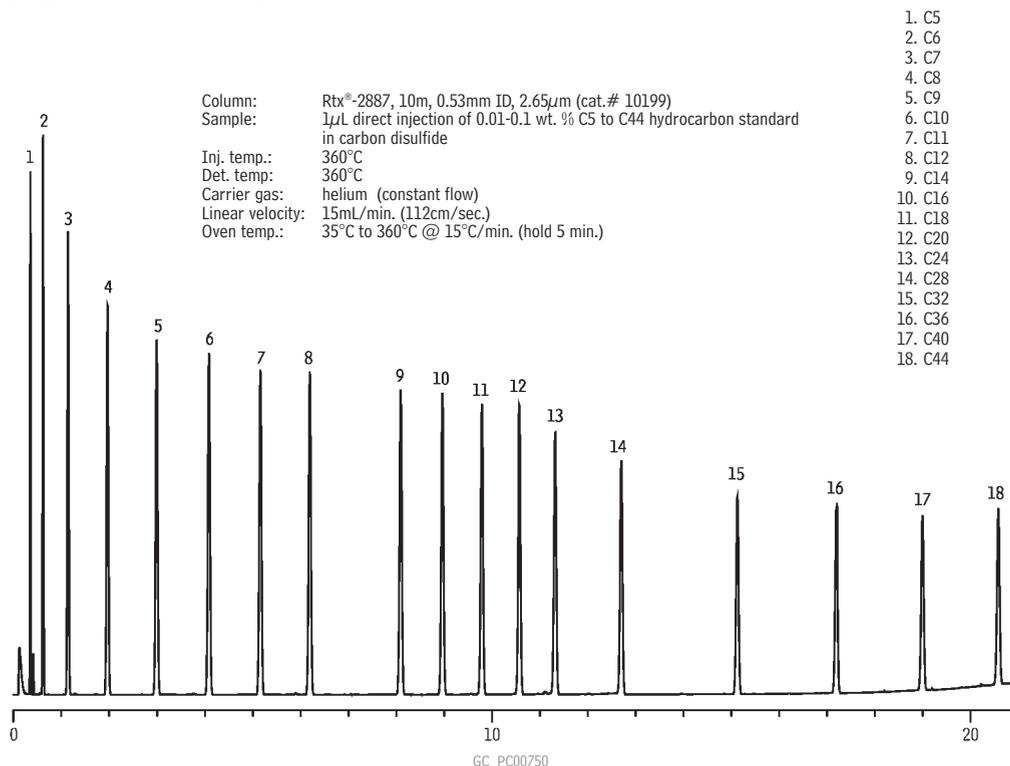
similar **phases**

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

Method Recommended Columns

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

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	0.10 μ m	-60 to 430/450°C	70112	
	0.20 μ m	-60 to 430/450°C	70115	
	0.21 μ m	-60 to 430/450°C		70118
	0.88 μ m	-60 to 400/430°C	70131	70134
	1.00 μ m	-60 to 380/400°C		70130
	1.20 μ m	-60 to 380/400°C		70119
	2.65 μ m	-60 to 360/400°C		70132
	5.00 μ m	-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!

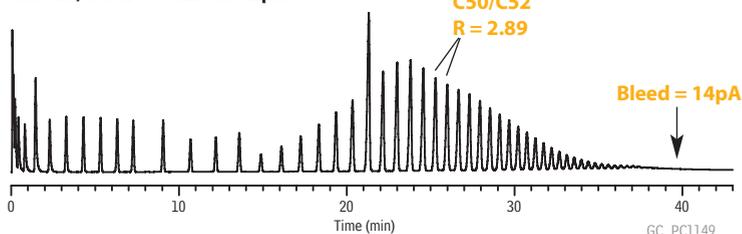
Higher efficiency means:

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

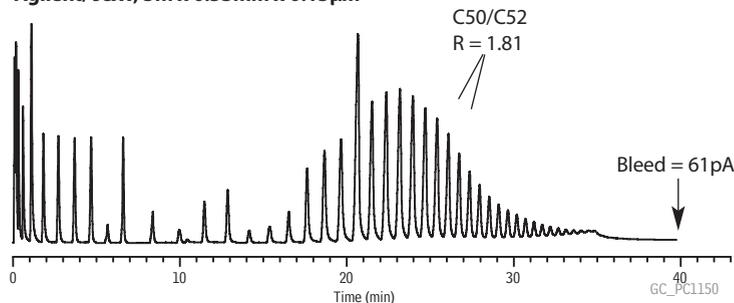
RESTEK ADVANTAGE:

Run more samples within method specifications!

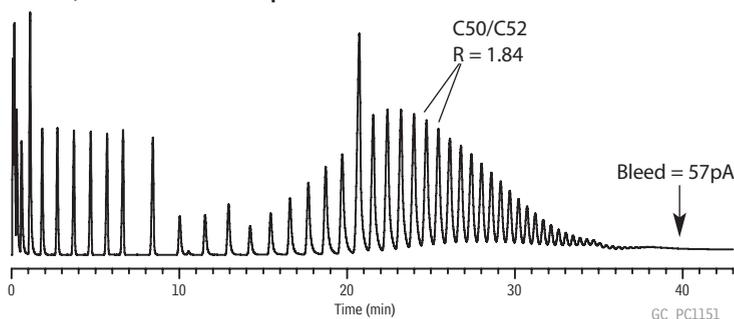
Restek, 5m x 0.53mm x 0.2 μ m



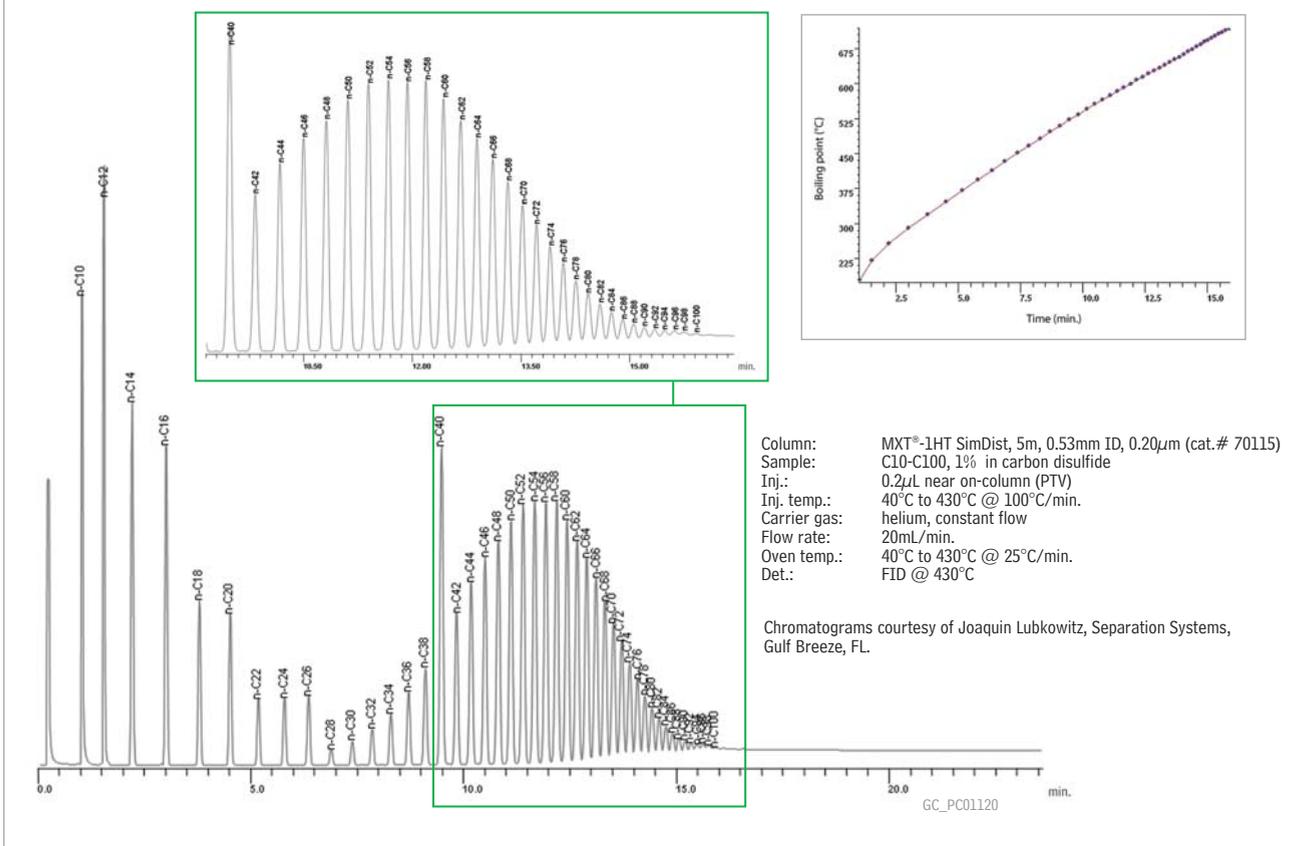
Agilent/ J&W, 5m x 0.53mm x 0.15 μ m



Varian, 5m x 0.53mm x 0.17 μ m



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



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	

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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.

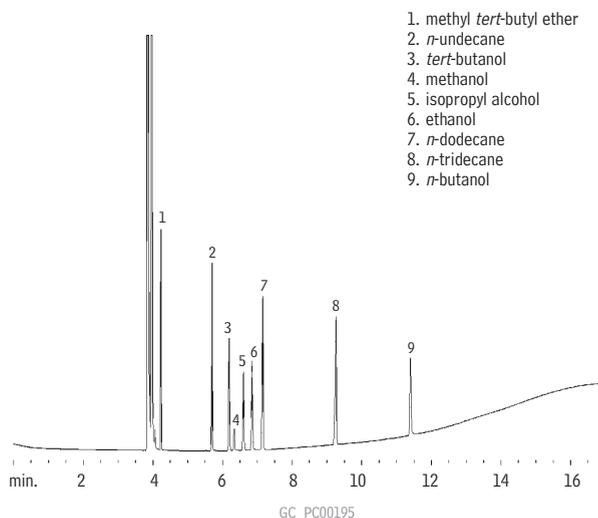
The Rt®-TCEP column incorporates a nonbonded stationary phase coated on a surface specialized for enhanced polymer stability and extended column lifetime. Solvent rinsing should be avoided. Conditioning is necessary only if the column is to be used at temperatures near the maximum operating temperature.

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 10¹¹ AFS
 Split flow: 46mL/min.



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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.

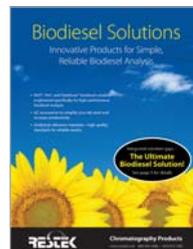
**Connected with low-dead-volume MXT connector.

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	

free literature



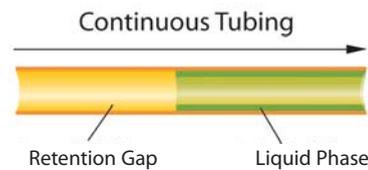
Biodiesel Solutions: Innovative Products for Simple, Reliable Biodiesel Analysis

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lit. cat.# 580207

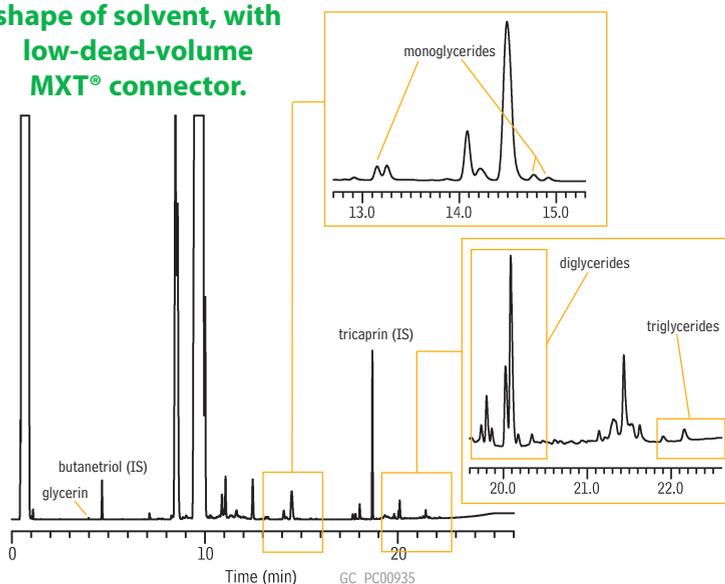
Integra-Gap® technology

- 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



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Baseline resolution in less than 3 minutes.

similar **phases**

DB-ALC1, DB-ALC2

Blood Alcohol Analysis

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.

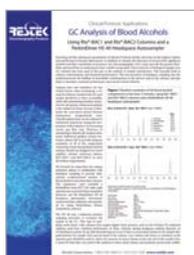
These columns separate to baseline all blood alcohol compounds in blood, breath, or urine, in less than 3 minutes, under isothermal conditions. Isothermal analysis increases productivity by eliminating the need for oven cycling. Confirmation is easily achieved with this tandem set because there are four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

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

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

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

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



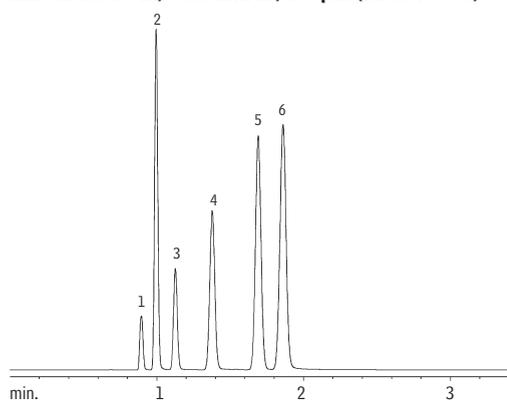
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GC Analysis of Blood Alcohols

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lit. cat.# 59598A

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

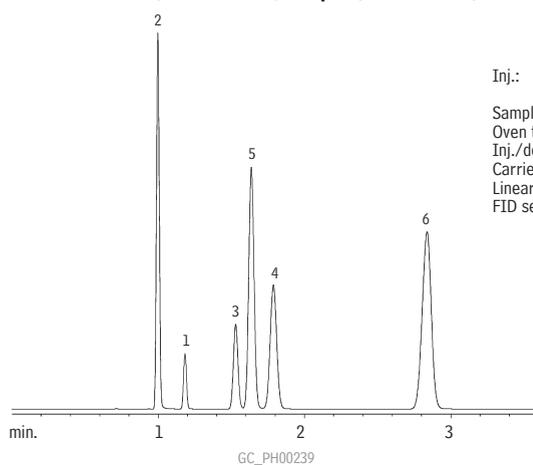
Rtx®-BAC1 30 m, 0.53 mm ID, 3.0 μ m (cat.# 18001)



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 μ m (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 10⁻¹¹ AFS

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Organic Volatile Impurities (OVI) Analysis

Rxi[®]-624Sil MS Columns for USP<467> Residual Solvents analysis

NEW!

Improve system suitability 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)

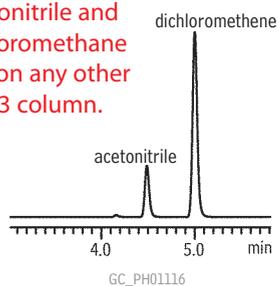
(midpolarity Crossbond[®] silarylene phase; equivalent to 6% cyanopropylphenyl/94% dimethyl arylene polysiloxane)

- 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	

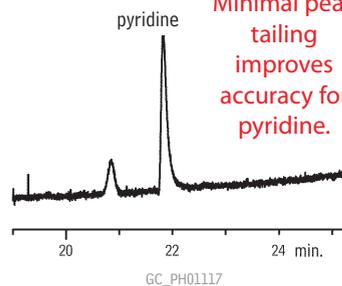
Class 2 Mix A

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



Class 2 Mix B

Minimal peak tailing improves accuracy for pyridine.

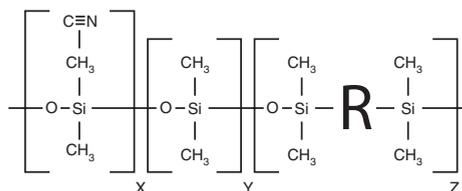


Column: Rxi[®]-624Sil MS, 30m, 0.32mm ID, 1.8µm (cat.# 13870)
 Inj.: 1.0mL manual headspace injection, split (3:1), 1mm split liner (cat.# 20972)
 Inj. temp.: 140°C
 Carrier gas: helium, constant flow
 Flow rate: 2.2mL/min.
 Oven temp.: 40°C (hold 20 min.) to 240°C @ 10°C/min. (hold 20 min.)
 Det: FID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

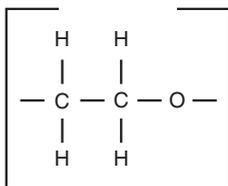
Rxi[®]-624Sil MS Structure



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

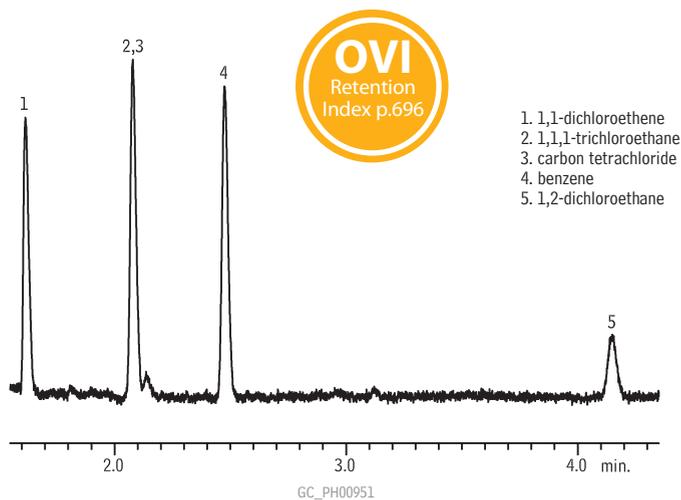
For our complete listing of Stabilwax® columns, see **page 59**.

ordering note

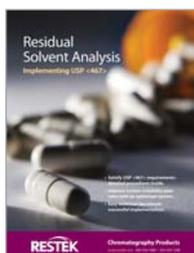
Get the protection without the connection!

For Stabilwax® columns with built-in Integra-Guard® guard columns, see **page 35**.

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



- 1,1-dichloroethene
- 1,1,1-trichloroethane
- carbon tetrachloride
- benzene
- 1,2-dichloroethane



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Residual Solvent Analysis

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lit. cat.# PHFL1018A

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.

Organic Volatile Impurities (OVI) Analysis

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.

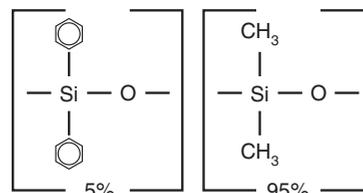
The 5% diphenyl/95% dimethyl polysiloxane stationary phase is the most popular GC stationary phase and is used in a wide variety of applications. All residual catalysts and low molecular weight fragments are removed from the Rtx®-5 polymer, providing a tight mono-modal distribution and extremely low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

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**.

G27 phase

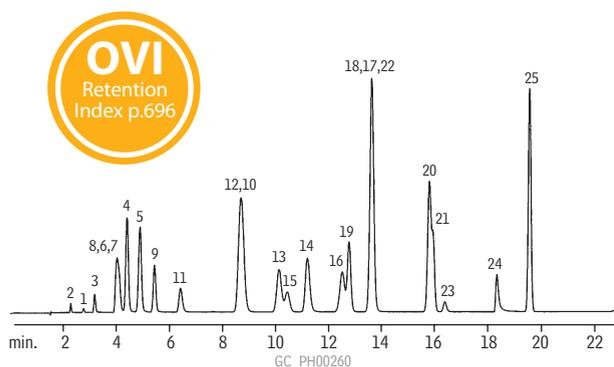
Rtx®-5 Structure



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)

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

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

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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

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A Technical Guide for Static Headspace Analysis Using GC

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Semivolatiles Analysis

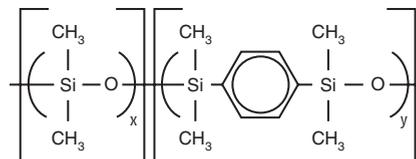
Rxi®-5Sil MS Columns (fused silica)

(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.

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**.

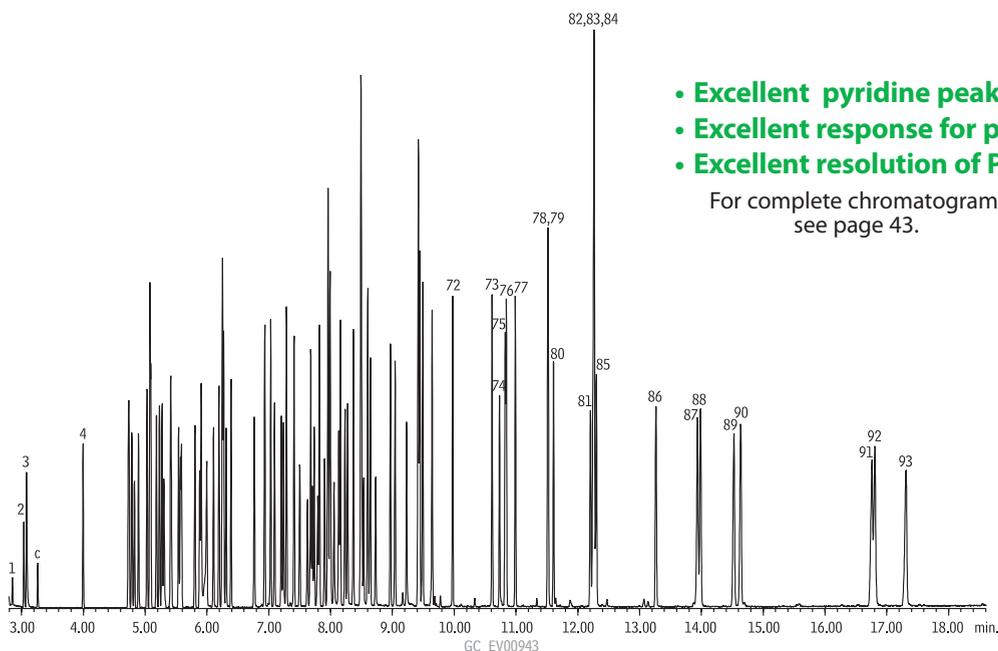
The Rxi®-5Sil MS column is recommended for US EPA Method 8270.



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	

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.

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**

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lit. cat.# EVFL1013

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

kit

ordering **note**

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

kit

kit

Chlorinated Pesticides Analysis

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.)

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

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	

also **available**

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

88 www.restek.com

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11/12

Chlorinated Pesticides Analysis

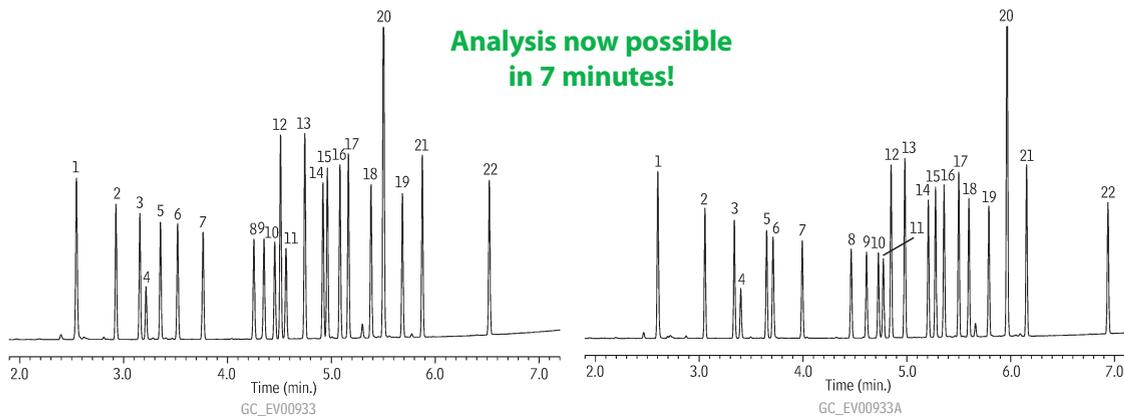


Fast GC analyses of chlorinated pesticides on Rtx®-CLPesticides and Rtx®-CLPesticides2 columns.

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

Rtx®-CLPesticides

Rtx®-CLPesticides2



Columns: Rtx®-CLPesticides, 30m, 0.32mm ID, 0.32 μ m (cat.# 11141) and Rtx®-CLPesticides2, 30m, 0.32mm ID, 0.25 μ m (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, 8-80 μ g/mL each component in hexane/toluene (cat.# 32292), Pesticide Surrogate Mix, 200 μ g/mL each component in acetone (cat.# 32000)

Inj.: 1.0 μ L 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.

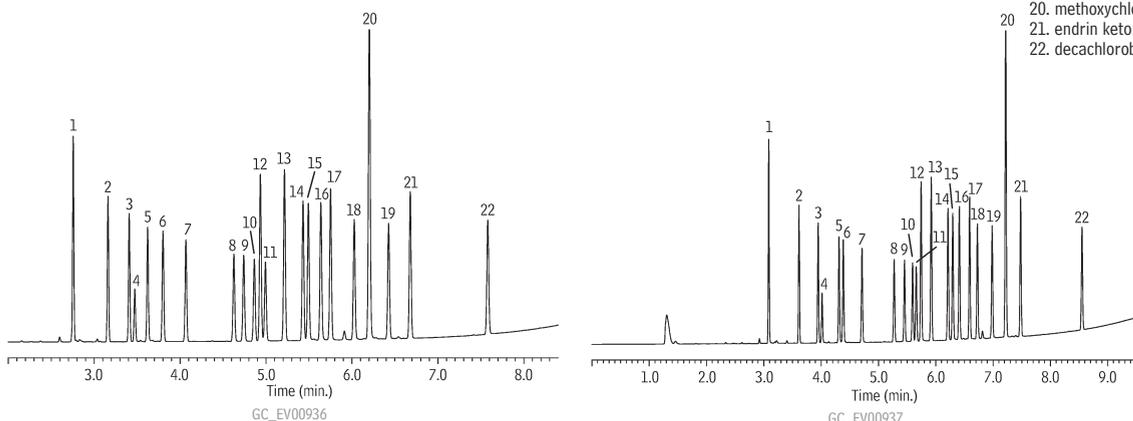
Det.: Agilent 6890 w/ μ -ECD @ 330°C

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, 0.50 μ m (cat.# 11140) and Rtx®-CLPesticides2, 30m, 0.53mm ID, 0.42 μ m (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, 8-80 μ g/mL each component in hexane/toluene (cat.# 32292), Pesticide Surrogate Mix, 200 μ g/mL each component in acetone (cat.# 32000)

Inj.: 1.0 μ L 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	0.25 μ m	-60 to 310/330°C	11540	11543
0.32mm	0.32 μ m	-60 to 310/330°C		11546
	0.50 μ m	-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	0.20 μ m	-60 to 310/330°C	11440	11443
0.32mm	0.25 μ m	-60 to 310/330°C	11441	11444

Stx[®]-CLPesticides Kits

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



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

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



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

Includes:	cat.#	price
30m, 0.32mm ID, 0.32 μ m Stx-CLPesticides Column	11546	
30m, 0.32mm ID, 0.25 μ m 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.



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Visit us at www.restek.com/enviro

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.



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)

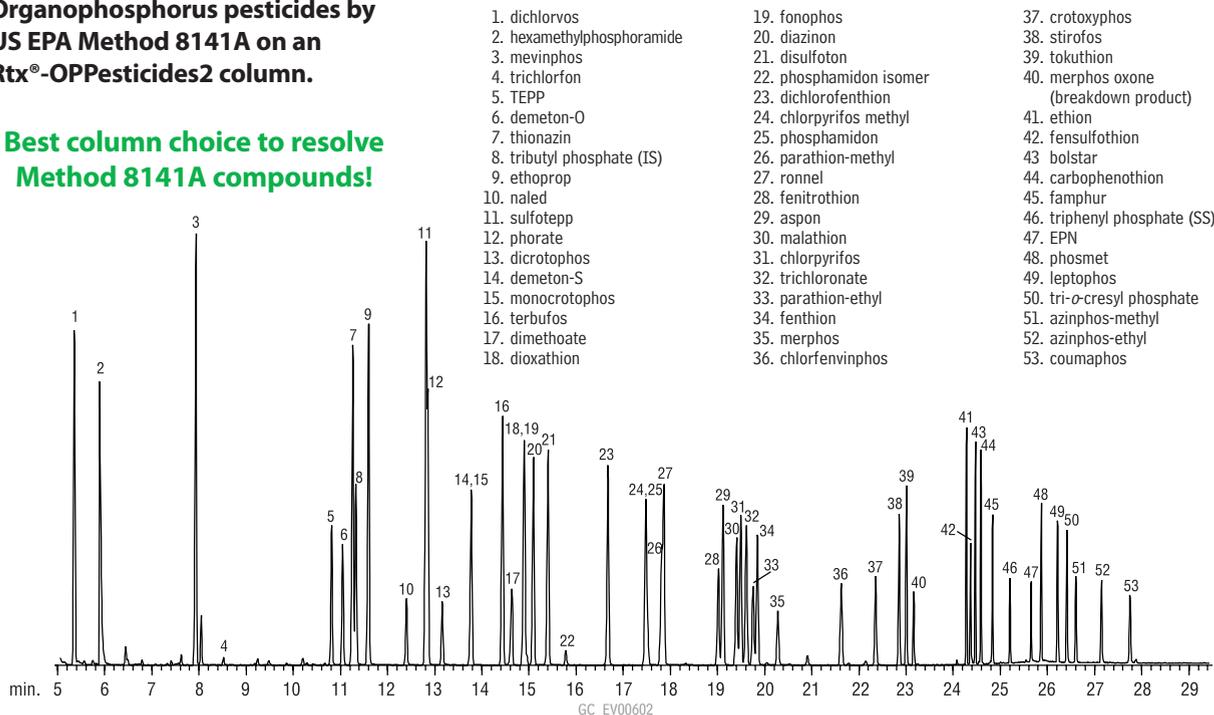
ID	df	temp. limits	30-Meter
0.32mm	0.50µm	-20 to 310/330°C	11239
0.53mm	0.83µm	-20 to 310/330°C	11240

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!



- dichlorvos
- hexamethylphosphoramide
- mevinphos
- trichlorfon
- TEPP
- demeton-O
- thionazin
- tributyl phosphate (IS)
- ethoprop
- naled
- sulfotepp
- phorate
- dicrotophos
- demeton-S
- monocrotophos
- terbufos
- dimethoate
- dioxathion
- fonophos
- diazinon
- disulfoton
- phosphamidon isomer
- dichlorofenthion
- chlorpyrifos methyl
- phosphamidon
- parathion-methyl
- ronnel
- fenitrothion
- aspon
- malathion
- chlorpyrifos
- trichloronate
- parathion-ethyl
- fenthion
- merphos
- chlorfenvinphos
- crotoxyphos
- stirofos
- tokuthion
- merphos oxone (breakdown product)
- ethion
- fensulfthion
- bolstar
- carbophenothion
- famphur
- triphenyl phosphate (SS)
- EPN
- phosmet
- leptophos
- tri-*o*-cresyl phosphate
- azinphos-methyl
- azinphos-ethyl
- coumaphos

Column: Rtx®-OPPesticides2, 30m, 0.25mm ID, 0.25µm (cat.# 11243)
 Sample: US EPA Method 8141A Custom Standard Mix 1µL 100ppm (100ng on column)
 Triphenylphosphate Standard (cat.# 32281)
 Tributylphosphate Standard (cat.# 32280)
 8140/8141 OP Pesticides Calibration Mix A (cat.# 32277)
 8141 OP Pesticides Calibration Mix B (cat.# 32278)
 Custom Mixes: Call Restek for Information
 Inj.: 1.0µL splitless (hold 0.4 min.), 4mm double gooseneck inlet liner (cat.# 20785)

Inj. temp.: 250°C
 Carrier gas: helium, constant flow
 Flow rate: 1.0mL/min.
 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.)
 Det: MS
 Transfer line temp.: 280°C
 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.

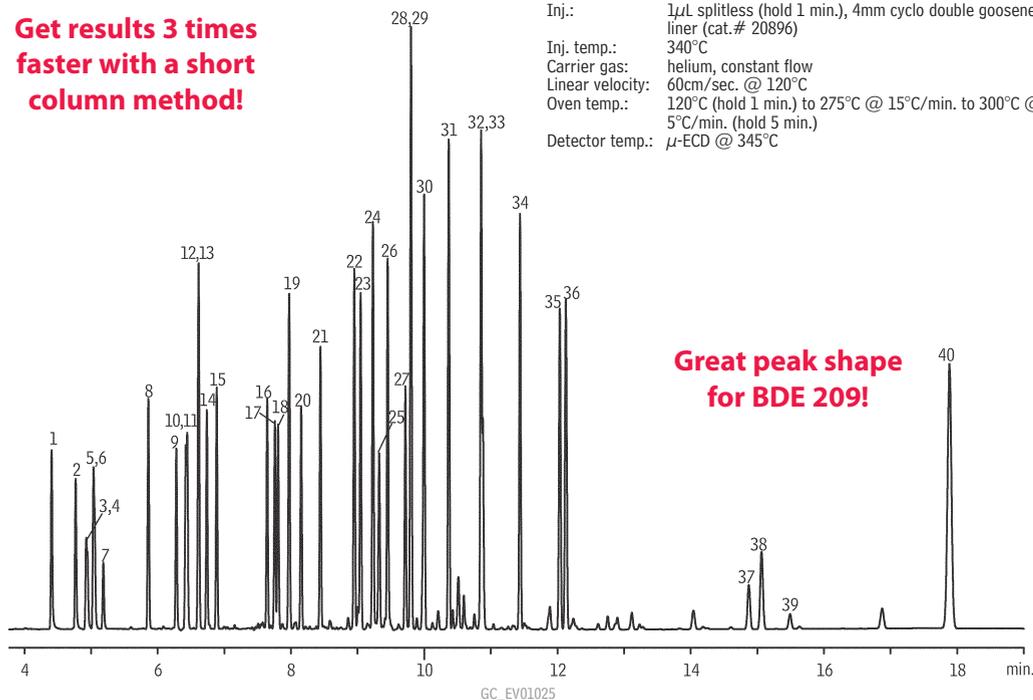
Table of Contents for
GC Chromatograms
see page 542



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.

Get results 3 times faster with a short column method!



Column: Rtx®-1614, 15m, 0.25mm ID, 0.10µm (cat.# 10296)
 Sample: 100-300ppb PBDE PAR Solution (cat.# EO-5113, Cambridge Isotope Laboratories Inc.), 500ppb decabromodiphenyl ether (cat.# BDE-209, Wellington Laboratories)
 Inj.: 1µL splitless (hold 1 min.), 4mm cyclo double gooseneck liner (cat.# 20896)
 Inj. temp.: 340°C
 Carrier gas: helium, constant flow
 Linear velocity: 60cm/sec. @ 120°C
 Oven temp.: 120°C (hold 1 min.) to 275°C @ 15°C/min. to 300°C @ 5°C/min. (hold 5 min.)
 Detector temp.: µ-ECD @ 345°C

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

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.

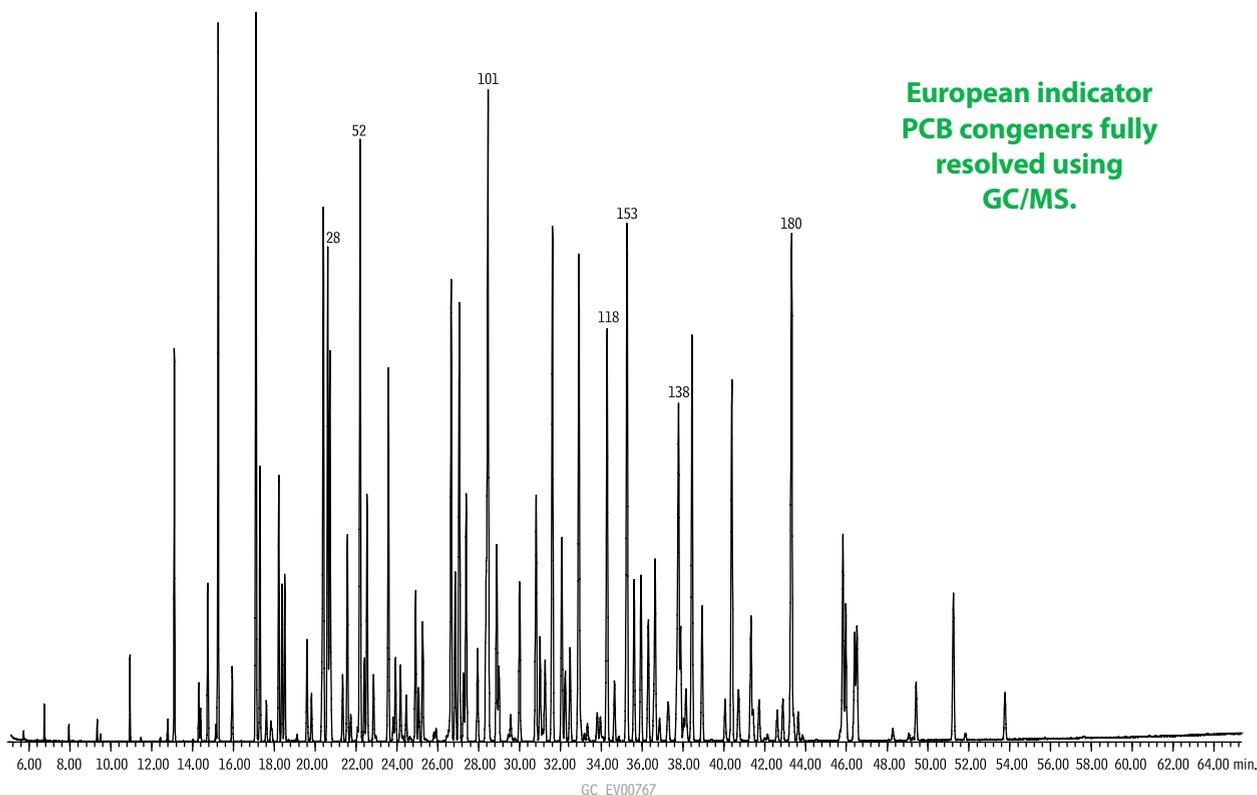
restek **innovation!**



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).

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.

similar phases

DB-XLB, VF-Xms

Chromatogram Search Tool

Search by compound name, synonym, CAS # or keyword

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Dioxin & Furan Congeners Analysis

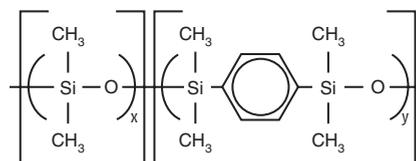
Rxi®-5Sil MS Columns (fused silica)

(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.

Rxi®-5Sil MS Structure



similar phases

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

also available

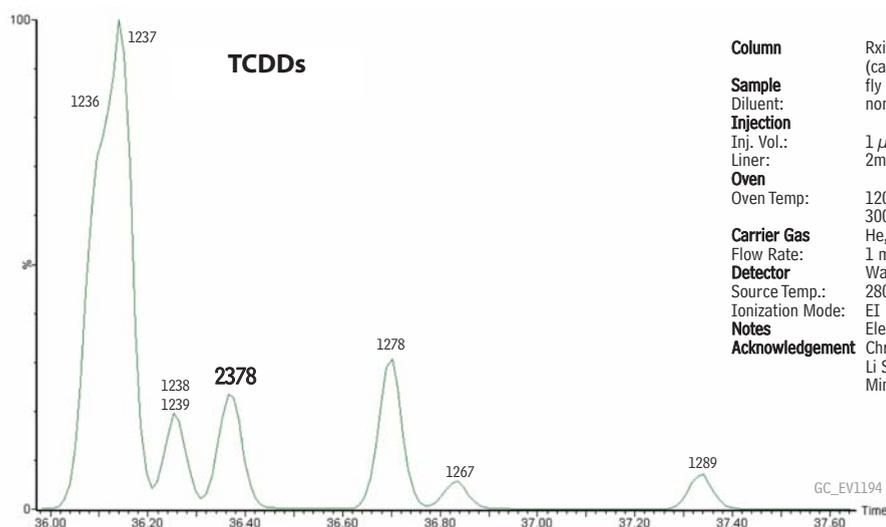
Other Dimensions!

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

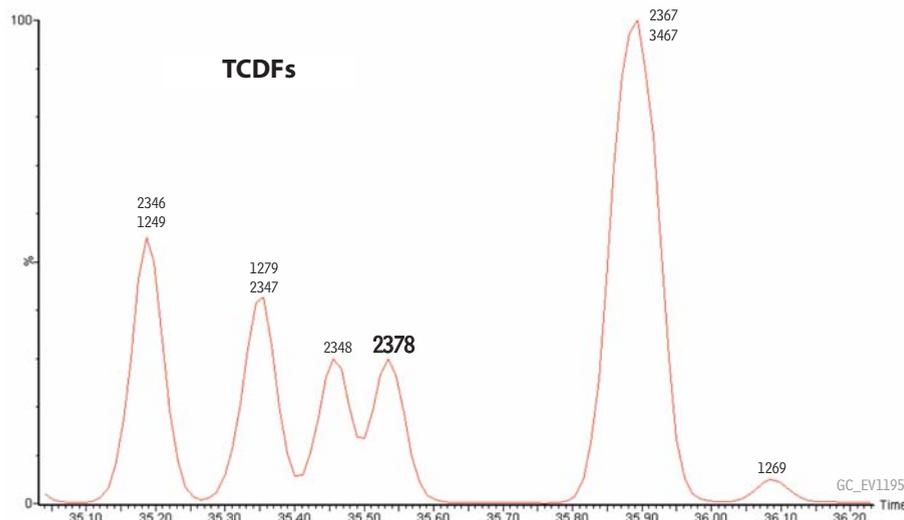
ID	df	temp. limits	30-Meter	60-Meter*
0.18mm	0.10µm	-60 to 320/350°C		43607
0.25mm	0.25µm	-60 to 330/350°C	13623	

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

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





restek **innovation!**

Excellent for dioxins or furans.

Dioxin & Furan Congeners Analysis

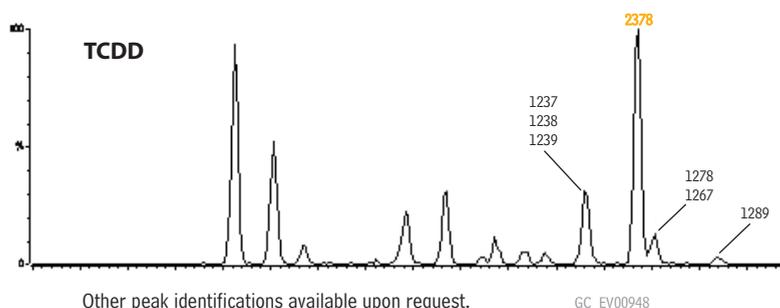
Rtx®-Dioxin2 Columns (fused silica)

(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.

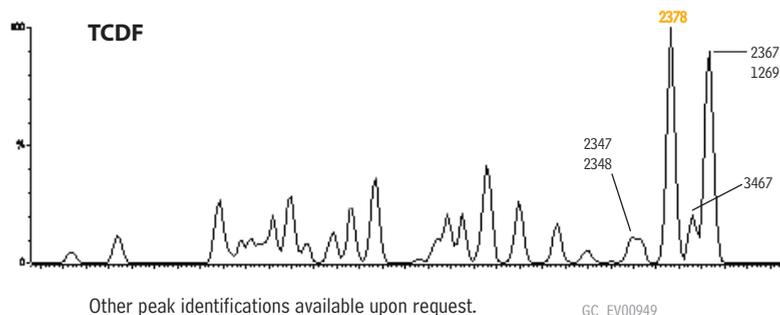
ID	df	temp. limits	40-Meter	60-Meter
0.18mm	0.18µm	20°C to 340°C	10759	
0.25mm	0.25µm	20°C to 340°C		10758

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



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.



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

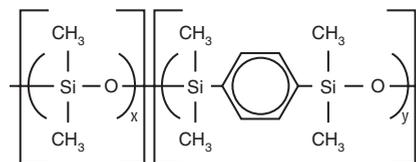
Polycyclic Aromatic Hydrocarbon (PAH) Analysis

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.

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.

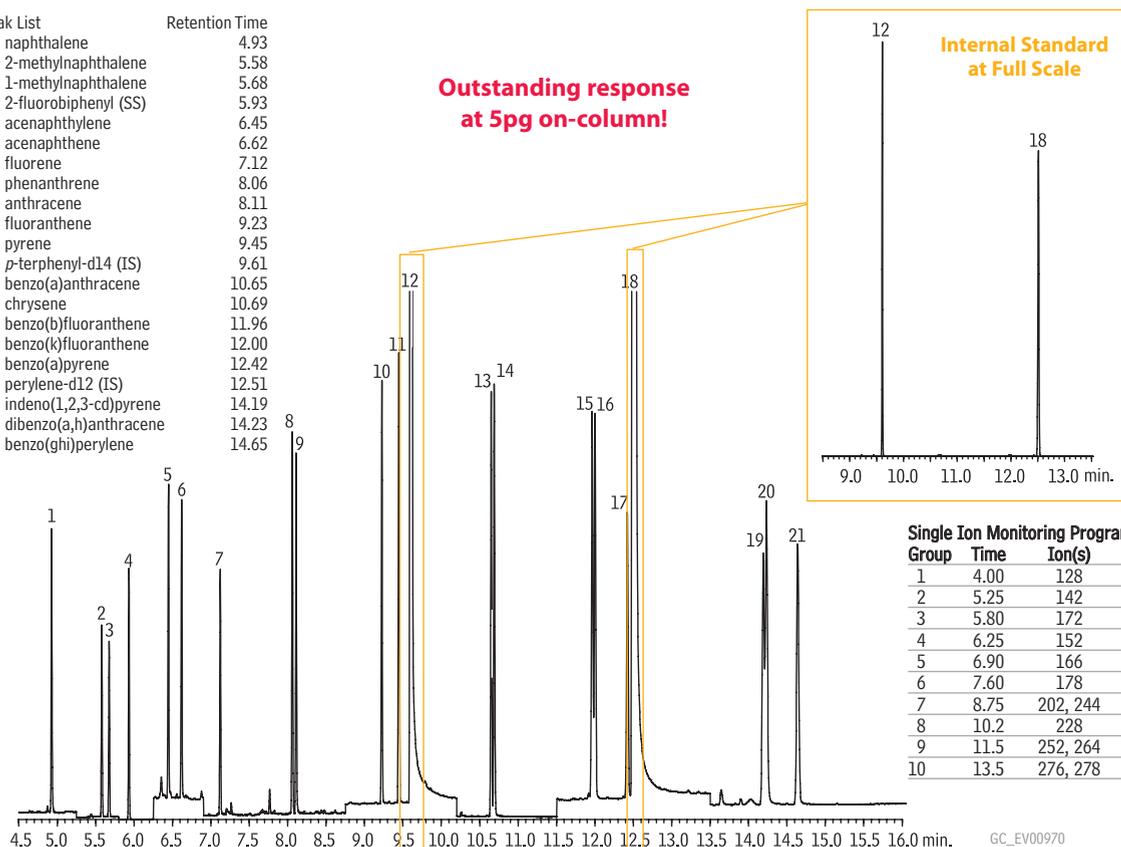
ID	df	temp. limits	15-Meter	30-Meter	60-Meter
0.25mm	0.10µm	-60 to 330/350°C	13605	13608	
	0.25µm	-60 to 330/350°C	13620	13623	13626
	0.50µm	-60 to 330/350°C	13635	13638	

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

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

Outstanding response
at 5pg on-column!



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

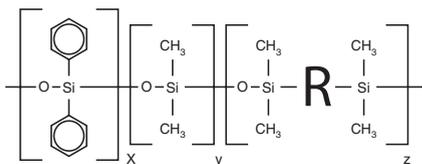
Mode: SIM

GC_EV00970



Polycyclic Aromatic Hydrocarbon (PAH) Analysis

Rxi®-17Sil MS Structure



Rxi®-17Sil MS Columns (fused silica)

(midpolarity Crossbond® silarylene phase; equivalent to 50% phenyl/50% dimethyl aryene 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	

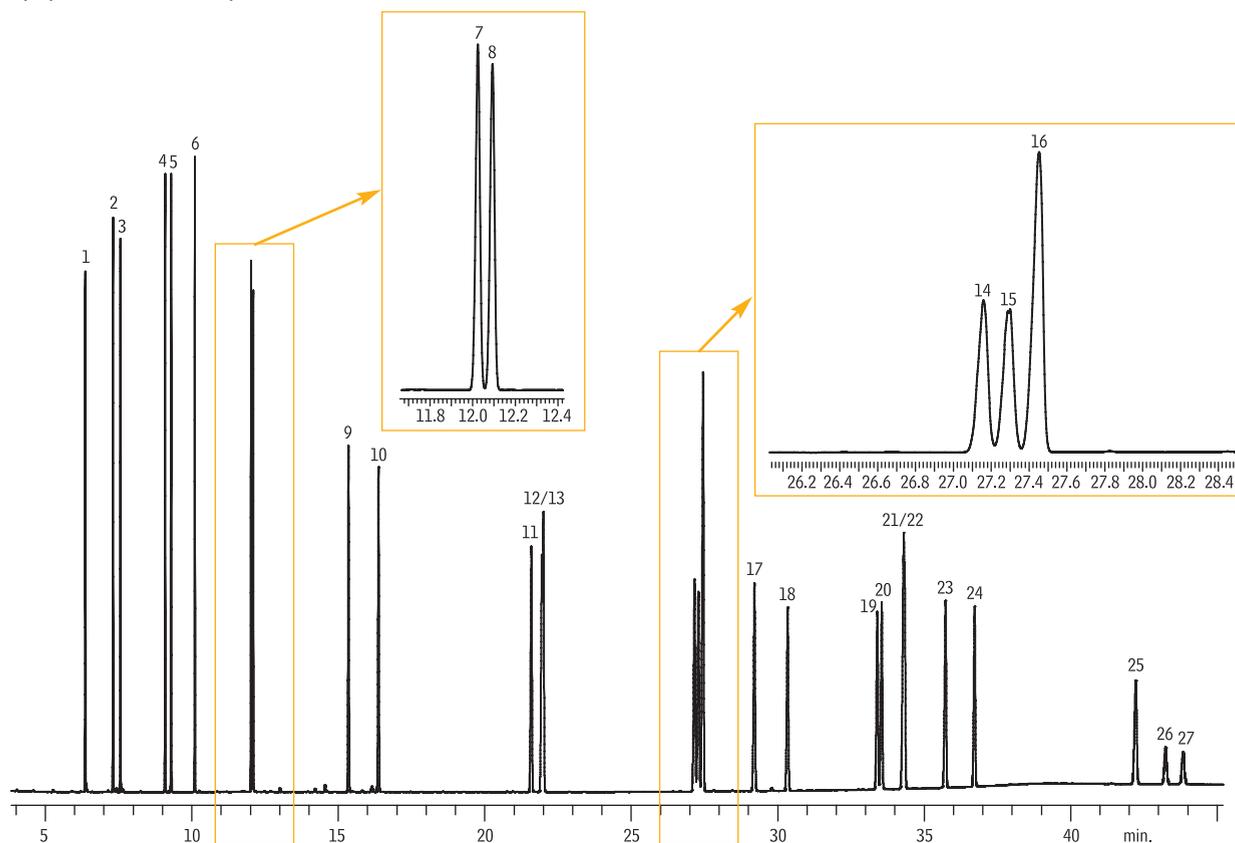
similar phases

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

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.

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



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 Sample

Diluent:
Conc.:
Injection
Inj. Vol.:
Liner:
Inj. Temp.:
Purge Flow:
Oven
Oven Temp:
Carrier Gas
Flow Rate:
Detector Instrument
Acknowledgement

Rxi®-17Sil MS, 30 m, 0.25 mm ID, 0.25 µm (cat.# 14123)
SV Calibration Mix #5 / 610 PAH Mix (cat.# 31011)
EPA Method 8310 PAH Mixture (cat.# 31841)
dichloromethane
10 ppm

0.5 µL splitless (hold 1.75 min.)
Auto SYS XL PSS Split/Splitless w/Wool (cat.# 21718)
320 °C
75 mL/min.

65 °C (hold 0.5 min.) to 220 °C at 15 °C/min. to 330 °C at 4 °C/min. (hold 15 min.)
He, constant flow
2.0 mL/min.
FID @ 320 °C
PE Clarus 600 GC
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.



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.

similar phases

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

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



Looking for a Simple Solution?



New Sky™ liners, featuring a state-of-the-art deactivation, give you the inertness you need for accurate, reproducible trace level results.

See pp. 206-211 for details.

Volatile Organics Analysis

Rtx®-VMS Columns (fused silica)

(proprietary Crossbond® phase)

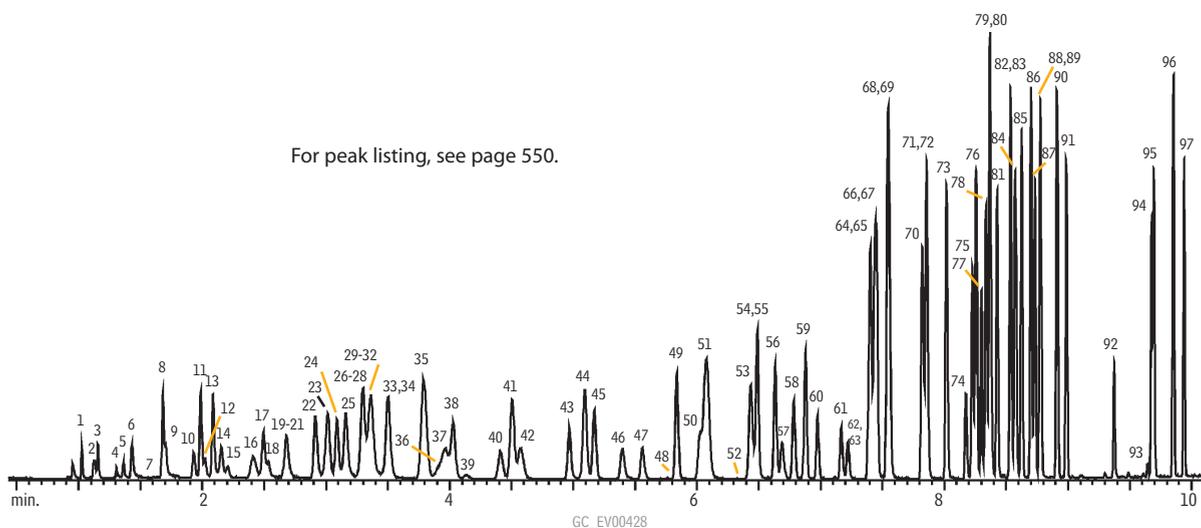
- Application-specific columns for volatile organic pollutants by GC/MS.
- Complete separation of US EPA Method 8260B compounds in less than 10 minutes.
- Stable to 260 °C.
- No known equivalent phases.

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.

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: Vocabr 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.

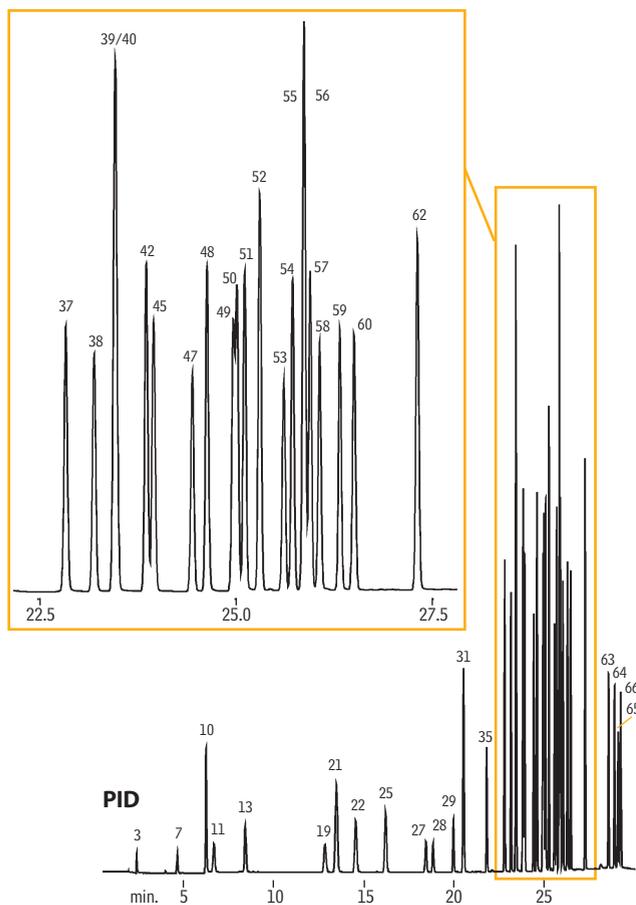
ID	df	temp. limits	30-Meter	60-Meter	75-Meter	105-Meter
0.25mm	1.40µm	-40 to 240/260°C	19315	19316		
0.32mm	1.80µm	-40 to 240/260°C	19319	19320		
0.45mm	2.55µm	-40 to 240/260°C	19308		19309	
0.53mm	3.00µm	-40 to 240/260°C	19385	19388	19374	19389

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.



For peak listing and run conditions,
please visit us at www.restek.com
Search for GC_EV00001

GC_EV00001

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



ChromaBLOGraphy

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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.

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

similar phase

DB-502.2

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.

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.

similar phase

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Volatile Organics Analysis

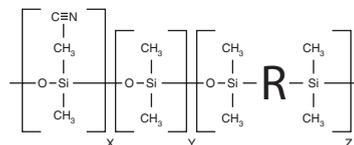


Rxi®-624Sil MS Columns (fused silica)

(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.

Rxi®-624Sil MS Structure

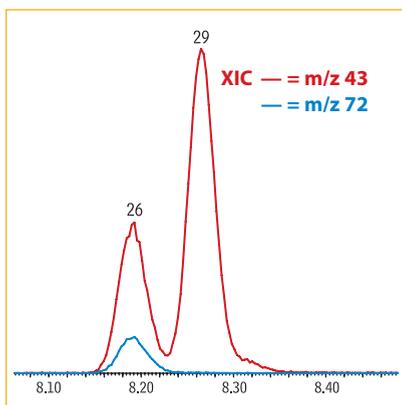


similar phases

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

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	

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

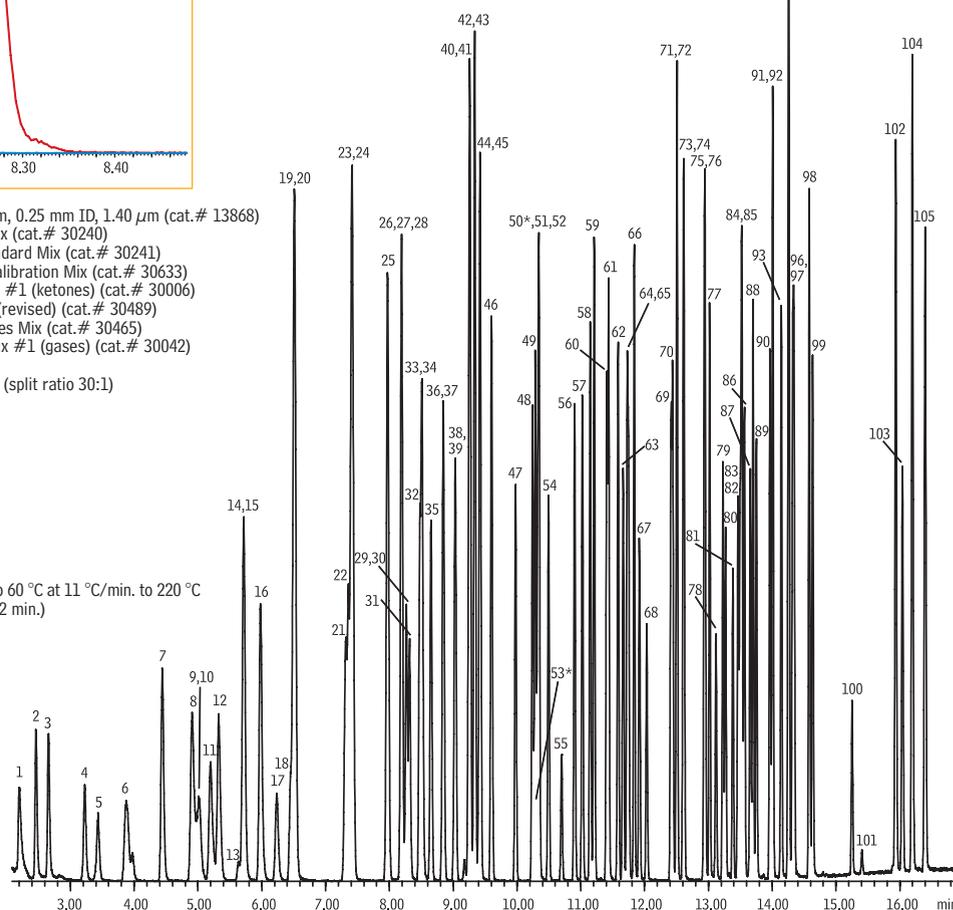
Purge and Trap
Instrument: OI Analytical 4660
Trap Type: 10 Trap
Purge: 11 min. @ 20 °C
Desorb Preheat Temp.: 180 °C
Desorb: 0.5 min. @ 190 °C
Bake: 5 min. @ 210 °C
Interface Connection: injection port

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



For peak list and complete conditions, see page 547.

GC_EV1169



GC COLUMNS

PLOT COLUMNS

PLOT Column Selection 105-107

Alumina BOND Columns

Rt-Alumina BOND/Na₂SO₄108
Rt-Alumina BOND/KCl108
Rt-Alumina Bond/CFC108
MXT-Alumina BOND/Na₂SO₄108

Molecular Sieve 5A Columns

Rt-Msieve 5A109
MXT-Msieve 5A109

Porous Polymer Columns

Rt-Q-BOND110
Rt-QS-BOND110
Rt-S-BOND110
Rt-U-BOND110
MXT-Q-BOND110
MXT-S-BOND110
PLOT Column Particle Trap111



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11/12

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 ₂ SO 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, SF ₆ , and CH ₄ , C ₂ H ₂ , 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 ₂ SO ₄ MXT-Alumina BOND	Aluminum oxide	GS-Alumina	Alumina-Sulfate	AT-Alumina	CP-Al ₂ O ₃ /NA ₂ SO ₄	—
Rt-Alumina BOND/KCl	Aluminum oxide	GC-Alumina KCl HP PLOT Al ₂ O ₃	Alumina-Chloride	—	CP-Al ₂ O ₃ /KCl	—
Rt-Alumina BOND/CFC			unique product			
Rt-Msieve 5A MXT-Msieve 5A	Molecular sieve 5A	HP PLOT Molsieve	Molsieve 5A PLOT	AT-Molsieve	CP-Molsieve 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

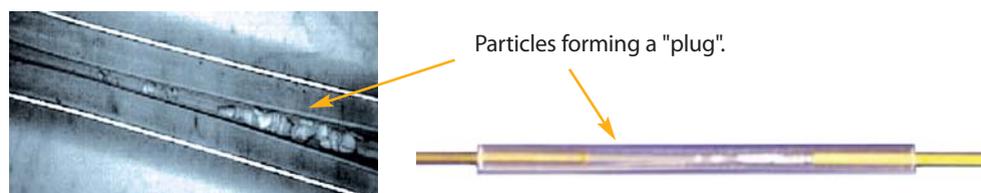
- Stabilized particle layers improve robustness and reproducibility of retention and flow.
- Fully compatible with valve switching and Deans switching systems.
- Highly efficient, reproducible analyses; ideal for permanent gases, solvents, and hydrocarbons.
- New manufacturing procedure reduces particle 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.

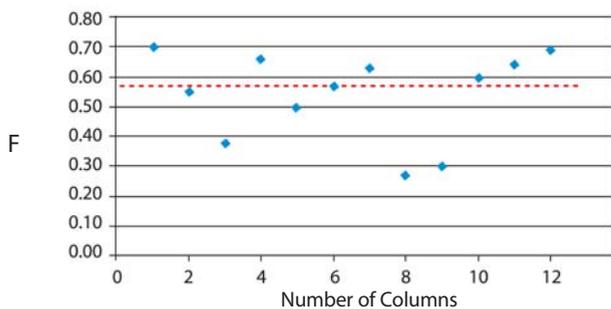


In order to evaluate flow restriction reproducibility, Restek is introducing a new factor: the flow restriction factor (F). This factor is based on the retention time of an unretained marker compound, as measured on both coated and uncoated tubing using the same backpressure setting (Equation 1). For 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.



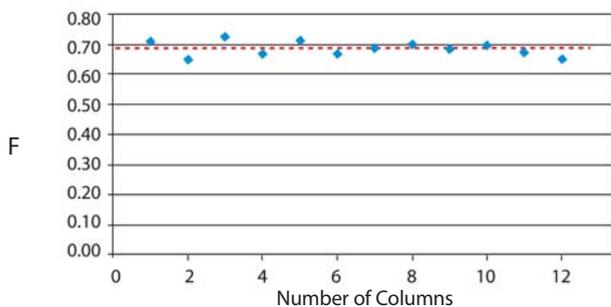
Equation 1 Flow restriction factor (F) is used to demonstrate coating consistency.

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

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.





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.

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/Na₂SO₄ Columns (fused silica PLOT)

(Na₂SO₄ 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



for more info

For more information on Rt®-Alumina BOND/CFC columns, see page 74.

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.

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



MXT®-Alumina BOND/Na₂SO₄ 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.

ID	df (µm)	temp. limits	3.5" coil	7" diameter 11-pin cage
			30-Meter	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/O₂ and other permanent gases, including CH₄, C₂H₆, 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/O₂ and H₂/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.

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)

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



advanced technology

Details on pages 106-107.



did you know?

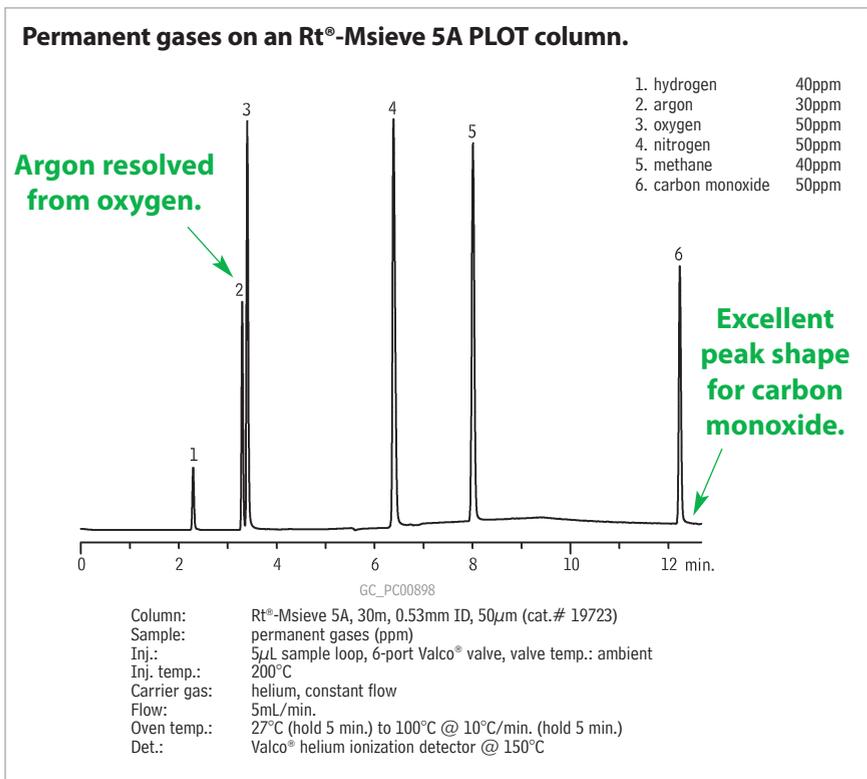
Rt®-Msieve 5A PLOT columns are designed for efficient separation of Ar/O₂ and other permanent gases, including CH₄, C₂H₆, and CO.

i 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.

i 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.





advanced
 technology

Details on pages 106-107.



For more chromatograms, see pages 652, 654 and 701-703, or use our chromatogram search tool at www.restek.com/chromatograms

least polar



most polar

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.

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 CO₂ simplifies gas analysis; CO₂ and methane separated from O₂/N₂/CO (Note: O₂/N₂/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.

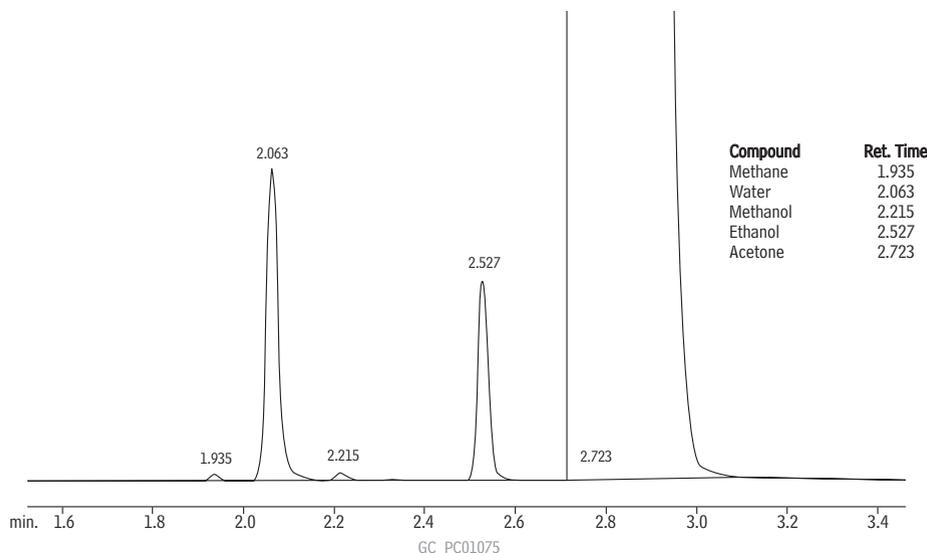
MXT[®]-Q-BOND Columns (Siltek[®]-treated stainless steel PLOT)

ID	df	temp. limits	15-Meter	3.5" coil	7" diameter 11-pin cage
				30-Meter	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	7" diameter 11-pin cage
			30-Meter	30-Meter
0.53mm	20µm	to 250°C	79712-273	79712

Water and ethanol in acetone on an Rt[®]-Q-BOND PLOT column.



Column: Rt[®]-Q-BOND, 30m, 0.53mm ID, 20 μ m (cat.# 19742)
 Sample: 0.5% water and ethanol in acetone
 Inj.: 3 μ L 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)

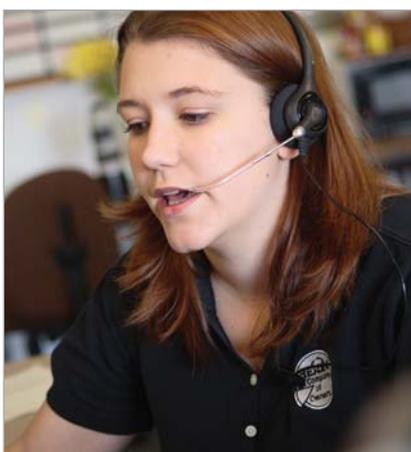
Monday–Friday 8:00 a.m.–6:00 p.m. ET

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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General Purpose Columns

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MXT-5116
MXT-20116
MXT-35117
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MXT-65117
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MXT-500 Sim Dist77, 120
MXT-502.2121
MXT-Volatiles121
MXT-624121



RESTEK **CHROMALYTIC** +61(0)3 9762 2034 **Australian Distributors**
ECHnology Pty Ltd Importers & Manufacturers www.chromtech.net.au **11/12**

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:

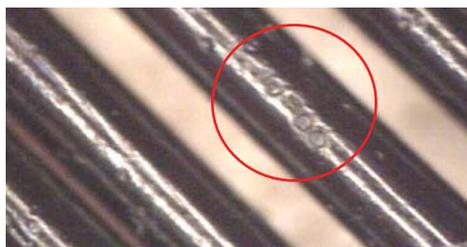
- | | | | |
|-----------|-------------|---------------------|--------------------|
| • MXT®-1 | • MXT®-65 | • MXT®-65TG | • MXT®-500 SimDist |
| • MXT®-5 | • MXT®-1301 | • MXT®-Biodiesel TG | • MXT®-502.2 |
| • MXT®-20 | • MXT®-1701 | • MXT®-2887 | • MXT®-Volatiles |
| • MXT®-35 | • MXT®-200 | • MXT®-1HT SimDist | • MXT®-624 |
| • MXT®-50 | • MXT®-WAX | • MXT®-1 SimDist | • Guard tubing |

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.

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.



also
available

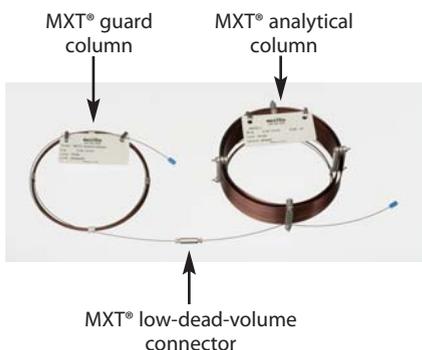
**Metal PLOT
columns!**

See pages 108-110.

MXT® guard columns are tested for inertness and bleed.



Connect MXT® columns using an MXT® Low-Dead-Volume Connector!



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.

also available

Column connector kits & ferrules
See page 292.

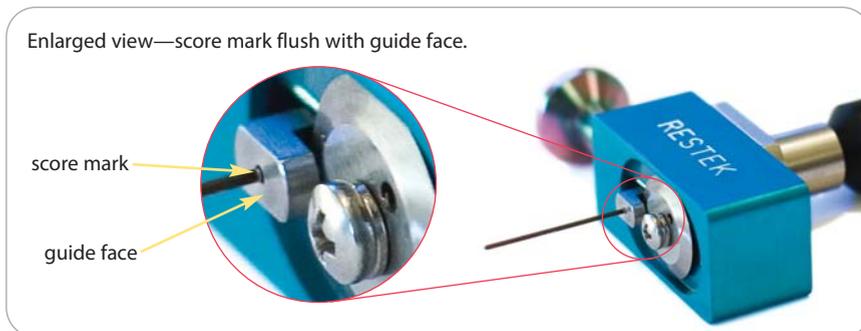
Restek Tubing Scorer for MXT® Columns

- 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.

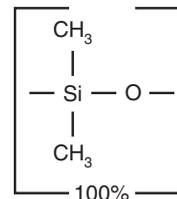
MXT®-1 columns exhibit long lifetime and very low bleed at high operating temperatures. A proprietary synthesis process eliminates residual catalysts that could cause degradation and increase bleed.

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-1701¹, 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-UPLOT², 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 cycles⁵, 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."

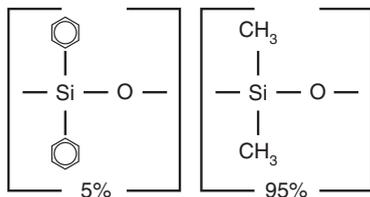
Robert STERNBERG

Responsible for the space GC team at LISA (Paris, France)

**References**

- ¹Sternberg, R., C. Szopa, D. Coscia, S. Zubrzycki, F. Raulin, C. Vidal-Madjar, H. Niemann and G. Israel *J. Chromatogr.*, 846, 307-315, (1999)
- ²C. Szopa, R. Sternberg, F. Raulin and H. Rosenbauer *Planetary and Space Science*, 51 (13) 863-877 (2003)
- ³Cabane, 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)
- ⁴Zampolli, M-G., D. Meunier, R. Sternberg, C. Szopa., F. Raulin, M. C. Pietrogrande, F. Dondi *Chirality* 18 (5):383-394 (2006)
- ⁵C. 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)

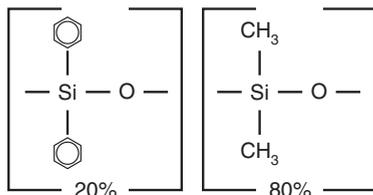
- General purpose columns for drugs, solvent impurities, pesticides, hydrocarbons, PCB congeners (e.g. Aroclor mixes), essential oils, and semivolatiles.
- Temperature range: -60 °C to 430 °C.
- Equivalent to USP G27, G36 phases.

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.

Chromatogram Search Tool

Search by compound name, synonym,
CAS # or keyword

www.restek.com/chromatograms

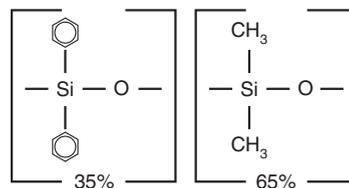


MXT®-35 Columns (Siltek® treated stainless steel)

(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

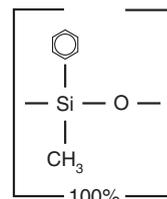
DB-35, HP-35, SPB-35, SPB-608

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

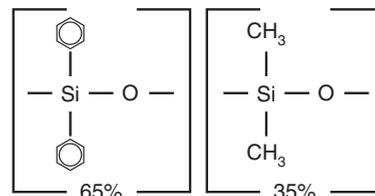
HP-17, SPB-50, SP-2250

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

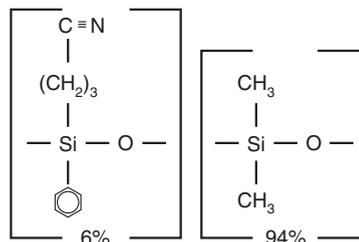
TAP-CB, 400-65HT, 007-65HT

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

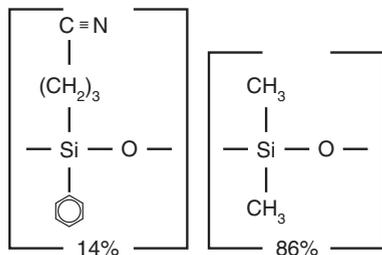
MXT®-1301 Structure

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

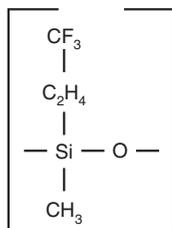
MXT®-1701 Columns (Siltek® treated stainless steel)

(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

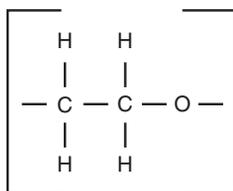
MXT®-200 Columns (Siltek® treated stainless steel)

(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

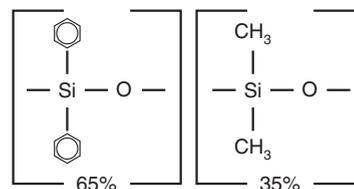
MXT®-65TG Columns (Siltek® treated stainless steel)

- (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.

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

MXT®-65TG Structure



Biodiesel Fuels Analysis

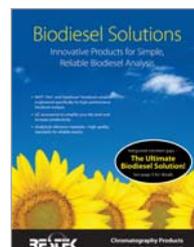
MXT®-Biodiesel TG Columns (Siltek® treated stainless steel)

- 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.



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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.

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

similar phases

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



MXT®-1HT Sim Dist column now available in even more dimensions.

similar phases

DB-1HT, CP-HT-Simdist CB

Simulated Distillation (C44-C100) Analysis

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	

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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

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.

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

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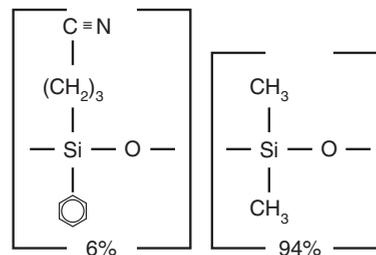
similar phase

DB-502.2

similar phase

VOCOL

MXT®-624 Structure



similar phases

DB-624, HP-624

GC COLUMNS PACKED/MICROPACKED COLUMNS

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11/12

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 life-times, 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 non-bonded 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.

Hydrocarbon	Retention Time			
	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



0.53 mm ID micropacked columns now available. See **page 132**.



Who says packed columns are old technology? Not Restek!
By combining flexible SilcoSmooth® tubing with low-bleed bonded phases, we have made the most significant improvements in packed column technology in more than 25 years!

Columns available in 0.53, 0.75, 1, 2, 3.2, & 5.2mm ID.

Bonded phase packings decrease conditioning times and bleed, and increase column lifetime.

Columns can be configured for all GC models.

Silcosmooth® tubing has a Siltek® treated surface, which is more inert than glass.

The most complete line of packing materials available.

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.

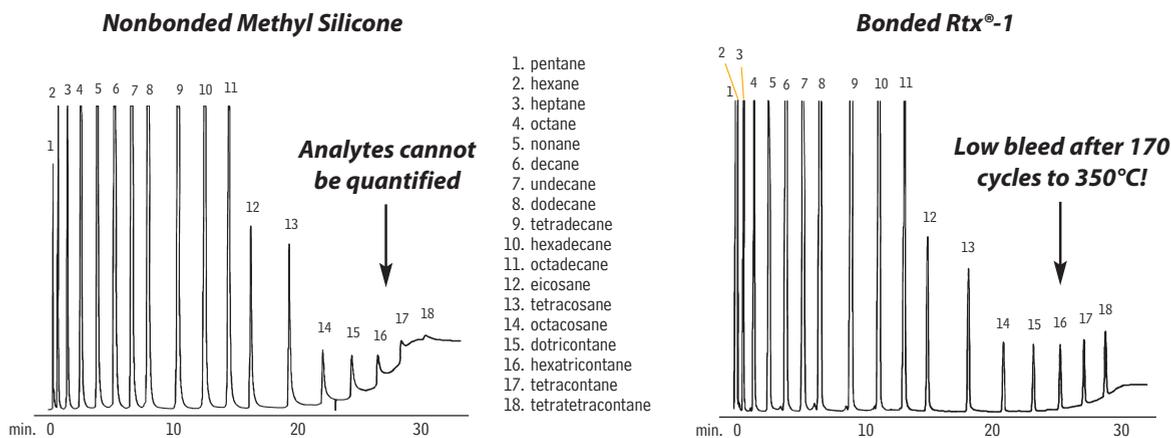
Bonded phases also last much longer than nonbonded phases. Bonded phases are more resistant to oxidation than nonbonded phases because of the stronger intermolecular forces produced by cross-linking. Because the material is thoroughly cross-linked, the phase will not migrate or puddle, as often happens 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

	BP-1, CC-1, CP-Sil 5CB, DB-1, DC-200, GE-SF-96, HP-1, HP-101, OV-1, OV-101,
Rtx-1	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.

GC_PC00369

25 μ x 1/8" x 2mm ID Rtx®-1 SimDist 2887 SilcoSmooth® stainless steel (cat.# 80000-800)
 1.0 μ l 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 CS₂) 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 weld drawn 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!



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.



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!



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.

Bonded Packed Column Stationary Phases

- Low bleed levels.
- Longer column lifetimes.
- Short conditioning times.

Bonded Phase on 100/120 Silcoport W	Stainless Steel Tubing					SilcoSmooth Tubing**				
	L (ft.)	OD (in.)	ID (mm)	cat.#**	price	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-	

Chromosorb®-Based Packed Columns

On 100/120 Silcoport W***	Stainless Steel Tubing					SilcoSmooth Tubing**				
	L (ft.)	OD (in.)	ID (mm)	cat.#**	price	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				SilcoSmooth Tubing**					
		L (ft.)	OD (in.)	ID (mm)	cat.#**	price	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					SilcoSmooth Tubing**				
	L (ft.)	OD (in.)	ID (mm)	cat.#**	price	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 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.

please **note**

Temperature limits for stationary phases are listed on **page 138**.

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.

also **available**

CarboBlack packing materials. See **page 134**.



On CarboBlack B	Mesh	Stainless Steel Tubing					SilcoSmooth Tubing**				
		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 ₃ PO ₄	60/80	6	1/8	2.1	80455-		1.8	1/8	2	80305-	

On CarboBlack B	Mesh	Nickel 200 Tubing				
		L (m)	OD (in.)	ID (mm)	cat.#**	price
5% Krytox (Ni 200 tubing)	60/80	3.05	1/8	2.1	80127-	\$315

On CarboBlack C	Mesh	Stainless Steel Tubing					SilcoSmooth Tubing**				
		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 ₃ PO ₄	60/80	2.5	3/16	3.1	80460-		0.75	3/16	3.1	80111-	

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 1-1/2" void on detector side.

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.

Molecular Sieve	Mesh	Stainless Steel Tubing					SilcoSmooth Tubing**				
		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.

Custom

Packed/Micropacked
Column Request Form

See page 142 or visit
www.restek.com/packed



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.

free literature

Resolve Benzene and Toluene in Spark Ignition Fuels Containing Ethanol

Download your free copy from

www.restek.com

lit. cat.# 580227



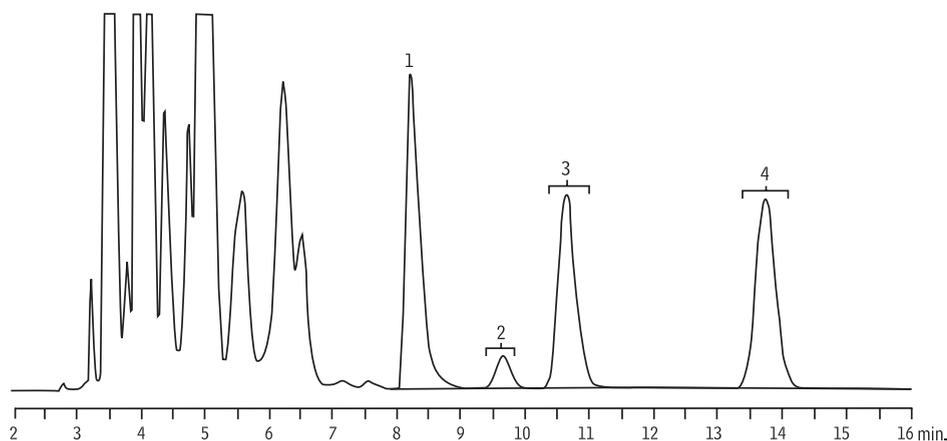
Conforms to the specifications established in ASTM method D3606-07 for the quantitation of benzene and toluene in spark ignition fuel containing ethanol.

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.



1. ethanol
2. benzene
3. 2-butanol
4. toluene

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

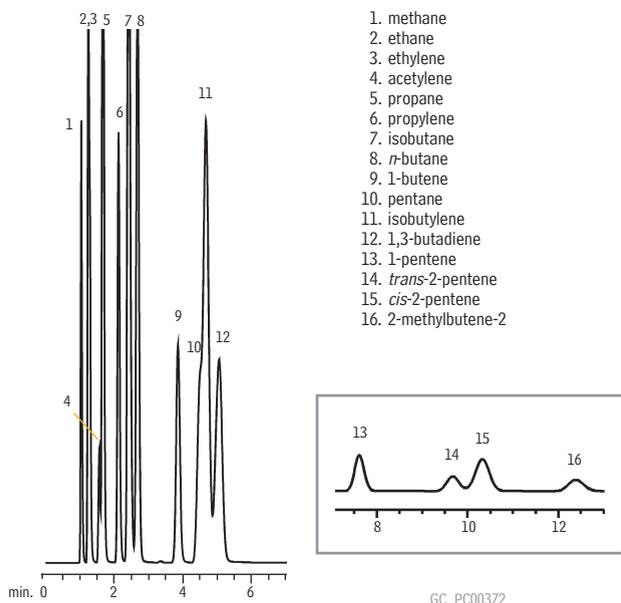
This 3-column set is finely tuned to resolve light hydrocarbons. When used in the proper valving system, it will elute C5+ hydrocarbons ahead of C1 through C4 hydrocarbons. (Figure 3)

Description	cat.#**	price
<i>n</i> -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.

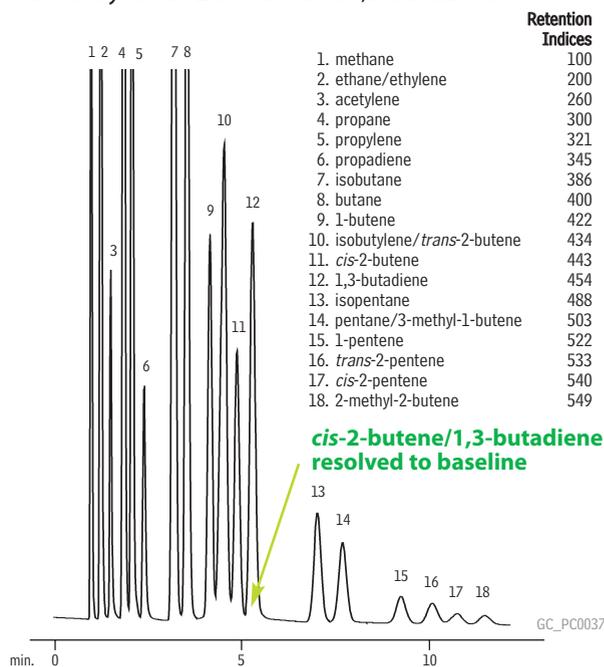
**This column set is for a valving system; therefore, packing material is filled to ends of columns.

Figure 1 *n*-Octane on Res-Sil® C packing has unique selectivity for unsaturated light hydrocarbons.



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

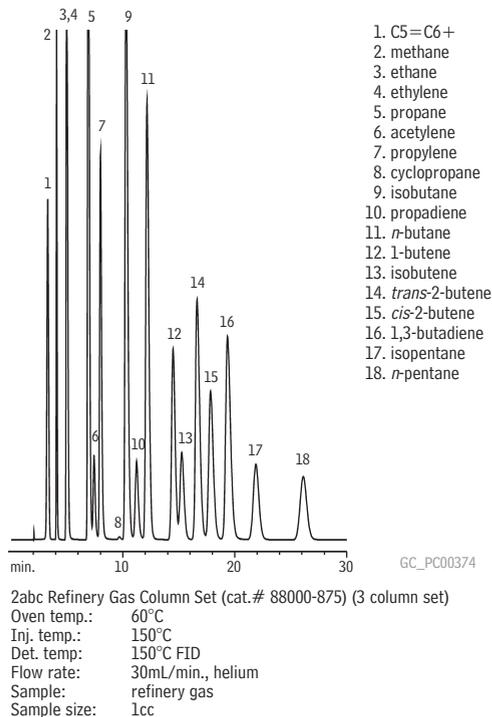
Figure 2 OPN on Res-Sil® C packing has unique selectivity for *cis*-2-butene and 1,3-butadiene.



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.



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/CO₂, 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 m²/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.

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.

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**.

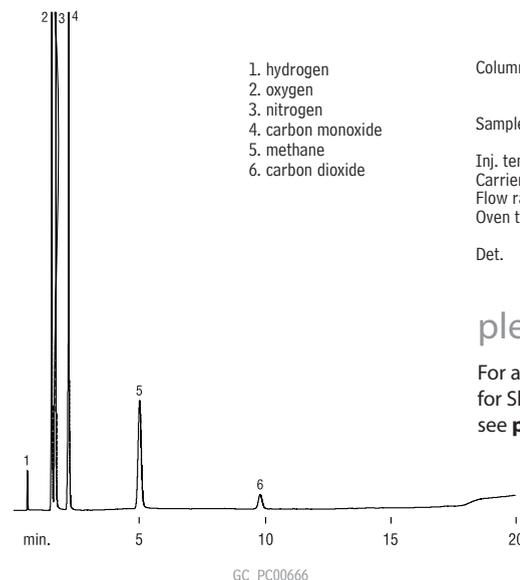
Chromatogram Search Tool

Search by compound name, synonym, CAS # or keyword

www.restek.com/chromatograms



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°C @ 8°C/min. (hold 10 min.)
 Det. HID @ 200°C

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 ppbv 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.

did you know?

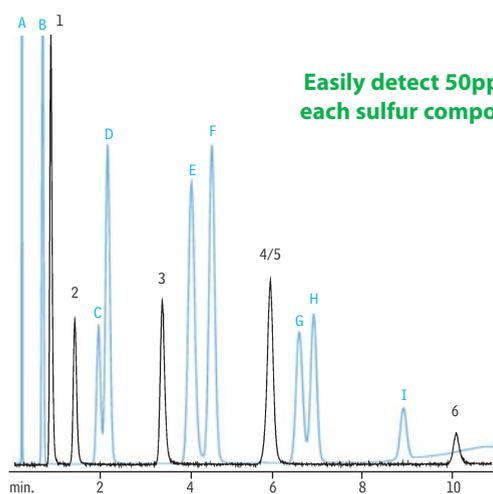
Rt[®]-XLSulfur columns are optimized for low ppb-level sulfur analysis!



also available

For adapter kits for installing packed/micropacked columns, see page 133.

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

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.

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 1 1/2" void on detector side.

Micropacked Columns



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!



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.



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

also **available**

For adapter kits for installing micropacked columns, see **page 133**.

Custom
Packed/Micropacked
Column Request Form
See page 142 or visit
www.restek.com/packed

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.

Description	For 1/8" Columns			For 3/16" Columns		
	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: 1/4" stainless steel nut (1), stainless steel Valco nut (1), 1/4" Vespel/graphite ferrule (1), stainless steel Valco ferrule (1), 1/4" stainless steel front ferrule (1), 1/4" stainless steel back ferrule (1).	kit	21067	

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 <i>Injection Port Adaptor Kit</i> 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 <i>Injection Port Adaptor Kit</i> 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	



Large-Bore Dual Vespel® Ring Inlet Seals



1/4" SS Nut



Large-Bore FID Adaptor



1/4" Vespel®/Graphite Ferrule



1/16" SS Nut



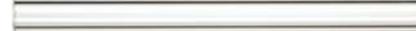
Large-Bore Reducing Nut



1/16" Vespel®/Graphite Ferrules



22430



20772



Lab Gas Issues?

Restek has the solution!

The ProFLOW 6000 Electronic Flowmeter measures volumetric flow for gases across a range of 0.5-500 mL/min.

See **page 274** for more information.

restek
innovation!



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 deacti-vants 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 Carbo-pack™ 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 Carbo-pack™ 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	
<i>n</i> -Octane on Res-Sil C	150°C	80/100	10g	25030	
2% Carbowax 1540 on Res-Sil C	150°C	80/100	10g	25044	

¹N.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

ChromaBLOGraphy

Topical and timely insights from top chromatographers.

Visit us at blog.restek.com



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	Mesh	Mesh
			60/80	80/100	100/120
			cat.#	cat.#	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		Mesh 80/100		Mesh 100/120	
			cat.#	price	cat.#	price	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	

also **available**

Custom packing materials are also available. See **page 140**.

HayeSep® Series Packings

Description	Temp. Limit	g/btl.	Mesh 60/80		Mesh 80/100		Mesh 100/120	
			cat.#	price	cat.#	price	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		Mesh 80/100	
			cat.#	price/g	cat.#	price/g
Tenax-TA	350°C	10g	25550		25551	
Tenax-GR	350°C	10g	25552		25553	



Restek's Learning Network

Sign up for our widely acclaimed seminars today!

Visit www.restek.com/seminars

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)	Phase	min./max. temp. (°C)
Apiezon L	50/300	OV-25, phenyl methyl diphenyl, 75% phenyl	0/350
<i>p,p'</i> -Azoxydiphenetole	132/140	OV-61, diphenyl, 33% phenyl	0/350
BC-120	0/125	OV-73, 5.5% diphenyl	0/325
Bentone-34	0/180	OV-101, dimethyl (fluid)	0/350
bis (2-ethoxyethyl) adipate	0/150	OV-105, cyanopropyl methyl	0/275
bis (2-ethylhexyl) phthalate	150 max.	OV-202, trifluoropropyl (fluid)	0/275
bis (2-methoxyethyl) adipate	20/100	OV-210, trifluoropropyl (fluid)	0/275
<i>n,n'</i> -Bis(<i>p</i> -methoxybenzylidene)- α,α' -bi- <i>p</i> -toluidine (BMBT)	189/225	OV-215, trifluoropropyl (gum)	0/275
Carbowax 1000	40/150	OV-225, cyanopropyl methylphenyl methyl	0/265
Carbowax 20M	60/225	OV-275, dicyanoallyl	25/250
Carbowax 20M-terephthalic acid	60/225	OV-330, silicone - Carbowax	0/250
Carbowax 400	10/100	OV-351	50/270
Carbowax 600	30/125	OV-1701, vinyl	0/250
Cyclohexanedimethanol succinate	100/250	Phenyldiethanolamine succinate	0/230
DC-11	0/300	Polethylene glycol adipate (EGA)	100/225
DC-200	0/200	Polyphenyl ether (5 rings) OS-124	0/200
DC-550	20/250	Polyphenyl ether (6 rings) OS-138	0/225
DEGS-PS	20/200	Polypropylene glycol	0/150
Di(2-ethylhexyl)sebacate	0/125	Rtx-1 (Rt-101)	0/350
Diethylene glycol succinate (DEGS)	20/200	Rt-1000	50/250
Diethylene glycol adipate (DEGA)	0/200	Rt-1200	25/200
Diisodecyl phthalate	0/175	Rt-1220	50/200
2,4-Dimethylsulfolane	0/50	Rt-1500, Rt-1510	50/230
Di- <i>n</i> -decyl phthalate	10/175	Rt-2100	0/350
Dinonyl phthalate	20/150	Rt-2300	20/275
Ethylene glycol adipate	100/225	Rt-2330, Rt-2340	25/275
Ethylene glycol phthalate	100/200	Rt-608Pkd	0/275
Ethylene glycol succinate	100/200	Rt-Sebaconitrile	25/110
FFAP	50/250	Rt-XLSulfur	250 max.
Fluorad FC-431, 50% solution in ethyl acetate	40/200	SE-30, SE-52, SE-54	50/300
Hallcomid M-18-OL	8/150	Silar 5 CP, Silar 10 CP	0/250
Halocarbon 10-25	20/100	Sorbitol	150 max.
Halocarbon K-352	0/250	Squalane	20/100
Halocarbon wax	50/150	Squalene	0/100
Igepal® CO-880 (Nonoxynol)	100/200	Stabilwax	40/240
Igepal CO-890	100/200	Tetracyanoethylated pentaerythritol	30/175
Krytox	-30/260	THEED (Tetrahydroxyethylenediamine)	0/125
Neopentyl glycol adipate	50/225	β,β -Thiodipropionitrile (TDPN)	100
Neopentyl glycol sebacate	50/225	Tricresyl phosphate	20/125
Neopentyl glycol succinate	50/225	1,2,3-Tris (2-cyanoethoxy) propane (TCEP)	0/175
Nonoxynol (Igepal CO-880)	100/200	Triton X-100, Triton X-305	0/200
β,β -Oxydipropionitrile	0/75	UC W982	0/300
OV-1, dimethyl (gum)	100/350	UCON 50-HB-2000	0/200
OV-1, vinyl	100/350	UCON 50-HB-280-X	0/200
OV-3, phenyl methyl	0/350	UCON 50-HB-5100	0/200
OV-7, phenyl methyl dimethyl, 20% phenyl	0/350	UCON HB-1800-X	200 max.
OV-11, phenyl methyl dimethyl, 35% phenyl	0/350	UCON LB-550-X	0/200
OV-17, phenyl methyl, 50% phenyl	0/375	Versamid 9000	190/275
OV-22, phenyl methyl diphenyl, 65% phenyl	0/350		

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
S1NS	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- <i>p</i> -phenylene oxide	Tenax TA
S10	highly cross-linked copolymer of acrylonitrile 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.

NAW—nonacid washed

**Silicone phase.

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 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

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.

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!



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.

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:**

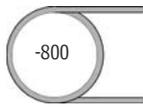
Complete this form and fax to Restek at 814-353-1309, or to your Restek representative.

This form is also available online at:
www.restek.com/packed

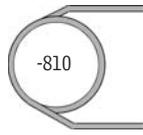
V/G = Vespel®/graphite

Standard Configurations (choose one)

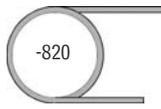
General Configuration



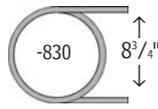
Agilent 5880, 5890, 5987, 6890, 7890



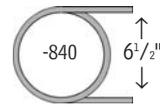
Varian 3700, Vista Series, FID



PE 900-3920, Sigma 1,2,3



PE Auto System 8300, 8400, 8700



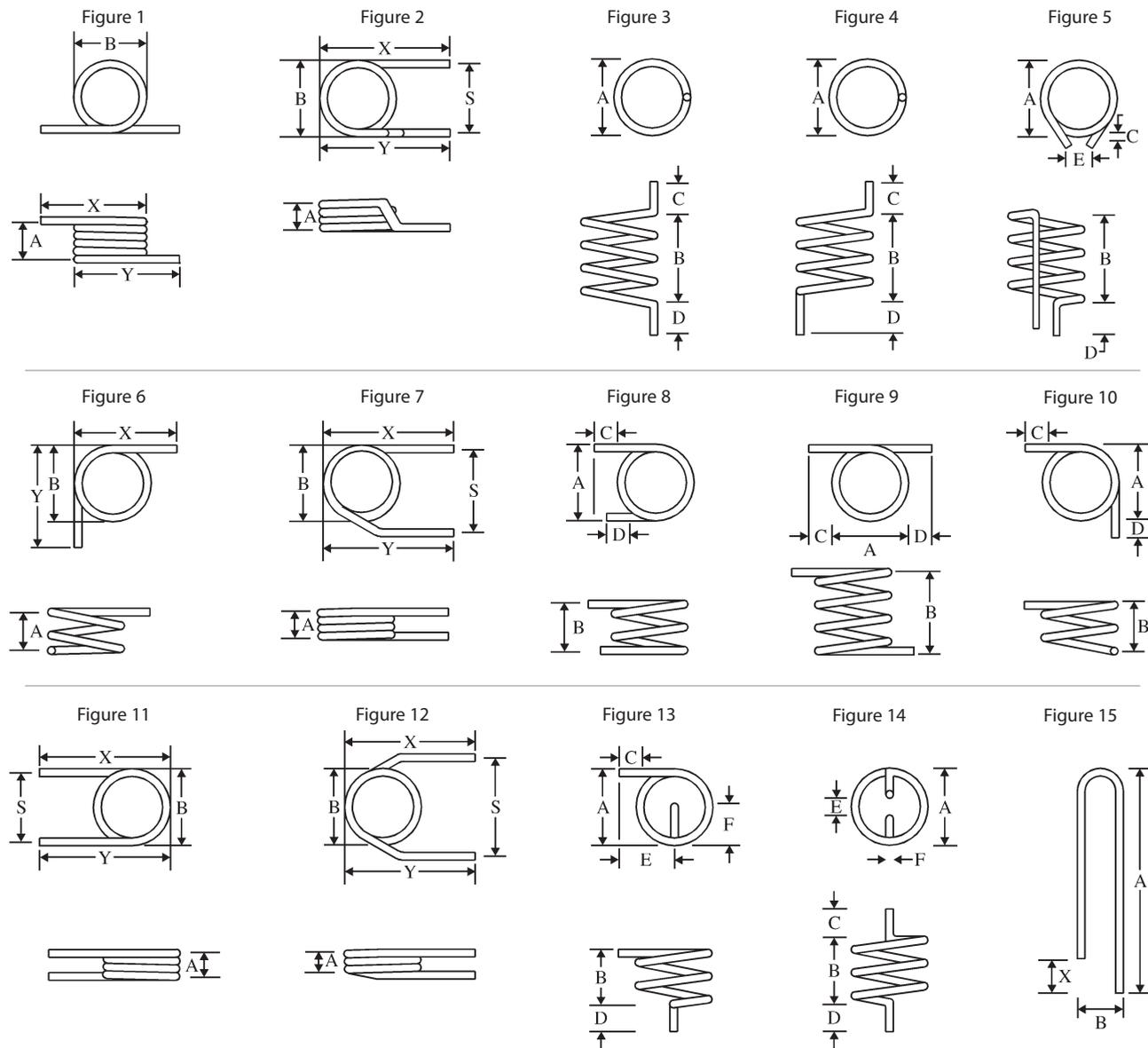
- 810 Agilent 5880, 5890, 5987, 6890, 7890
- 811 Agilent 6850
- 820 Varian 3700, Vista Series, FID
- 821 Varian 3800
- 830 PerkinElmer 900-3920, Sigma 1,2,3
- 840 PerkinElmer Auto System 8300, 8400, 8700, Clarus 500 (C500)
- 841 PerkinElmer Auto Sys XL
- 845 ABB 3100, AAI (4" coil)
- 850 Shimadzu 14A, 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)



Rxi[®]-624Si MS Columns

Exceptionally Inert,
Low Bleed Columns for
Volatiles Analysis

- **Optimized selectivity** for volatiles and polar compounds ensures good separations.
- **Highly inert columns** improve accuracy and allow lower detection limits, even for active compounds.
- **Most thermally stable** 624 column available; low bleed, fully MS compatible.

www.restek.com/rxi

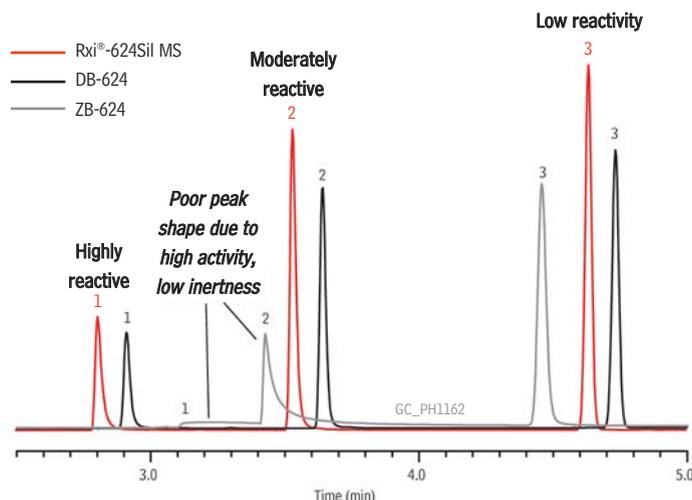
NEW! Rxi®-624Sil MS Columns: Increase Confidence in Data Accuracy

While mid polarity 624 type stationary phases are widely used for analyzing polar analytes and volatile organic compounds (VOCs), not all columns combine the selectivity needed for critical separations with the high inertness and low bleed that can further improve data quality. Whether you are developing methods for residual solvents, analyzing environmental VOCs, or running other applications for volatile organics, you can improve data quality with Rxi®-624Sil MS columns. These new columns incorporate a new stationary phase chemistry, unique column deactivation, and optimized manufacturing process that is specifically designed to provide the high inertness and thermal stability needed for greater accuracy and lower detection limits. The unique selectivity, inertness, and thermal stability of the Rxi®-624Sil MS column make it ideal for numerous applications, from detecting impurities in pharmaceuticals to monitoring environmental VOCs.

Exceptional Inertness Provides Better Peak Shape, Higher Sensitivity, and More Accurate Data

Column inertness is difficult to achieve, but critical to improving data quality. The deactivation process used for Rxi®-624Sil MS columns yields a fully passivated surface that is demonstrably more inert than other 624 columns. Comprehensive deactivation results in higher responses, more symmetric peaks, and easy, accurate integration, even for active compounds at low levels (Figures 1 and 2). Rxi®-624Sil MS columns, with their superior deactivation, provide the inertness needed for improved linearity, greater accuracy, and lower detection limits.

Figure 1 Highly inert Rxi®-624Sil MS columns provide better peak shape and simplify integration for active compounds at low levels (5 ng on-column).



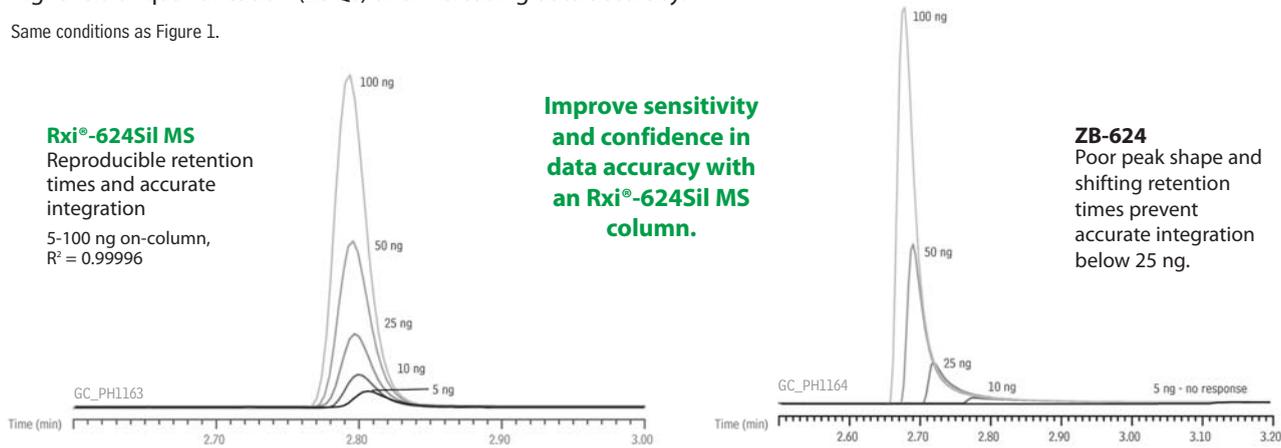
Rxi®-624Sil MS columns give more accurate results for active compounds.

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

Column: 30 m, 0.32 mm ID, 1.8 µm; **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.

Figure 2 Active compounds like isopropylamine can be more accurately integrated on an Rxi®-624Sil MS column, lowering levels of quantification (LOQs) and increasing data accuracy.

Same conditions as Figure 1.



Lowest Bleed 624 Available—Assured GC/MS Compatibility

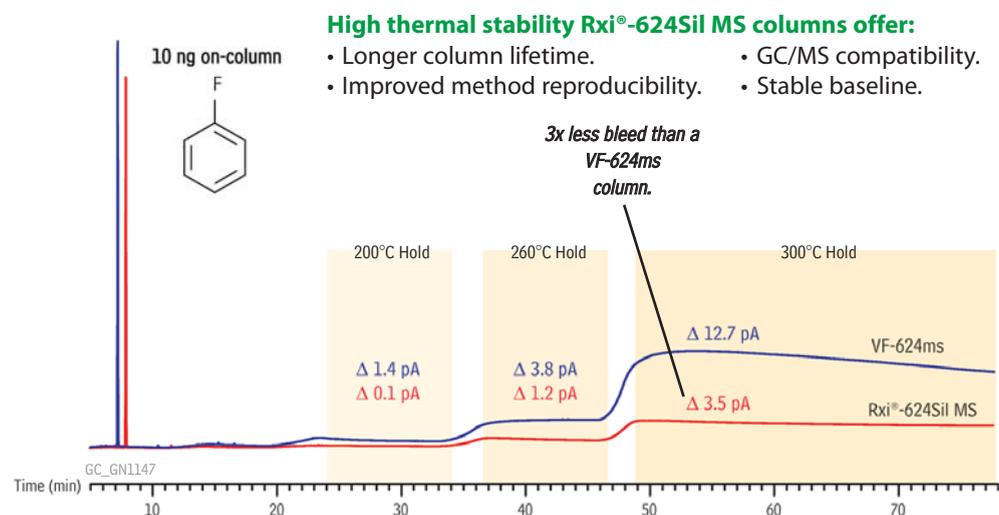
In addition to providing greater inertness and more accurate results for active compounds, the Rxi®-624Sil MS column offers higher temperature stability than any other column in its class (Table I, Figure 3). Even though most 624 columns provide adequate selectivity for polar compounds, poor thermal stability results in stationary phase bleed that can reduce column lifetime, decrease detector sensitivity, and interfere with the quantification of later eluting compounds. The highly effective stationary phase bonding chemistry of the Rxi®-624Sil MS column ensures extremely low bleed up to 320°C. While other 624 columns generate too much bleed to be useful for continuous mass spec work, the Rxi®-624Sil MS column is fully compatible with both quadrupole and ion trap mass spectrometers. In addition to MS compatibility, higher thermal stability results in more stable baselines, longer column lifetimes, and improved method reproducibility.

Table I The Rxi®-624Sil MS column has the highest thermal stability of any 624 column.

Column	Manufacturer	Maximum Programmable Temperature
Rxi-624Sil MS	Restek	320 °C
VF-624ms	Varian	300 °C
DB-624	Agilent J&W	260 °C
ZB-624	Phenomenex	260 °C

Data obtained from company website or literature for a 30 m x 0.25 mm x 1.4 µm df column.

Figure 3 The Rxi®-624Sil MS column has the lowest bleed of any column in its class and provides true GC/MS capability.



Column: 30 m, 0.25 mm ID, 1.4 µm (Columns are of equivalent dimensions and were tested after equivalent conditioning) Sample: Fluorobenzene in methanol, 10 ng on-column; Detector: FID @ 250 °C. Complete analytical conditions for chromatogram GC_GN1147 are available at www.restek.com

Rxi®-624Sil MS Columns (fused silica)

(midpolarity Crossbond® silarylene phase; equivalent to 6% cyanopropylphenyl/94% dimethyl 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 VOCs.
- 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	\$405			
0.25mm	1.40µm	-20 to 300/320°C			13868	\$500	
0.32mm	1.80µm	-20 to 300/320°C			13870	\$540	13872 \$900
0.53mm	3.00µm	-20 to 280/300°C			13871	\$615	



get more

For more information on the new Rxi®-624Sil MS column, visit www.restek.com and review our technical literature.

- *Volatile Impurities Method Development* (flyer PHFL1245)
- *Residual Solvent Analysis: Implementing USP<467>* (flyer PHFL1018A)
- *Optimized Volatiles Analysis Ensures Fast VOC Separations* (online article)

NEW! Rxi®-624Sil MS Columns:

Assure Reliable Separation of Volatile Impurities in Pharmaceuticals



In the pharmaceutical industry, timing and certainty are everything. Time-to-market is a key driver for new drugs, and efficient batch testing is critical for releasing approved products. Whether developing new methods or conducting routine analysis, increasing productivity depends on choosing the right column for the application. Rxi®-624Sil MS columns provide enhanced retention of polar compounds and volatile analytes, as well as full MS compatibility, making them the best choice for many drug analyses.

Fast, Effective Method Development

Often, 1 and 5 type columns are used initially for GC/MS method development because of their thermal stability; however, their nonpolar character results in poor retention for polar compounds, which increases method development time. In contrast, effective methods can be developed quickly on mid polarity Rxi®-624Sil MS columns, because they provide greater retention and selectivity for polar compounds as well as good thermal stability. For example, highly volatile, polar alkyl halide genotoxic impurities are difficult to retain on 1s and 5s, but Rxi®-624Sil MS columns provide the retention needed to ensure adequate separation (Figure 4). Increased retention makes GC/MS analysis easier to control and ultimately allows faster method development.

Improving Results for Routine Analysis

Once a drug is approved, fast, reliable methods are needed for routine batch analysis. Establishing system suitability is an important part of these procedures and a major factor in overall lab productivity. Rxi®-624Sil MS columns provide the optimized selectivity and guaranteed reproducibility needed to increase pass rates. For example, batch throughput can be improved for residual solvent testing under USP <467> by using a column that provides increased resolution for system suitability components (Figure 5). Greater resolution of critical pairs means higher system suitability pass rates, which allows more batches to be analyzed per shift.

Optimized phase chemistry, complete column deactivation, and tightly-controlled manufacturing make Rxi®-624Sil MS columns the best choice for many pharmaceutical applications. With better retention of polar volatiles, lower bleed, and higher inertness, Rxi®-624Sil MS columns can improve lab productivity by allowing new methods to be developed quickly and routine applications to be run more reliably.

learn more

For more pharmaceutical applications on Rxi®-624Sil MS columns, visit www.restek.com and download flyer PHFL1245.



Tim Herring, Technical Service Specialist

When running USP <467> by headspace, using a smaller bore liner (1 mm) can improve system suitability pass rates. Larger bore liners (4 mm) are used with direct liquid injection because the sample is vaporized in the injection port and the liner must be able to accommodate the solvent expansion volume. In contrast, in headspace analysis, the sample is vaporized in a vial instead of the injection port, so a large volume liner is not needed, and in fact it can be deleterious. In headspace methods, using a smaller bore liner reduces band broadening by increasing linear velocity, allowing faster sample transfer and improving resolution.

TECH TIP!

Resolution passes USP <467> criteria when using a 1mm liner (red line), but fails if a 4mm liner is used (black line).

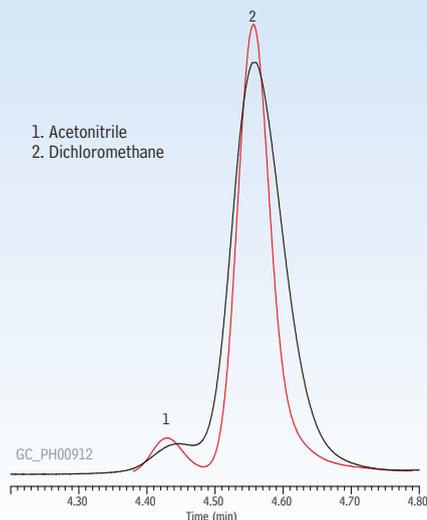


Figure 4 Polar compounds, such as alkyl halides, are highly retained on mid polarity Rxi®-624Sil MS columns, making method development faster and easier than on a nonpolar 1 or 5 type column.

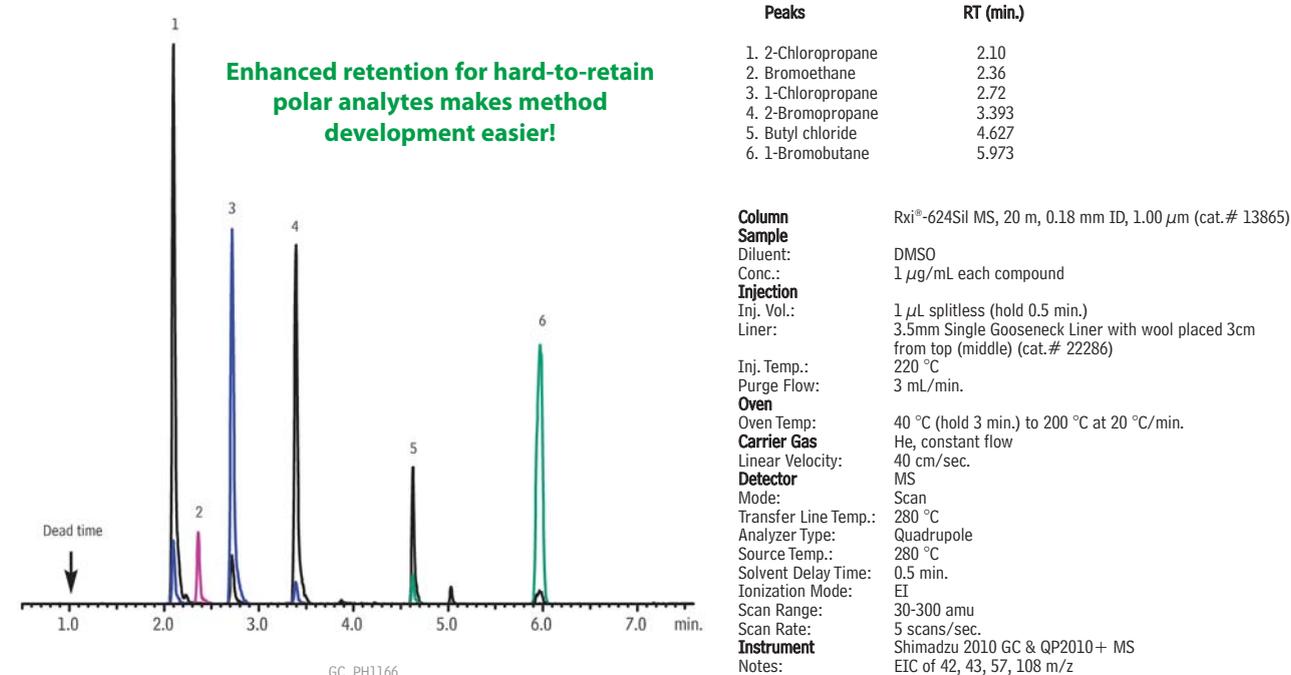
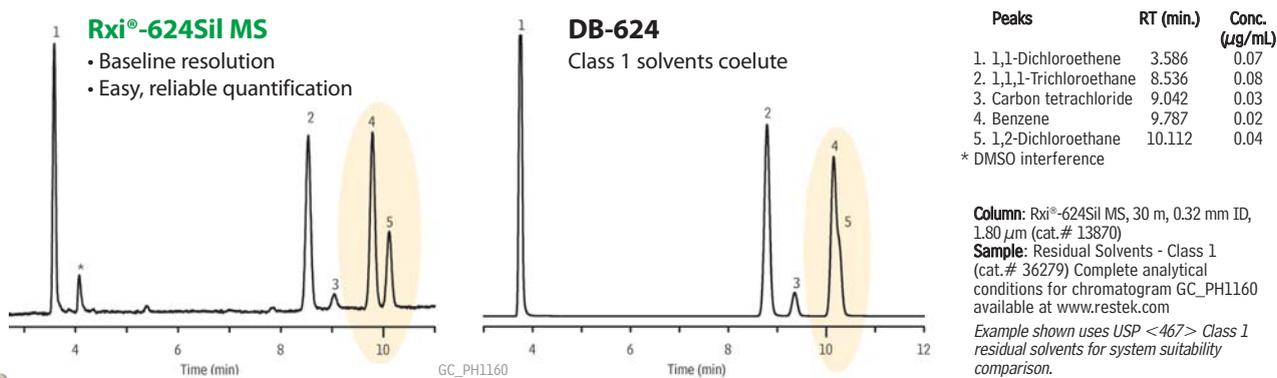


Figure 5 System suitability pass rates can be improved with Rxi®-624Sil MS columns. The innovative polymer chemistry provides greater resolution of critical pairs that are difficult to separate on other 624 type columns.



Custom Residual Solvent Mixes

A perfect match for validated residual solvent methods

Save time and money with mixes prepared to your specific solvent set and concentrations. The more you buy the less you pay per ampul!

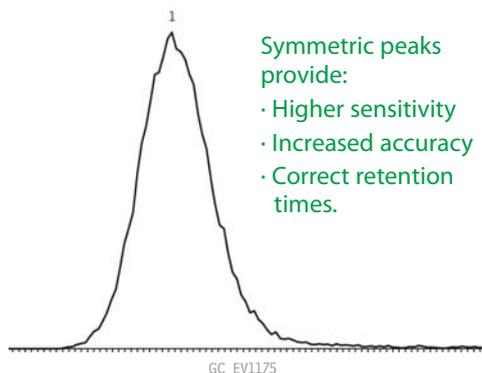
Easy online order form! www.restek.com/customusp

NEW! Rxi®-624Sil MS Columns: Increase Sample Throughput for Environmental VOCs

Fast sample throughput is a primary concern for environmental labs interested in improving productivity. Volatiles methods typically are time-consuming, but developing optimized procedures can be challenging because compound lists are extensive and analytes vary significantly in chemical characteristics. The selectivity and inertness of Rxi®-624Sil MS columns make them ideal for optimizing environmental volatiles methods for better resolution and faster analysis time.

Establishing conditions that maximize sample throughput can be difficult, because conditions optimized for speed can result in problematic coelutions, while conditions optimized for resolution can result in long analysis times. The exceptional inertness of Rxi®-624Sil MS columns produces highly symmetric peaks for active compounds, as shown in Figure 6, which improves resolution and allows separations to be maintained even under faster conditions. Here, an optimized method was developed using an Rxi®-624Sil MS column to maintain adequate resolution, while throughput was maximized by synchronizing purge and trap cycles with instrument cycles.

Figure 6 Exceptionally inert Rxi®-624Sil MS columns produce highly symmetric peaks for active compounds, simplifying quantification and improving accuracy.



For complete conditions visit www.restek.com and enter chromatogram GC_EV1175 in the search function.

Improve Productivity and Resolve Critical Pairs

Initially, several critical pairs were chosen for computational modeling using Pro ezGC software. The temperature program first determined by the software provided the best resolution, but also resulted in an analysis time of 19 minutes. Since the purge and trap cycle time was 16.5 minutes, other conditions were evaluated to see if adequate resolution could be maintained using a faster instrument cycle. The final program, shown in Figure 7, reduced instrument downtime by better synchronizing purge and trap cycles with instrument cycles, and also provided excellent resolution. Using these conditions, up to 36 samples can be analyzed following EPA Method 8260 in a typical 12-hour shift.

Labs interested in optimizing both sample throughput and resolution of VOCs can adopt the synchronized conditions established here on Rxi®-624Sil MS columns to maximize productivity and assure accurate, reliable results.

For the complete application, visit www.restek.com/adv002



NEW!

ProFLOW 6000 Electronic Flowmeter

Go to www.restek.com/flowmeter for product features.

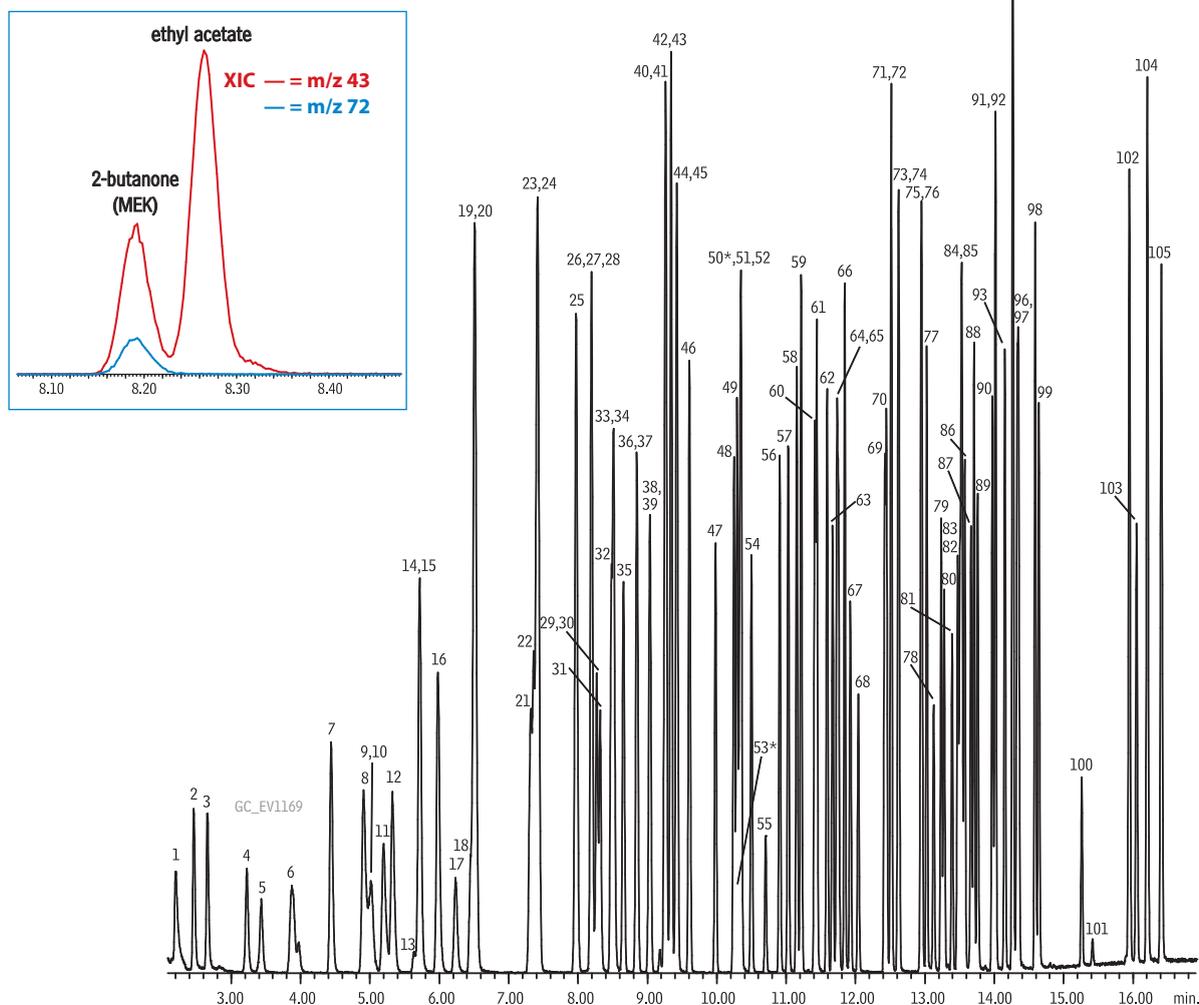


Figure 7 Using an Rxi®-624Sil MS column under optimized conditions increases productivity by assuring good resolution and minimal downtime when analyzing environmental volatiles.

Critical pairs resolved using an Rxi®-624Sil MS column under synchronized conditions:

Peak #s	Compounds	Common Ions
26/29	2-butanone (MEK)/ethyl acetate	43
41/42	benzene/1,2-dichloroethane	62
41/45	benzene/ <i>tert</i> -amyl methyl ether (TAME)	43

Analyze up to 36 samples per shift by synchronizing instrument and purge and trap cycles.



For peak identifications and conditions visit www.restek.com and enter chromatogram GC_EV1169 in the search function.

Rxi®-624Sil MS Columns (fused silica)

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

ID	df	temp. limits	20-Meter		30-Meter		60-Meter	
0.18mm	1.00µm	-20 to 300/320°C	13865	\$405				
0.25mm	1.40µm	-20 to 300/320°C			13868	\$500		
0.32mm	1.80µm	-20 to 300/320°C			13870	\$540	13872	\$900
0.53mm	3.00µm	-20 to 280/300°C			13871	\$615		



New Sky™ inlet liners are easy to recognize as the best choice for optimal chromatography. All Sky™ liners come in specially marked boxes and are packaged in ultra-clean blister packs.

Visit us at www.restek.com/sky

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ISO 9001:2008
cert.# FM80397

Lit. Cat.# GNFL1334

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www.chromtech.net.au

11/12

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.

Lower Detection Limits with Ground-Breaking Column Technology

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

Contact 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

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

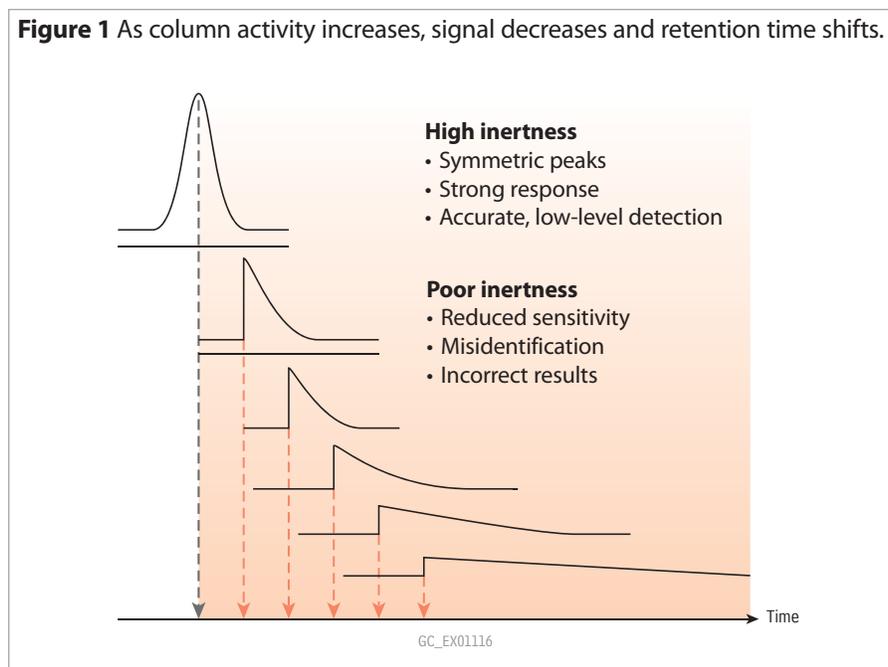
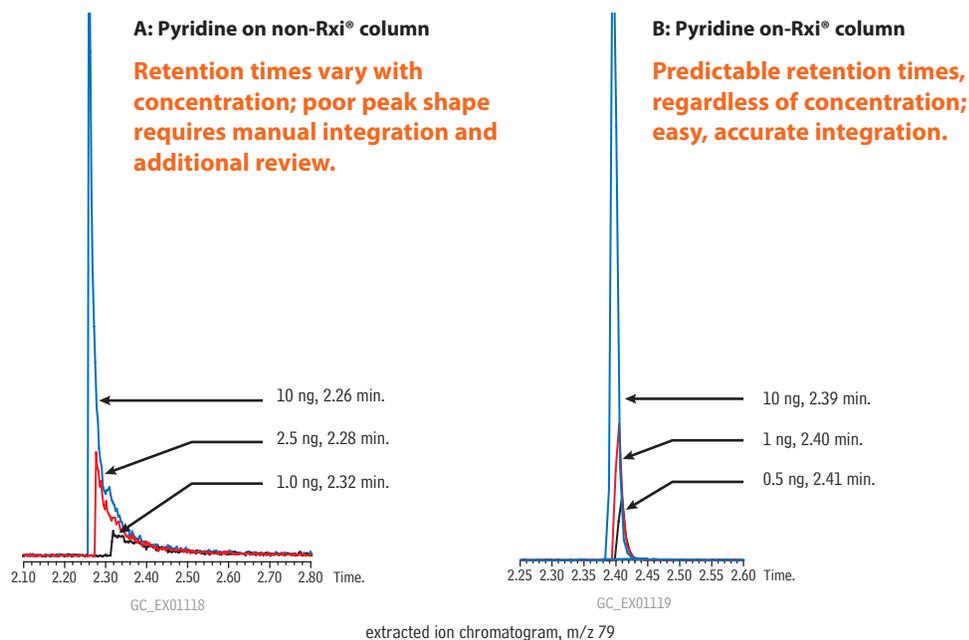


Figure 2 Analyte levels in samples are unknown; only inert columns, which prevent concentration from affecting retention time, can assure accurate results.



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.

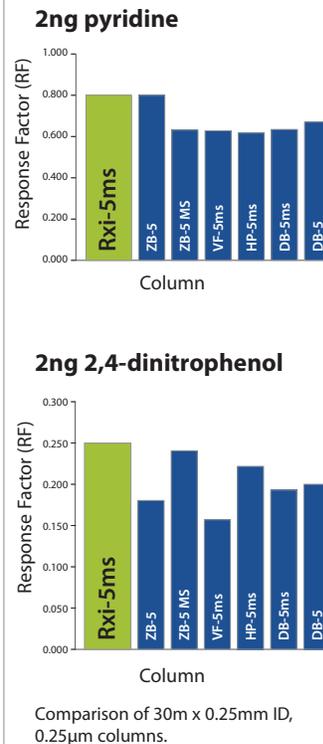
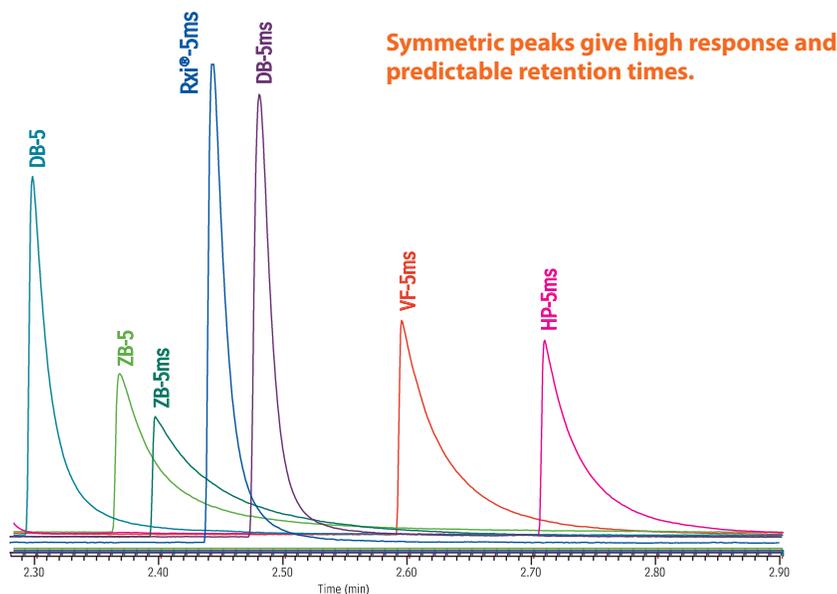


Figure 4 Rxi® columns are the most inert columns on the market providing the most symmetric peak shape for basic compounds, such as pyridine.



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*

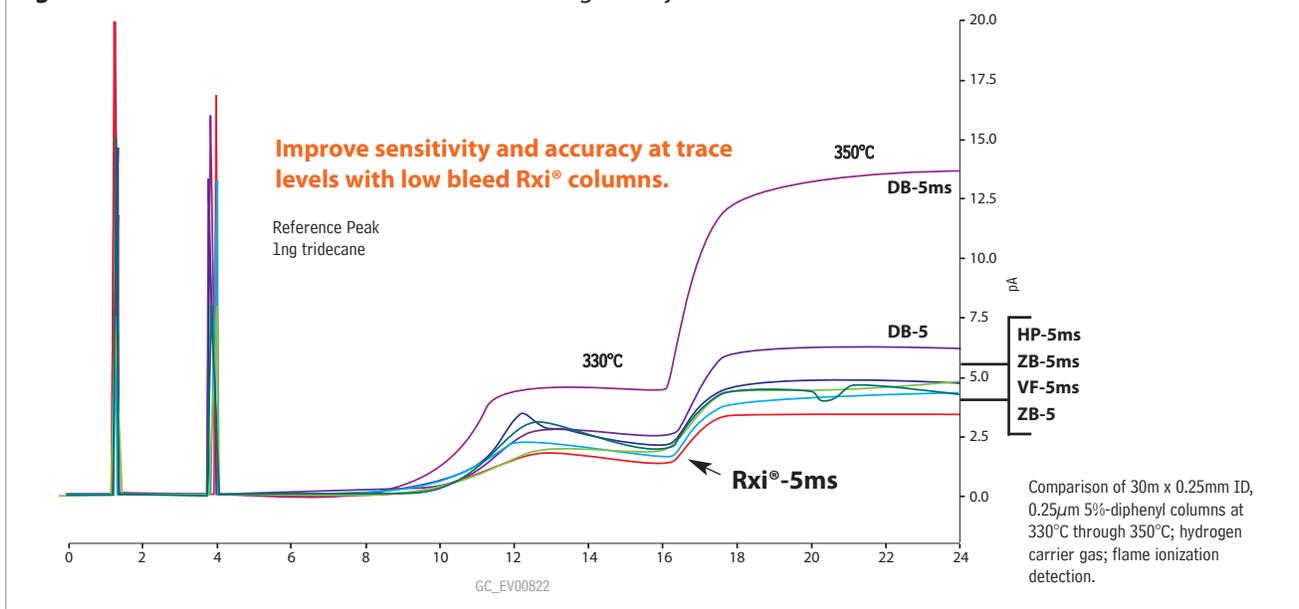
How can we help you today?
Contact support@restek.com or your local Restek representative for helpful, knowledgeable technical support.

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.

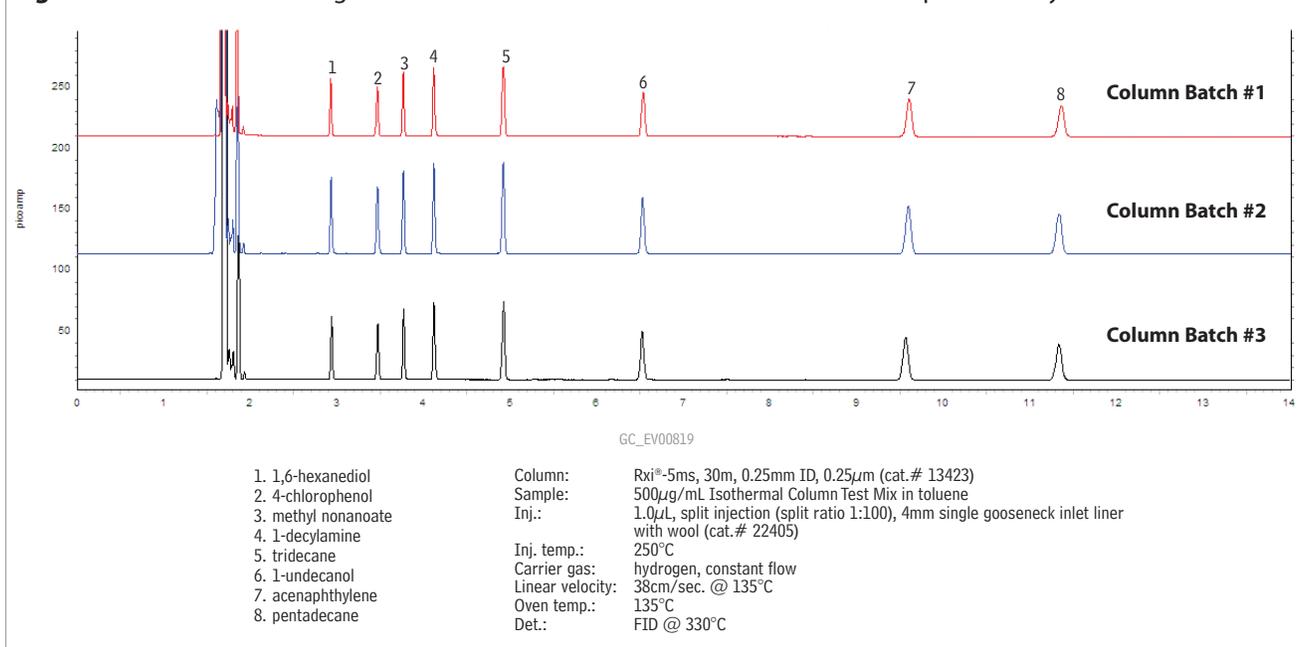
Figure 5 Rxi® columns have the lowest bleed among all major brands of columns.



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.



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
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®-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.

Rxi®-5ms (fused silica)

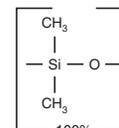
(low polarity phase, Crossbond® 5% diphenyl/95% dimethyl polysiloxane)

- 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®-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

Innovation & Service

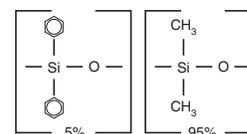
"Restek's technical support and preparation of our custom calibration standards, as well as their innovative column technology, have significantly increased the productivity of our GC/MS analyses."

*Dan Wright, Lab Director
Shealy Environmental Services, Inc.*

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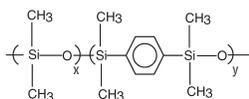
Rxi®-5ms Structure



similar phases

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

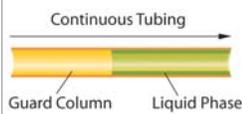
Rxi®-5Sil MS Structure



similar phases

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

**Save Time!
Eliminate column
coupling with
Integra-Guard®
built-in guard
columns**



similar phases

DB-5HT, VF-5HT, ZB-5HT

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

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

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.

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

similar phases

DB-XLB, VF-Xms

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.

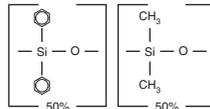
similar **phases** DB-35ms, MR2, VF-35ms

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	Restek	Phase Composition	Agilent	Varian/ Chrompack	SGE	Phenomenex	Machery-Nagel	Supelco
	nonpolar	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
	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		
polar	Rxi-17Sil MS	50% phenyl, 50% dimethyl arylene siloxane	DB-17ms	VF-17ms	BPX-50			

PATENTS & TRADEMARKS

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



Lit. Cat.# GNFL1173

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Stabilized GC PLOT Columns

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- 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.

Columns Now **AVAILABLE:**

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Rt[®]-Q-BOND,

Rt[®]-U-BOND

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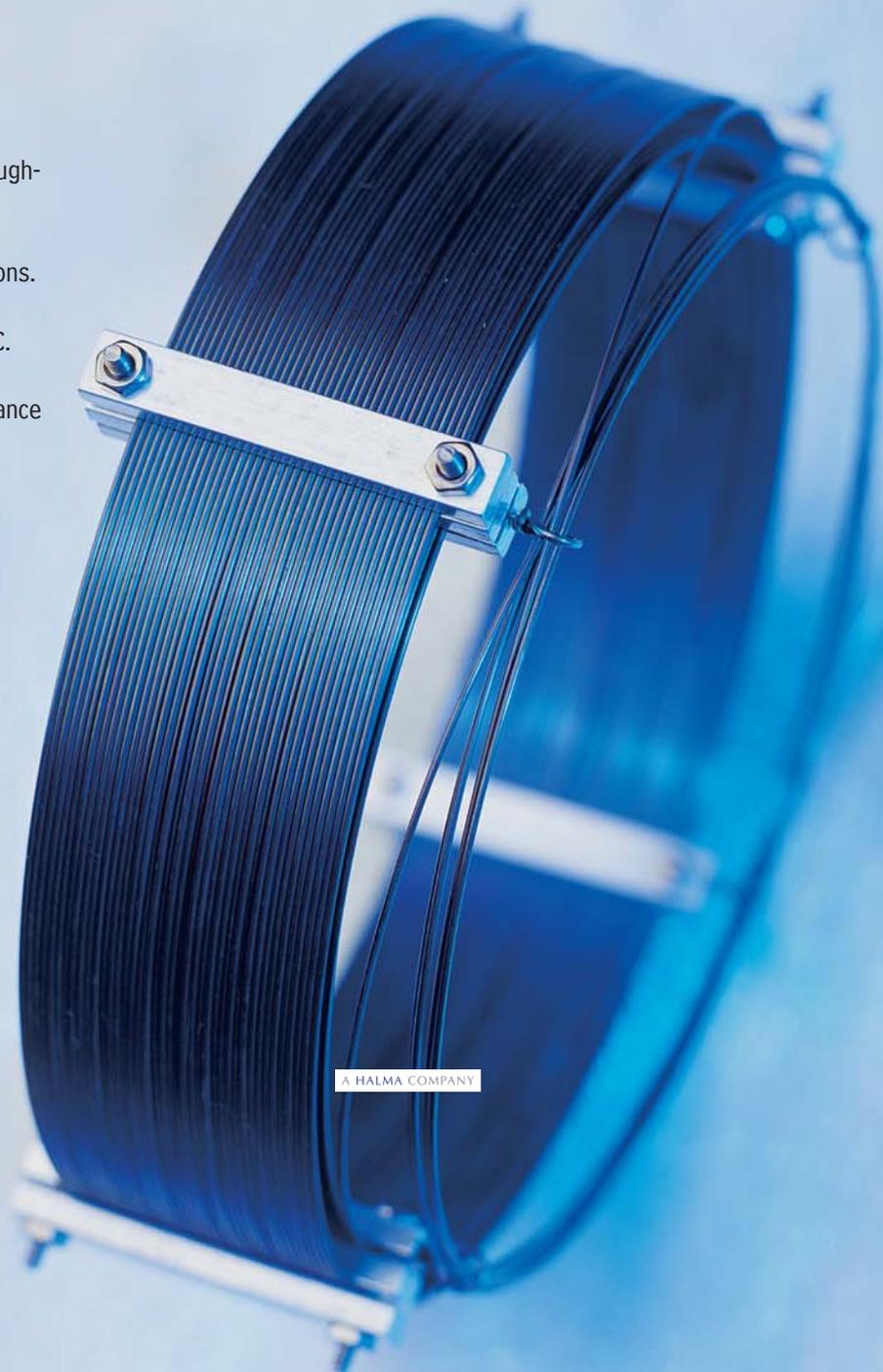
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- Confidence—consistent column-to-column performance provides reliable, repeatable results.



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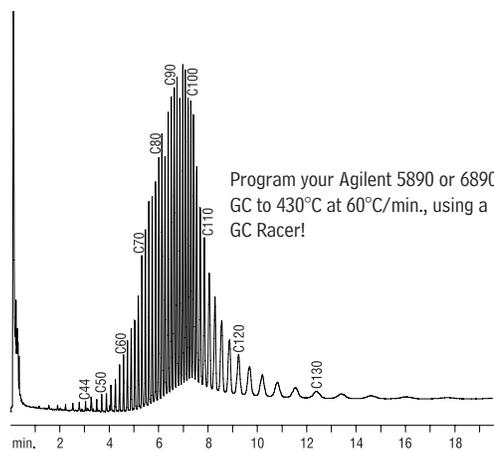
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MXT® Columns

With Restek, you are not limited to conventional phases for metal GC columns. We offer the most complete metal column line available, including many special-purpose phases.

Figure 1—Hydrocarbons, C44-C130, on an MXT®-1HT Sim Dist column.



Program your Agilent 5890 or 6890 GC to 430°C at 60°C/min., using a GC Racer!

GC_PC00543

MXT®-1HT Sim Dist 5m, 0.53mm ID, 0.10µm (cat.# 70100)
 Sample: Polywax® 1000 (cat.# 36227)
 Solvent: carbon disulfide
 Sample size: 0.2µL
 Instrument: Agilent 5890 GC w/GC Racer*
 Injector: on-column (track oven)
 Carrier gas: hydrogen, constant pressure (1.0psi)
 Detector: FID/430°C
 Oven temp.: 40°C to 430°C @ 60°C/min. (hold 30 min.)

*Manufactured by Zip Scientific, distributed by Restek Corporation (see our catalog or website)

MXT®-2887 (Silcosteel® treated stainless steel)

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

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

MXT®-1HT Sim Dist (Siltek® treated stainless steel)

ID	df (µm)	temp. limits	5-Meter
0.53mm	0.10	-60 to 430°C	70100

MXT®-1 Sim Dist (Siltek® treated stainless steel)

ID	df (µm)	temp. limits	6-Meter
0.53mm	0.15	-60 to 400°C	70101

MXT®-500 Sim Dist (Siltek® treated stainless steel)

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

MXT®-1 (Silcosteel® treated stainless steel)

(Crossbond® 100% dimethyl polysiloxane)

ID	df (µm)	temp. limits	6-Meter	15-Meter	30-Meter	60-Meter
0.25mm	0.10	-60 to 330/400°C		70105	70116	70117
	0.25	-60 to 360°C		70120	70123	70126
	0.50	-60 to 350°C		70135	70138	70141
	1.00	-60 to 340°C		70150	70153	70156
0.28mm	0.10	-60 to 360°C	70102*	70106	70109	
	0.25	-60 to 360°C		70121	70124	70127
	0.50	-60 to 330°C		70136	70139	70142
	1.00	-60 to 320°C		70151	70154	70157
0.53mm	3.00	-60 to 285°C		70181	70184	70187
	0.15	-60 to 400°C	70101**			
	0.25	-60 to 360°C		70122	70125	70128
	0.50	-60 to 330°C		70137	70140	70143
1.00	1.00	-60 to 320°C		70152	70155	70158
	1.50	-60 to 310°C		70167	70170	70173
	3.00	-60 to 285°C		70182	70185	70188
	5.00	-60 to 270°C		70177	70179	70183
7.00	7.00	-60 to 250°C		70191	70192	70193
	0.18mm	0.20	-60 to 330/350°C	71811	71812	71813
	0.40	-60 to 320/340°C	71814	71815	71816	

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

*Temperature limits are -60 to 400°C.

**For simulated distillation.

MXT®-WAX (Silcosteel® treated stainless steel)

(Crossbond® Carbowax® polyethylene glycol—provides oxidation resistance)

ID	df (µm)	temp. limits	15-Meter	30-Meter	60-Meter
0.25mm	0.10	40 to 260°C	70605	70608	70611
	0.25	40 to 260°C	70620	70623	70626
	0.50	40 to 260°C	70635	70638	70641
0.28mm	0.25	40 to 250°C	70621	70624	70627
	0.50	40 to 250°C	70636	70639	70642
	1.00	40 to 240°C	70651	70654	70657
0.53mm	0.25	40 to 250°C	70644	70647	70650
	0.50	40 to 250°C	70637	70640	70643
	1.00	40 to 240°C	70652	70655	70658
	1.50	40 to 230°C	70666	70669	70672
2.00	40 to 220°C	70667	70670		
0.18mm	0.20	40 to 250°C	71861	71862	71863
	0.40	40 to 250°C	71864	71865	71866

Other Stationary Phases Available:

MXT®-5	MXT®-65TG	MXT®-50
MXT®-20	MXT®-502.2	MXT®-200
MXT®-624	MXT®-Volatiles	MXT®-BAC1
MXT®-35	MXT®-1301	MXT®-BAC2
MXT®-65	MXT®-1701	

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Other Trademarks:
 Carbowax (Union Carbide Corp.), Polywax (Petrolite Specialty Polymers group)

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Increase Productivity: Get More Runs from Your SimDist Setup Using Next Generation MXT[®]-1HT SimDist Columns

- 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.

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Increase Productivity: Get More Runs from Your SimDist Setup Using Next Generation MXT®-1HT Columns

- 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 column available, outperforming other metal columns for critical method parameters.

Low bleed is an important column characteristic in simulated distillation. High phase bleed shortens retention times, making it necessary to frequently rerun boiling point calibrations. In contrast, with a low bleed column, the stationary phase remains in place giving stable retention times. This results in longer in-calibration periods, extended column lifetimes, and more accurate final boiling point determinations. Efficiency is also a critical factor as columns that are higher in efficiency produce sharper peaks and higher resolution values, meaning that more samples can be analyzed before the minimum resolution specification is reached.

When compared to columns from other manufacturers, MXT®-1HT SimDist columns meet all D6352 method criteria and easily outperform competitors (Figures 1 and 2). In addition, field testing under accelerated conditions further demonstrates column robustness, even at 450°C (Figure 3). The exceptionally low bleed and high efficiency characteristics of the new MXT®-1HT SimDist columns translate directly into assured method performance, more analyses per calibration, and longer column lifetimes.

Figure 1 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!

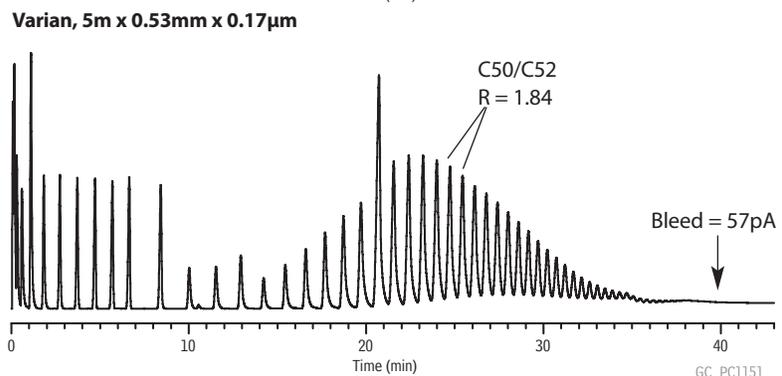
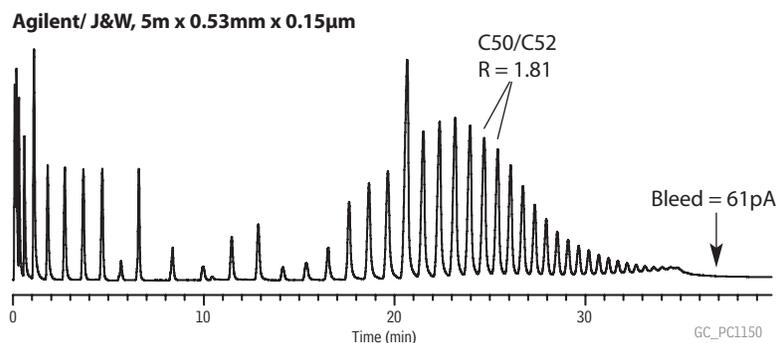
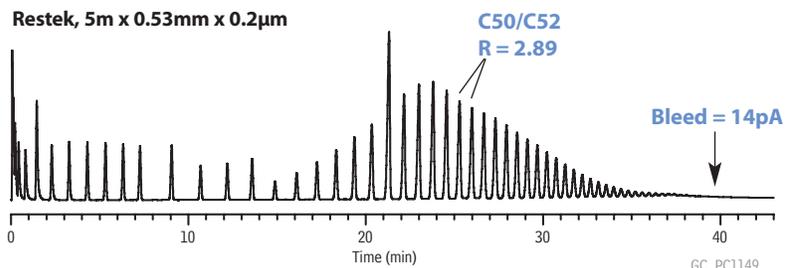
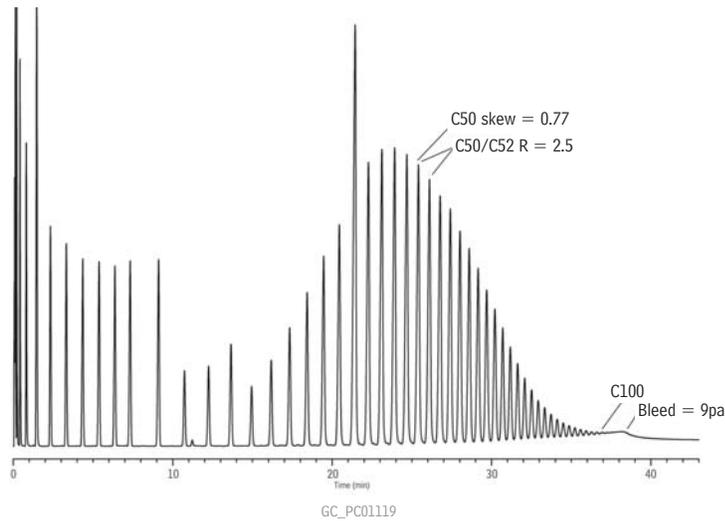


Figure 2 Superior resolution and peak shape on MXT®-1HT SimDist columns result in more accurate final boiling point determinations.



Column: MXT®-1HT Sim Dist, 5m, 0.53mm ID, 0.20 μ m (cat.# 70115)
 Sample: C5-C100, 1% in carbon disulfide
 Inj.: 1 μ L on-column (PTV)
 Inj. temp.: 53°C to 430°C @ 10°C/min. (hold 5 min.)
 Carrier gas: helium, constant flow
 Flow rate: 18mL/min.
 Oven temp.: 50°C to 430°C @ 10°C/min. (hold 5 min.)
 Det.: FID @ 430°C
 Instrument: Shimadzu 2010

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

Replaces: DB-1HT, DB-HT SimDis, CP-HT-Simdist CB

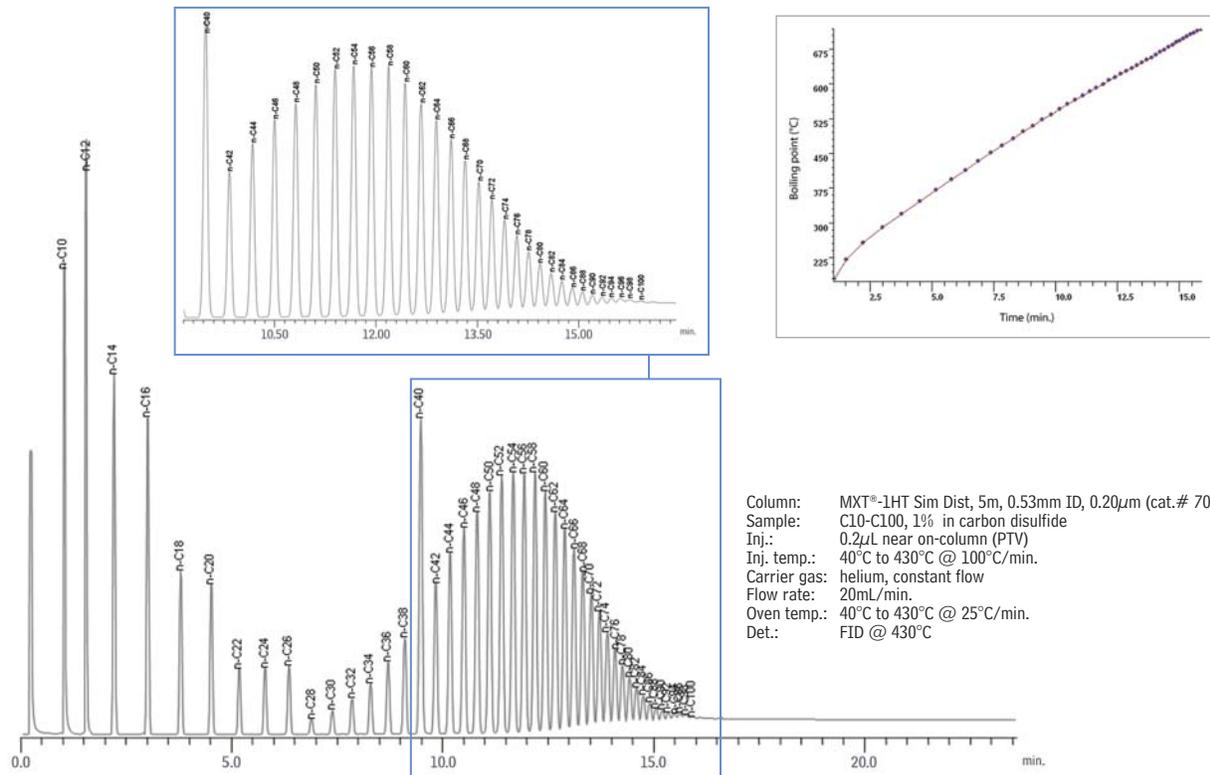
ID	df (μ m)	temp. limits	length	cat. #
0.53mm	0.10	-60 to 430/450°C	5-Meter	70112
0.53mm	0.20	-60 to 430/450°C	5-Meter	70115
0.53mm	0.21	-60 to 430/450°C	10-Meter	70118
0.53mm	0.88	-60 to 400/430°C	5-Meter	70131
0.53mm	1.0	-60 to 380/400°C	10-Meter	70130
0.53mm	1.2	-60 to 380/400°C	10-Meter	70119
0.53mm	2.65	-60 to 360/400°C	10-Meter	70132
0.53mm	5.0	-60 to 360/400°C	10-Meter	70133

Table I: Recommended SimDist columns (100% PDMS) for use in ASTM SimDist methods.

ASTM Method	Range	Recommended Column
D2887	C5-C44	5/10m x 0.53mm, df = 0.88 – 2.65 μ m
D7213 (2887-ext)	C5-C60	5m x 0.53mm, df = 0.15 – 1.2 μ m
D3710	Gasoline up to FBP 260°C (C14)	10m x 0.53mm, df = 2.65 μ m
D5307	Crude up to FBP 538°C (C42)	5m x 0.53mm, df = 0.2 μ m PDMS
D6352/ D7500	C10-C90/ C7-C110	5m x 0.53mm, df = 0.1 – 0.2 μ m
D7169	C5-C100	5m x 0.53mm, df = 0.2 μ m

FBP = final boiling point

Figure 3 Robust MXT®-1HT SimDist columns meet all ASTM D6352 requirements, even under accelerated conditions.



Column: MXT®-1HT Sim Dist, 5m, 0.53mm ID, 0.20 μ m (cat.# 70115)
 Sample: C10-C100, 1% in carbon disulfide
 Inj.: 0.2 μ L 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.



Practical Tips for High Temperature Analyses

Oxygen and moisture will dramatically reduce siloxane phase stability, especially at temperatures over 400°C. To ensure maximum column lifetime, follow these guidelines for proper instrument set-up.



- Use gas filters to remove oxygen and moisture from the carrier gas.



- When installing a column, prevent leaks by using a proper cutting device (such as a scoring wafer or MXT® tubing scorer) to ensure the column is not crushed. (cat. # 20523)



- Use graphite ferrules for column installation; Vespel®/graphite ferrules may leak, due to expansion and contraction at high temperatures (>400°C).



- Check the system for leaks using an electronic leak detector. (cat. # 22839)

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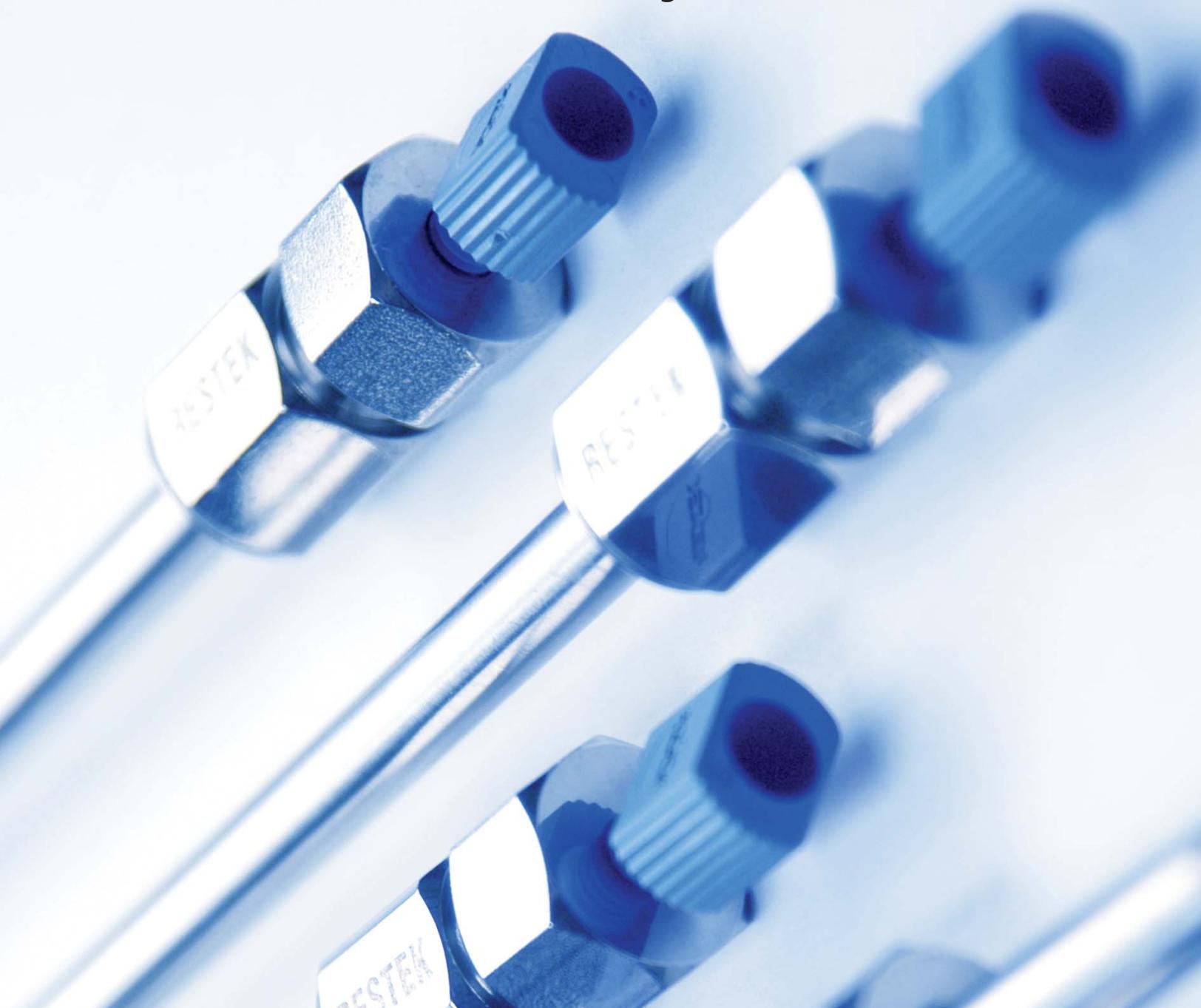
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VIVA™ Wide Pore HPLC Columns

Exceptional Performance for Peptides,
Proteins, or Other Large Molecules



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Turning Visions into Reality™

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We start with the best wide pore silica...

- Largest available surface area in 250-350Å pores—ideal for larger molecules.
- Excellent base deactivation.
- Viva™ silica manufactured by Restek for consistency.

Conventional reversed phase HPLC packing materials with 60-150Å pores generally are poorly suited for separating peptides, proteins, or other larger biomolecules. The analyte molecules cannot access the surface area within these pores, and the pores can be fouled with large molecular weight debris. Silicas with wider pores address this need for more resolving power: theoretically, larger analytes enter the pores, access more of the surface, and are retained longer, promoting better selectivity.

For analytes with molecular weights larger than 3000, pore diameters of 250-350Å offer the best combination of retention and stability - pores larger than 500Å can make a silica impractically fragile for many applications. A narrow distribution about the mean pore diameter can aid in separating analytes that differ only slightly in hydrodynamic size. A large pore volume allows more analyte molecules into the pores, and provides better separations of complex mixtures. Pore volumes exceeding 1.2mL/g, however, make the silica particles more fragile.

In developing Viva™ wide pore silica, we evaluated materials from other manufacturers, and found some do not possess sufficient pore volume in the pore diameter range needed for effectively separating large molecules. Of the materials we tested, Viva™ 300Å silica has the greatest available surface area in 250-350Å pores (Table I), and the greatest percentage of pores narrowly distributed around the mean diameter (Figure 1).

...which makes exceptional HPLC columns...

- Excellent efficiency and peak symmetry.
- Best selectivity and retention among five tested manufacturers' columns.

We compared column efficiency, peak asymmetry, and retention for Viva™ C18 and four other popular C18 wide pore columns. Table II and Figure 2 show the Viva™ column ranked highest in retention and selectivity and produced the best peak symmetry measurements.

...for peptides, proteins, or other large molecules.

- Exceptional selectivity, for resolving larger biomolecules.
- Excellent base deactivation, for more symmetrical peaks and greater sensitivity without mobile phase modifiers.

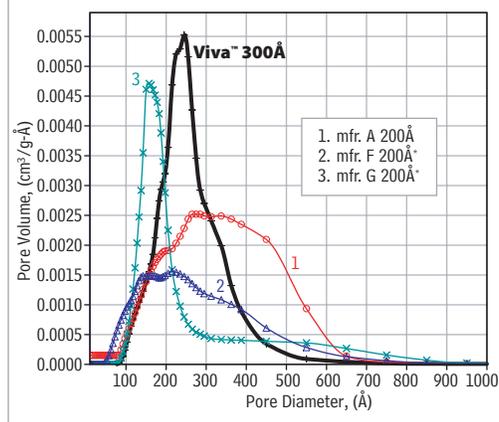
Even with wide pore packings, limitations often are encountered when samples contain closely related compounds, such as complex tryptic digests or genetic variants of a protein. These applications call for columns with maximum resolving power.

Viva™ HPLC columns are ideal for challenging analyses. To determine overall separating power, retention, and peak shape, we evaluated each manufacturer's column with peptide and protein test mixes. The Viva™ C18 column provided excellent resolution and peak shapes, as Figures 3 and 4 show.

Size exclusion studies show Viva™ wide pore columns are well suited for analyses of molecules over a weight range of approximately 800 to 212,000 Dalton. For additional technical information about Viva™ wide pore columns, request Restek Advantage 2005v1 (lit.# 59077) and 2005v2 (lit.# 59923).

Exceptionally large available surface area, a highly desirable pore volume, and a narrow pore diameter distribution help ensure effective retention of peptides, proteins, or other large molecules, and make Viva™ wide pore columns the best choice for your analysis.

Figure 1 Only Viva™ silica has a majority of pores in the 250-350Å range, in a narrow distribution. (BJH desorption)



*Materials F and G are 200Å materials being sold as 300Å.

Table I Viva™ silica has the largest available surface area in 250-350Å pores, allowing the greatest interaction with large molecules.

Silica	Surface Area (m²/g)			Total Pore Volume (mL/g)
	0-100Å	250-350Å	Total Desorp	
Nominal Pore Diameter (300Å)				
Viva™ lot X	1.6	46.5	144.5	116.9
Viva™ lot Y	2.3	40.6	138.6	112.4
mfr. A	2.9	34.4	118.2	101.6
mfr. A	4.2	33.1	130.3	111.3
mfr. B	3.7	22.2	83.6	73.9
Nominal Pore Diameter (200Å)				
mfr. A	41.0	2.7	231.6	189.2
mfr. A	34.1	0.9	243.4	200.0
mfr. D*	9.2	23.0	158.4	129.8
mfr. E	21.7	19.2	90.7	93.0
mfr. F*	24.7	15.6	105.8	58.5
mfr. G*	2.6	6.7	115.3	91.6

*Materials D, F, and G are 200Å materials being sold as 300Å.

Table II Viva™ wide pore columns provide the best overall performance.

Column	Efficiency (plates/m) (10³)	Asymmetry (biphenyl)	Retention	
			Time (biphenyl)	Pressure (bar)
Viva™ C18	>50	1.16	6.30	60
mfr. F C18	>50	1.30	5.89	66
mfr. C C18	~50	1.46	5.77	72
mfr. D C18	>50	1.46	4.96	102
mfr. H C18	<50	1.49	3.79	80

150 x 2.1mm C18 phase columns, 5µm particles; reversed phase test mix

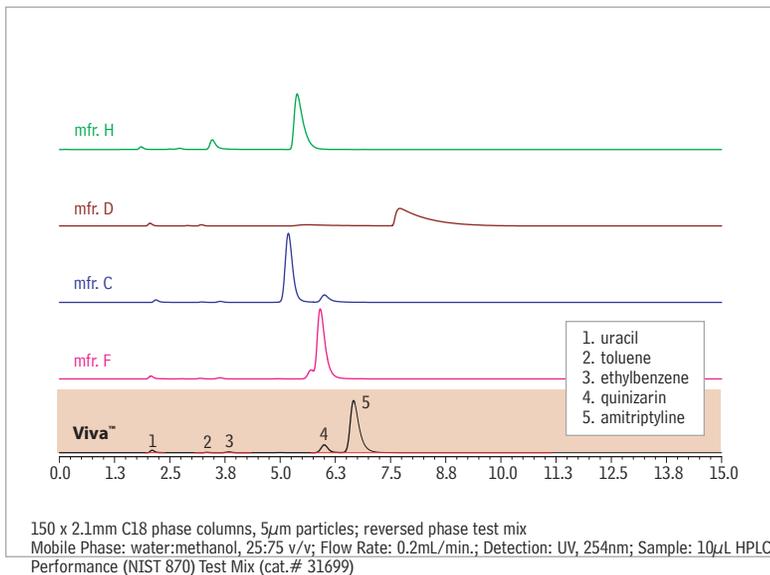


Figure 3 Viva™ C18: excellent resolution of peptides.

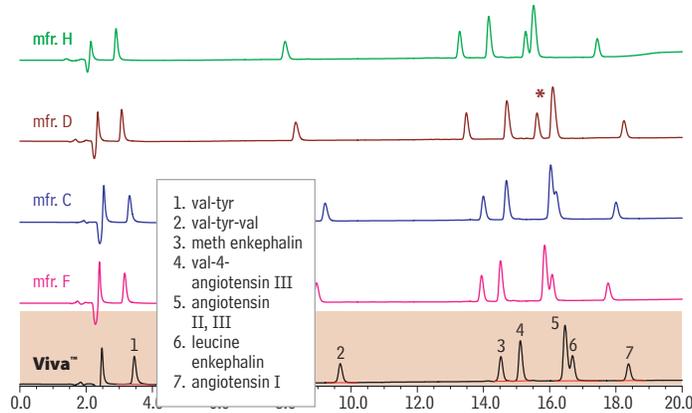
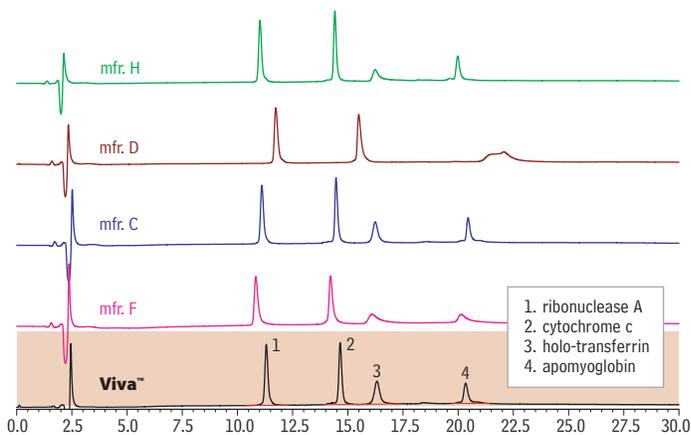


Figure 4 Viva™ C18: superior performance with proteins.



Viva™ wide pore HPLC columns, only from Restek - we think you will be impressed!

Superior physical characteristics and strong evaluation performances show Viva™ columns are an excellent choice for analyzing peptides, proteins, or other larger molecules or biomolecules. For the best results from your large molecule analysis, talk with us about Viva™ columns, today.

C18, C8, C4, and silica columns currently available; other phases and particle sizes on request.

Bulk packing materials also are available.



guard columns

To order:

2.1mm, 3.2mm, or 4.6mm ID column with a Trident™ Integral Inlet Fitting, add "-700" to the catalog number for the column.

Example: 100mm x 4.6mm ID Viva™ C18 column with Trident™ Integral Inlet Fitting: 9514515-700

Nominal additional charge for guard cartridges and fittings for these columns, see our catalog or visit our website.

Length	1.0mm ID cat.#	2.1mm ID cat.#	3.2mm ID cat.#	4.6mm ID cat.#
Viva™ C18 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
Viva™ C8 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™ C4 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™ Silica 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

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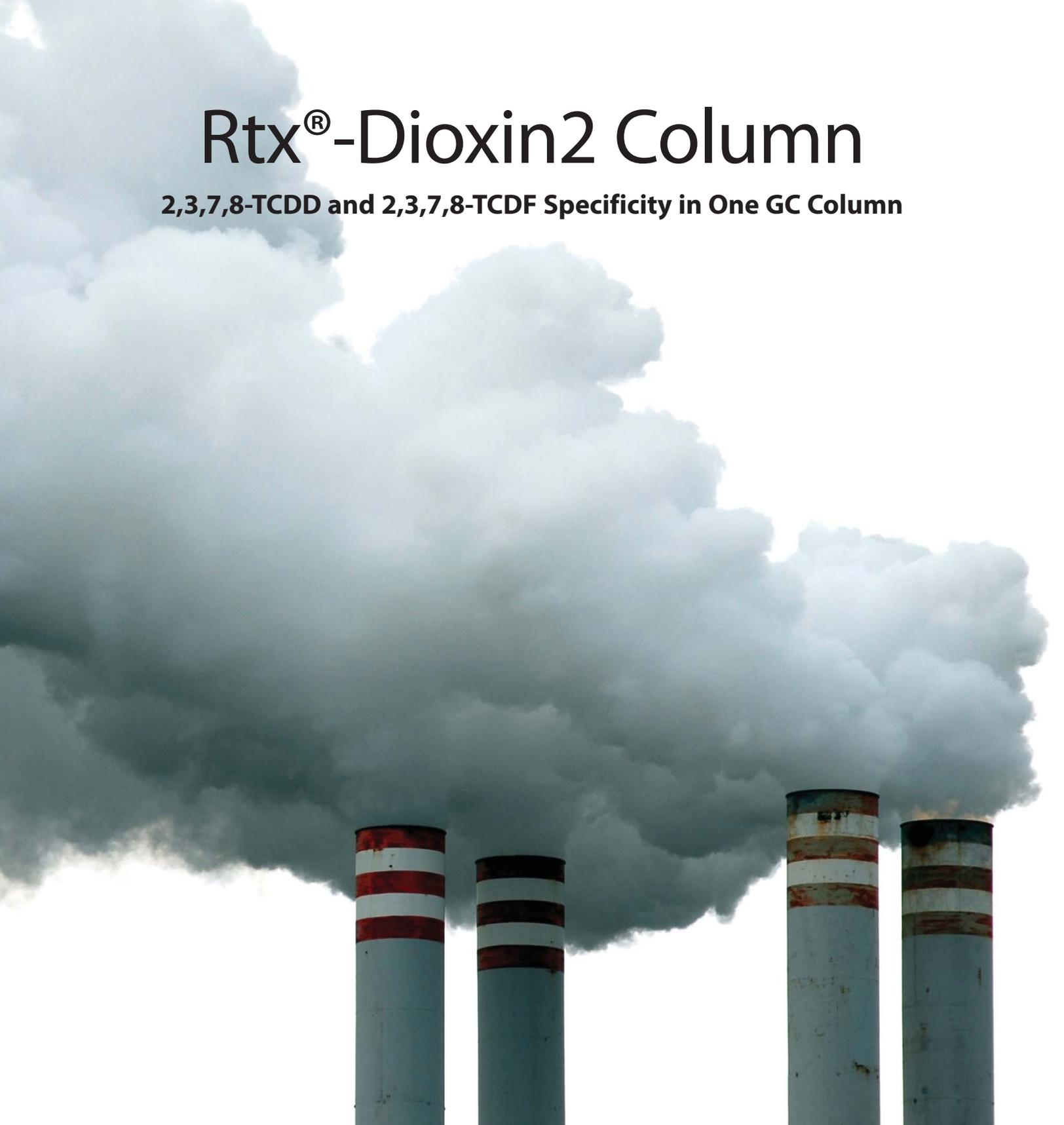
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Rtx[®]-Dioxin2 Column

- 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 primary or confirmation GC column.

Accurate GC analysis of polychlorinated dibenzodioxin (PCDD) and polychlorinated dibenzofuran (PCDF) congeners is a challenge, even when using a high resolution mass spectrometer. Separation of the toxic congeners (substitutions at the 2, 3, 7, and 8 positions) from the nontoxic congeners proves difficult on almost all stationary phases. Most laboratories perform an initial analysis using a 5% diphenyl/95% dimethyl polysiloxane column (e.g., an Rxi[™]-5ms column) to obtain reasonable estimates of concentrations for the 2,3,7,8-substituted congeners. For some of the target congeners, this quantification is biased toward high values, due to coelution with non-toxic congeners. For example, as many as five nontoxic TCDFs can coelute with 2,3,7,8-tetrachlorodibenzofuran in an analysis on a 5% diphenyl or equivalent column. The coelution issue has resulted in the need for confirmation columns, most commonly high cyanopropyl stationary phases (e.g., Rtx[®]-225 and Rtx[®]-2330 columns), in order to more accurately quantify the toxic congeners. Unfortunately, cyanopropyl columns exhibit poor thermal stability, and therefore offer poor lifetime. To address these issues Restek designed the Rtx[®]-Dioxin2 column, a column with unique selectivity for both 2,3,7,8 substituted dioxins and furans that also has excellent thermal stability.

Resolution of 2,3,7,8-TCDD and 2,3,7,8-TCDF

The Rtx[®]-Dioxin2 column is specific for both 2,3,7,8-TCDD and 2,3,7,8-TCDF, something that usually requires the use of at least two GC columns. The column is stable to 340°C, and is available in the dimensions commonly used for this analysis. Figure 1 shows a chromatogram of tetrachlorodibenzodioxins in lake sediment extract (certified reference material WMS-01) on a 60m, 0.25mm, 0.25µm Rtx[®]-Dioxin2 column. 2,3,7,8-TCDD is well-resolved from the other congeners in this group and can be quantified accurately in WMS-01 and other samples (Table 1). The data in Figure 2 illustrate resolution of the 2,3,7,8-TCDF congener from the nontoxic congeners in the same sediment extract analyzed on an Rtx[®]-Dioxin2 column. Values for 2,3,7,8-TCDF in a variety of sample types obtained with an Rtx[®]-Dioxin2 column compare favorably with values obtained on a cyanopropyl-type column (the column typically used for TCDF specificity) and with the certified values (Table 2). However, the quantified values from the 5% diphenyl column are biased high due to other TCDF interferences.

Table 1 Comparative results (pg/g) for 2378-TCDD in certified reference materials.

Sample	5% diphenyl	Rtx [®] -Dioxin2	Certified Value
Sediment (WMS-01)	21	14	17.7 ± 5.6
Sediment	8.5	9	6
Flyash	5.6	4.4	5
Flyash-2	< 3	4.4	4

WMS-01 was obtained from Wellington Laboratories, Inc., Guelph, Ontario, Canada.

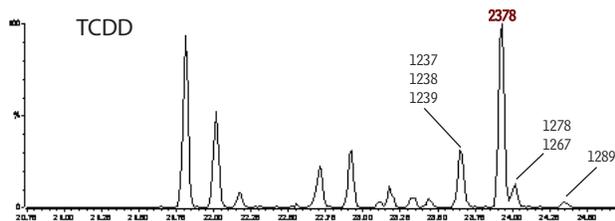
Table 2 Comparative results (pg/g) for 2378-TCDF in certified reference materials.

Note the quantitative bias for the 5% diphenyl results due to other TCDF interferences.

Sample	5% diphenyl	225	Rtx [®] -Dioxin2	Certified Value
Sediment (WMS-01)	78	46	47	52.5 ± 16
Sediment	37	19	19	23
Flyash	240	38	32	31
Flyash-2	250	40	32	28

WMS-01 was obtained from Wellington Laboratories, Inc., Guelph, Ontario, Canada.

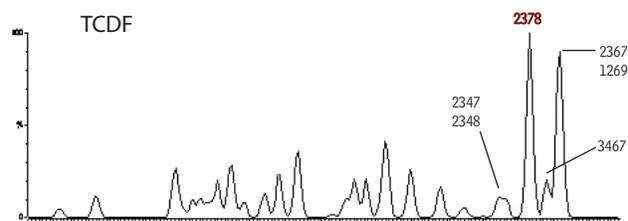
Figure 1 2,3,7,8-Tetrachlorodibenzodioxin resolved from other TCDD congeners, using an Rtx®-Dioxin2 column..



Other peak identifications available upon request.

Column: Rtx-Dioxin®2, 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

Figure 2 Tetrachlorodibenzofuran congeners on an Rtx®-Dioxin2 column.



Other peak identifications available upon request.

Column: Rtx-Dioxin®2, 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

also **available**

Rxi™-5ms GC Columns!

These new industry-leading low bleed and inert columns have the selectivity and life-time required by chemists using the 5% diphenyl / 95% dimethyl polysiloxane phase. Request lit. cat.# 580086 for more information.

Resolution of PCDDs and PCDFs by Chlorination Level

Extracted ion profiles of quantitative native PCDDs and PCDFs, and window definer compounds are shown in Figure 3 and Figure 4. The tetra- through octachlorodibenzodioxin compounds are chromatographically separated by chlorination level. The tetrachlorodibenzofurans are chromatographically separated by chlorination level, except for 1,2,8,9-tetrachlorodibenzofuran and 1,3,4,6,8-pentachlorodibenzofuran, which exhibit a slight window overlap.

Conclusion

The Rtx®-Dioxin2 column is an excellent column for the analysis of dioxin and furan congeners. It has a unique selectivity for the toxic PCDDs and PCDFs, including specificity for 2,3,7,8-TCDD and 2,3,7,8-TCDF.

Acknowledgment

Chromatograms and data courtesy of Karen MacPherson and Eric Reiner, Ontario Ministry of the Environment, Toronto, Ontario, Canada.

Product Listing

Rtx®-Dioxin2 (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 primary or confirmation GC column.



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

GET YOUR MIX

Time-Saving MegaMix™ Environmental Reference Mixes.

- Largest number of target analytes in one mix, formulated for maximum stability.
- Available for US EPA methods 8260, 8270, 502.2, 524.2, 525.2, 624, 625, SOM01.1, OLC 03.2, OLM 04.2, Skinner List volatiles, Skinner List semivolatiles.

MegaMix™ mixes simplify preparation of calibration mixes, and shorten preparation time, because they include a maximum numbers of compatible target analytes. In some applications a second calibration analysis has been required for coeluting target compounds, but the MegaMix™ formulation ensures all included analytes can be calibrated in one analysis (e.g., 3- and 4- methylphenol with other components in OLC 03.2 semivolatiles mix; *m*- & *p*- xylene with other components in OLC 03.2 volatiles mix).

Save time, save effort, minimize potential for preparation problems – use MegaMix™ reference mixes, only from Restek or authorized distributors.



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Lit. Cat.# 580119A

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Rtx[®]-XLB

Low Bleed Capillary Columns

Lit. Cat.# 59957-INT

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Ultra-Low-Bleed Rtx®-XLB Columns

- Extremely low bleed, ideal for high-sensitivity GC/MS (stable to 340°C).
- Excellent resolution for semivolatile compounds in water, including environmental pollutants - pesticides - PCBs.
- Proprietary low-polarity phase, similar to DB®-XLB.

Compared to columns produced through older synthesis technologies, ultra-low-bleed Rtx®-XLB columns help ensure better detection limits and greater instrument stability in semivolatiles analysis. If noisy baselines are keeping you from taking full advantage of your high sensitivity system, or if semivolatile analytes are causing detection or resolution difficulties, an Rtx®-XLB column is your best choice for solving the problem.

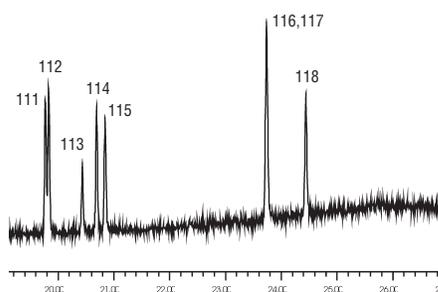
Maximize Performance from High-Sensitivity GC/MS Systems

Recent improvements to GC/MS systems design have greatly increased instrument sensitivity. Consequently, column bleed levels that formerly were acceptable now often prevent an analyst from taking full advantage of the capabilities of the system.

To address the growing need for ultra-low-bleed columns, Restek has developed Rtx®-XLB columns. Through a new approach to polymer synthesis, and state-of-the-art tubing deactivation, these columns minimize interference with high temperature analyses of high molecular weight active compounds: our bleed specification for Rtx®-XLB columns is less than 6pA at 340°C!

Figure 1 shows the bleed from an Rtx®-XLB column at 330°C, the ending temperature in US EPA Method 525 analysis of semivolatile pollutants, as observed with an Agilent 6890/5973 GC/MS. Clearly, column bleed is not a factor in this analysis.

Figure 1 An Rtx®-XLB column exhibits less than 6pA bleed—even at 330°C.



Rtx®-XLB 30m, 0.25mm ID, 0.25 μ m (cat.# 12823)
Sample: US EPA Method 525 standards, 1 μ L, 2.5ng per analyte on-column
See Figure 2 for conditions.

Semivolatile Pollutants

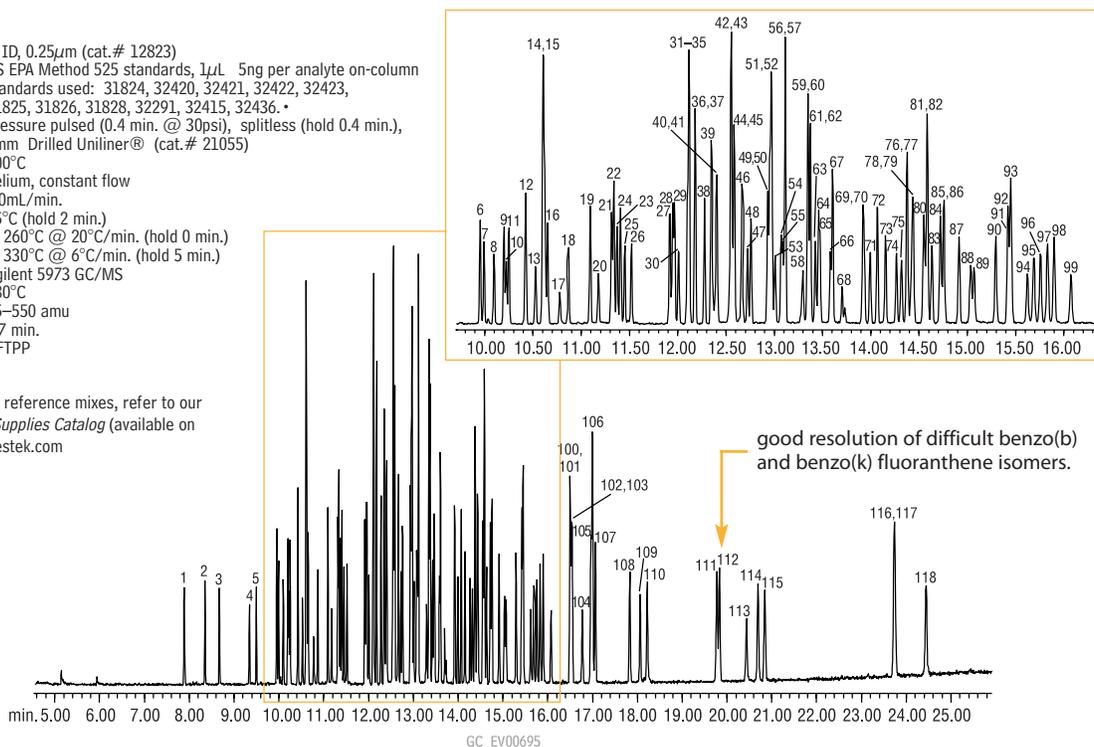
Low Bleed - Excellent Inertness - Isomer Resolution

The new Rtx®-XLB stationary phase, in combination with a sensitive GC/MS system, is especially well suited for analyses of high molecular weight active compounds, such as semivolatile environmental pollutants. Analysts using Rtx®-XLB columns can achieve low bleed and exceptional sensitivity with on-column concentrations of 5ng, as Figure 2 shows, or less. Figure 2 also shows that Rtx®-XLB columns offer excellent resolution of isomer pairs such as benzo(b)fluoranthene and benzo(k)fluoranthene, peaks 111 and 112.

Figure 2 Excellent inertness and selectivity for semivolatile pollutants at 5ng on-column.

Rtx®-XLB 30m, 0.25mm ID, 0.25µm (cat.# 12823)
 Sample: US EPA Method 525 standards, 1µL 5ng per analyte on-column standards used: 31824, 32420, 32421, 32422, 32423, 31825, 31826, 31828, 32291, 32415, 32436.
 Inj.: pressure pulsed (0.4 min. @ 30psi), splitless (hold 0.4 min.), 4mm Drilled Unliner® (cat.# 21055)
 Inj. Temp.: 300°C
 Carrier Gas: helium, constant flow
 Flow Rate: 1.0mL/min.
 Oven Temp.: 35°C (hold 2 min.) to 260°C @ 20°C/min. (hold 0 min.) to 330°C @ 6°C/min. (hold 5 min.)
 Det: Agilent 5973 GC/MS
 Transfer Line Temp.: 280°C
 Scan Range: 45-550 amu
 Solvent Delay: 4.7 min.
 Tune: DFTPP

* For information about reference mixes, refer to our 2006 Chromatography Supplies Catalog (available on request) or visit www.restek.com

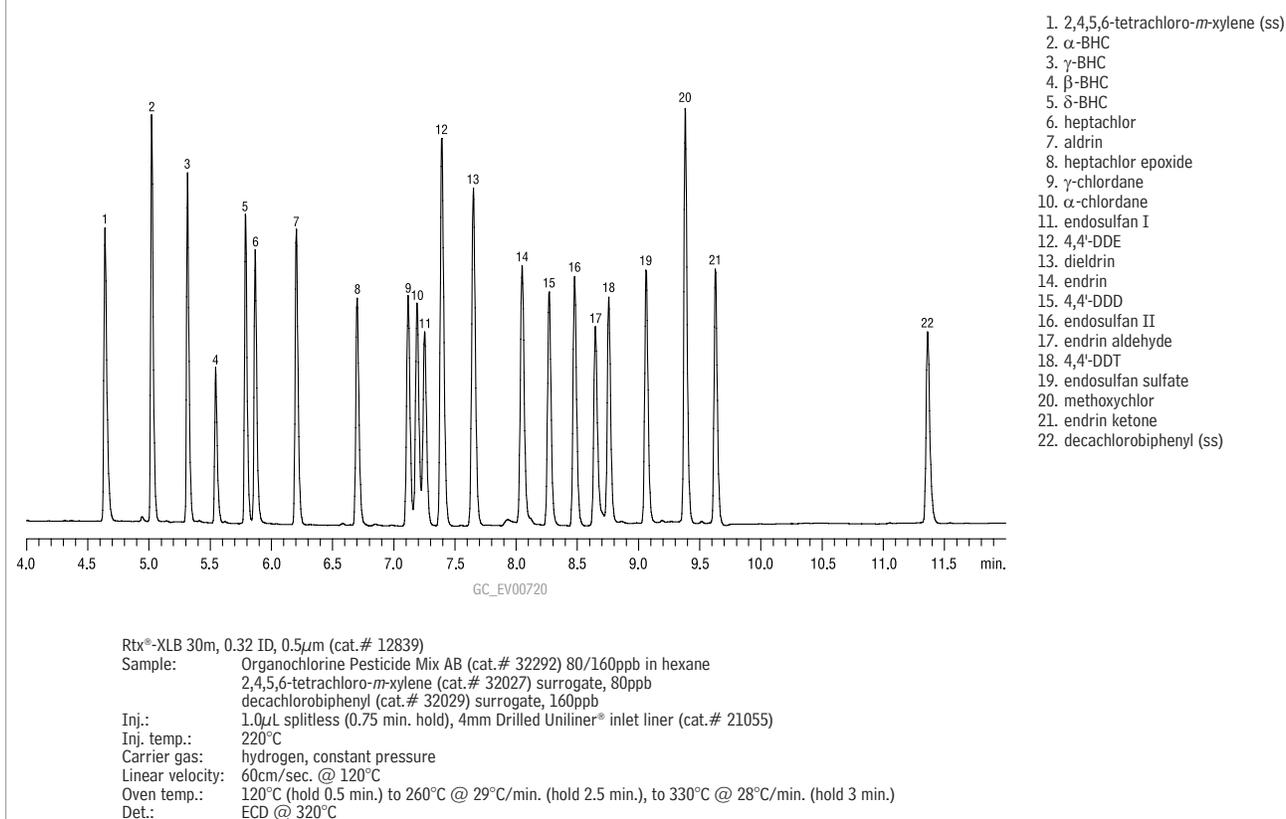


- | | | | | |
|------------------------------|-------------------------------------|---|--|--|
| 1. isophorone | 26. chlorpropham | 50. prometryne | 72. butachlor | 96. 4,4'-DDT |
| 2. 2-nitro- <i>m</i> -xylene | 27. 2,3-dichlorobiphenyl (BZ#5) | 51. ametryn | 73. stirofos (tetrachlorvinphos) | 97. triphenylphosphate |
| 3. dichlorvos | 28. atraton | 52. simetryn | 74. fenamiphos | 98. hexazinone |
| 4. hexachlorocyclopentadiene | 29. prometon | 53. δ-BHC | 75. α-chlordane | 99. endosulfan sulfate |
| 5. EPTC | 30. α-BHC | 54. heptachlor | 76. napropamide | 100. bis(2-ethylhexyl)phthalate |
| 6. butylate | 31. hexachlorobenzene | 55. chlorothalonil | 77. γ-chlordane | 101. methoxychlor |
| 7. mevinphos | 32. propazine | 56. di- <i>n</i> -butylphthalate | 78. endosulfan I | 102. 2,2',3,3',4,5',6,6'-octachlorobiphenyl (BZ#207) |
| 8. vernolate | 33. simazine | 57. terbutryn | 79. <i>trans</i> -nonachlor | 103. 2,2',3,3',4,4',6-heptachlorobiphenyl (BZ#171) |
| 9. pebulate | 34. atrazine | 58. bromacil | 80. pyrene-d10 | 104. endrin ketone |
| 10. etridiazole (Terrazole®) | 35. metribuzin | 59. chlorpyrifos | 81. pyrene | 105. benzo(a)anthracene |
| 11. dimethylphthalate | 36. diazinon | 60. metolachlor | 82. 4,4'-DDE | 106. chrysene-d12 |
| 12. acenaphthylene | 37. terbufos | 61. DCPA methyl ester (Dacthal®) | 83. 2,2',4,4',5,6'-hexachlorobiphenyl (BZ#154) | 107. chrysene |
| 13. 2,6-dinitrotoluene | 38. pronamide | 62. 2,2',4,4'-tetrachlorobiphenyl (BZ#47) | 84. <i>p</i> -terphenyl-d14 | 108. fenarimol |
| 14. acenaphthene-d10 | 39. pentachlorophenol | 63. aldrin | 85. dieldrin | 109. <i>cis</i> -permethrin |
| 15. 2-chlorobiphenyl (BZ#1) | 40. β-BHC | 64. triadimefon | 86. carboxin | 110. <i>trans</i> -permethrin |
| 16. chloroneb | 41. disulfoton | 65. cyanazine (Bladex) | 87. chlorbenzilate | 111. benzo(b)fluoranthene |
| 17. tebuthiuron | 42. terbacil | 66. MGK-264 | 88. tricyclazole | 112. benzo(k)fluoranthene |
| 18. molinate | 43. phenanthrene-d10 | 67. diphenamid | 89. endrin | 113. fluridone (Sonar®) |
| 19. diethyl phthalate | 44. methyl parathion OA | 68. merphos | 90. 4,4'-DDD | 114. benzo(a)pyrene |
| 20. 2,4-dinitrotoluene | 45. phenanthrene | 69. 2,2',3',4,6-pentachlorobiphenyl (BZ#98) | 91. bis(2-ethylhexyl)adipate | 115. perylene-d12 |
| 21. propachlor | 46. anthracene | 70. heptachlor epoxide (isomer B) | 92. butyl benzyl phthalate | 116. dibenzo(a,h)anthracene |
| 22. fluorene | 47. γ-BHC (lindane) | 71. heptachlor epoxide (isomer A) | 93. endosulfan II | 117. indeno(1,2,3- <i>cd</i>)pyrene |
| 23. ethoprop | 48. 2,4,5-trichlorobiphenyl (BZ#29) | | 94. endrin aldehyde | 118. benzo(ghi)perylene |
| 24. cycloate | 49. alachlor | | 95. norflurazon | |

Excellent Choice for Organochlorine Pesticides

In many environmental and food laboratories, samples are analyzed for organochlorine pesticides using highly sensitive electron capture detectors (ECDs). In order to take full advantage of the detector's sensitivity, the analytical column must exhibit low bleed, to minimize background noise, and exceptional inertness, to prevent loss of labile pesticides, in addition to the selectivity necessary to separate complex mixtures. Low bleed and excellent inertness make an Rtx®-XLB column the perfect choice for this application. Figure 3 and Figure 4 (overside) show an Rtx®-XLB column will separate complex mixtures of organochlorine pesticides. Table 1 lists retention times for the extended list of analytes.

Figure 3 Low bleed and exceptional inertness ensure excellent results for organochlorine pesticides in US EPA Method 8081.



tech tip

In combination with an Rtx®-XLB column, a few simple adjustments to injection conditions can greatly improve sensitivity for active and high molecular weight 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. For information about Drilled Uniliner® inlet liners, request lit. cat. # 59877, or refer to our current chromatography supplies catalog.

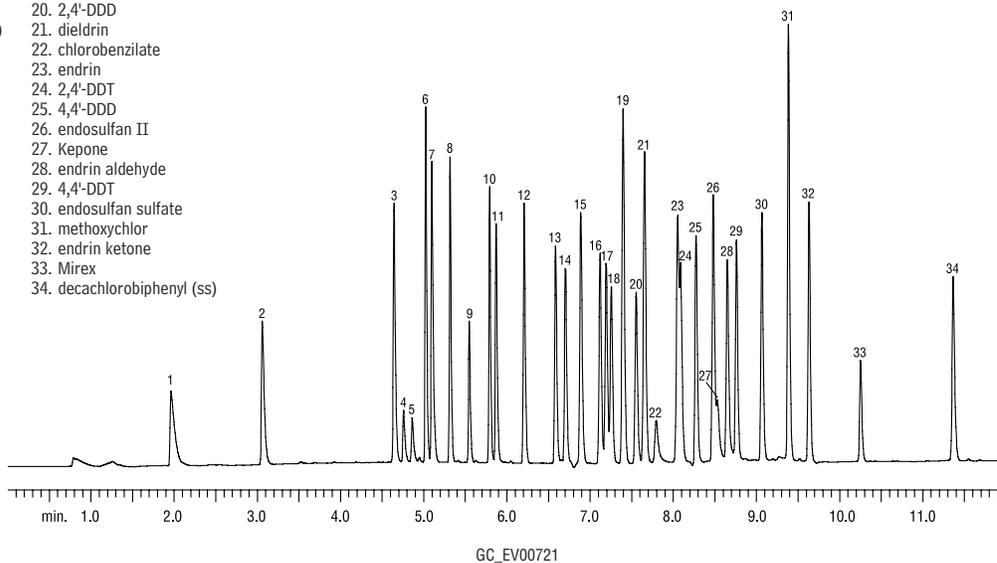
* Pulsed injection also helps minimize breakdown, by reducing the time the analytes spend in the injection port. A 30psi/0.5 min. pulse was used to obtain Figure 2. To avoid breaking the seal between the column and a Drilled Uniliner® inlet liner, do not exceed 50psi.

* When analyzing semivolatiles, a 35°C initial temperature helps ensure sharp, symmetric peaks for early-eluting analytes (Figure 2).

Resolve Complex Mixtures of Organochlorine Pesticides

Figure 4 Complex mix of organochlorine pesticides resolved on an Rtx®-XLB column.

- | | |
|---|-----------------------------|
| 1. 1,2-dibromo-3-chloropropane | 19. 4,4'-DDE |
| 2. hexachlorocyclopentadiene | 20. 2,4'-DDD |
| 3. 2,4,5,6-tetrachloro- <i>m</i> -xylene (ss) | 21. dieldrin |
| 4. <i>cis</i> -diallate | 22. chlorobenzilate |
| 5. <i>trans</i> -diallate | 23. endrin |
| 6. α -BHC | 24. 2,4'-DDT |
| 7. hexachlorobenzene | 25. 4,4'-DDD |
| 8. γ -BHC | 26. endosulfan II |
| 9. β -BHC | 27. Kepone |
| 10. δ -BHC | 28. endrin aldehyde |
| 11. heptachlor | 29. 4,4'-DDT |
| 12. aldrin | 30. endosulfan sulfate |
| 13. isodrin | 31. methoxychlor |
| 14. heptachlor epoxide | 32. endrin ketone |
| 15. 2,4'-DDE | 33. Mirex |
| 16. γ -chlordane | 34. decachlorobiphenyl (ss) |
| 17. α -chlordane | |
| 18. endosulfan I | |



Rtx®-XLB 30m, 0.32mm ID, 0.5 μ m (cat.# 12839)
 Sample: 8081A pesticides, 80-160ppb in hexane
 Inj.: 1.0 μ L splitless (hold 0.75 min.), 4mm Drilled Uniliner® inlet liner (cat.# 21055)
 Inj. temp.: 220°C
 Carrier gas: hydrogen, constant pressure
 Linear velocity: 60cm/sec. @ 120°C
 Oven temp.: 120°C (hold 0.5 min.) to 260°C @ 29°C/min. (hold 2.5 min.),
 to 330°C @ 28°C/min. (hold 3 min.)
 Det.: ECD @ 320°C

Sample Components
 8081A Pesticides/Surrogates (cat.# 32292)
 8080 Organochlorine Pesticide Mix AB #2 (20 components) (cat.# 32295)
 8081a Organochlorine Pesticide Mix C #2 (7 components) (cat.# 32200)
 2,4'-DDT (cat.# 32098)
 2,4'-DDD (cat.# 32099) (custom)
 Kepone (custom)
 Mirex (custom)
 2,4,5,6-tetrachloro-*m*-xylene (ss, 20ppb) (cat.# 32027)
 decachlorobiphenyl (ss, 40ppb) (cat.# 32029)

Table 1 Retention times for extended list of organochlorine pesticides on an Rtx®-XLB column.

Pesticide	Retention Time (min.)	Pesticide	Retention Time (min.)	Pesticide	Retention Time (min.)
1,2-dibromo-3-chloropropane	1.96	heptachlor	5.87	dieldrin	7.65
hexachlorocyclopentadiene	3.06	aldrin	6.21	chlorobenzilate	7.80
2,4,5,6-tetrachloro- <i>m</i> -xylene (ss)	4.64	isodrin	6.58	endrin	8.05
<i>cis</i> -diallate	4.76	heptachlor epoxide	6.70	2,4'-DDT	8.09
<i>trans</i> -diallate	4.86	2,4'-DDE	6.89	4,4'-DDD	8.27
α -BHC	5.02	γ -chlordane	7.12	endosulfan II	8.48
hexachlorobenzene	5.10	α -chlordane	7.19	Kepone	8.53
γ -BHC	5.32	endosulfan I	7.26	endrin aldehyde	8.65
β -BHC	5.55	4,4'-DDE	7.40	4,4'-DDT	8.76
δ -BHC	5.79	2,4'-DDD	7.55	endosulfan sulfate	9.07
				methoxychlor	9.38
				endrin ketone	9.63
				Mirex	10.25
				decachlorobiphenyl (ss)	11.36

Rtx®-XLB 30m, 0.32mm ID, 0.5 μ m (cat.# 12839)
 Sample: US EPA Method 8081A pesticides, 80-160ppb in hexane
 Inj.: 1.0 μ L splitless (hold 0.75 min.), 4mm Drilled Uniliner® inlet liner (cat.# 21055)
 Inj. temp.: 220°C
 Carrier gas: hydrogen, constant pressure
 Linear velocity: 60cm/sec. @ 120°C
 Oven temp.: 120°C (hold 0.5 min.) to 260°C @ 29°C/min. (hold 2.5 min.), to 330°C @ 28°C/min. (hold 3 min.)
 Det.: ECD @ 320°C

Product Listing

Rtx®-XLB Columns (fused silica)

(proprietary low-polarity phase)



ID	df (μm)	temp. limits*	15-Meter	30-Meter	60-Meter
0.25mm	0.10	30 to 340/360°C		12808	
	0.25	30 to 340/360°C	12820	12823	12826
	0.50	30 to 340/360°C		12838	
0.32mm	1.00	30 to 340/360°C	12850	12853	
	0.10	30 to 340/360°C		12809	
	0.25	30 to 340/360°C	12821	12824	12827
0.53mm	0.50	30 to 340/360°C		12839	
	1.00	30 to 340/360°C		12854	
	1.50	30 to 340/360°C	12867	12870	
ID	df (μm)	temp. limits	12-Meter	20-Meter	25-Meter
0.18mm	0.18	30 to 340/360°C		42802	
0.20mm	0.33	30 to 340/360°C	42815		42820

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



Change columns in minutes—without venting!

EZ No-Vent™ GC Column-Mass Spectrometer Connector

Description	qty.	cat.#
EZ No-Vent™ Connector Kit for Agilent 5971/5972 and 5973 GC/MS Kit includes: EZ No-Vent™ Connector, two 0.4mm ID ferrules for capillary column, two 0.4mm ID ferrules for transfer line, 100μm deactivated transfer line (3 ft.), column plug, column nut.	kit	21323
Replacement ferrules for connecting capillary column to EZ No-Vent™: 0.4mm ID	2-pk.	21015
0.5mm ID	2-pk.	21016
Replacement ferrules for connecting transfer line to EZ No-Vent™: 0.4mm ID	2-pk.	21043
Replacement 100μm deactivated transfer line	3 ft.	21018
Replacement EZ No-Vent™ Column Nut	5-pk.	21900
Replacement EZ No-Vent™ Plug	2-pk.	21915
Open-End Wrenches (1/4" x 5/16")	2-pk.	20110

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Rxi[®]-624Si MS

The "Go To" GC Column for Fast,
Effective Volatile Impurities
Method Development



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Rxi[®]-624Sil MS

The **Go To** GC Column for Fast, Effective Volatile Impurities Method Development

In drug development, time-to-market is everything, but finding the right column can be laborious and time-consuming. Commonly, “624” (6% cyanopropyl phenyl/94% dimethyl polysiloxane) type columns are used for GC/FID impurity analyses to provide the necessary selectivity, but when mass spectrometry is needed, method development often starts with lower bleed “1” (100% dimethyl polysiloxane) and “5” (5% diphenyl/95% dimethyl polysiloxane) type columns. Now, you can get to market faster and more efficiently by using a single column that combines these attributes—the new Rxi[®]-624Sil MS column. With enhanced retention and selectivity of polar compounds, compatibility with mass spec detectors, and unsurpassed inertness, Rxi[®]-624Sil MS columns are the most broadly applicable GC columns available to the pharmaceutical industry. Speed up successful method development by making Rxi[®]-624Sil MS your “go to” column of choice for polar impurities.

Go To...the right column first

For better retention of polar analytes and improved accuracy, peak shape, and response for active compounds.

Go To...mass spec directly

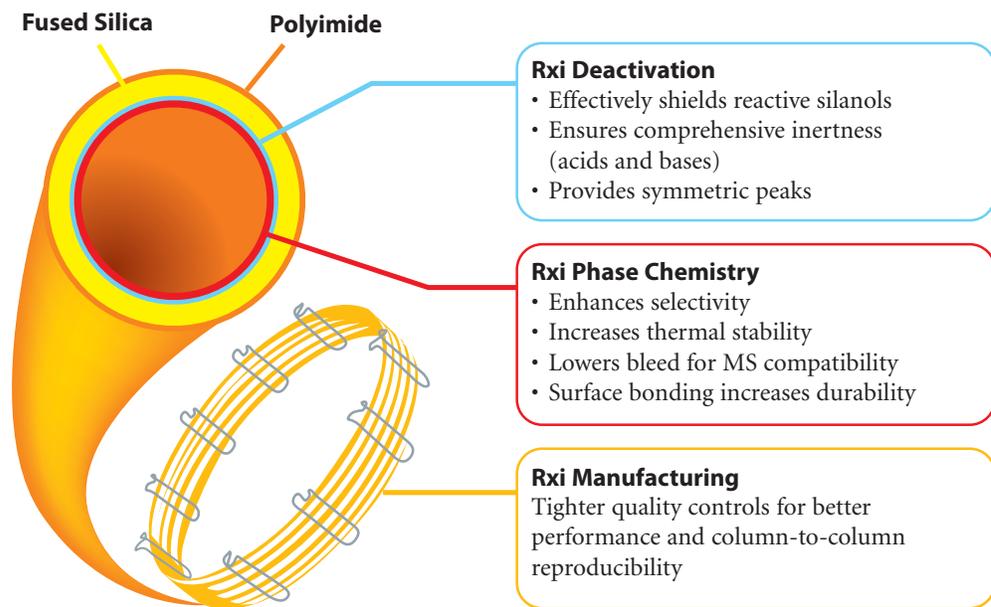
With the lowest bleed 624 column available; stable up to 320 °C, for easy transfer of methods to GC/MS.

Go To...the next batch faster

With the best-in-class G43 for USP methods.

How did we create the **Rxi** Column Family?

We've optimized phase chemistry, column deactivation, and our manufacturing process to ensure the comprehensive performance that makes Rxi[®]-624Sil MS columns the best starting point for method development.

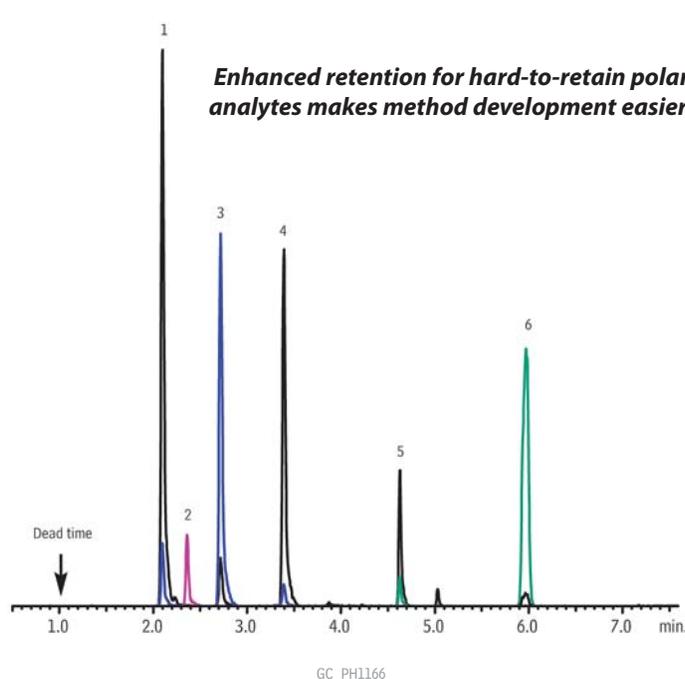


Go To...the Right Column First

Balanced Retention Simplifies Method Development For Polar Impurities

While “1s and 5s” are often used initially in GC/MS method development because of their thermal stability, their nonpolar character results in poor retention for polar compounds and costs additional development time. In contrast, midpolarity Rxi®-624Sil MS columns provide improved retention and selectivity for polar compounds and are also more compatible with polar injection solvents. Highly volatile, polar alkyl halide genotoxic impurities, for example, are difficult to retain on 1s and 5s, but the Rxi®-624Sil MS column provides higher retention capacity, making GC/MS analysis easier to control and allowing faster method development (Figure 1).

Figure 1 Polar compounds, such as alkyl halides, are highly retained on midpolarity Rxi®-624Sil MS columns, making method development faster and easier than on a nonpolar 1 or 5 type column.



Peaks	RT (min.)
1. 2-Chloropropane	2.10
2. Bromoethane	2.36
3. 1-Chloropropane	2.72
4. 2-Bromopropane	3.393
5. Butyl chloride	4.627
6. 1-Bromobutane	5.973

Column Rxi®-624Sil MS, 20 m, 0.18 mm ID, 1.00 µm (cat.# 13865)
Sample
Diluent: DMSO
Conc.: 1 µg/mL each compound
Injection
Inj. Vol.: 1 µL splitless (hold 0.5 min.)
Liner: 3.5mm Single Gooseneck Liner with wool placed 3cm from top (middle) (cat.# 22286)
Inj. Temp.: 220 °C
Purge Flow: 3 mL/min.
Oven
Oven Temp: 40 °C (hold 3 min.) to 200 °C at 20 °C/min.
Carrier Gas He, constant flow
Linear Velocity: 40 cm/sec.
Detector MS
Mode: Scan
Transfer Line Temp.: 280 °C
Analyzer Type: Quadrupole
Source Temp.: 280 °C
Solvent Delay Time: 0.5 min.
Ionization Mode: EI
Scan Range: 30-300 amu
Scan Rate: 5 scans/sec.
Instrument Shimadzu 2010 GC & QP2010+ MS
Notes: EIC of 42, 43, 57, 108 m/z



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



The versatility of an Rxi®-624Sil MS column makes it a perfect fit for Quality By Design.



Go To...the Right Column First

Balanced Inertness Gives Higher Data Quality— Excellent Peak Symmetry and Reproducibility for Active Compounds

In addition to offering better retention of polar analytes, Rxi®-624Sil MS columns are exceptionally inert, reducing the need to switch columns when developing methods for active compounds, such as amines. Amines are commonly found on pharmaceutical impurities and can interact with surface silanols resulting in a tailing peak. Proper deactivation is the best way to combat this, and Rxi® technology provides the most balanced deactivation, assuring good peak symmetry for both basic and acidic compounds. Columns that are not effectively deactivated for basic compounds produce unacceptable peak tailing (Figure 2). In contrast, the Rxi®-624Sil MS column provides excellent peak shape, which leads to consistent peak integration, improved linearity, and higher method sensitivity (Figure 3).

Figure 2 Innovative Rxi® deactivation technology provides excellent peak symmetry at 5 ng on-column for primary, secondary, and tertiary amines, which is not possible on competitive columns.

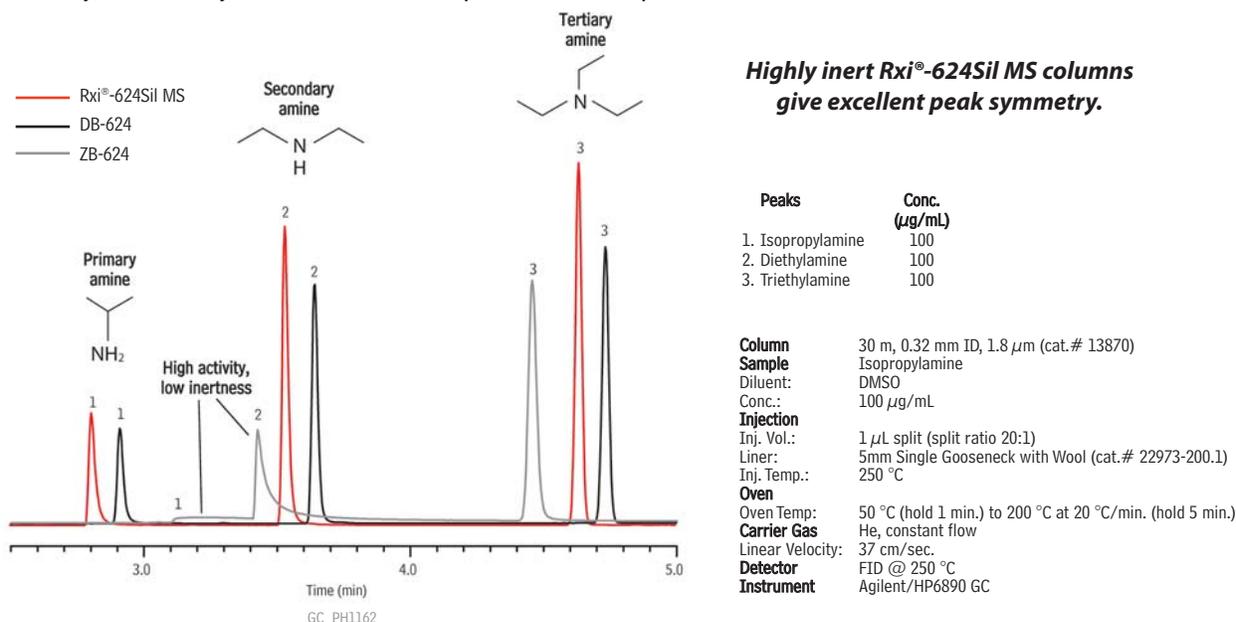
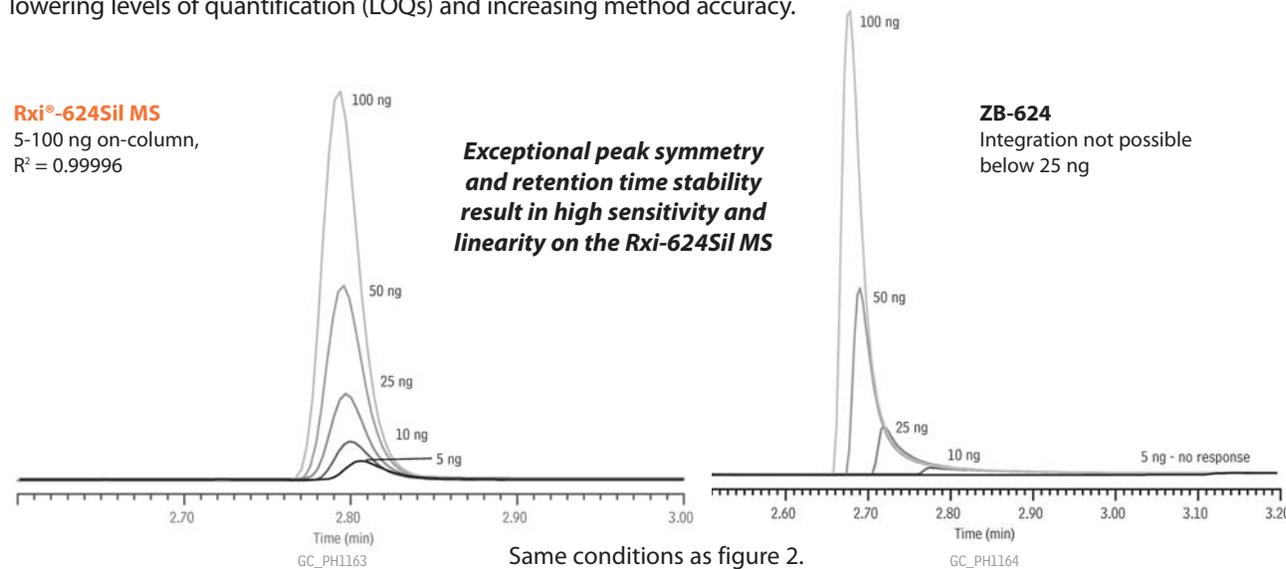


Figure 3 Primary amines, such as isopropylamine, can be more accurately integrated on an Rxi®-624Sil MS column, lowering levels of quantification (LOQs) and increasing method accuracy.



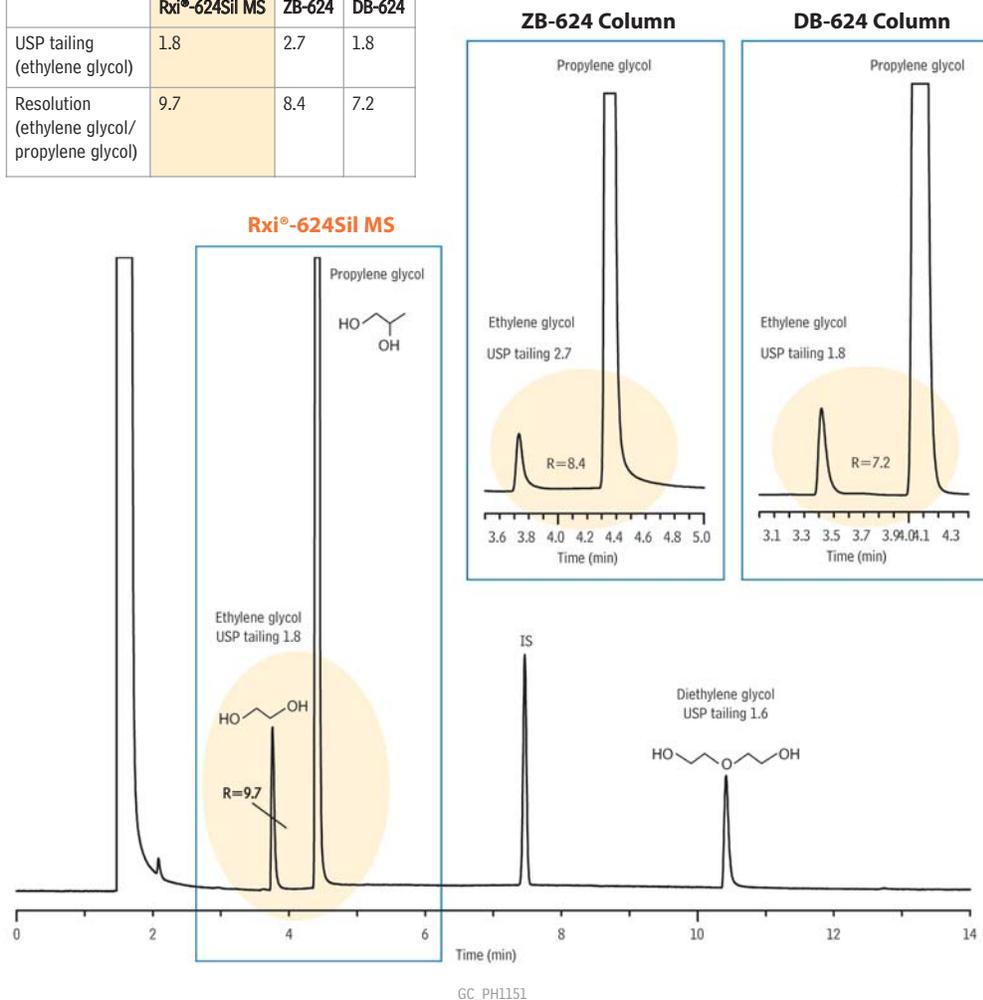
Go To...the Right Column First

Other active compounds, such as glycols, also exhibit peak tailing as a result of reactivity with the chromatographic system. For example, when analyzing ethylene glycol and diethylene glycol in glycerin, glycol, or sorbitol solutions according to a new FDA Guidance for Industry, only the Rxi®-624Sil MS column gives the selectivity and peak symmetry needed for these reactive compounds (Figure 4). Satisfy this and other industry guidances quickly, by choosing the right column, the first time.

Figure 4 Rxi®-624Sil MS columns provide the best overall inertness and selectivity for ethylene glycol and diethylene glycol impurities in glycerin, glycol, or sorbitol solutions.

Best in Class—Rxi®-624Sil MS

	Rxi®-624Sil MS	ZB-624	DB-624
USP tailing (ethylene glycol)	1.8	2.7	1.8
Resolution (ethylene glycol/propylene glycol)	9.7	8.4	7.2



Column 30 m, 0.32 mm ID, 1.80 μm (cat.# 13870)
Sample methanol
Diluent:
Injection 1 μL split (split ratio 10:1)
Inj. Vol.: 5mm Single Gooseneck with Wool (cat.# 22973-200.1)
Liner: 220 °C
Inj. Temp.:
Oven
Oven Temp: 100 °C (hold 4 min.) to 120 °C at 50 °C/min. (hold 10 min.) to 220 °C at 50 °C/min. (hold 6 min.)
Carrier Gas He, constant flow
Linear Velocity: 40 cm/sec.
Detector FID @ 250 °C
Instrument Agilent/HP6890 GC
Notes Columns tested: Rxi®-624Sil MS, ZB-624, and DB-624

Peaks	RT (min.)	Conc. (mg/mL)
Ethylene glycol	3.757	0.05
Propylene glycol	4.422	2.0
2,2,2-Trichloroethanol (IS)	7.461	0.1
Diethylene glycol	10.416	0.05

Innovation & Service

"Having a background in LC/MS/MS does not automatically qualify one to run GC/MS. Julie Kowalski spent time with me to help me decide which column would be the best for my application as well as which consumables I would need to do routine maintenance. The time and knowledge she shared with me saved me multiple headaches and will keep me a loyal Restek customer!"

Richard, Biologist
National Institute of Health

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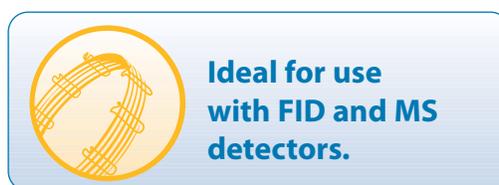
Go To...Mass Spec Directly

High Thermal Stability and Low Bleed for GC/MS Compatibility

While midpolarity 624 type columns offer better retention of polar analytes than 1s and 5s, most 624s have low thermal stability and generate too much column bleed to be useful for mass spec work. However, the Rxi®-624Sil MS column is fully compatible with mass spectrometry, due to stabilizing technology that delivers the highest thermal stability and lowest bleed of any polar capillary column in its class (Table I, Figure 5). Eliminate the need to change columns when mass spec is required—unlike other 624 columns, Rxi®-624Sil MS columns take your method directly to GC/MS. Keep the same 624 retention and selectivity, but leave the bleed behind.

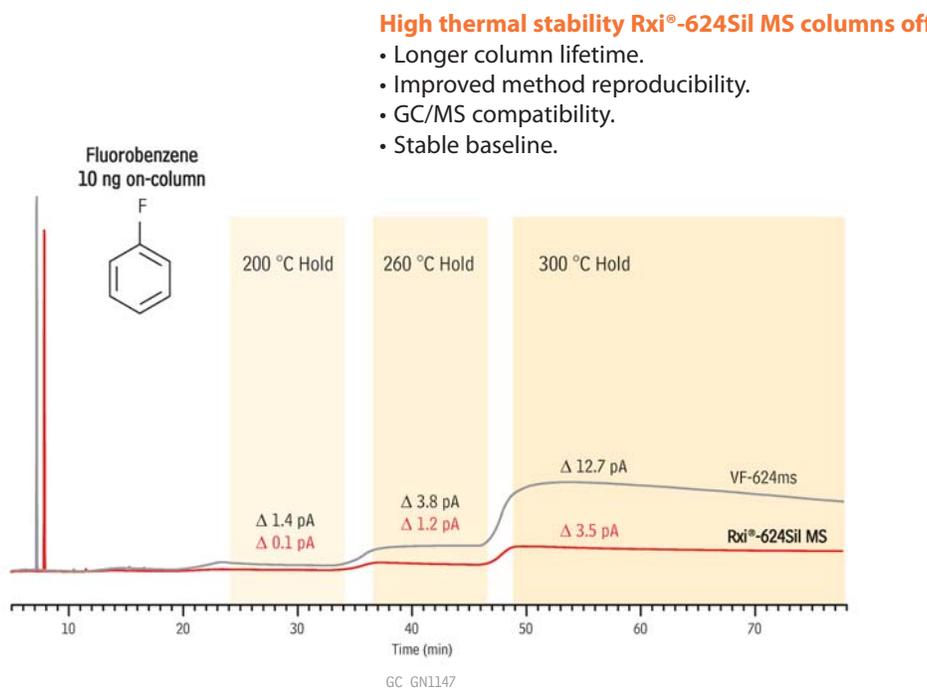
Table I The Rxi®-624Sil MS column has the highest thermal stability of any 624 column.

Column	Manufacturer	Highest Temperature Limit (Isothermal)
Rxi®-624Sil MS	Restek	320 °C
VF-624ms	Varian	300 °C
DB-624	Agilent J&W	260 °C
ZB-624	Phenomenex	260 °C



Data obtained from company website or literature for a 30 m x 0.25 mm x 1.4 µm df column.

Figure 5 The Rxi®-624Sil MS column has the lowest bleed of any column in its class, providing true GC/MS capability.



Column 30 m, 0.25 mm ID, 1.4 µm (cat.# 13868)
Sample Fluorobenzene (cat.# 30030)
Diluent: methanol
Conc.: 200 µg/mL
Injection
Inj. Vol.: 1 µL split (split ratio 20:1)
Liner: 4mm Split Liner with Wool (cat.# 20781)
Inj. Temp.: 220 °C
Oven
Oven Temp: 40 °C (hold 5 min.) to 60 °C at 20 °C/min. (hold 5 min.) to 120 °C at 20 °C/min. (hold 5 min.) to 200 °C at 20 °C/min. (hold 10 min.) to 260 °C at 20 °C/min. (hold 10 min.) to 300 °C at 20 °C/min. (hold 20 min.)
Carrier Gas
Linear Velocity: 40 cm/sec.
Detector FID @ 250 °C
Instrument Agilent/HP6890 GC
Notes Columns are of equivalent dimensions and were tested after equivalent conditioning.

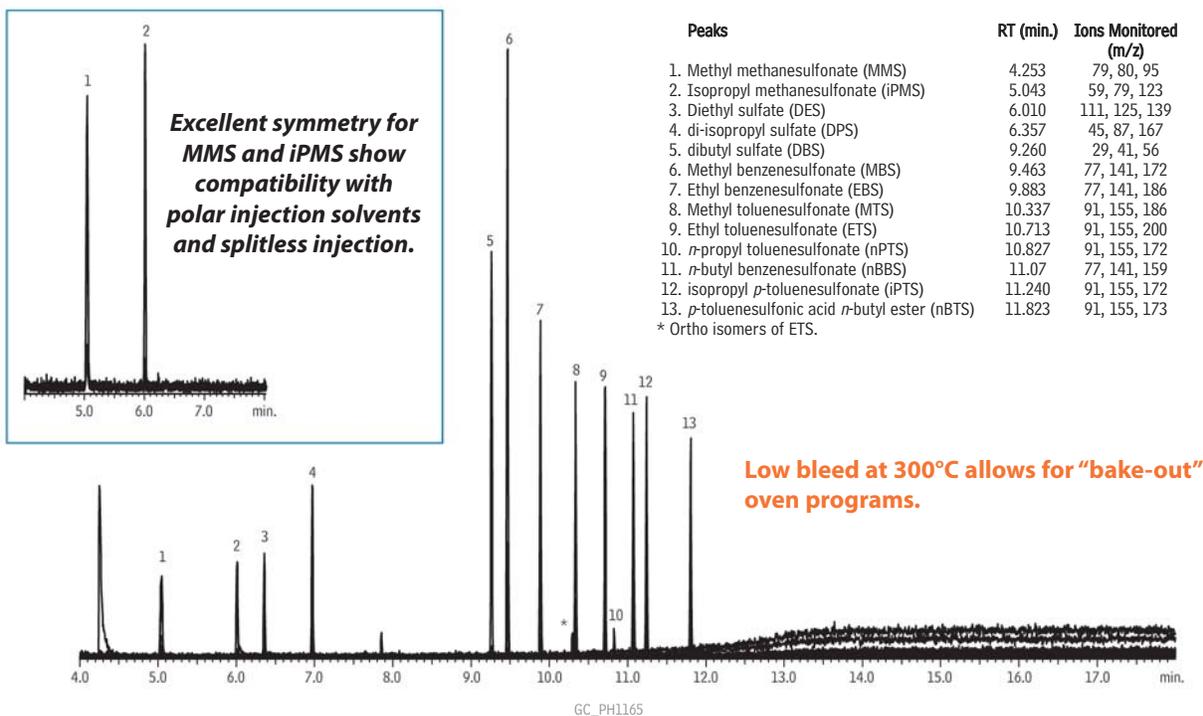


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Selective, Retentive, and Compatible with Polar Injection Solvents

The Rxi®-624Sil MS column combines the thermal stability of a mass spec friendly column with the selectivity, retention, and injection solvent compatibility needed to analyze polar impurities. For example, when analyzing mesylate, besylate, and tosylate genotoxic impurities by GC/MS, the Rxi®-624Sil MS column provides excellent selectivity, stability, and sensitivity (Figure 6). The innovative stationary phase is compatible with a variety of injection solvents, allowing splitless injection techniques to be used for heightened sensitivity. Bleed-free thermal stability allows oven “bake-out” programs to be used for contaminant removal and longer column life-times.

Figure 6 The Rxi®-624Sil MS phase is more compatible with polar injection solvents than 1 or 5 type columns, providing higher sensitivity and less time needed for optimizing injection parameters.



Column Rxi®-624Sil MS, 20 m, 0.18 mm ID, 1.00 µm (cat.# 13865)
Sample
 Diluent: 90:10 acetonitrile:water
 Conc.: 500 ng/mL
Injection
 Inj. Vol.: 1 µL splitless (hold 0.5 min.)
 Liner: 3.5mm Single Gooseneck Liner with wool placed 3cm from top (middle) (cat.# 22286)
 Inj. Temp.: 220 °C
 Purge Flow: 3 mL/min.
Oven
 Oven Temp: 80 °C (hold 2 min.) to 300 °C at 20 °C/min. (hold 5 min.)
Carrier Gas
 Linear Velocity: He, constant flow 45 cm/sec.

Detector MS
 Mode: SIM
 Transfer Line
 Temp.: 280 °C
 Analyzer Type: Quadrupole
 Source Temp.: 280 °C
 Solvent Delay
 Time: 4 min.
 Ionization
 Mode: EI
Instrument Shimadzu 2010 GC & QP2010+ MS
Acknowledgement In collaboration with Merck and Company

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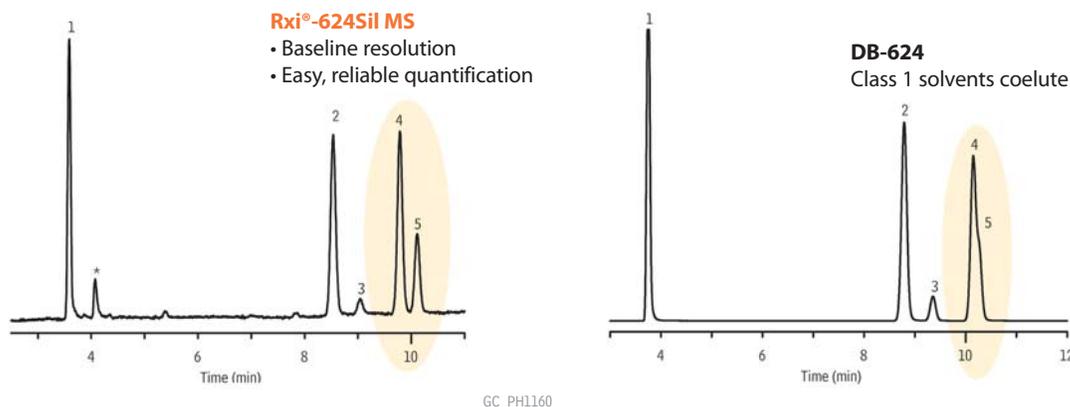


Go To...the Next Batch Faster

Improve Pass Rates with the Best-In-Class G43 for USP <467>

System suitability is a major factor in overall lab productivity, and Rxi®-624Sil MS columns provide the optimized selectivity and guaranteed reproducibility needed to increase pass rates. For example, batch throughput can be improved for USP <467> residual solvents analysis by using a column that provides increased resolution and sensitivity for system suitability components (Figures 7 and 8). Benefits include industry-leading resolution of acetonitrile and dichloromethane, as well as benzene and 1,2-dichloroethane. No other 624 type column performs as well as Rxi®-624Sil MS columns for these critical system suitability requirements.

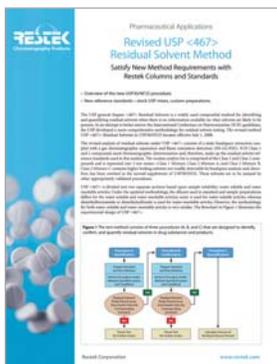
Figure 7 Improve system suitability pass rates—the innovative polymer chemistry of the Rxi®-624Sil MS column provides greater resolution of critical pairs.



Peaks	RT (min.)	Conc. (µg/mL)	Column	Pressure
1. 1,1-Dichloroethene	3.586	0.07	Rxi®-624Sil MS, 30 m, 0.32 mm ID, 1.80 µm (cat.# 13870)	Equilibration Time: 0.05 min.
2. 1,1,1-Trichloroethane	8.536	0.08	Residual Solvents - Class 1 (cat.# 36279)	Loop Pressure: 5 psi
3. Carbon tetrachloride	9.042	0.03	Diluent: water	Loop Fill Time: 0.1 min.
4. Benzene	9.787	0.02	Injection: headspace-loop split (split ratio 5:1)	Oven
5. 1,2-Dichloroethane	10.112	0.04	Liner: 1mm Split (cat.# 20972)	Oven Temp: 40 °C (hold 20 min.) to 240 °C at 10 °C/min. (hold 20 min.)
* DMSO interference			Headspace-Loop	Carrier Gas
			Inj. Port Temp.: 140 °C	Linear Velocity: He, constant flow 35 cm/sec.
			Instrument: Tekmar HT3	Dead Time: 1.45 min. @ 40 °C
			Inj. Time: 1 min.	Detector
			Transfer Line Temp.: 110 °C	Data Rate: 5 Hz
			Valve Oven Temp.: 110 °C	Instrument
			Sample Temp.: 80 °C	Acknowledgement
			Sample Equil. Time: 60 min.	Agilent/HP6890 GC
			Vial Pressure: 10 psi	Teledyne Tekmar
			Pressurize Time: 0.5 min.	

Columns were tested under identical operating conditions and after identical conditioning.

For the complete application note and technical tips on USP<467>, visit www.restek.com/usp467.



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Save time and money with mixes prepared to your specific solvent set and concentrations. The more you buy the less you pay per ampule!

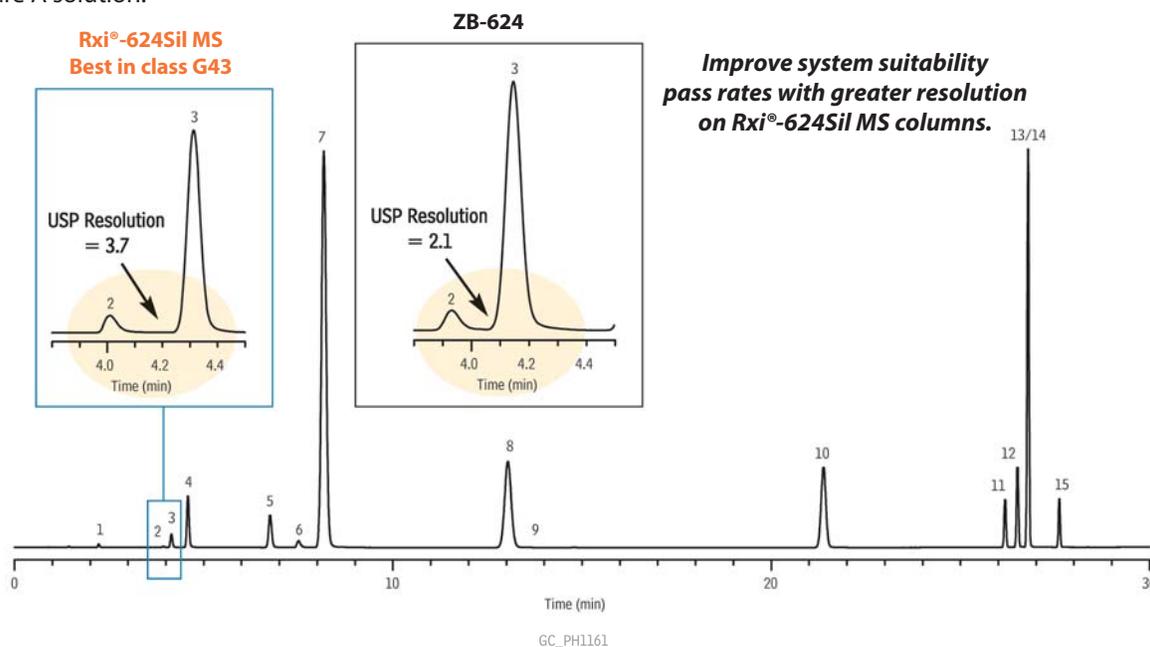
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Figure 8 The Rxi®-624Sil MS column provides best-in-class system suitability performance for the USP <467> Class 2 Mixture A solution.



Peaks	RT (min.)	Conc. (µg/mL)			
1. Methanol	2.281	25.00	8. Methylcyclohexane	14.099	9.83
2. Acetonitrile	4.009	3.42	9. 1,4-Dioxane	15.054	3.17
3. Dichloromethane	4.313	5.00	10. Toluene	22.018	7.42
4. <i>trans</i> -1,2-Dichloroethene	4.798	7.83	11. Chlorobenzene	26.570	3.00
5. <i>cis</i> -1,2-Dichloroethene	7.028	7.83	12. Ethylbenzene	26.837	3.07
6. Tetrahydrofuran	7.706	5.75	13. <i>m</i> -Xylene	27.147	10.85
7. Cyclohexane	8.708	32.33	14. <i>p</i> -Xylene	27.147	2.53
			15. <i>o</i> -Xylene	27.927	1.63

Columns were tested under identical operating conditions and after identical conditioning. See Figure 7 for conditions.

Screw-Thread Headspace Vials (18mm)

Description	Volume	Color	Dimensions	100-pk.	1000-pk.
Headspace Vial	10mL	Clear	22 x 45mm	23084	23085
Headspace Vial	10mL	Amber	22 x 45mm	23088	23089
Headspace Vial	20mL	Clear	22 x 75mm	23082	23085
Headspace Vial	20mL	Amber	22 x 75mm	23086	23089

Caps not included.



Magnetic Screw-Thread Caps (18mm)

Description	Septa Material	100-pk.	1000-pk.
Magnetic Caps and Septa	PTFE/Silicone	23090	23091
Magnetic Caps and Septa	PTFE/Silicone for SPME	23092	23093
Magnetic Caps and Septa	PTFE/Red Chlorobutyl	23094	23095



Hot Swap Capillary Column Nuts

Quickly change columns for USP <467> Procedures A and B using a Hot Swap Capillary Column Nut!

Description	qty.	cat.#
For use with "compact" Agilent-style ferrules.		
Hot Swap Capillary Column Nut	ea.	22348
For use with standard 1/8"-type ferrules.		
Hot Swap Capillary Column Nut	ea.	22347



NOTE: For proper operation, oven fan must be kept operational during change out or risk of burn may occur.

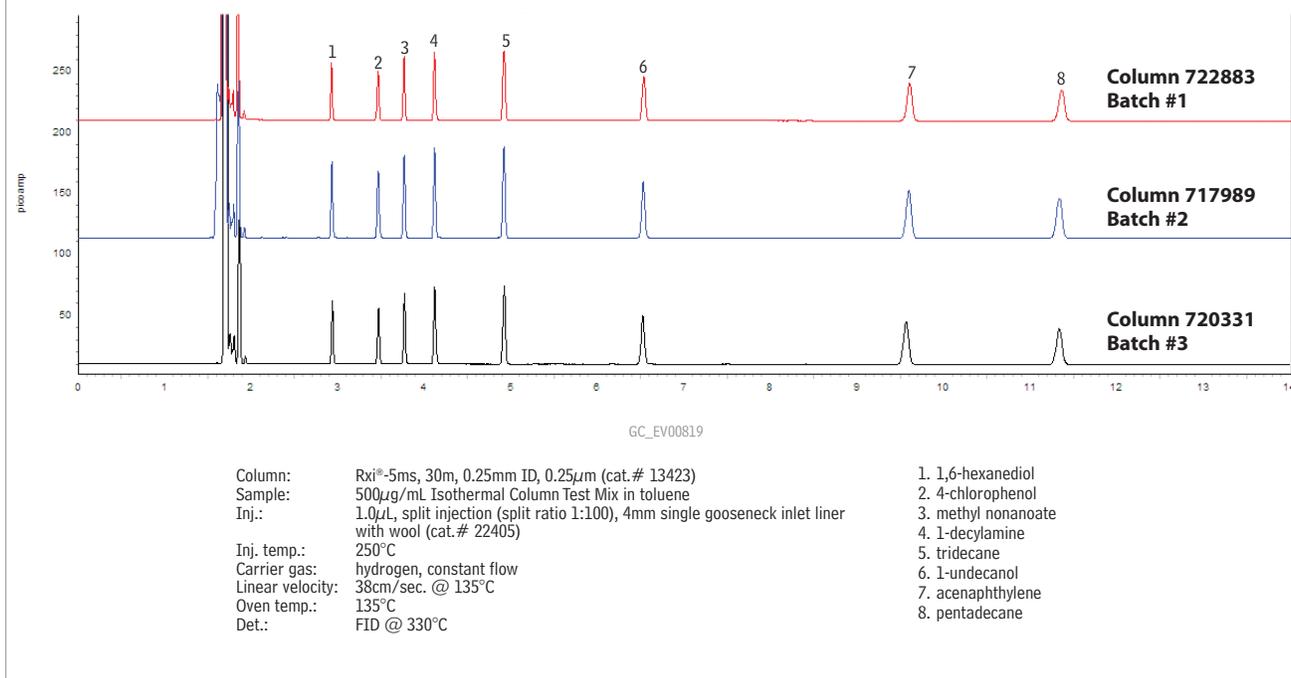


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Guaranteed Reliable Column-to-Column Performance

Reliable column-to-column performance also contributes to lab productivity as less column variation means faster setup and more consistent results. Rxi® column technology has enabled Restek to tighten our quality control standards and guarantee consistency. Columns from multiple manufacturing batches show the excellent reproducibility obtained using the new Rxi® manufacturing process (Figure 9). All Rxi® columns are individually tested to assure performance.

Figure 9 Three manufacturing batches of Rxi® columns show excellent reproducibility.



Go To...Rxi®-624Sil MS Columns for Faster Method Development

Optimized phase chemistry, column deactivation, and manufacturing make Rxi®-624Sil MS columns the “go to” column for pharmaceutical method development. With better retention of polar compounds than 1 and 5 type columns, lower bleed than any other 624 column, and unsurpassed inertness, Rxi®-624Sil MS columns offer the most comprehensive performance, allowing you to develop successful methods quickly, easily, and reliably. Try one for your next method today.

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

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(mid polarity Crossbond® silarylene phase; equivalent to 6% cyanopropylphenyl/94% dimethyl 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 (µm)	temp. limits	20-Meter	30-Meter	60-Meter
0.18mm	1.00	-20 to 300/320°C	13865		
0.25mm	1.40	-20 to 300/320°C		13868	
0.32mm	1.80	-20 to 300/320°C		13870	13872
0.53mm	3.00	-20 to 280/300°C		13871	



Restek Electronic Leak Detector

Why have a small leak turn into a costly repair? Protect your data and analytical column by using a Restek Leak Detector.

Description	qty.	cat.#
Leak Detector with Hard-Sided Carrying Case and Universal Charger Set (US, UK, European, Australian)	ea.	22839
Soft-Side Storage Case	ea.	22657
Small Probe Adaptor	ea.	22658

Avoid using liquid leak detectors on a GC! Liquids can be drawn into the system.



GC/MS Cleaning Kit

Description	qty.	cat.#
Mass Spec Cleaning Kit with Dremel Tool	kit	27194
Mass Spec Cleaning Kit without Dremel Tool	kit	27195
Mass Spec Cleaning Kit Replacement Parts Kit (includes cloths, micro mesh sheets, small and large gloves)	kit	27196



ETP Electron Multipliers

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Description	qty.	cat.#
Electron Multipliers for Agilent GC/MS and LC/MS		
For Agilent 5970 GC/MS	ea.	23072
For Agilent 5971, 5972, GC GC/MS	ea.	23073
For Agilent 5973 & 5975 GC/MS (includes mount for initial installation)*†	ea.	23074
For Agilent 5973 & 5975 GC/MS and LC/MSD (Replacement Multiplier)*†	ea.	23075
For Agilent LC/MSD (includes mount for initial installation)*†	ea.	23076
Electron Multiplier for Applied Biosystems (Sciex)		
For API 300, 3000 & 4000 Applied Biosystems	ea.	23077
Electron Multiplier for Thermo Finnigan GC/MS		
For Thermo TRACE DSQ, DSQII, and Polaris-Q GC/MS	ea.	23081



*First time installation requires a mount which includes the mechanical housing. After initial installation, only the replacement electron multiplier is required.

†This unit is designed for use in the 5975, 5973 GC and the LC/MSD.



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Rtx[®]-5Sil MS Columns

Enhanced Performance



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Rtx[®]-5Sil MS Columns

- Inert, high temperature stable polymer (Figure 1).
- Faster analyses.
- Longer column lifetime.

Enhanced Column Performance

Our new polymer and new manufacturing process greatly enhance the performance of Rtx[®]-5Sil MS columns in analyses of semivolatile environmental compounds. Figure 2 shows a sub 17-minute analysis of more than 100 semivolatile environmental compounds, using a 30m x 0.25mm ID Rtx[®]-5Sil MS column. Typically, this many compounds, or more, are targets in these analyses. In most circumstances a 0.25mm ID Rtx[®]-5Sil MS column with a 0.50 μ m phase film best combines fast analysis time with extended column lifetime.

Figure 1 Rtx[®]-5Sil MS polymer.

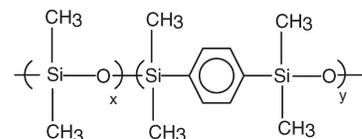
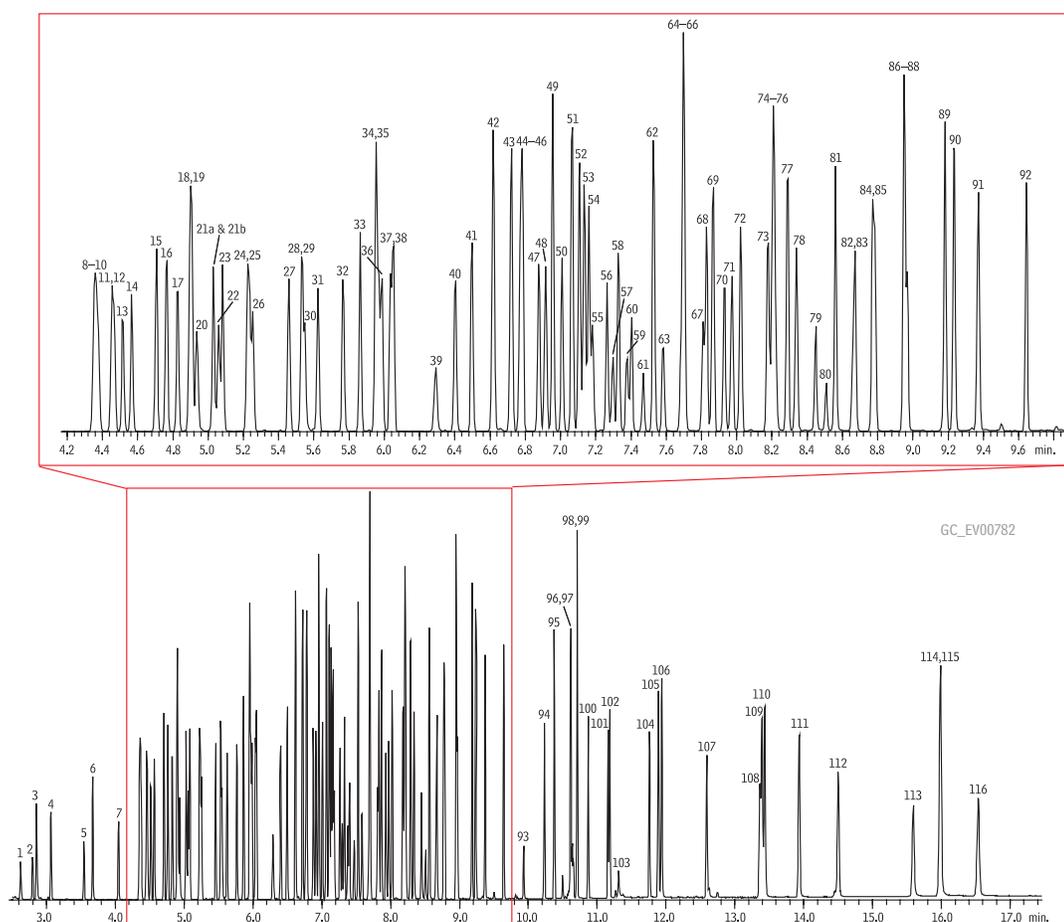


Figure 2 16.5-Minute analysis of semivolatile organics in US EPA Method 8270D Appendix IX, using a 30m x 0.25mm ID Rtx[®]-5Sil MS column.



Column: Rtx[®]-5Sil MS 30m, 0.25mm ID, 0.50 μ m (cat.# 12738)
 Sample: US EPA Method 8270D Appendix IX mix
 8270 MegaMix[®] (cat.# 31850)
 Appendix IX Mix #2 (cat.#31806)
 Acid Surrogate Mix (4/89 SOW) (cat.# 31063)
 B/N Surrogate Mix (4/89 SOW) (cat.# 31062)
 Inj.: 0.5 μ L, splitless, 100ppm each compound (50ng on column)
 2mm Cyclo double gooseneck splitless inlet liner
 (cat.# 20907), 0.3 min. splitless hold time, 0.4 min.
 pressure pulse @ 30psi
 Inj. temp.: 250 $^{\circ}$ C
 Carrier gas: helium, constant flow
 Flow rate: 1.1mL/min.

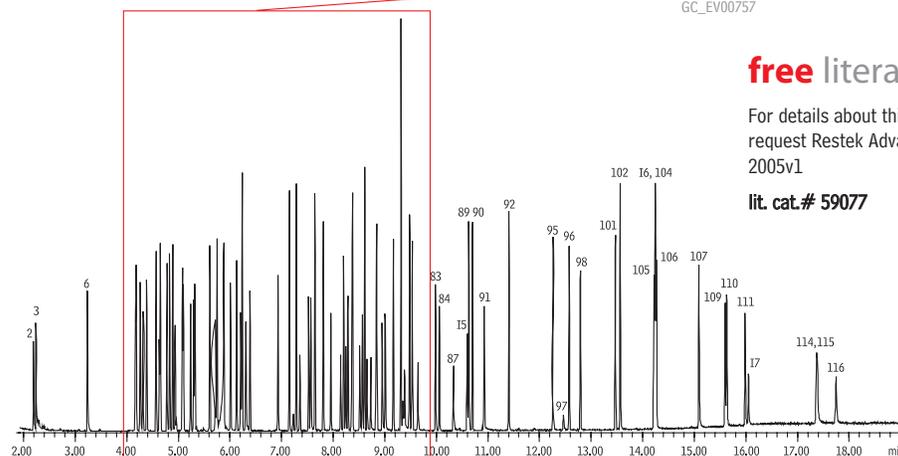
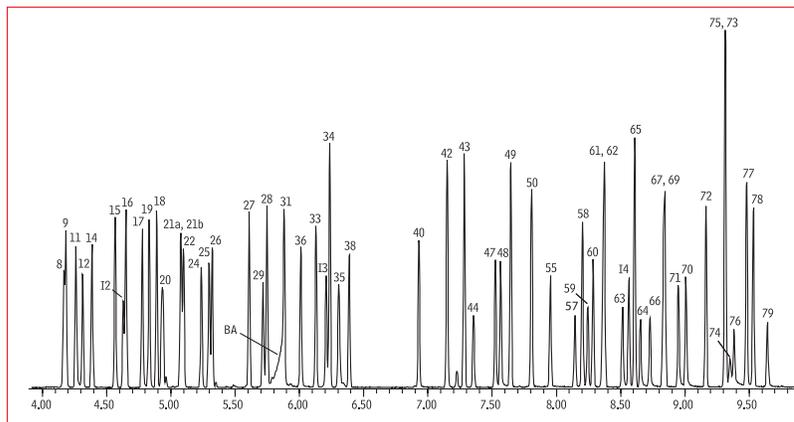
Oven temp.: 50 $^{\circ}$ C (hold 0.5 min.) to 310 $^{\circ}$ C @ 25 $^{\circ}$ C/min.
 (hold 0 min.) to 330 $^{\circ}$ C @ 4 $^{\circ}$ C/min. (hold 4 min.)
 Det.: MS
 Det. temp.: 280 $^{\circ}$ C
 Transfer line
 temp.: 280 $^{\circ}$ C
 Scan range: 35-550 amu
 Solvent Delay: 1 min.
 Tune: DFTPP
 Ionization: EI
 Instrument: Agilent 6890 / 5973

Some analysts prefer using shorter, narrower ID columns to analyze for semivolatiles. When using such columns, both matrix interferences and on-column amounts of target compounds must be reduced, so the column is not overloaded, and to maintain column lifetime. Figure 3 shows an 18-minute analysis of 90 semivolatile pollutants, surrogates, and internal standards on a 20m x 0.18mm ID, 0.36µm film Rtx®-5Sil MS column. A splitless injection was used, but results are equivalent with split injections.

Figure 3 90 semivolatile analytes separated in 18 minutes on a 20m x 0.18mm ID Rtx®-5Sil MS column.

Compounds in Figures 2 & 3

1. 1,4-dioxane
2. N-nitrosodimethylamine
3. pyridine
4. ethyl methacrylate
5. methyl methanesulfonate
6. 2-fluorophenol
7. ethyl methanesulfonate
8. phenol-d6
9. phenol
10. benzaldehyde
11. aniline
12. bis(2-chloroethyl)ether
13. pentachloroethane
14. 2-chlorophenol
15. 1,3-dichlorobenzene
16. 1,4-dichlorobenzene
17. benzyl alcohol
18. 2-methylphenol
19. 1,2-dichlorobenzene
20. bis(2-chloroisopropyl)ether
- 21a. 4-methylphenol
- 21b. 3-methylphenol
22. N-nitroso-di-n-propylamine
23. acetophenone
24. hexachloroethane
25. nitrobenzene-d5
26. nitrobenzene
27. isophorone
28. 2,4-dimethylphenol
- BA. benzoic acid*
29. 2-nitrophenol
30. diallate (isomer)
31. bis(2-chloroethoxy)methane
32. 2,4-dichlorophenol
33. 1,2,4-trichlorobenzene
13. naphthalene-d8*
34. naphthalene
35. 4-chloroaniline
36. 2,6-dichlorophenol
37. hexachloropropene
38. hexachlorobutadiene
39. ε-caprolactam
40. 4-chloro-3-methylphenol
41. isosafrole (cis)
42. 2-methylnaphthalene
43. 1-methylnaphthalene
44. hexachlorocyclopentadiene
45. isosafrole (trans)
46. 1,2,4,5-tetrachlorobenzene
47. 2,4,6-trichlorophenol
48. 2,4,5-trichlorophenol
49. 2-fluorobiphenyl
50. 2-chloronaphthalene
51. biphenyl
52. safrole
53. 1-chloronaphthalene
54. diphenyl ether
55. 2-nitroaniline
56. 1,4-naphthoquinone
57. 1,4-dinitrobenzene
58. dimethylphthalate
59. 1,3-dinitrobenzene
60. 2,6-dinitrotoluene
61. 1,2-dinitrobenzene
62. acenaphthylene
63. 3-nitroaniline
14. acenaphthene-d10*
64. 2,4-dinitrophenol
65. acenaphthene
66. 4-nitrophenol
67. 2,4-dinitrotoluene
68. pentachlorobenzene
69. dibenzofuran
70. 2,3,5,6-tetrachlorophenol
71. 2,3,4,6-tetrachlorophenol
72. diethyl phthalate
73. 4-chlorophenyl phenyl ether
74. 4-nitroaniline
75. fluorene
76. 4,6-dinitro-2-methylphenol
77. diphenylamine
78. azobenzene
79. 2,4,6-tribromophenol
80. 1,3,5-trinitrobenzene
81. phenacetin
82. diallate
83. 4-bromophenyl phenyl ether
84. hexachlorobenzene
85. atrazine
86. pronamide
87. pentachlorophenol
15. phenanthrene-d10*
88. pentachloronitrobenzene
89. phenanthrene
90. anthracene
91. carbazole
92. di-n-butylphthalate
93. 4-nitroquinoline-N-oxide
94. isodrin
95. fluoranthene
96. pyrene
97. benzidine
98. p-terphenyl-d14
99. Aramite
100. chlorobenzilate
101. benzyl butyl phthalate
102. bis(2-ethylhexyl)adipate
103. Kepone
104. bis(2-ethylhexyl)phthalate
105. benzo(a)anthracene
16. chrysene-d12*
106. chrysene
107. di-n-octyl phthalate
108. 7,12-dimethylbenzo(a)anthracene
109. benzo(b)fluoranthene
110. benzo(k)fluoranthene
111. benzo(a)pyrene
17. perylene-d12*
112. 3-methylcholanthrene
113. dibenzo(a,j)acridine
114. indeno(1,2,3-cd)pyrene
115. dibenzo(a,h)anthracene
116. benzo(ghi)perylene



GC_EV00757

free literature

For details about this analysis, request Restek Advantage 2005v1

lit. cat.# 59077

* Present in Figure 3 only

Column: Rtx®-5Sil MS, 20m, 0.18mm ID, 0.36µm (cat.# 42704)
 Sample: US EPA Method 8270D analytes, 10ppm each (10ng on column)
 8270 MegaMix® (cat.# 31850),
 Benzidine (cat.# 31441),
 Benzoic Acid (cat.# 31415),
 2,4-Dinitrophenol (cat.# 31291),
 Acid Surrogate Mix (4/89 SOW) (cat.# 31063),
 B/N Surrogate Mix (4/89 SOW) (cat.# 31062)
 Inj.: 1.0µL, splitless, 4mm ID gooseneck splitless inlet liner
 (cat.# 20798), splitless hold time 0.15 min.,
 pressure pulse 0.20 min. @ 30psi

GC: Agilent 6890
 Inj. temp.: 250°C
 Carrier gas: helium, constant flow
 Flow rate: 1.2mL/min.
 Oven temp.: 50°C (hold 0.5 min.) to 330°C @ 18°C/min. (hold 3 min.)
 Det.: Agilent 5973 GC/MS
 Transfer line temp.: 280°C
 Scan range: 35-550 amu
 Solvent Delay: 1 min.
 Tune: DFTPP
 Ionization: EI

Table 1. Response factors and linearity for active semivolatile compounds.*

Compound	CAS #	On-Column Quantity							Mean RRF	RSD (%)
		1ng	4ng	10ng	20ng	50ng	80ng	160ng		
N-nitrosodimethylamine	39885-14-8	0.876	0.940	0.980	0.969	0.940	0.958	0.946	0.956	2
pyridine	110-86-1	1.438	1.641	1.707	1.724	1.597	1.634	1.607	1.652	3
aniline	62-53-3	3.762	3.989	4.056	3.941	3.614	3.391	2.975	3.661	12
2,4-dichlorophenol	120-83-2	0.280	0.314	0.308	0.308	0.269	0.252	0.239	0.282	11
hexachlorocyclopentadiene	77-47-4	0.258	0.310	0.311	0.337	0.301	0.289	0.278	0.304	7
3-nitroaniline	99-09-2	0.344	0.433	0.437	0.417	0.419	0.408	0.367	0.413	6
2,4-dinitrophenol	51-28-5	0.075	0.123	0.153	0.162	0.185	0.176	0.155	0.159	14
4-nitrophenol	100-02-7	0.145	0.201	0.215	0.213	0.220	0.219	0.197	0.211	4
azobenzene	103-33-3	1.390	1.606	1.568	1.502	1.440	1.347	1.162	1.437	11
pentachlorophenol	87-86-5	0.096	0.128	0.146	0.147	0.143	0.141	0.141	0.141	5
benzidine	92-87-5	0.710	1.149	1.162	1.047	1.085	1.040	1.015	1.083	6
benzo(b)fluoranthene	205-99-2	1.117	1.289	1.405	1.383	1.280	1.273	1.320	1.325	4

*The 1ng value is not included in the mean relative response factor (RRF) or relative standard deviation (RSD).

Assured Column Quality

To guarantee individual column performance and column-to-column reproducibility, we test every Rtx®-5Sil MS column we make. Our isothermal test verifies coating efficiency, film thickness, inertness, and bleed.

Rtx®-5Sil MS Columns (fused silica)

(Crossbond®, selectivity similar to 5% diphenyl/95% dimethyl polysiloxane)

ID	df (µm)	temp. limits	15-Meter	25-Meter	30-Meter	40-Meter	60-Meter
0.25mm	0.10	-60 to 330/350°C	12705		12708		
	0.25	-60 to 330/350°C	12720		12723		12726
	0.50	-60 to 330/350°C	12735		12738		12796
	1.00	-60 to 325/350°C	12750		12753		12797
0.28mm	0.25	-60 to 330/350°C	12790		12793		
	0.50	-60 to 330/350°C	12791		12794		
	1.00	-60 to 325/350°C	12792		12795		
0.32mm	0.10	-60 to 330/350°C	12706		12709		
	0.25	-60 to 330/350°C	12721		12724		12780
	0.50	-60 to 330/350°C	12736		12739		
	1.00	-60 to 325/350°C	12751	12781	12754		12782
0.45mm	1.50	-60 to 310/330°C				12798	
0.53mm	0.50	-60 to 320/340°C	12737		12740		
	1.00	-60 to 320/340°C	12752		12755		
	1.50	-60 to 310/330°C	12767		12770		
ID	df (µm)	temp. limits	10-Meter	12-Meter	20-Meter	25-Meter	50-Meter
0.18mm	0.18	-60 to 330/350°C	42703		42702		
	0.36	-60 to 330/350°C			42704		
0.20mm	0.20	-60 to 330/350°C				42706	42707
	0.33	-60 to 330/350°C		42705			
	0.35	-60 to 330/350°C		42708			42709

for **more info**

Rtx®-5Sil MS columns are optimized for use with conventional MS detectors but, for the fastest analyses, they are equally compatible with time-of-flight mass spectrometers. To see a 9-minute TOFMS analysis of semivolatiles on an Rtx®-5Sil MS column, request Restek Advantage 2005v1 (page 8).

lit. cat.# 59077

did you **know?**

Split injections of semivolatiles can reduce analysis time, relative to splitless injections, due to the characteristically sharp analyte focus at the column inlet.

Restek Trademarks:
Rtx, Crossbond, MegaMix, Restek logo.



Lit. Cat.# 59204B

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Simple, Sensitive HPLC/UV Analysis for Paraquat and Diquat

Using High-Recovery Solid Phase Extraction and an Ultra Quat HPLC Column

Paraquat (1,1'-dimethyl-4,4'-bipyridylium dichloride, $C_{12}H_{14}N_2Cl_2$), and diquat (1,1'-ethylene-2,2'-bipyridilium dibromide, $C_{12}H_{12}N_2Br_2$, Figure 1), are non-selective contact herbicides, plant growth regulators and desiccants widely used in agriculture to control broadleaf and aquatic weeds. Paraquat has been used to kill illegal marijuana plants in the US and Mexico. Paraquat is listed by the US Environmental Protection Agency as a Restricted Use Pesticide (RUP). Additionally, these herbicides have been banned, or

their use restricted, in several European countries and in Japan, and the World Health Organization considers them moderately hazardous pesticides. These herbicides must be monitored routinely because of their significant toxicity to humans through oral ingestion or respiratory or dermal contact. Despite the fact that the half-life of either compound in water can be less than 48 hours, there is great concern about even low-level human exposure (US EPA Safe Drinking Water Act maximum contamination level = 20ppb for diquat).

Depending on the initial sample matrix, these herbicides have been analyzed using colorimetric spectrophotometry, enzyme linked immunosorbent assay (ELISA), or liquid scintillation counting (LCS), but HPLC analysis with UV or fluorescence detection has gained wide acceptance. The highly charged quaternary amines are difficult to retain by standard reversed phase HPLC, however, and alternative approaches are required. Most widely used is an ion exchange column coupled to a post-column reactor that creates a fluorescing complex. Detection is highly sensi-

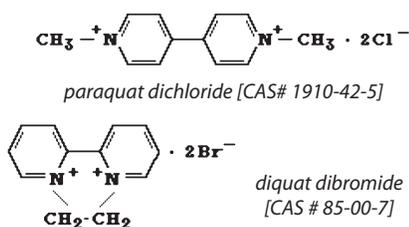
tive, but the drawbacks are the costs of the specialty column—often exceeding \$1,000 US—and of the post-column derivatization unit and fluorescence detector. This supplemental hardware can be beyond the budget of smaller laboratories.

A less costly technique, described in US EPA Method 549.2, calls for a conventional HPLC column and hardware and incorporates an ion pairing agent in the mobile phase. This analytical system is less complex, but adequate, with detection limits of 0.44 μ g/L for diquat and 0.8 μ g/L for paraquat, based on solid phase extraction of a 250mL water sample. The mobile phase for Method 549.2 consists of water, phosphoric acid, acetonitrile, heptane or hexane sulfonic acid (ion pairing agent), and diethylamine (DEA). Diethylamine likely was included to reduce tailing on columns that exhibit high silanol activity. The sulfonic acids also can reduce tailing but, additionally, the ion pair complexes they form allow better retention of the highly charged quaternary amines. Unfortunately, this complicated chemistry and methodology, in combination with variation among manufacturers' HPLC columns, can present serious problems. In addition to amplifying the potential for mixing inconsistencies and errors, the complex mobile phase has three significant flaws: 1) Acid/base reaction between DEA and the ion pair reagent consumes both, eliminating the ion pairing capacity of the system and restoring the potential for peak tailing. A sulfonic acid ion pair reagent alone should eliminate tailing by the analytes and, as neutral species, they should not be affected by residual silanols. 2) The mobile phase lacks a true buffer control system needed for reproducible retention in an ion pair system. 3) The exact pH of the mobile phase—a critical issue for an ion pairing method—is not specified.

Because they are highly charged, paraquat and diquat will not be retained well on an alkyl stationary phase, and any standard reversed phase HPLC technique that relies on the hydrophobicity of the column and the strength of the mobile phase likely will fail to achieve a separation. So, if altering the hydrophobicity of the stationary phase will not be effective, the next choice is to lower the hydrophilicity of the mobile phase. A separation system we have developed for paraquat and diquat makes use of a different analytical property—chaotropism: disruption of water's ability to solvate ions, thereby altering the charged interactions among the analyte, the mobile phase, and the stationary phase. In this case, by dispersing the analyte's charge, the solubility of the highly polar analyte on a non-polar substrate (the stationary phase) can be enhanced. Retention of the analyte is maximized because it remains longer on the adsorbed solvent layer (acetonitrile) present on the stationary phase. The chaotropic agents are inorganic anionic salts added to the aqueous portion of the mobile phase.¹

Figure 1

Paraquat and diquat herbicides.



To minimize interactions between the analytes and residual silanols or metal ions in the column, and consequent tailing and unwanted / unpredictable retention, we began by manufacturing a new column packing for this application, using high purity (type B) silica, and designed a stationary phase to give proper selectivity and analyte retention. To complement the new column, we developed a mobile phase additive that alters the chemical nature of the analytes as perceived by the column and mobile phase. This chaotropic agent reduces the ability of water to solvate the analytes by hydrogen bonding, thereby greatly improving retention—and resolution. The analysis can be performed on any HPLC system capable of performing Method 549.2 (Figure 2).

Unlike ion pairing techniques, this new approach requires only acetonitrile, water, and solvation-blocking Ultra Quat Reagent Solution (cat.# 32441) to accomplish the separation. We chose acetonitrile for the organic component of the mobile phase for its inability to hydrogen bond—it disrupts hydrogen bonding in the system.^a Using solid phase extractin (SPE) to concentrate the analytes, the Ultra Quat column, and note that the conditions listed for Figure 2, the detection limit is 6ppb for either herbicide—a detectable amount of 0.12 nanograms on column, and the analysis is completed in less than 10 minutes. Data are summarized in Table I and the consistency of the analytical method is demonstrated in Figure 2. To confirm sensitivity, we inject 20µL of multiple

Figure 2

Consistent resolution, retention times, and peak symmetry for paraquat and diquat reference standards, using an Ultra Quat column.

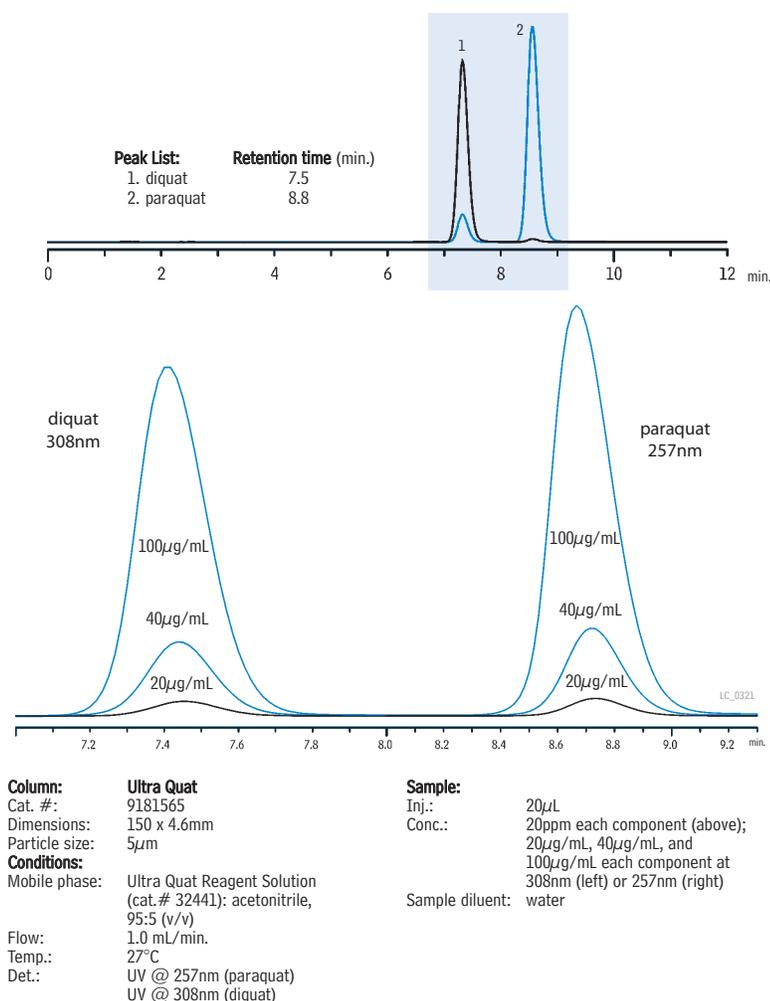


Table III

High recoveries of paraquat and diquat after solid phase extraction, using Ultra Quat SPE Tubes.

Analyte	% Recovery	%RSD
paraquat	97.2	5.4
Diquat	100.3	5.6

1L samples, N=5

Table I

Approximate detection/quantitation limits for paraquat and diquat, using an Ultra Quat column, SPE, and the simplified HPLC/UV method.^b

On column limit of detection (LOD): 0.12ng
On column limit of quantitation (LOQ): 0.4ng

Sample Volume (mL)	Injection Volume (µL)	Limit of Detection (ppb)	Limit of Quantification (ppb)
1	20	6	20
100	20	0.06	0.2
250	20	0.024	0.08
1000	20	0.006	0.02
1	100	1.2	4
100	100	0.012	0.04
250	100	0.0048	0.016
1000	100	0.0012	0.004
1	200	0.6	2
100	200	0.006	0.02
250	200	0.0024	0.008
1000	200	0.0006	0.002

Table II

Solid phase extraction of paraquat and diquat.

Sample Extraction

SPE Tube: Ultra Quat SPE, 6mL/500mg (cat.# 25499)
Tube Conditioning: 4mL acetonitrile, then 4mL deionized water
Sample: 1L water passed through tube @ 20-25mL/min.
Tube Wash: Rinse inner surface of tube with a minimal volume (1-2mL) of deionized water
Tube Dry: Less than 30 sec.
Extraction: 2mL acidic elution solution.* Allow to soak into bed for up to 1 min.; follow with 2 x 2mL acidic elution solution. Pass solutions through bed at a slow, dropwise rate into deactivated collection vessels.** Neutralize samples with 5-7µL concentrated ammonium hydroxide; adjust final volume to 5mL for analysis (if necessary, dilute with deionized HPLC grade water).

*1mL 85% H₃PO₄ diluted to 1L with deionized HPLC grade water (0.1% solution).

**Collection and analytical vessels must be deactivated before use (see text).

dilutions of Paraquat & Diquat Calibration Mix (cat# 32437) into the system, and monitor for paraquat at 257nm and for diquat at 308nm.

Note that EPA Method 549.2 requires retesting of all samples if the response for the reference standards changes by more than 20% over the time of the analysis. We find all reference standards show degradation after only 1 hour in untreated glassware, and the lowest concentrations are affected most. 30% losses in response are not uncommon; a reference standard of 6ppb diquat in water was undetectable. This makes non-reactive glassware critical; all volumetric ware and vials used for preparing and extracting samples containing paraquat and diquat, or paraquat/diquat reference standards, must be deactivated. In our studies we use dimethyldichlorosilane (DMDCS) to deactivate all glassware.

To achieve the lowest detection levels, solid phase extraction (SPE) is used to extract, clean, and concentrate the samples. The extraction procedure in EPA Method 549.2 relies on the same ion pairing technique as the HPLC method, and would not be compatible with our simplified, chaotropic analytical method. Using the new SPE procedure detailed in Table II, we removed UV interferences and concentrated the herbicide analytes 200-fold before analysis. The simple and rugged procedure, using an optimized weak cation exchanger (Ultra Quat SPE), produced the quantitative and highly reproducible recovery results detailed in Table III. Sample volumes of up to 1 liter can be extracted through this procedure. The water samples we used did not require pH adjustment, but all samples should be at pH 6-7 to assure that the analytes are fully charged before extraction. Glassware used for extraction was deactivated using DMDCS, following label directions, and the extracted samples were stored and analyzed in Silcote CL7-deactivated autosampler vials. By concentrating the SPE eluate to a smaller volume, or increasing the injection volume, quantification and detection limits can be further reduced.

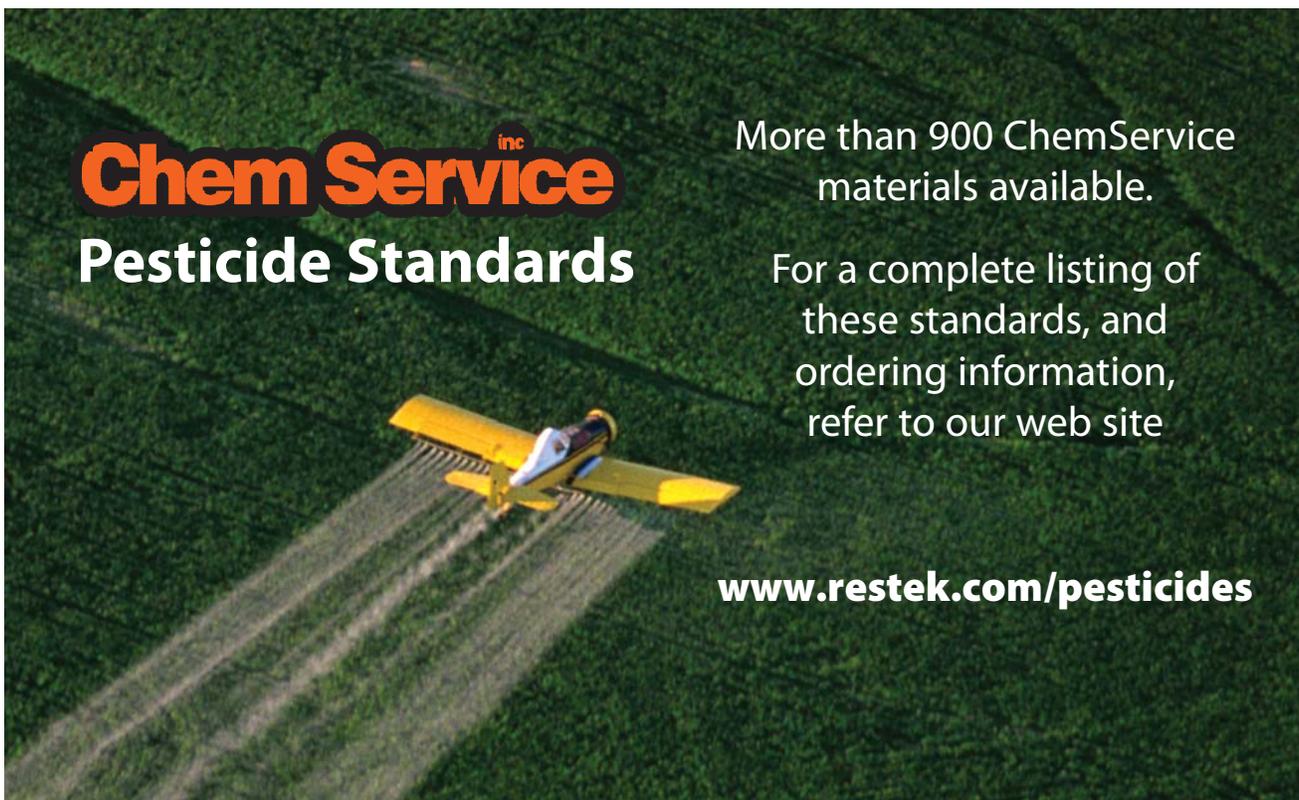
Our specially designed Ultra Quat HPLC column, Ultra Quat Reagent Solution, Ultra Quat SPE tubes, and paraquat/diquat reference materials, used according to the conditions described here, will not only simplify your analysis, but will also provide the most accurate and consistent information about paraquat and diquat.

^aAn appropriate solvent, such as acetonitrile, must be used for this separation. Organic solvents that can form hydrogen bonds will cause loss of retention.

^bNote that limits will vary with differing systems and levels of optimization. The detector will detect a finite lower amount of material (e.g., 0.12ng), but as this amount is present in an increasingly larger volume, the detected *concentration* will be lower.

Reference

1. Pan, L., R. LoBrutto, Y.V. Kazakevich, R. Thompson *Influence of inorganic mobile phase additives on the retention, efficiency and peak symmetry of protonated basic compounds in reversed phase liquid chromatography*; J. Chromatogr. A, 1049: 63-73 (2004).



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Ultra Quat HPLC Column

Physical Characteristics:

particle size: 5µm, spherical
pore size: 100Å

pH range: 2.5 to 7.5
temperature limit: 80°C

Chromatographic Properties:

A retentive, high-purity, base deactivated reversed phase packing. Ideal for the analysis of paraquat and diquat when used with Ultra Quat Reagent Solution mobile phase additive (cat. # 32441).

Length	4.6mm ID cat.#
5µm Column 150mm	9181565

Ultra Quat columns in other dimensions are available on request.

To order a column with a Trident™ Integral Inlet Fitting, add "-700" to the catalog number for the column: 9181565-700. Nominal additional charge.

Ultra Quat Guard Cartridges and Guard Cartridge Fittings

Length	2.1mm ID cat.#	4.0mm ID cat.#
10mm	918150212, 3-pk.	918150210, 3-pk.
20mm	918150222, 2-pk.	918150220, 2-pk.
Description	qty.	cat.#
XG-XF Fitting for 10mm Guard Cartridge	ea.	25026
XG-XF Fitting for 20mm Guard Cartridge	ea.	25062

Ultra Quat Solid Phase Extraction Cartridges

These cartridges have been specifically designed to provide consistent and reproducible results US EPA Method 549.2: HPLC analysis of paraquat/diquat.

Description	Tube Volume, Bed Weight	qty.	cat.#
Ultra Quat SPE Cartridges	6mL, 500mg	30-pk.	25499



Convenience Kits: Vials, Caps, & Septa

Vials packaged in a clear-lid tray. Caps with septa packaged in a plastic bag.

Description	100-pk.	1000-pk.
2.0mL Clear Vial, Deactivated, PTFE/Natural Rubber Seal†	24671	24672
2.0mL Amber Vial, Deactivated, PTFE/Natural Rubber Seal†	24673	24674
2.0mL Clear Vial, Untreated, PTFE/Natural Rubber Seal	21196	21197
2.0mL Amber Vial, Untreated, PTFE/Natural Rubber Seal	21198	21199
2.0mL Clear Vial, Untreated, PTFE/Silicone Seal	24646	24647
2.0mL Amber Vial, Untreated, PTFE/Silicone Seal	24648	24649

†Silcote™ CL7 deactivation.

Ultra Quat Reagent Solution

Use to prepare 1 liter of mobile phase.

In water, 20mL/ampul cat. # 32441 (ea.)

Paraquat & Diquat Calibration Mix

diquat dibromide paraquat dichloride

1,000µg/mL each in water, 1mL/ampul cat. # 32437 (ea.)

Dimethyldichlorosilane (DMDCS)

Restek offers dimethyldichlorosilane (DMDCS), for deactivating liners and other glassware. Simply dilute the neat material to a 5% solution in toluene, soak the glass item(s) in the solution for 15 minutes, and rinse with toluene and methanol. DMDCS reacts with active hydroxyl groups on the glass surface producing a deactivated surface. A detailed procedure is included with the product.

dimethyldichlorosilane (DMDCS)

Neat, 20mL/ampul cat. # 31840 (ea.)

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into Reality, the Restek logo.



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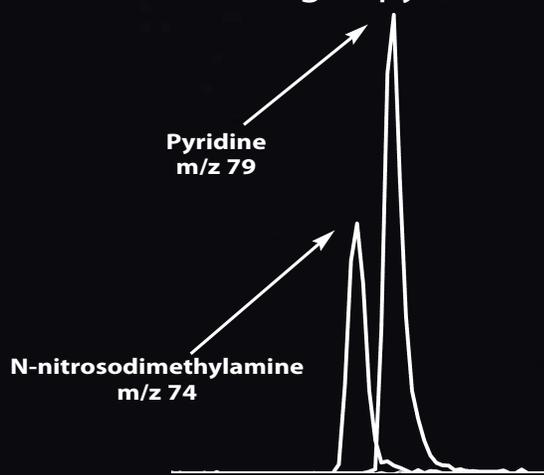


Rxi™ -5ms Columns

Restek's Exceptionally Inert (Rxi™)
Fused Silica Capillary Columns

- Unsurpassed inertness for low level basic and acidic compounds.
- Ultra-low bleed
- Reliable performance, guaranteed column-to-column reproducibility

Sharp, symmetric peak
for 0.5ng of pyridine!



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Rxi™-5ms Fused Silica Columns

Restek's Exceptionally Inert (Rxi™) Fused Silica Capillary Columns

- Unsurpassed inertness for low level basic and acidic compounds.
- Ultra-low bleed
- Reliable performance, guaranteed column-to-column reproducibility
- Guaranteed to work perfectly with retention time-locking software.

The Ultimate High Performance Fused Silica Capillary Column

The Restek research chemists have developed new technology for making GC capillary columns, including new deactivation chemistry, new polymer synthesis routes, and a new manufacturing process. The overall results of these efforts are columns demonstrating unsurpassed inertness, ultra-low bleed, and totally reliable column-to-column performance.

Excellent Inertness

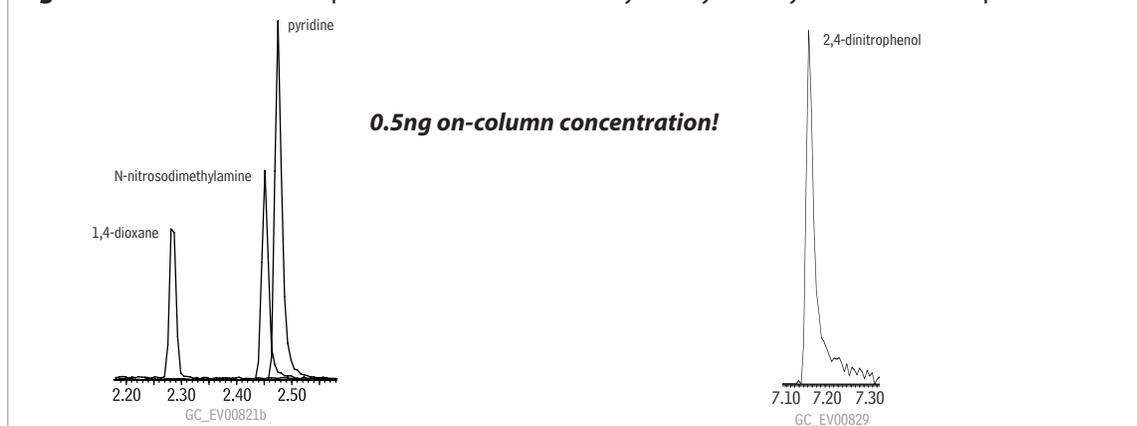
Many acidic and basic compounds require the inertness of Rxi™-5ms columns. We use 2,4-dinitrophenol (acidic) and pyridine (basic) to evaluate the inertness of our columns. Surface activity in the column is revealed by the peak shapes for these analytes, and sub-nanogram test quantities make for a stringent test. The data below show the peak response for 0.5ng of pyridine and 0.5ng of 2,4-dinitrophenol on an Rxi™-5ms, 30m x 0.25mm, 0.25µm film column. Rxi™-5ms columns' excellent inertness allows acidic or basic compounds to be analyzed under the same conditions.



Restek's exceptionally inert (Rxi™) fused silica capillary columns:

The processes we use to make new Rxi™ columns enable us to **guarantee** highly uniform performance, column-to-column and lot to lot, including perfect match-up with retention time-locking software. It is our promise and commitment to you that every Rxi™ column you receive will be **exactly** as good as the one it replaces.

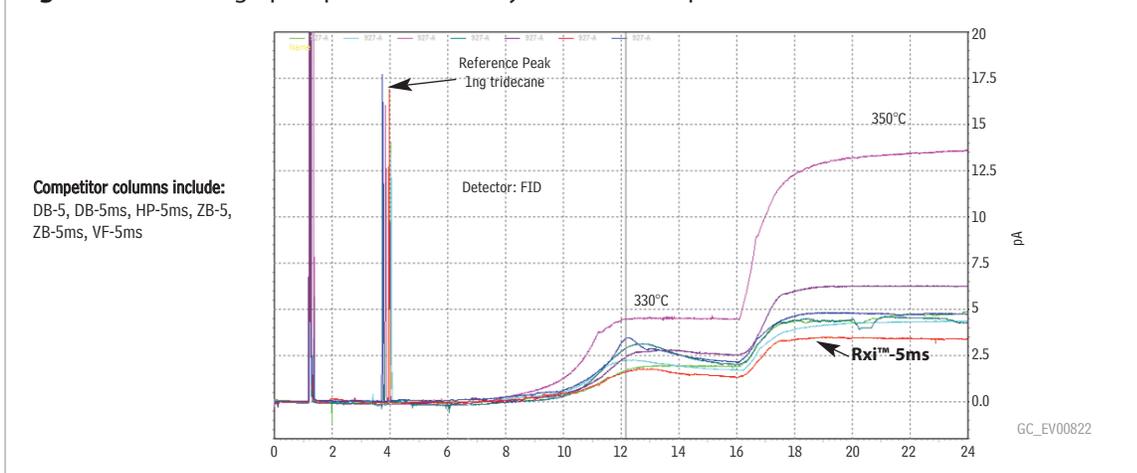
Figure 1 Rxi™-5ms columns provide excellent sensitivity and symmetry for difficult compounds.



Ultra Low Bleed

Bleed from Rxi™-5ms columns is negligible, simplifying trace-level GC/MS analysis or detection by electron capture (ECD), nitrogen-phosphorus (NPD), or other sensitive methods. The graph below shows the bleed from 30m x 0.25mm, 0.25µm film columns. Compared to the other columns, including silarylene type phases, the Rxi™-5ms column exhibits the lowest bleed.

Figure 2 Chromatographic profiles for widely used columns prove Rxi™-5ms has the lowest bleed!



Reliable Column-to-Column Performance

Chromatographers need to know every column they receive is going to perform in the same way as the column it replaces. Rxi™-5ms column technology has enabled us to tighten our quality control standards for passing columns, and guarantees column reproducibility. Columns from three manufacturing batches show the excellent reproducibility of retention times and peak shape assured by the new manufacturing process.

Figure 3 Three manufacturing batches of Rxi™ columns show excellent reproducibility (isothermal test mix).

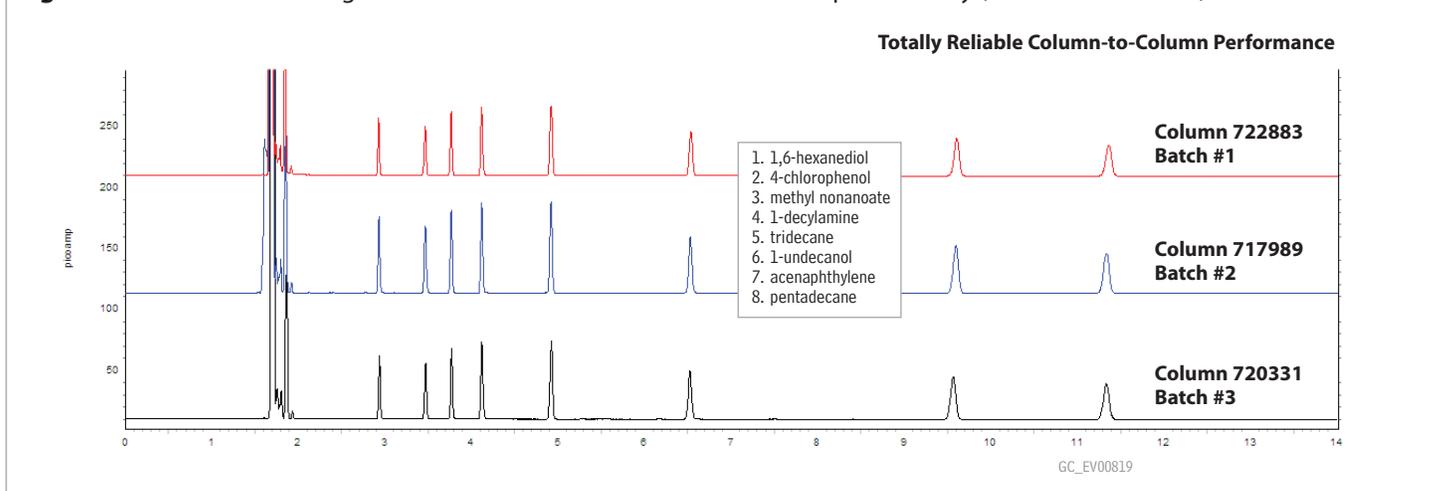
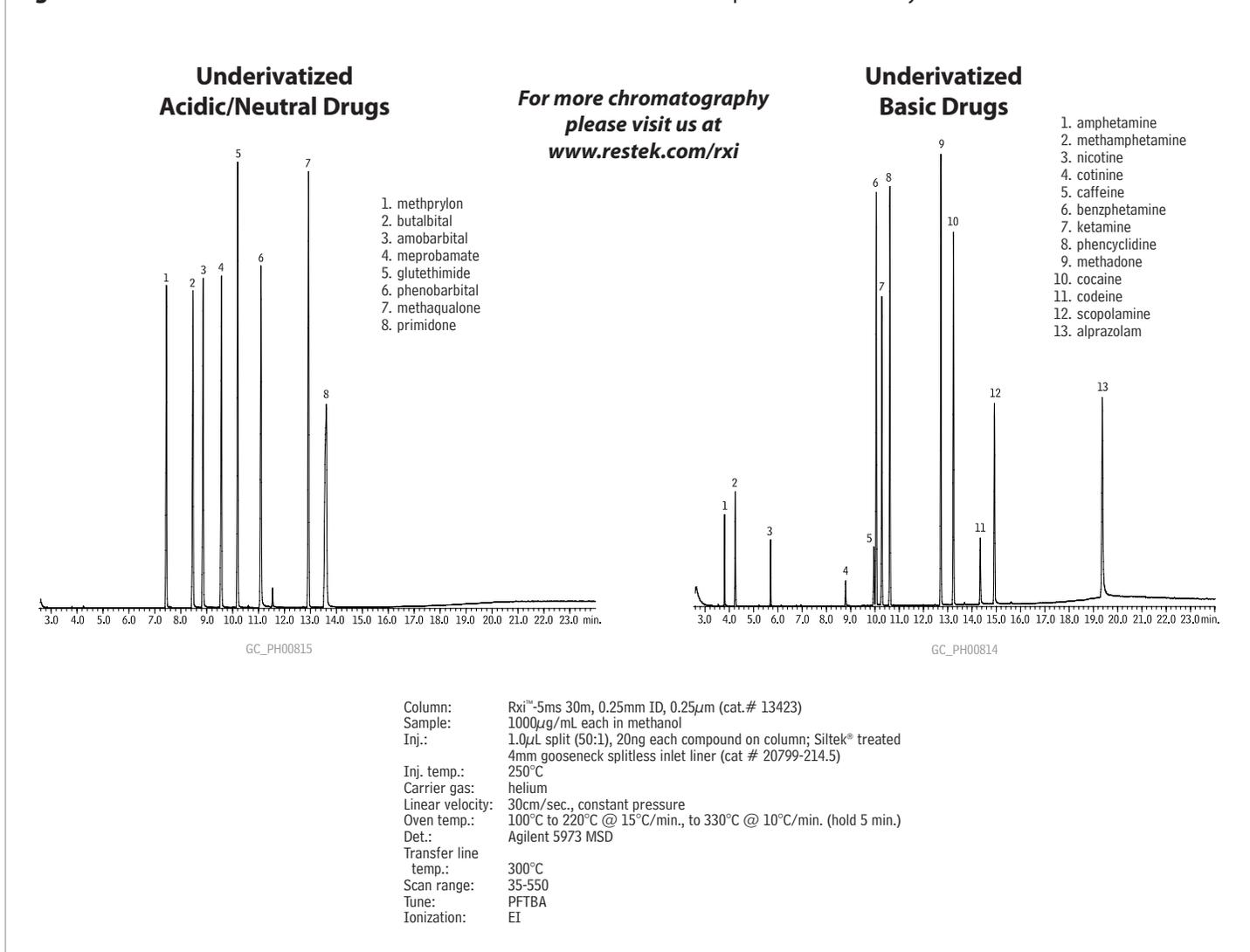
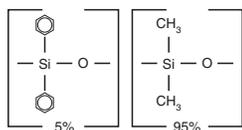


Figure 4 Rxi™-5ms columns' excellent inertness allows acidic or basic compounds to be analyzed under the same conditions.





Guaranteed Quality and Reliability

Restek is committed to supplying the most reliable GC columns in the industry. Every Rxi™-5ms column is individually challenged to pass our stringent requirements for film thickness, selectivity, inertness, coating efficiency, and bleed. We believe Rxi™-5ms column technology produces the most reliable columns available, anywhere, and it is our promise and commitment to you that every Rxi™-5ms column you receive will be as good as the one it replaces.

Rxi™-5ms Fused Silica Columns

- Nonpolar 5% diphenyl 95% dimethylpolysiloxane phase (equivalent to USP phase G27).
- Most widely used general purpose column.
- Temperature range: -60°C to 330/350°C (330° = bleed tested temperature/350° = maximum operating temperature).



Typical Applications: alcohols, amines, aromatic hydrocarbons, bile acids, drugs, US EPA methods, esters, fatty acid methyl esters (FAMES), flavors and aromas, glycerides, halogenated hydrocarbons, herbicides, hydrocarbons, organic acids, oxygenates, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), pesticides, phenols, polymers, solvents, steroids, sugars, sulfur compounds.

Similar to these phases: DB-5, DB-5ms, HP-5, HP-5ms, SPB-5, Equity-5, SLB-5, Ultra-5, BPX-5, 007-5, AT-5, Optima-5, ZB-5, ZB-5ms, VF-5ms, CP-Sil 8 CB, Rtx-5, Rtx-5MS, Xti-5
Selectivity of Rxi-5ms is equivalent to HP-5 and HP-5ms.

Rxi™-5ms Columns (fused silica)

(Crossbond® 5% diphenyl / 95% dimethyl polysiloxane)

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	12-Meter	20-Meter	25-Meter	50-Meter
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™ Test Mix (Rev. A) (8 components)

acenaphthylene	methyl nonanoate
4-chlorophenol	n-pentadecane
n-decylamine	n-tridecane
1,6-hexanediol	1-undecanol

1,000µg/mL each in toluene, 1mL/ampul
cat. # 35241 (ea.)

For more chromatography please visit us at
www.restek.com/rxi

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Other Trademarks:
DB, HP (Agilent Technologies, Inc.),
Equity (Sigma-Aldrich Co.)

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Lit. Cat.# 580046A

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RESTEK

NEW Rxi™ - 1ms

The Ultimate High Performance
Fused Silica Capillary Column



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See details online at
www.restek.com/rxi



Chromatography Products

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New Rxi™-1ms Fused Silica Columns

Restek's Exceptionally Inert (Rxi™) Fused Silica Capillary Columns

- Stable at high temperatures; improved signal to noise ratios.
- Excellent inertness for acids and bases; predictable column performance.
- Engineered to assure column to column reproducibility.

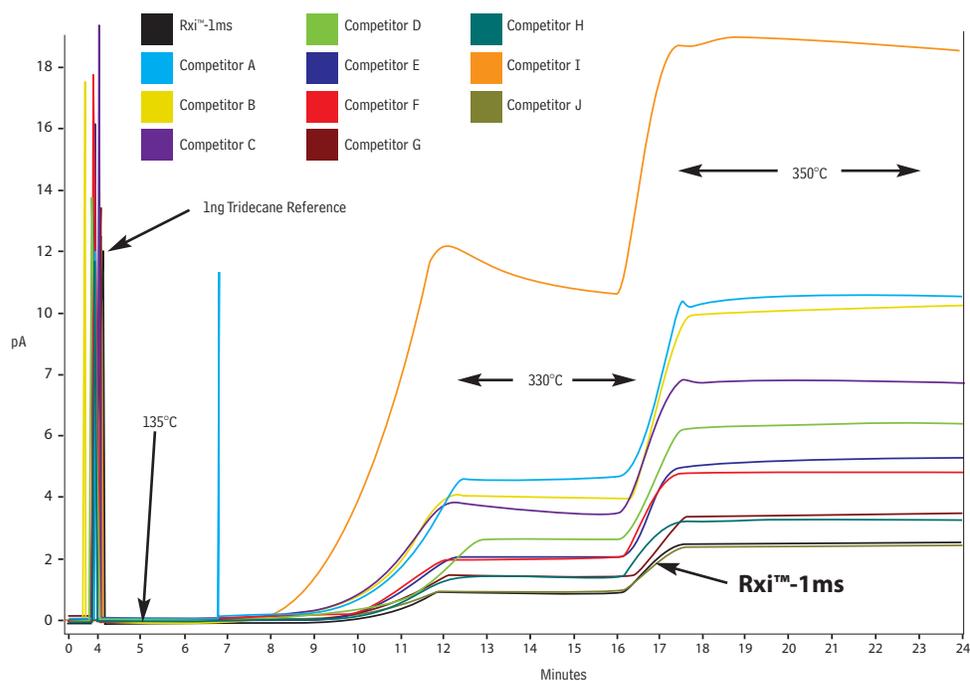
The combination of ultra low bleed and unsurpassed inertness make the Rxi™-1ms the best column choice for analysis using a 100% Polydimethyl siloxane stationary phase.

Lowest Bleed

Restek chemists have developed a new GC column manufacturing technique that assures low bleed, unsurpassed inertness, and exceptionally reproducible columns from batch to batch. The reduced bleed and increased inertness produced by the new manufacturing process result in increased signal to noise ratios and thus lower detection limits for active compounds. The Rxi™-1ms column offers maximum compound response for quantitative GC and GC/MS analysis.

We compared the bleed profiles of ten competitor columns at both 330°C and 350°C to the Rxi™-1ms column. At both temperatures the Rxi™-1ms column exhibits the lowest bleed level or equivalent of all the columns tested.

Figure 1 The Rxi™-1ms column has the lowest bleed available, allowing better accuracy and lower detection limits for active compounds.



please note

Columns included in the comparison are BP-1, DB-1, DB-1ms, EQ-1, HP-1, HP-1ms, Rtx-1, Rxi-1ms, VF-1ms, ZB-1, and ZB-1ms. The bleed profiles in Figure 1 are labeled randomly.

Column: 100% dimethyl polysiloxane 30m, 0.25 ID, 0.25 μ m
Sample: 1 ng. on column tridecane in dichloromethane
Inj.: 1.0 μ L split (split ratio 40:1), 4mm splitless inlet liner (cat.# 20799)
Inj. temp.: 250°C
Carrier gas: helium, constant pressure
Linear velocity: 60cm/sec. @ 135°C
Oven temp.: 135°C (hold 6 min.) to 330°C @ 30°C/min. (hold 4 min.) to 350°C @ 15°C/min. rate (hold 6 min.)
Det.: FID @350°C

Unsurpassed Inertness

The Rxi™-1ms exhibits excellent inertness for both acidic and basic compounds. We used 2, 4-dinitrophenol (acidic) and pyridine (basic) to evaluate the Rxi™-1ms column. This test is stringent, with an on-column amount of 0.5ng for each compound. Surface activity in the column is revealed by the peak shapes and response factors for acidic and basic compounds. The outstanding inertness of the Rxi™-1ms column allows acidic and basic compounds to be run under the same conditions, as shown below.

Figure 2 Basic analytes on an Rxi™-1ms column (0.5ng each; extracted ion chromatograms).

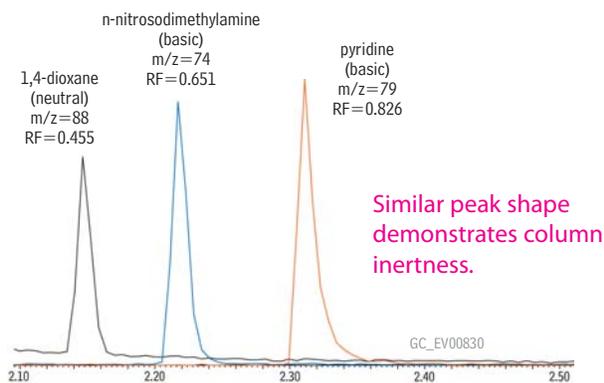


Figure 3 Acidic analyte on an Rxi™-1ms column (0.5ng; extracted ion chromatogram).

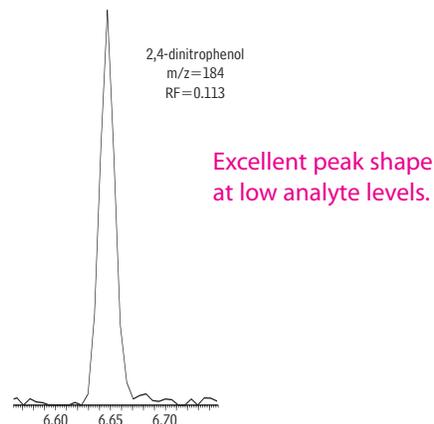
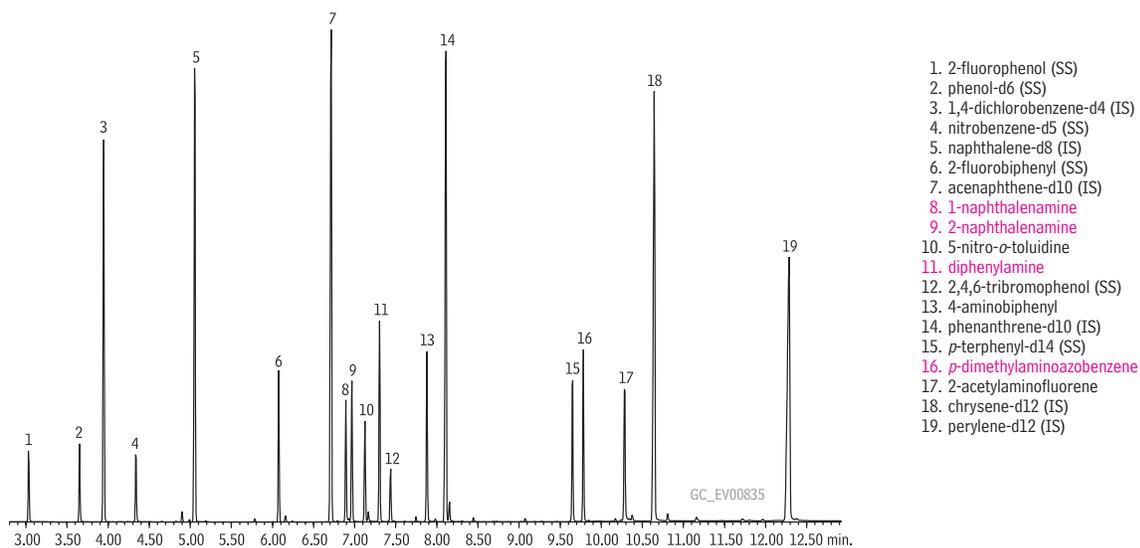


Figure 4 Outstanding peak symmetry even for difficult basic compounds at 5.0ng on an Rxi™-1ms column.



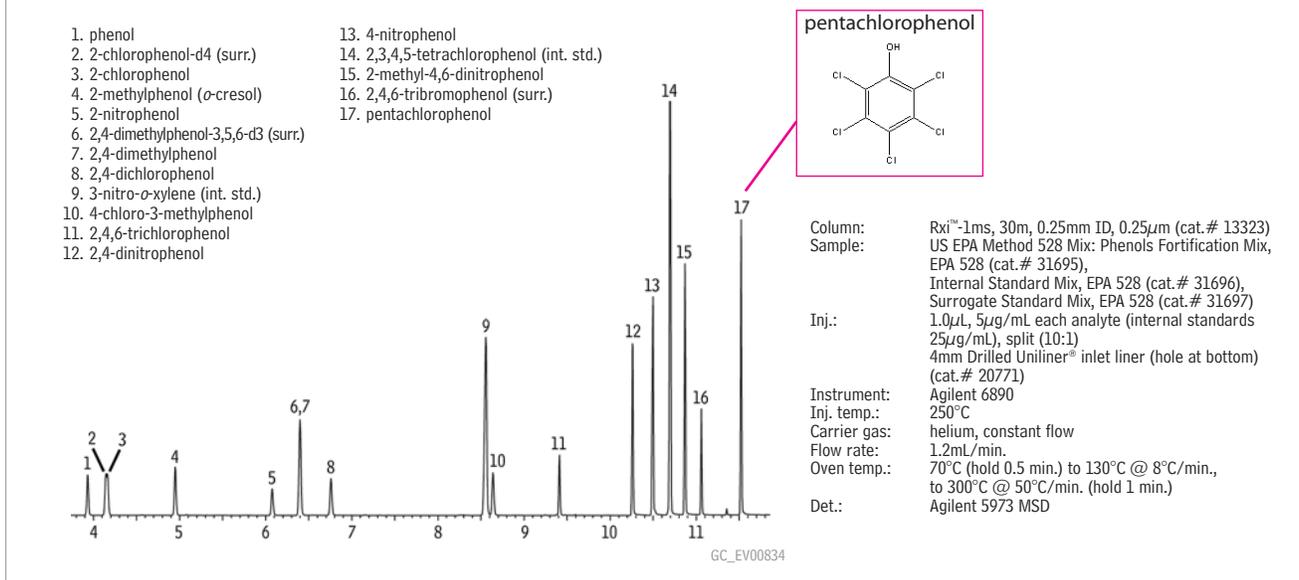
Column: Rxi™-1ms, 30m, 0.25mm ID, 0.25 μ m (cat.# 13323)
 Sample: Custom Appendix IX Mix, plus SV Internal Standard Mix (cat.# 31206), B/N Surrogate Mix (4/89 SOW) (cat.# 31024), Acid Surrogate Mix (4/89 SOW) (cat.# 31025)
 Inj.: 1.0 μ L, 5 μ g/mL each analyte (internal standards 25 μ g/mL), split (10:1)
 4mm Drilled Uniliner® inlet liner (hole at bottom) (cat.# 20771)
 Instrument: Agilent 6890
 Inj. temp.: 250°C
 Carrier gas: helium, constant flow

Flow rate: 1.2mL/min.
 Oven temp.: 50°C (hold 0.5 min.) to 300°C @ 25°C/min. (hold 5 min.)
 Det.: Agilent 5973 MSD
 Transfer line temp.: 280°C
 Scan range: 35-550 amu
 Solvent delay: 2.35 min.
 Tune: DFTPP
 Ionization: EI

Conclusion

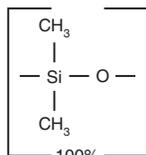
The Rxi™-1ms column is the new industry standard for 100% dimethyl polysiloxane columns. Column bleed is the lowest in the industry, improving compound signal to noise ratios and allowing lower detection limits for active compounds. The unsurpassed inertness of the column allows both acidic and basic compounds to be analyzed, often under the same conditions. We guarantee you will be 100% satisfied with the performance of the Rxi™-1ms column.

Figure 5 Excellent peak shape for acidic compounds, even phenols, at 5.0ng on an Rxi™-1ms column (extracted ion chromatogram).



replace these similar phases

DB-1, DB-1ms, HP-1,
HP-1ms, Ultra-1, SPB-1,
Equity-1, ZB-1, VF-1ms,
Rtx-1, Rtx-1ms



Restek Trademarks:
Crossbond, Restek logo, Rtx,
Rxi, Uniliner.

For other trademark attributions, please refer to our catalog.

Rxi™-1ms Fused Silica Columns

- General purpose columns for drugs of abuse, essential oils, hydrocarbons, pesticides, polychlorinated biphenyl (PCB) congeners or (e.g.) Aroclor® mixes, sulfur compounds, amines, solvent impurities, simulated distillation, oxygenates, gasoline range organics (GRO), refinery gases.
- Nonpolar phase (Crossbond® 100% dimethyl polysiloxane) Equivalent to USP G2 phase.
- Temperature range: -60°C to 330/350°C (330°=bleed tested temperature/350°=maximum operating temperature).

(Crossbond® 100% dimethyl polysiloxane)

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	
0.53mm	4.00	-60 to 330/350°C		13396		
	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		
ID	df (µm)	temp. limits	12-Meter	20-Meter	25-Meter	50-Meter
0.18mm	0.18	-60 to 330/350°C		13302	\$385	
0.20mm	0.33	-60 to 330/350°C	13397		13398	13399

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New Rxi™ columns

from Restek—the innovators in column technology



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Unsurpassed inertness

Ultra-low bleed

Guaranteed reproducibility

Unmatched performance



Turning Visions into Reality™

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New Rxi™ Columns

Exceptionally Inert Capillary Columns

- Unsurpassed inertness for low level basic and acidic compounds.
- Ultra-low bleed.
- Assured column-to-column reproducibility.
- Guaranteed to work perfectly with retention time-locking software.

Rxi™ columns were developed from Restek's unwavering passion to create capillary columns superior to all others.

Our mission was to invent a column that had the **highest inertness**, the **lowest bleed**, and the **greatest reproducibility** in every measurable facet of performance. The end result of our work had to be clearly observable as better than any column used in the past, by chromatographers in any laboratory around the world. **Clearly different and absolutely the best** were the non-negotiable goals of our research.

To achieve these aims, we hired the world's best polymer chemists and built a new, fully-equipped facility. The products this team is developing, Rxi™ columns, genuinely have exceeded our goals. The first of these new columns, Rxi™-1ms and Rxi™-5ms columns, are absolutely the best on the market today. How are they different? Until now, powerful new MS systems have been capable of analyzing low levels of active compounds, but column limitations have kept analysts from using this ability to their advantage. Now, with Rxi™ columns, you can chromatograph sub-nanogram levels of acidic and basic compounds in one analysis. Other columns exhibit peak tailing for these active compounds, causing integration errors and producing non-linear calibration curves, and thereby limiting low-level analysis. Only Rxi™ technology will enable you to reliably chromatograph both acidic and basic compounds at previously unattainable trace levels.

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A new industry standard

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We guarantee bleed from Rxi™ columns will be the lowest bleed of any column you have ever used.

In addition, we tightened our column dimension and column production specifications, to ensure the highest efficiency and most

reproducible retention indices,

thereby creating a new industry

standard. You will find support of

our claims and enthusiasm on the succeeding pages of this booklet. Simply put, an Rxi™ column will be the

best of the best columns you have ever used, unequivocally – you have our 100% satisfaction guarantee!

An Rxi™ column will be the best of the best columns you have ever used – you have our 100% satisfaction guarantee!

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Unsurpassed inertness

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Tailing peaks and poor responses for active compounds reveal surface activity in a column. In contrast, the peak shapes for 0.5ng of pyridine (basic) and for 2,4-dinitrophenol (acidic), on page 9, demonstrate the excellent inertness of Rxi™-5ms columns. Basic and acidic compounds can be analyzed on the same column, often under the same conditions.

An Rxi™ column's inertness allows analysis of active compounds at levels not attainable with other manufacturers' columns.

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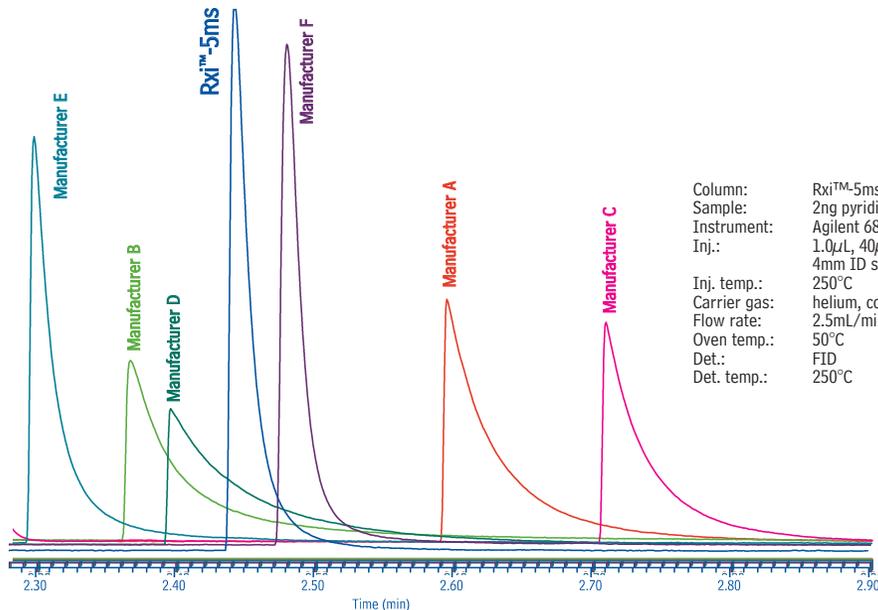


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Unsurpassed inertness

An Rxi™-5ms column provides the most symmetric peak for pyridine, a basic compound.

Among columns from 7 manufacturers, the Rxi™-5ms column produces the most symmetric peak for pyridine. Each overlay is 2ng of pyridine on-column, at 50°C, on a 30m x 0.25mm ID, 0.25µm column.

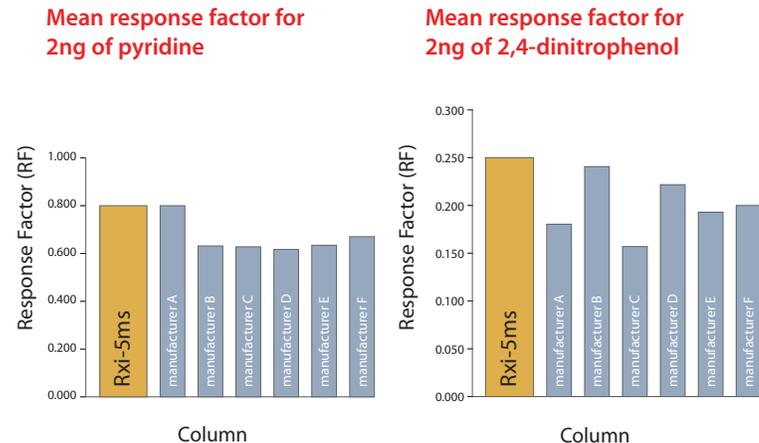


Column: Rxi™-5ms, 30m, 0.25mm ID, 0.25µm (cat.# 13423)
Sample: 2ng pyridine on-column
Instrument: Agilent 6890
Inj.: 1.0µL, 40µg/mL pyridine (2ng on column), split (20:1),
4mm ID split inlet liner w/ fused silica wool (cat#20781)
Inj. temp.: 250°C
Carrier gas: helium, constant flow
Flow rate: 2.5mL/min.
Oven temp.: 50°C
Det.: FID
Det. temp.: 250°C

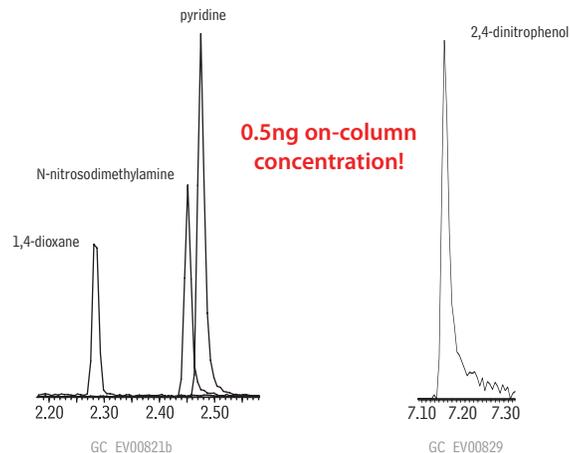
GC_EV00857

An Rxi™-5ms column gives the best overall performance for both basic and acidic compounds.

In addition to pyridine, 2,4-dinitrophenol, an acidic compound, was acquired at 2ng on-column. An Rxi™-5ms column gives the best response for both the basic compound and the acidic compound. Comparison of 30m x 0.25mm ID, 0.25µm columns.



Peak symmetry for pyridine or 2,4-dinitrophenol is excellent from an Rxi™-5ms column, even with 0.5ng on-column!



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Ultra-low bleed

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With the lowest column bleed in the industry, Rxi™-5ms columns improve detection for trace level GC/MS analysis. Ultra-low bleed also reduces conditioning time after instrument maintenance.

Save time and money through faster baseline stabilization.

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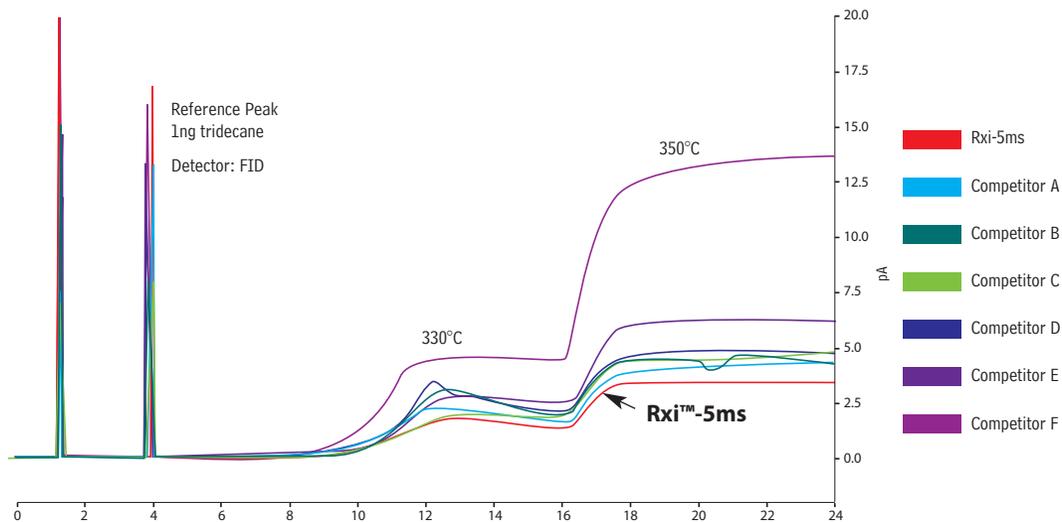
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Ultra-low bleed

Rxi™-5ms columns have the lowest bleed among all major brands of columns.

Comparison of 30m x 0.25mm ID, 0.25µm columns. Bleed was compared at 330°C and 350°C; hydrogen carrier gas; flame ionization detection.



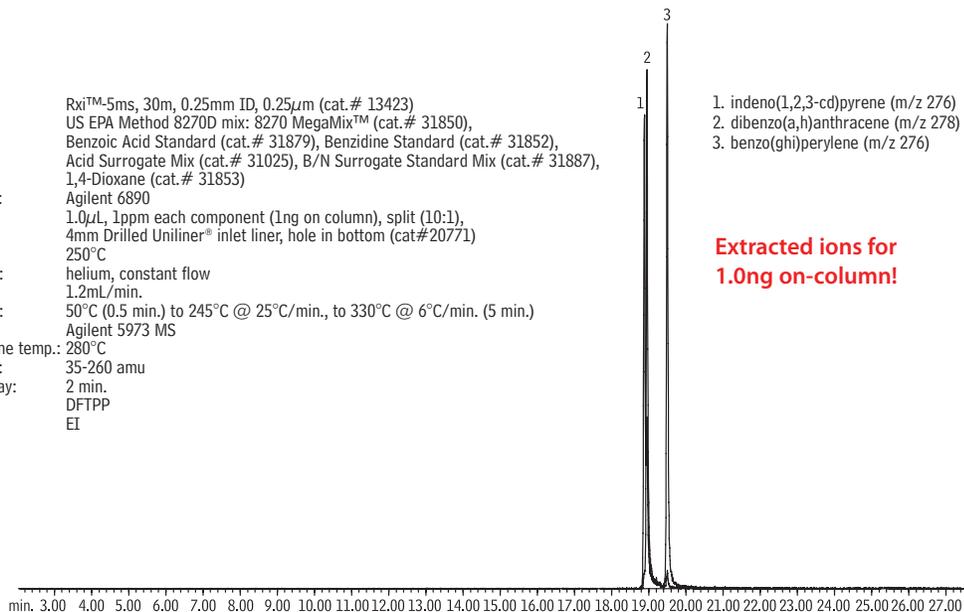
GC_EV00822

Ultra-low bleed makes Rxi™ columns ideal for GC/MS applications.

This chromatogram shows an excellent signal-to-noise ratio for late-eluting polycyclic aromatic hydrocarbons (PAHs), using an Rxi™-5ms column and MS detection.

Column: Rxi™-5ms, 30m, 0.25mm ID, 0.25 μ m (cat.# 13423)
 Sample: US EPA Method 8270D mix: 8270 MegaMix™ (cat.# 31850), Benzoic Acid Standard (cat.# 31879), Benzidine Standard (cat.# 31852), Acid Surrogate Mix (cat.# 31025), B/N Surrogate Standard Mix (cat.# 31887), 1,4-Dioxane (cat.# 31853)

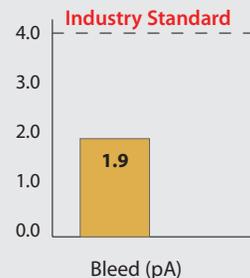
Instrument: Agilent 6890
 Inj.: 1.0 μ L, 1ppm each component (1ng on column), split (10:1), 4mm Drilled Uniliner® inlet liner, hole in bottom (cat#20771)
 Inj. temp.: 250°C
 Carrier gas: helium, constant flow
 Flow rate: 1.2mL/min.
 Oven temp.: 50°C (0.5 min.) to 245°C @ 25°C/min., to 330°C @ 6°C/min. (5 min.)
 Det.: Agilent 5973 MS
 Interface line temp.: 280°C
 Scan range: 35-260 amu
 Solvent delay: 2 min.
 Tune: DFTPP
 Ionization: EI



Extracted ions for
 1.0ng on-column!

GC_EV00858

Consistently low bleed, column after column.



Our average is less than half of the industry standard!

Mean = 1.9 pA
 Std. dev. = 0.7 pA

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Guaranteed
reproducibility



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Consistency is everything. You want every new column you install to provide the same performance. With Rxi™ column technology, we guarantee it: every new column will perform exactly as the column it replaces.

Rxi™ -1ms and Rxi™ -5ms columns are perfect for use with Retention Time Locking (RTL) or other retention indices software.

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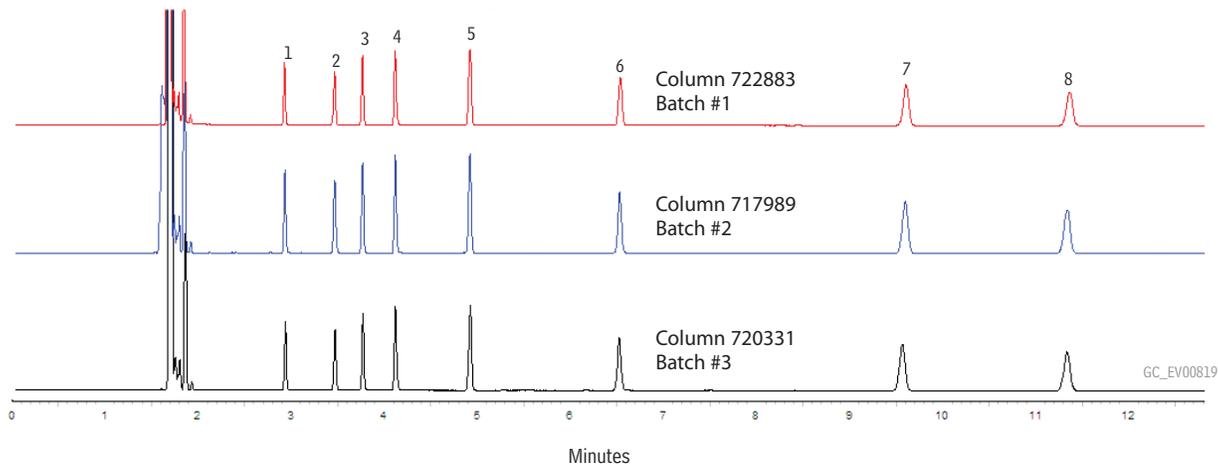
Guaranteed reproducibility

Rxi™ column technology assures reliable column-to-column performance.

The examples shown here are for 30m x 0.25mm ID, 0.25µm Rxi™-5ms columns from three manufactured batches. We perform this isothermal test on every column, to verify that our tight quality control specifications are met.

Isothermal test mix:

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



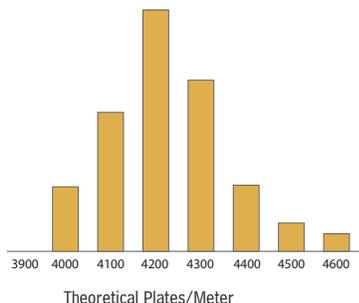
Rxi™ columns are held to rigorous quality control standards, to guarantee column to column reproducibility.

Every column is individually tested for coating efficiency, selectivity, film thickness, inertness, and bleed, and is proven to meet our stringent specifications.

Theoretical Plates/Meter

Rxi™-5ms
(30m x 0.25mm, 0.25µm)

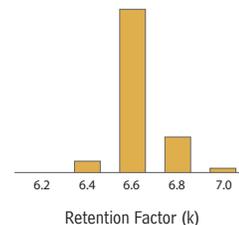
Narrow distribution ensures high column coating efficiency, which means the resolution power will be consistent, column-to-column.



Retention Factor (k)

Rxi™-5ms
(30m x 0.25mm, 0.25µm)

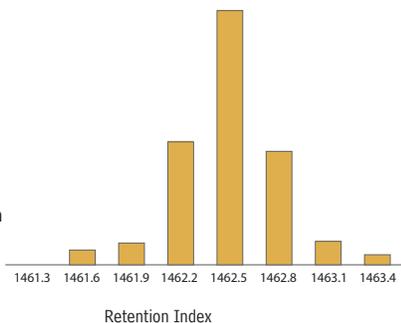
Narrow distribution ensures consistent polymer film thickness, which means retention times will be consistent, column-to-column



Retention Index: Acenaphthalene

Rxi™-5ms
(30m x 0.25mm, 0.25µm)

Narrow distribution ensures consistent column selectivity, which means relative retention times will be consistent, column-to-column



Retention Index: Undecanol

Rxi™-5ms
(30m x 0.25mm, 0.25µm)





Unmatched performance

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No other column guarantees the combination of inertness, ultra-low bleed, and reproducibility of Rxi™-1ms and Rxi™-5ms columns.

Every Rxi™ column is held to stringent performance specifications for coating efficiency, selectivity, film thickness, inertness, and bleed. This guarantees

you the most reliable columns available anywhere. It is our promise that every new Rxi™ column will be as good as the one it replaces.

The Rxi™ column combination of inertness, ultra-low bleed, and column-to-column reproducibility guarantees you columns that will have the longest lifetimes of any columns on the market.

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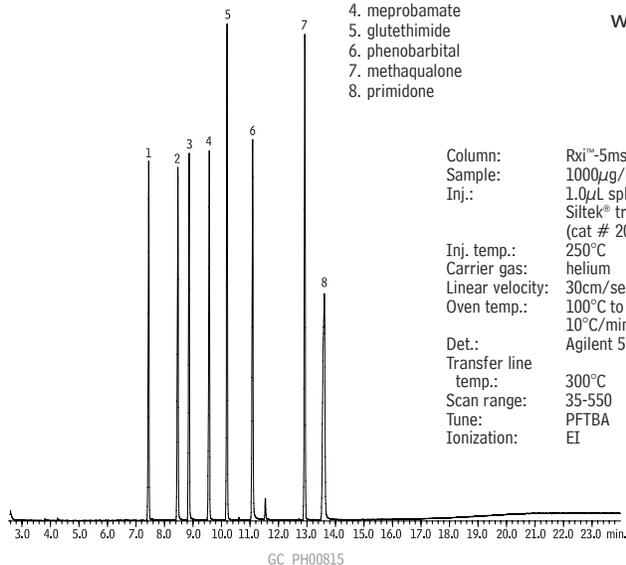
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Unmatched performance

Use an inert Rxi™-5ms column to analyze acidic and basic compounds under the same conditions.

Underderivatized Acidic/Neutral Drugs

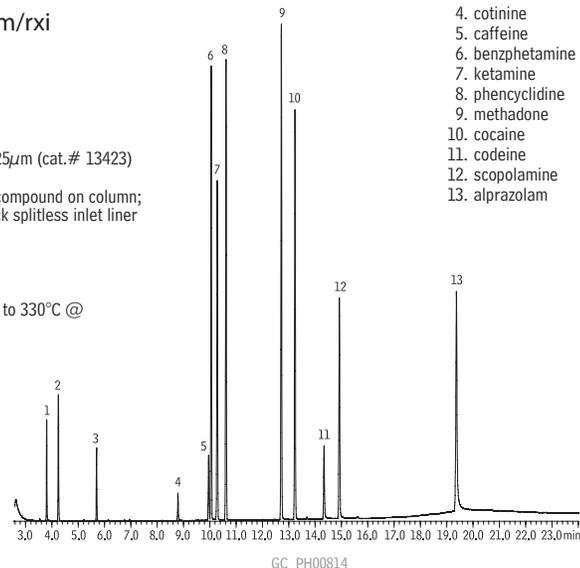


1. methprylon
2. butalbital
3. amobarbital
4. meprobamate
5. glutethimide
6. phenobarbital
7. methaqualone
8. primidone

For additional applications
please visit us at
www.restek.com/rxi

Column: Rxi™-5ms 30m, 0.25mm ID, 0.25µm (cat.# 13423)
Sample: 1000µg/mL each in methanol
Inj.: 1.0µL split (50:1), 20ng each compound on column;
Siltek® treated 4mm gooseneck splitless inlet liner
(cat # 20799-214.5)
Inj. temp.: 250°C
Carrier gas: helium
Linear velocity: 30cm/sec., constant pressure
Oven temp.: 100°C to 220°C @ 15°C/min., to 330°C @
10°C/min. (hold 5 min.)
Det.: Agilent 5973 MSD
Transfer line temp.: 300°C
Scan range: 35-550
Tune: PFTBA
Ionization: EI

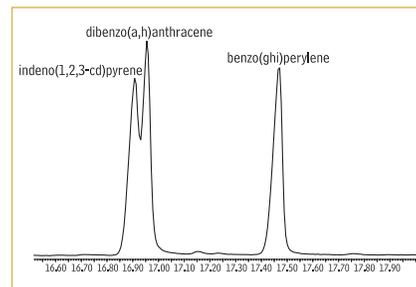
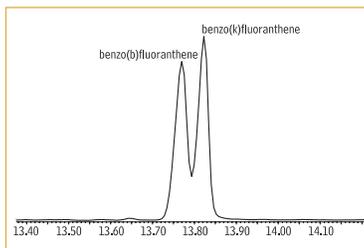
Underderivatized Basic Drugs



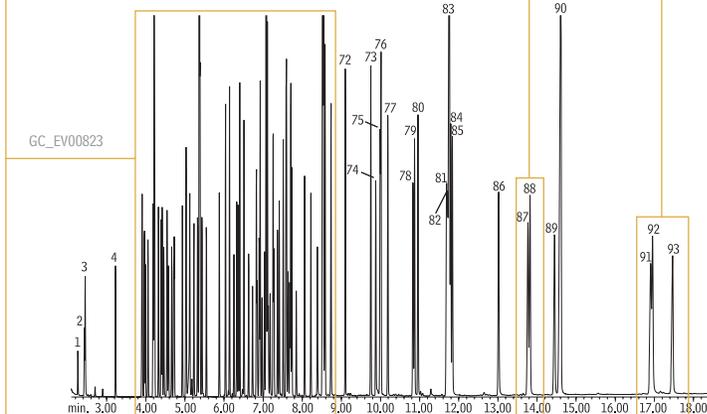
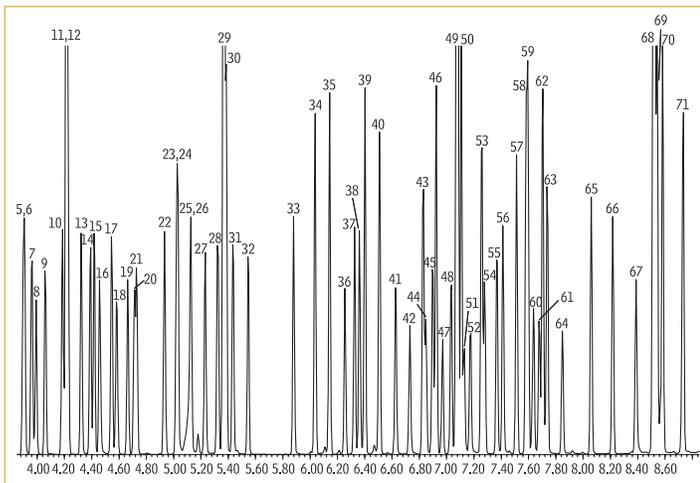
1. amphetamine
2. methamphetamine
3. nicotine
4. cotinine
5. caffeine
6. benzphetamine
7. ketamine
8. phencyclidine
9. methadone
10. cocaine
11. codeine
12. scopolamine
13. alprazolam

Use an Rxi™-5ms column to analyze acidic and basic compounds in semivolatiles methods.

Column: Rxi™-5ms, 30m, 0.25mm ID, 0.25 μ m (cat.# 13423)
 Sample: 1.0 μ L, US EPA Method 8270D mix (cat.# 31850, cat.# 31879, cat.# 31852, cat.# 31025, cat.# 31887, cat.# 31853)
 10ppm each analyte (10ng on column), splitless (hold 0.1 min.)
 4mm Drilled Uniliner® inlet liner (cat.# 20771)
 Instrument: Agilent 6890
 Inj. temp.: 250°C
 Carrier gas: helium, constant flow, 1.2mL/min.
 Oven temp.: 50°C (hold 0.5 min.) to 265°C @ 25°C/min., to 330°C @ 6°C/min. (hold 2 min.)
 Det.: Agilent 5973 GC/MS: transfer line temp.: 280°C scan range: 35-550 amu, solvent delay: 2 min., tune: DFTPP, ionization: EI



For peak identifications, please visit www.restek.com/rxi



www.restek.com/rxi

HRoMalytic Chromatography Products '08
 Australian Distributors **ECHnology**

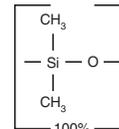


replace these
similar phases

DB-1, DB-1ms, HP-1,
HP-1ms, Ultra-1, SPB-1,
Equity-1, ZB-1, VF-1ms,
Rtx-1, Rtx-1ms

Rxi™-1ms Fused Silica Columns

- General purpose columns for drugs of abuse, essential oils, hydrocarbons, pesticides, polychlorinated biphenyl (PCB) congeners or (e.g.) Aroclor® mixes, sulfur compounds, amines, solvent impurities, simulated distillation, oxygenates, gasoline range organics (GRO), refinery gases.
- Nonpolar phase (Crossbond® 100% dimethyl polysiloxane) Equivalent to USP G2 phase.
- Temperature range: -60°C to 330/350°C
(330°=bleed tested temperature/350°=maximum operating temperature).

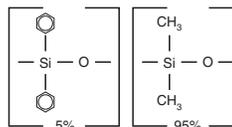


ID	df (µm)	temp. limits	15-Meter	30-Meter	60-Meter	
0.25mm	0.25	-60 to 330/350°C	13320	13323	13326	
	0.50	-60 to 330/350°C	13335	13338	13341	
	1.00	-60 to 330/350°C	13350	13353	13356	
0.32mm	0.25	-60 to 330/350°C	13321	13324	13327	
	0.50	-60 to 330/350°C	13336	13339	13342	
	1.00	-60 to 330/350°C	13351	13354	13357	
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		
ID	df (µm)	temp. limits	12-Meter	20-Meter	25-Meter	50-Meter
0.18mm	0.18	-60 to 330/350°C		13302		
0.20mm	0.33	-60 to 330/350°C	13397		13398	13399



Rxi™-5ms Fused Silica Columns

- General purpose columns for alcohols, amines, aromatic hydrocarbons, bile acids, drugs, US EPA methods, esters, fatty acid methyl esters (FAMES), flavors and aromas, glycerides, halogenated hydrocarbons, herbicides, hydrocarbons, organic acids, oxygenates, polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), pesticides, phenols, polymers, solvents, steroids, sugars, sulfur compounds. Most widely used general purpose column.
- Nonpolar phase (Crossbond® 5% diphenyl / 95% dimethyl polysiloxane) Equivalent to USP G27 phase.
- Temperature range: -60°C to 330/350°C
(330° = bleed tested temperature/350° = maximum operating temperature).



replace these similar phases

DB-5, DB-5ms, HP-5,
HP-5ms, SPB-5, SLB-5,
Equity-5, Ultra-5, BPX-5,
007-5, AT-5, Optima-5,
ZB-5, ZB-5ms, VF-5ms,
CP-Sil 8 CB, Rtx-5,
Rtx-5ms, Xti-5

Selectivity of Rxi-5ms is
equivalent to HP-5 and HP-5ms.

ID	df (μm)	temp. limits	15-Meter	30-Meter	60-Meter	
0.25mm	0.25	-60 to 330/350°C	13420	13423	13426	
	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	12-Meter	20-Meter	25-Meter	50-Meter
0.18mm	0.18	-60 to 330/350°C		13402		
	0.36	-60 to 330/350°C		13411		
0.20mm	0.33	-60 to 330/350°C	13497		13498	13499

Want more information about Rxi™ Columns?
www.restek.com/rxi

HRoMalytic Chromatography
Australian Distributors **ECH**nology Products '08
www.chromtech.net.au E-mail : info@chromtech.net.au Tel : +61 3 9762 2034 Fax : +61 3 9761 1169



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20% DISCOUNT

on any stock Rxi™-1ms, Rxi™-5ms, Rxi™-17 or Rxi™-50

Rxi™ Columns

Unsurpassed
inertness



Ultra-low bleed



Guaranteed
reproducibility



Unmatched
performance



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Chromatography Products

www.restek.com



Ultra II™ LC Columns

The Column Line Designed for Optimal Chromatography on **Any LC System**, Based on Highly Inert Restek Silica

Available Phases:

- C18
- Silica
- Biphenyl
- PFP Propyl
- Aromax
- Aqueous C18

Available Particle Sizes:

- 1.9µm for UHPLC
- 2.2µm for UFLC and RRLC
- 3µm and 5µm for HPLC

**More phases
coming soon!**



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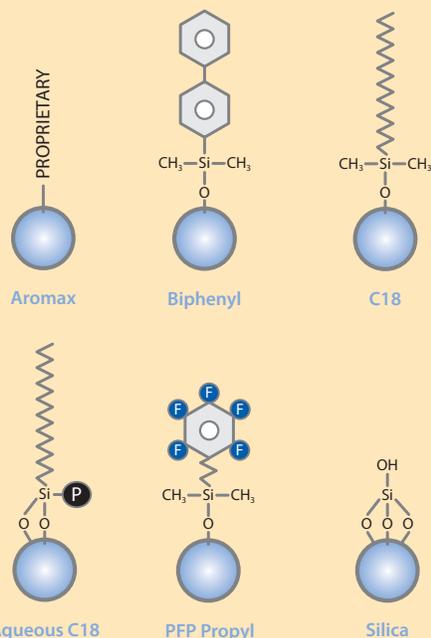


Chromatography Products

www.restek.com

Website : www.chromtech.net.au E-mail : info@chromtech.net.au TelNo : 03 9762 2034 . . . in Australia

NEW! Ultra II™ LC Columns



Ultra II™ Aromax Columns (USP L11)

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.

Ultra II™ Biphenyl Columns (USP L11)

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.

Ultra II™ C18 Columns (USP L1)

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.

Ultra II™ Aqueous C18 Columns (USP L1)

Highly retentive and selective for reversed phase separations of polar analytes. Highly base-deactivated. Compatible with highly aqueous (up to 100%) mobile phases.

Ultra II™ PFP Propyl Columns (USP L43)

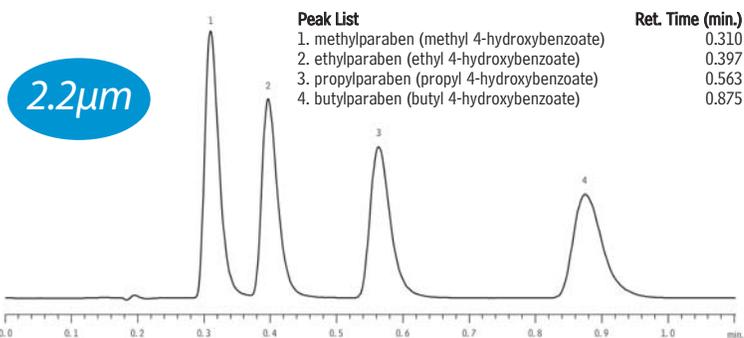
A pentafluorophenyl phase with a propyl spacer. Highly retentive for basic analytes. An excellent phase for separating nucleosides, nucleotides, purines, pyrimidines, and halogenated compounds.

Ultra II™ Silica Columns (USP L3)

High surface area. Type B silica packing.

The Ultra II™ product line is the first LC column line specifically designed for universal application—optimal chromatography on any system. This column line is built on a highly inert, high surface area silica that is completely Restek manufactured, providing excellent column-to-column reproducibility. Only Ultra II™ columns are available in a comprehensive range of particle sizes (1.9µm, 2.2µm, 3µm, and 5µm), creating truly scalable chromatography on any type of LC instrument, from conventional to ultra-high pressure systems. Ultra II™ columns are available in traditional phases (C18, Aqueous C18, Silica) and unique chemistries which provide alternate selectivity (Biphenyl, Aromax, PFP Propyl).

Parabens on Ultra II™ C18

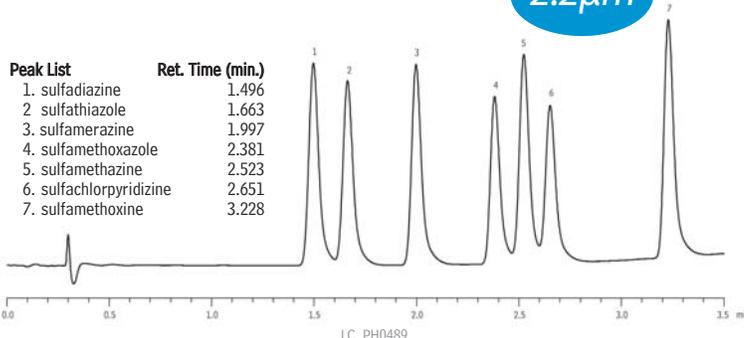


Sample:
 Inj.: 1µL
 Conc.: 50µg/mL each component
 Sample diluent: methanol

Conditions:
 Instrument: Shimadzu Prominence UFLCXR
 Mobile phase: 0.1% formic acid in water:methanol (35:65)
 Flow: 1.5mL/min.
 Temp.: 30°C
 Pressure: 630bar
 Det.: UV @ 254nm

Column: Ultra II™ C18
 Cat.#: 9604853
 Dimensions: 50mm x 3.0mm
 Particle size: 2.2µm
 Pore size: 100Å

Sulfa Drugs on Ultra II™ Biphenyl



Sample:
 Inj.: 3µL
 Conc.: 25µg/mL each component
 Sample diluent: methanol

Conditions:
 Instrument: Shimadzu Prominence UFLCXR
 Mobile phase: A. 0.1% formic acid in water
 B. methanol
 Time (min.) %B
 0 25
 3.5 65

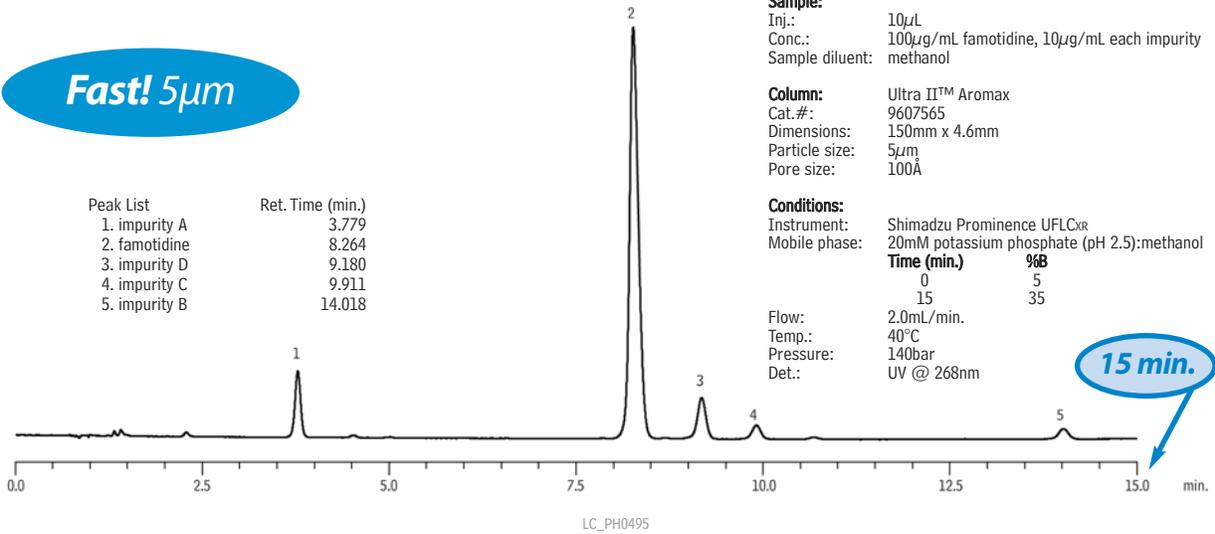
Column: Ultra II™ Biphenyl
 Cat.#: 9609853
 Dimensions: 50mm x 3.0mm
 Particle size: 2.2µm
 Pore size: 100Å

Flow: 1.0mL/min.
Temp.: 30°C
Pressure: 540bar
Det.: UV @ 254nm

Famotidine on Ultra II™ Aromax

Fast! 5µm

Peak List	Ret. Time (min.)
1. impurity A	3.779
2. famotidine	8.264
3. impurity D	9.180
4. impurity C	9.911
5. impurity B	14.018



Sample:
 Inj.: 10µL
 Conc.: 100µg/mL famotidine, 10µg/mL each impurity
 Sample diluent: methanol

Column: Ultra II™ Aromax
 Cat.#: 9607565
 Dimensions: 150mm x 4.6mm
 Particle size: 5µm
 Pore size: 100Å

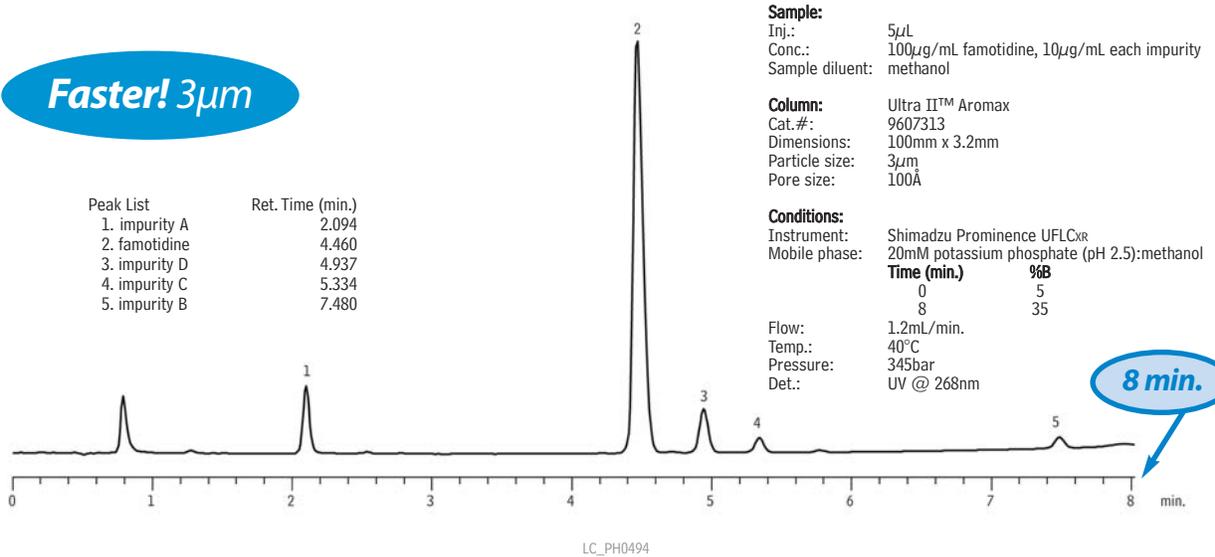
Conditions:
 Instrument: Shimadzu Prominence UFLCXR
 Mobile phase: 20mM potassium phosphate (pH 2.5):methanol

Time (min.)	%B
0	5
15	35

Flow: 2.0mL/min.
 Temp.: 40°C
 Pressure: 140bar
 Det.: UV @ 268nm

Faster! 3µm

Peak List	Ret. Time (min.)
1. impurity A	2.094
2. famotidine	4.460
3. impurity D	4.937
4. impurity C	5.334
5. impurity B	7.480



Sample:
 Inj.: 5µL
 Conc.: 100µg/mL famotidine, 10µg/mL each impurity
 Sample diluent: methanol

Column: Ultra II™ Aromax
 Cat.#: 9607313
 Dimensions: 100mm x 3.2mm
 Particle size: 3µm
 Pore size: 100Å

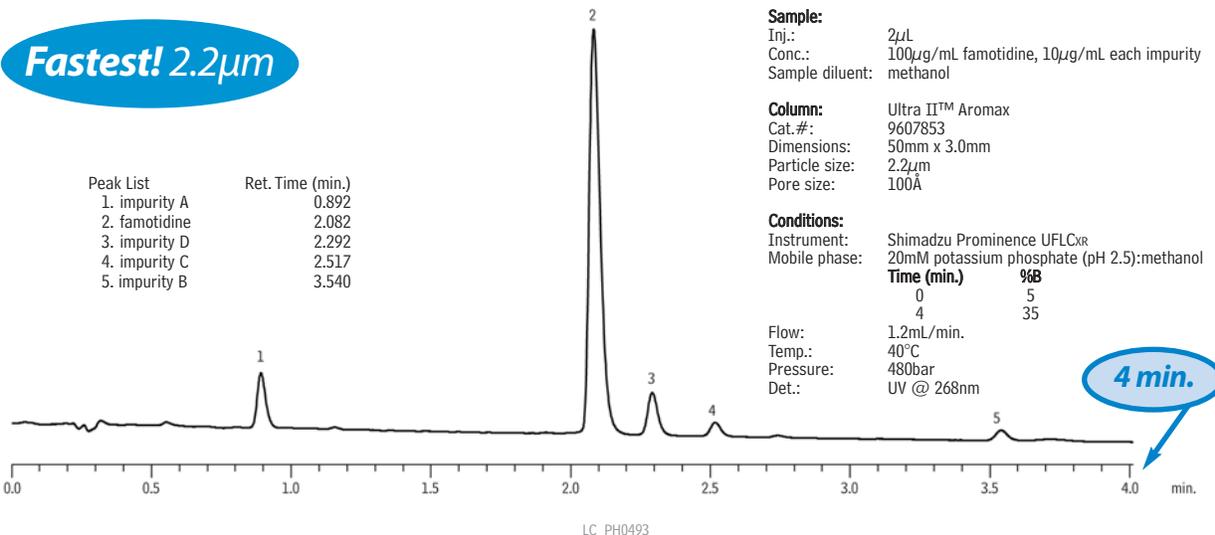
Conditions:
 Instrument: Shimadzu Prominence UFLCXR
 Mobile phase: 20mM potassium phosphate (pH 2.5):methanol

Time (min.)	%B
0	5
8	35

Flow: 1.2mL/min.
 Temp.: 40°C
 Pressure: 345bar
 Det.: UV @ 268nm

Fastest! 2.2µm

Peak List	Ret. Time (min.)
1. impurity A	0.892
2. famotidine	2.082
3. impurity D	2.292
4. impurity C	2.517
5. impurity B	3.540



Sample:
 Inj.: 2µL
 Conc.: 100µg/mL famotidine, 10µg/mL each impurity
 Sample diluent: methanol

Column: Ultra II™ Aromax
 Cat.#: 9607853
 Dimensions: 50mm x 3.0mm
 Particle size: 2.2µm
 Pore size: 100Å

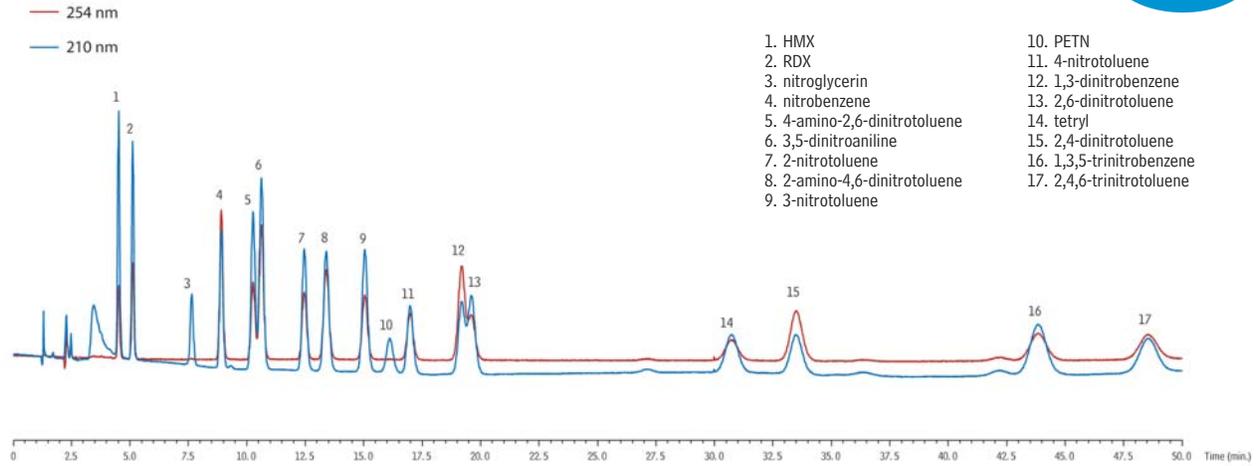
Conditions:
 Instrument: Shimadzu Prominence UFLCXR
 Mobile phase: 20mM potassium phosphate (pH 2.5):methanol

Time (min.)	%B
0	5
4	35

Flow: 1.2mL/min.
 Temp.: 40°C
 Pressure: 480bar
 Det.: UV @ 268nm

Explosives on Ultra II™ Aromax

5µm



- | | |
|-------------------------------|---------------------------|
| 1. HMX | 10. PETN |
| 2. RDX | 11. 4-nitrotoluene |
| 3. nitroglycerin | 12. 1,3-dinitrobenzene |
| 4. nitrobenzene | 13. 2,6-dinitrotoluene |
| 5. 4-amino-2,6-dinitrotoluene | 14. tetryl |
| 6. 3,5-dinitroaniline | 15. 2,4-dinitrotoluene |
| 7. 2-nitrotoluene | 16. 1,3,5-trinitrobenzene |
| 8. 2-amino-4,6-dinitrotoluene | 17. 2,4,6-trinitrotoluene |
| 9. 3-nitrotoluene | |

LC_EV0484

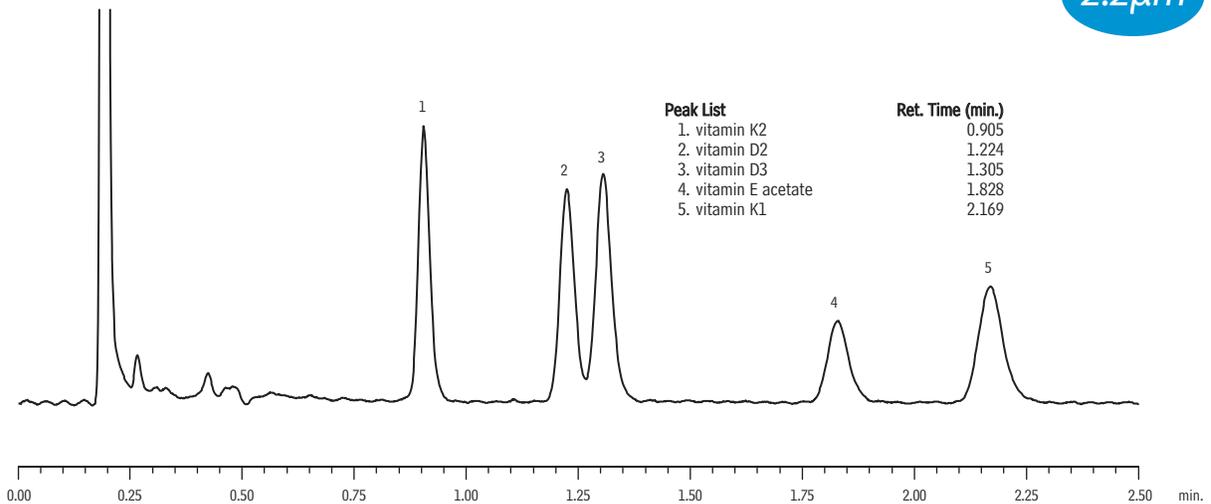
Sample: Nitroaromatics and Nitramine Explosives by HPLC,
EPA 8330B (cat.# 33204)
Inj.: 10µL
Conc.: 10µg/mL each component
Sample diluent: methanol

Column: Ultra II™ Aromax
Cat.#: 9607575
Dimensions: 250mm x 4.6mm
Particle size: 5µm
Pore size: 100Å

Conditions:
Instrument: Shimadzu Prominence
Mobile phase: water:methanol, 35:65 (v/v)
Flow: 1.2mL/min.
Temp.: 30°C
Pressure: 170bar
Det.: UV @ 254nm and 210nm

Fat Soluble Vitamins on Ultra II™ C18

2.2µm



Peak List	Ret. Time (min.)
1. vitamin K2	0.905
2. vitamin D2	1.224
3. vitamin D3	1.305
4. vitamin E acetate	1.828
5. vitamin K1	2.169

LC_PH0492

Sample:
Inj.: 1µL
Conc.: 100µg/mL each component
Sample diluent: acetone

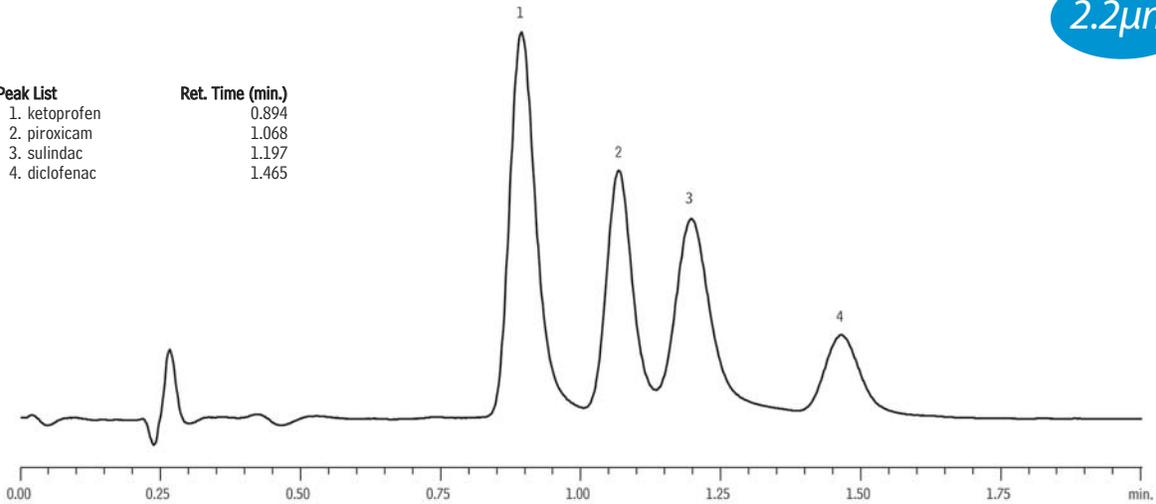
Column: Ultra II™ C18
Cat.#: 9604853
Dimensions: 50mm x 3.0mm
Particle size: 2.2µm
Pore size: 100Å

Conditions:
Instrument: Shimadzu Prominence UFLCxr
Mobile phase: acetonitrile:methanol (85:15)
Flow: 1.5mL/min.
Temp.: ambient
Pressure: 280bar
Det.: UV @ 230nm

NSAIDs on Ultra II™ Biphenyl

2.2µm

Peak List	Ret. Time (min.)
1. ketoprofen	0.894
2. piroxicam	1.068
3. sulindac	1.197
4. diclofenac	1.465



LC_PH0487

Sample:
 Inj.: 5µL
 Conc.: 15µg/mL each component
 Sample diluent: methanol

Column: Ultra II™ Biphenyl
 Cat.#: 9609853
 Dimensions: 50mm x 3.0mm
 Particle size: 2.2µm
 Pore size: 100Å

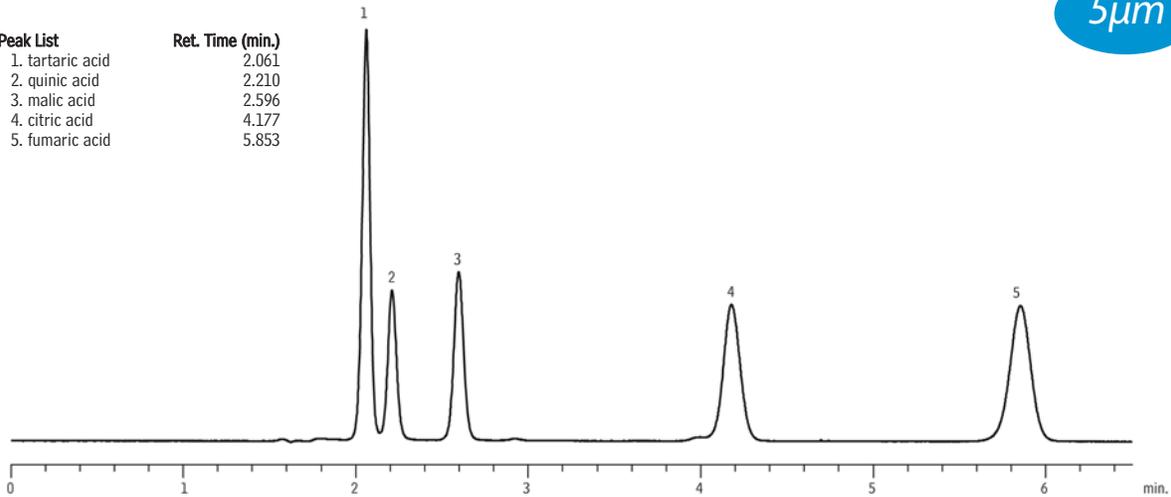
Conditions:
 Instrument: Shimadzu Prominence UFLCXR
 Mobile phase: 20mM potassium phosphate, pH 2.5: methanol (30:70)

Flow: 1.2mL/min.
 Temp.: 40°C
 Pressure: 460bar
 Det.: UV @ 254nm

Organic Acids on Ultra II™ Aqueous C18

5µm

Peak List	Ret. Time (min.)
1. tartaric acid	2.061
2. quinic acid	2.210
3. malic acid	2.596
4. citric acid	4.177
5. fumaric acid	5.853



LC_PH0498

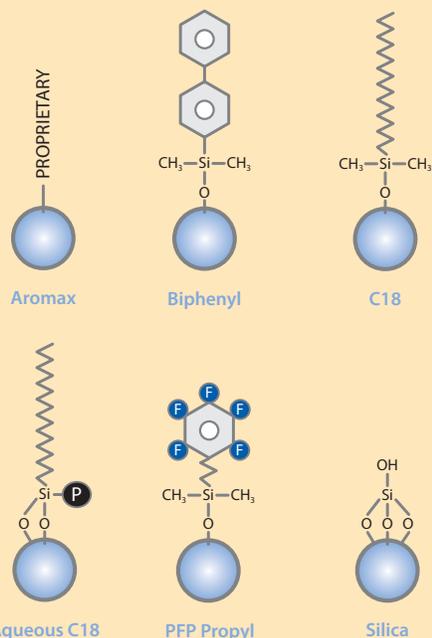
Sample:
 Inj.: 5µL
 Conc.: 10µg/mL fumaric acid,
 2,000µg/mL each other acids
 Sample diluent: water

Column: Ultra II™ Aqueous C18
 Cat.#: 9608565
 Dimensions: 150mm x 4.6mm
 Particle size: 5µm
 Pore size: 100Å

Conditions:
 Instrument: Shimadzu Prominence UFLCXR
 Mobile phase: 100% 20mM potassium phosphate (pH 2.5)
 Flow: 1.0mL/min.
 Temp.: 30°C
 Pressure: 80bar
 Det.: UV @ 226nm

NEW! Ultra II™ LC Columns

The Ultra II™ product line is the first LC column line specifically designed for universal application—optimal chromatography on any system. This column line is built on a highly inert, high surface area silica that is completely Restek manufactured, providing excellent column-to-column reproducibility. Only Ultra II™ columns are available in a comprehensive range of particle sizes (1.9µm, 2.2µm, 3µm, and 5µm), creating truly scalable chromatography on any type of LC instrument, from conventional to ultra-high pressure systems. Ultra II™ columns are available in traditional phases (C18, Aqueous C18, Silica) and unique chemistries which provide alternate selectivity (Biphenyl, Aromax, PFP Propyl).



Ultra II™ Aromax Columns (USP L11)

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.

Ultra II™ Biphenyl Columns (USP L11)

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.

Ultra II™ C18 Columns (USP L1)

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.

Ultra II™ Aqueous C18 Columns (USP L1)

Highly retentive and selective for reversed phase separations of polar analytes. Highly base-deactivated. Compatible with highly aqueous (up to 100%) mobile phases.

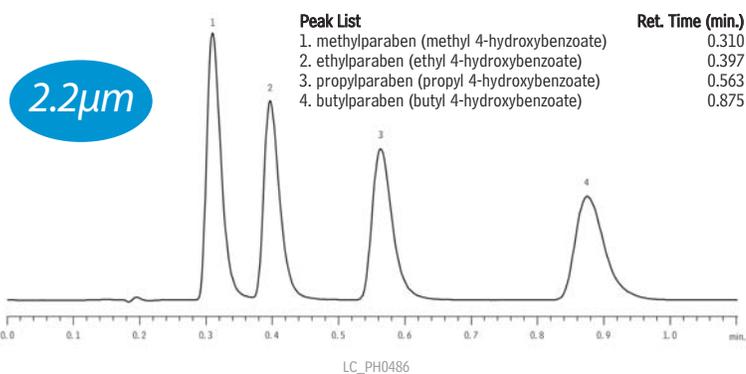
Ultra II™ PFP Propyl Columns (USP L43)

A pentafluorophenyl phase with a propyl spacer. Highly retentive for basic analytes. An excellent phase for separating nucleosides, nucleotides, purines, pyrimidines, and halogenated compounds.

Ultra II™ Silica Columns (USP L3)

High surface area. Type B silica packing.

Parabens on Ultra II™ C18

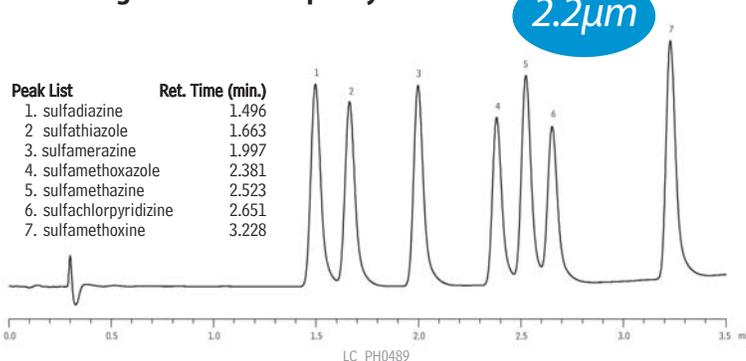


Sample:
 Inj.: 1µL
 Conc.: 50µg/mL each component
 Sample diluent: methanol

Conditions:
 Instrument: Shimadzu Prominence UFLCXR
 Mobile phase: 0.1% formic acid in water:methanol (35:65)
 Flow: 1.5mL/min.
 Temp.: 30°C
 Pressure: 630bar
 Det.: UV @ 254nm

Column:
 Ultra II™ C18
 Cat.#: 9604853
 Dimensions: 50mm x 3.0mm
 Particle size: 2.2µm
 Pore size: 100Å

Sulfa Drugs on Ultra II™ Biphenyl



Sample:
 Inj.: 3µL
 Conc.: 25µg/mL each component
 Sample diluent: methanol

Conditions:
 Instrument: Shimadzu Prominence UFLCXR
 Mobile phase: A. 0.1% formic acid in water
 B. methanol
 Time (min.) %B
 0 25
 3.5 65

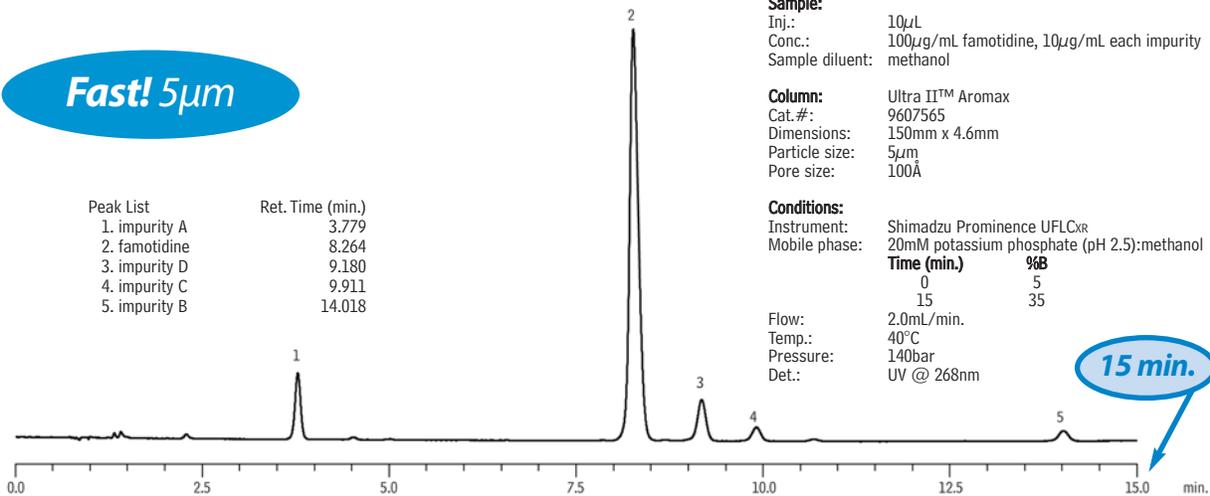
Column:
 Ultra II™ Biphenyl
 Cat.#: 9609853
 Dimensions: 50mm x 3.0mm
 Particle size: 2.2µm
 Pore size: 100Å

Flow: 1.0mL/min.
Temp.: 30°C
Pressure: 540bar
Det.: UV @ 254nm

Famotidine on Ultra II™ Aromax

Fast! 5µm

Peak List	Ret. Time (min.)
1. impurity A	3.779
2. famotidine	8.264
3. impurity D	9.180
4. impurity C	9.911
5. impurity B	14.018



Sample:
 Inj.: 10µL
 Conc.: 100µg/mL famotidine, 10µg/mL each impurity
 Sample diluent: methanol

Column: Ultra II™ Aromax
 Cat.#: 9607565
 Dimensions: 150mm x 4.6mm
 Particle size: 5µm
 Pore size: 100Å

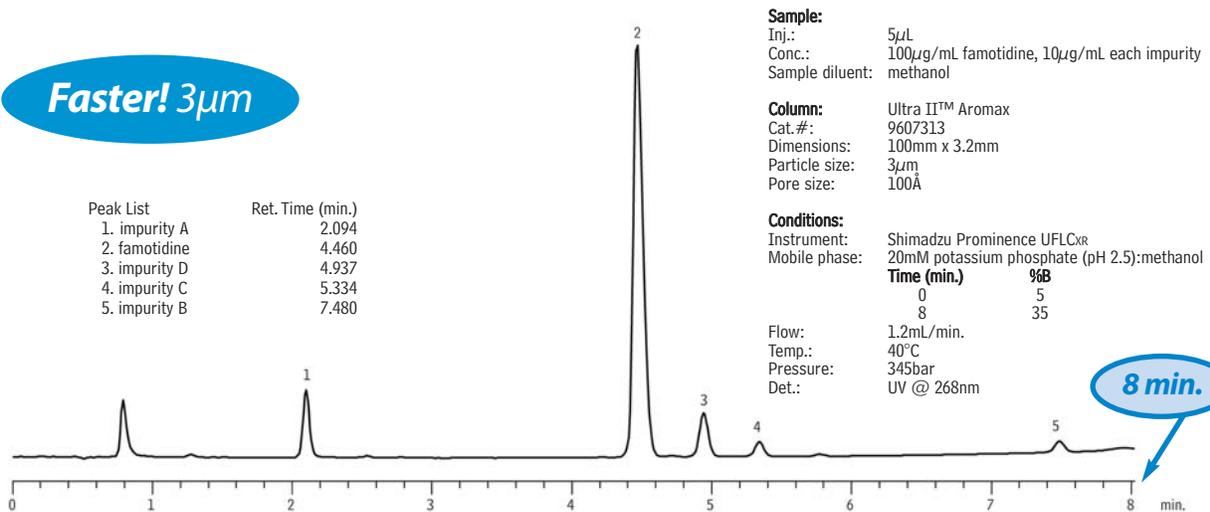
Conditions:
 Instrument: Shimadzu Prominence UFLCXR
 Mobile phase: 20mM potassium phosphate (pH 2.5):methanol

Time (min.)	%B
0	5
15	35

Flow: 2.0mL/min.
 Temp.: 40°C
 Pressure: 140bar
 Det.: UV @ 268nm

Faster! 3µm

Peak List	Ret. Time (min.)
1. impurity A	2.094
2. famotidine	4.460
3. impurity D	4.937
4. impurity C	5.334
5. impurity B	7.480



Sample:
 Inj.: 5µL
 Conc.: 100µg/mL famotidine, 10µg/mL each impurity
 Sample diluent: methanol

Column: Ultra II™ Aromax
 Cat.#: 9607313
 Dimensions: 100mm x 3.2mm
 Particle size: 3µm
 Pore size: 100Å

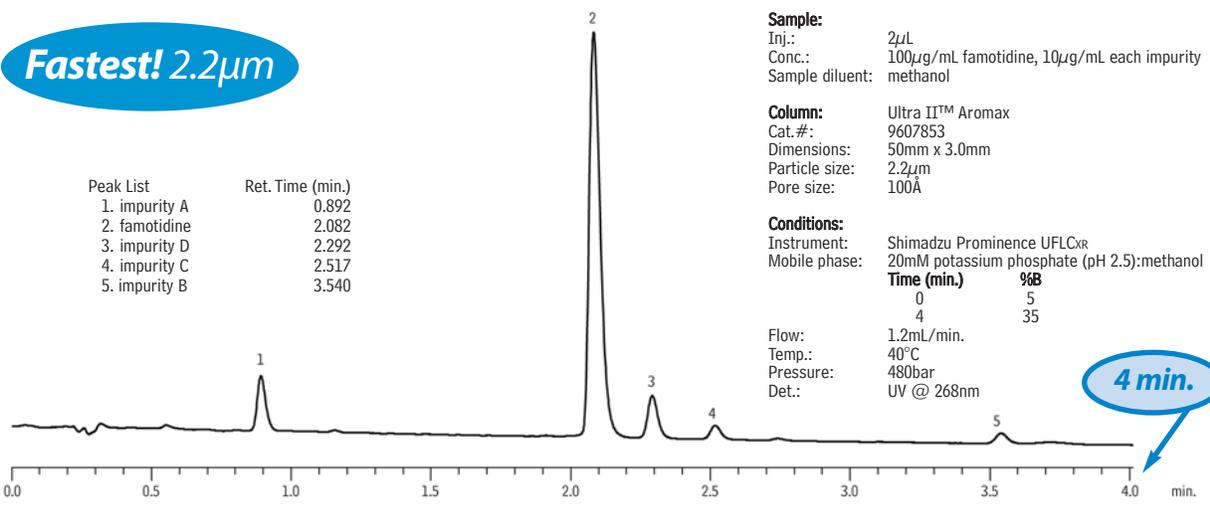
Conditions:
 Instrument: Shimadzu Prominence UFLCXR
 Mobile phase: 20mM potassium phosphate (pH 2.5):methanol

Time (min.)	%B
0	5
8	35

Flow: 1.2mL/min.
 Temp.: 40°C
 Pressure: 345bar
 Det.: UV @ 268nm

Fastest! 2.2µm

Peak List	Ret. Time (min.)
1. impurity A	0.892
2. famotidine	2.082
3. impurity D	2.292
4. impurity C	2.517
5. impurity B	3.540



Sample:
 Inj.: 2µL
 Conc.: 100µg/mL famotidine, 10µg/mL each impurity
 Sample diluent: methanol

Column: Ultra II™ Aromax
 Cat.#: 9607853
 Dimensions: 50mm x 3.0mm
 Particle size: 2.2µm
 Pore size: 100Å

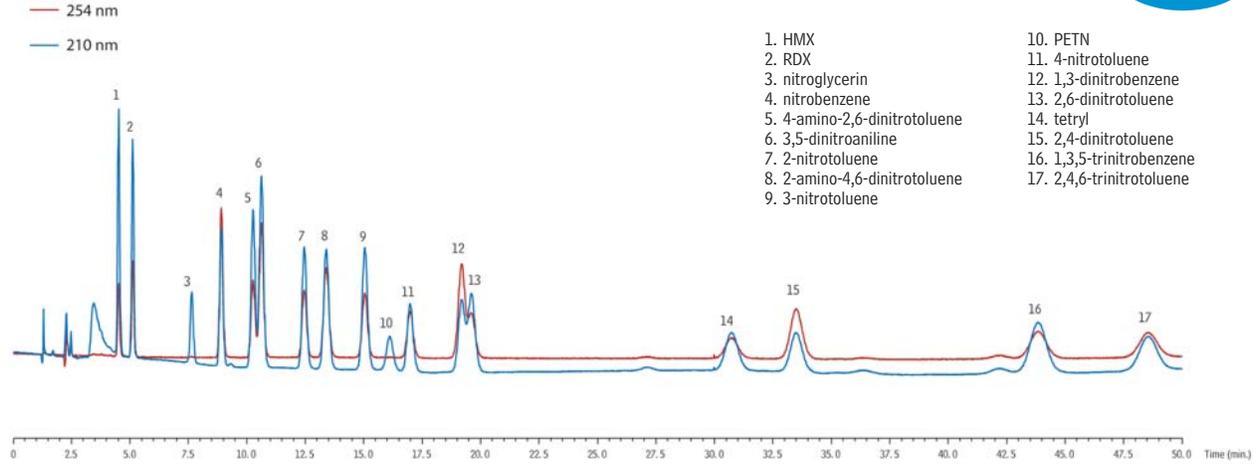
Conditions:
 Instrument: Shimadzu Prominence UFLCXR
 Mobile phase: 20mM potassium phosphate (pH 2.5):methanol

Time (min.)	%B
0	5
4	35

Flow: 1.2mL/min.
 Temp.: 40°C
 Pressure: 480bar
 Det.: UV @ 268nm

Explosives on Ultra II™ Aromax

5µm



LC_EV0484

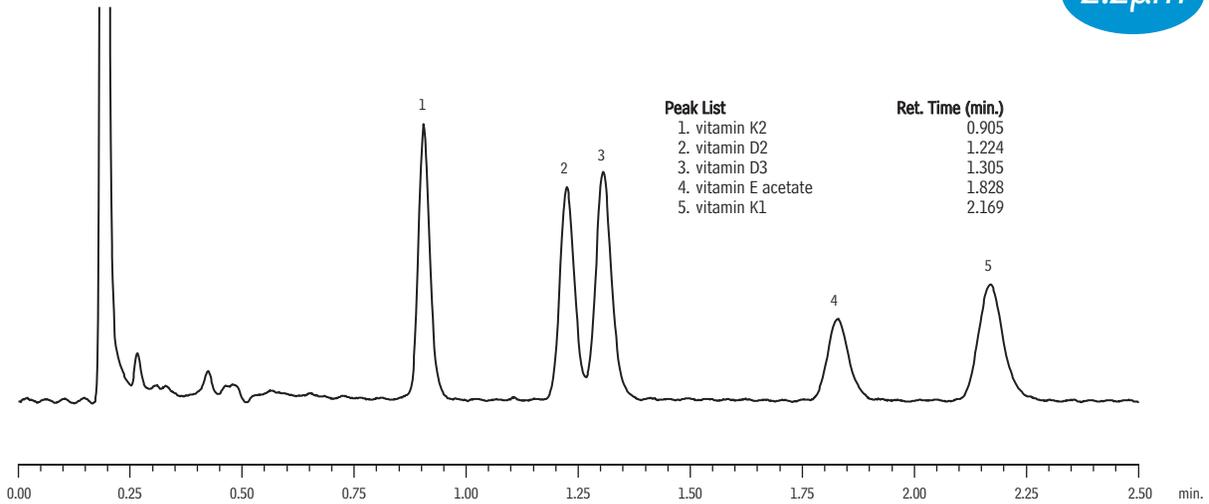
Sample: Nitroaromatics and Nitramine Explosives by HPLC, EPA 8330B (cat.# 33204)
Inj.: 10µL
Conc.: 10µg/mL each component
Sample diluent: methanol

Column: Ultra II™ Aromax
Cat.#: 9607575
Dimensions: 250mm x 4.6mm
Particle size: 5µm
Pore size: 100Å

Conditions:
Instrument: Shimadzu Prominence
Mobile phase: water:methanol, 35:65 (v/v)
Flow: 1.2mL/min.
Temp.: 30°C
Pressure: 170bar
Det.: UV @ 254nm and 210nm

Fat Soluble Vitamins on Ultra II™ C18

2.2µm



LC_PH0492

Sample:
Inj.: 1µL
Conc.: 100µg/mL each component
Sample diluent: acetone

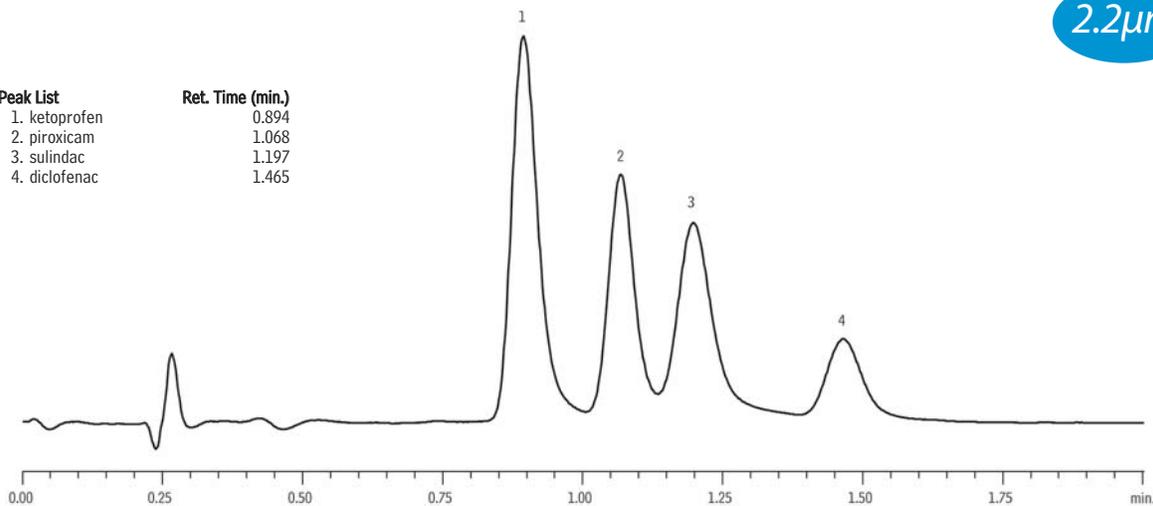
Column: Ultra II™ C18
Cat.#: 9604853
Dimensions: 50mm x 3.0mm
Particle size: 2.2µm
Pore size: 100Å

Conditions:
Instrument: Shimadzu Prominence UFLCxr
Mobile phase: acetonitrile:methanol (85:15)
Flow: 1.5mL/min.
Temp.: ambient
Pressure: 280bar
Det.: UV @ 230nm

NSAIDs on Ultra II™ Biphenyl

2.2μm

Peak List	Ret. Time (min.)
1. ketoprofen	0.894
2. piroxicam	1.068
3. sulindac	1.197
4. diclofenac	1.465



LC_PH0487

Sample:
 Inj.: 5μL
 Conc.: 15μg/mL each component
 Sample diluent: methanol

Column: Ultra II™ Biphenyl
 Cat.#: 9609853
 Dimensions: 50mm x 3.0mm
 Particle size: 2.2μm
 Pore size: 100Å

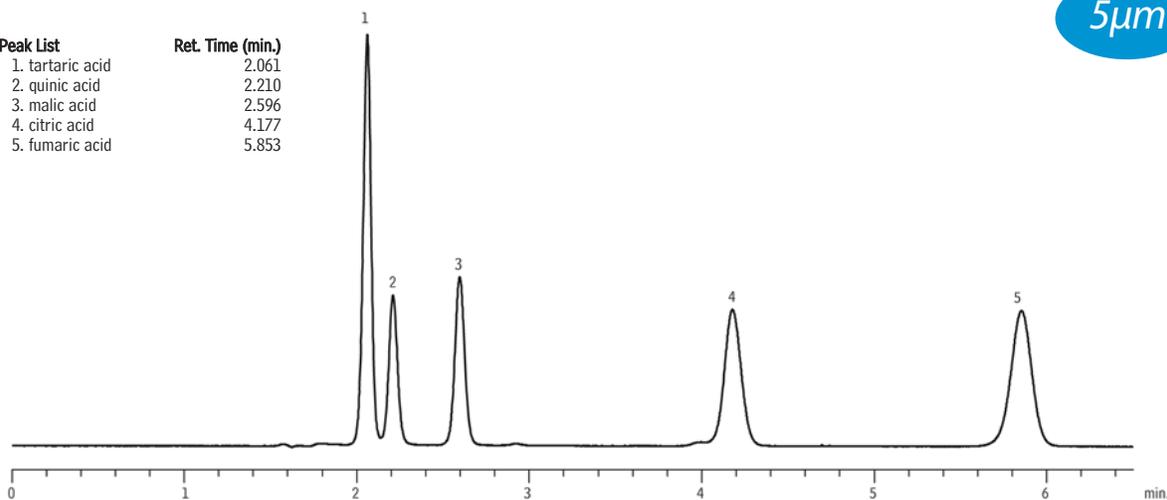
Conditions:
 Instrument: Shimadzu Prominence UFLCXR
 Mobile phase: 20mM potassium phosphate, pH 2.5: methanol (30:70)

Flow: 1.2mL/min.
 Temp.: 40°C
 Pressure: 460bar
 Det.: UV @ 254nm

Organic Acids on Ultra II™ Aqueous C18

5μm

Peak List	Ret. Time (min.)
1. tartaric acid	2.061
2. quinic acid	2.210
3. malic acid	2.596
4. citric acid	4.177
5. fumaric acid	5.853



LC_PH0498

Sample:
 Inj.: 5μL
 Conc.: 10μg/mL fumaric acid,
 2,000μg/mL each other acids
 Sample diluent: water

Column: Ultra II™ Aqueous C18
 Cat.#: 9608565
 Dimensions: 150mm x 4.6mm
 Particle size: 5μm
 Pore size: 100Å

Conditions:
 Instrument: Shimadzu Prominence UFLCXR
 Mobile phase: 100% 20mM potassium phosphate (pH 2.5)
 Flow: 1.0mL/min.
 Temp.: 30°C
 Pressure: 80bar
 Det.: UV @ 226nm

Alcohol Metabolites on Ultra II™ Biphenyl

5µm

Sample:
 Inj.: 5µL
 Conc.: 5µg/mL each component
 Sample diluent: urine diluted 1:10 with mobile phase

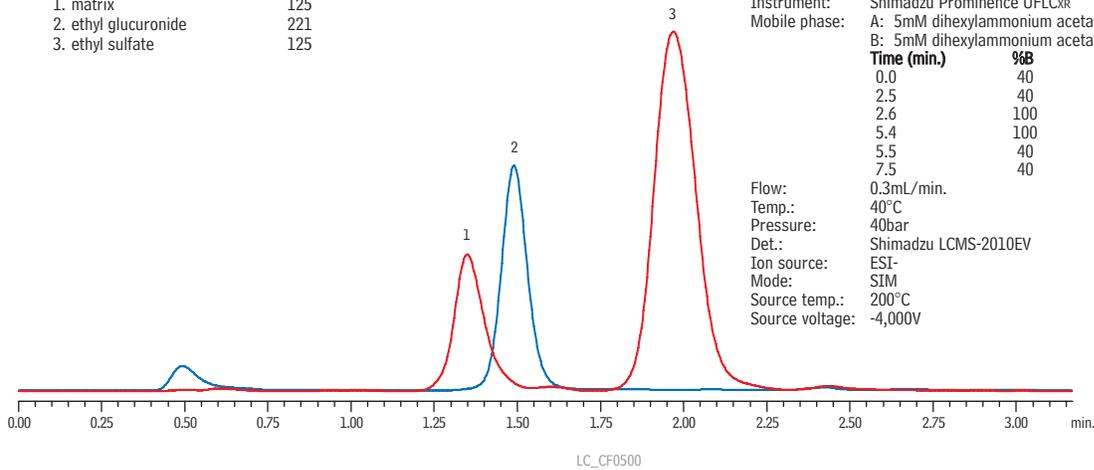
Column: Ultra II™ Biphenyl
 Cat.#: 9609552
 Dimensions: 50mm x 2.1mm
 Particle size: 5µm
 Pore size: 100Å

Conditions:
 Instrument: Shimadzu Prominence UFLCXR
 Mobile phase: A: 5mM dihexylammonium acetate in water
 B: 5mM dihexylammonium acetate in methanol

Time (min.)	%B
0.0	40
2.5	40
2.6	100
5.4	100
5.5	40
7.5	40

Flow: 0.3mL/min.
 Temp.: 40°C
 Pressure: 40bar
 Det.: Shimadzu LCMS-2010EV
 Ion source: ESI-
 Mode: SIM
 Source temp.: 200°C
 Source voltage: -4,000V

Peak List	m/z
1. matrix	125
2. ethyl glucuronide	221
3. ethyl sulfate	125



Cannabinoids on Ultra II™ Biphenyl

2.2µm

- Peak List:**
- cannabidiol
 - THC-COOH
 - cannabinol
 - Δ⁹-THC-d₃
 - Δ⁹-THC

Sample:
 Inj.: 20µL
 Conc.: 300ng/mL urine sample with 50ng/mL internal standard

Column: Ultra II™ Biphenyl
 Cat.#: 9609853
 Dimensions: 50mm x 3.0mm
 Particle size: 2.2µm
 Pore size: 100Å

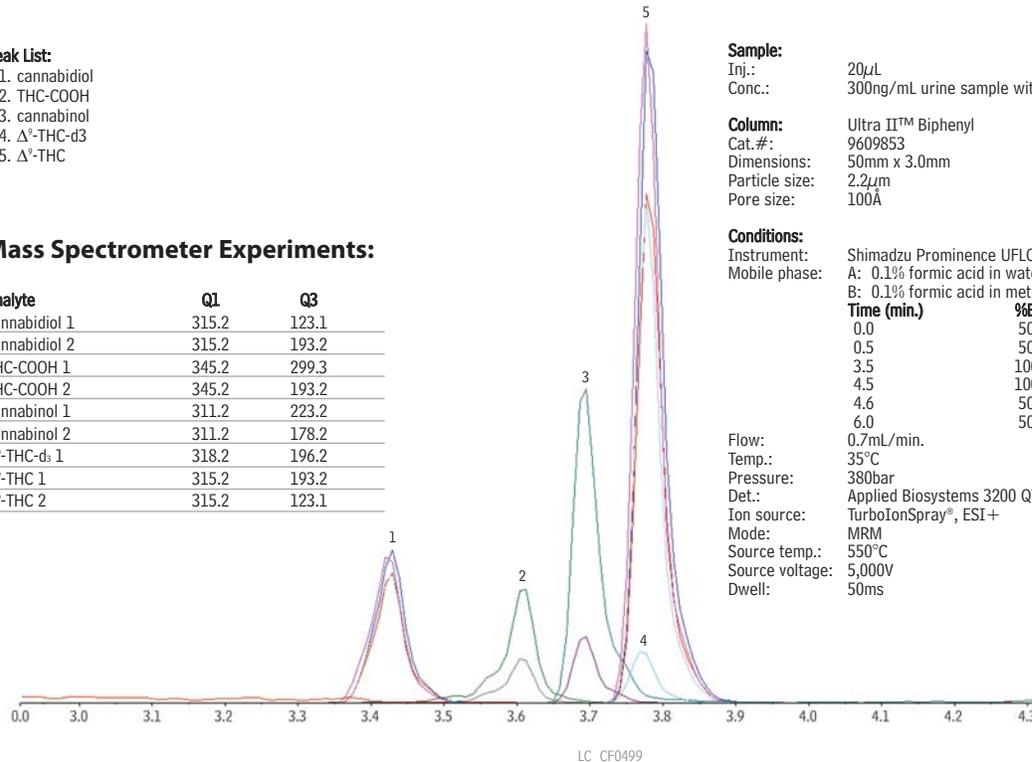
Conditions:
 Instrument: Shimadzu Prominence UFLCXR
 Mobile phase: A: 0.1% formic acid in water
 B: 0.1% formic acid in methanol

Time (min.)	%B
0.0	50
0.5	50
3.5	100
4.5	100
4.6	50
6.0	50

Flow: 0.7mL/min.
 Temp.: 35°C
 Pressure: 380bar
 Det.: Applied Biosystems 3200 QTRAP™ LC/MS/MS system
 Ion source: TurboIonSpray®, ESI+
 Mode: MRM
 Source temp.: 550°C
 Source voltage: 5,000V
 Dwell: 50ms

Mass Spectrometer Experiments:

Analyte	Q1	Q3
cannabidiol 1	315.2	123.1
cannabidiol 2	315.2	193.2
THC-COOH 1	345.2	299.3
THC-COOH 2	345.2	193.2
cannabinol 1	311.2	223.2
cannabinol 2	311.2	178.2
Δ ⁹ -THC-d ₃ 1	318.2	196.2
Δ ⁹ -THC 1	315.2	193.2
Δ ⁹ -THC 2	315.2	123.1



Ultra II™ Silica Columns (USP L3)

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 7.5
temperature limit: 80°C

1.9µm Column, 2.1mm	cat. #
30mm	9600232
50mm	9600252
100mm	9600212
2.2µm Column, 3.0mm	cat. #
30mm	9600833
50mm	9600853
100mm	9600813
3µm Column, 1.0mm	cat. #
30mm	9600331
50mm	9600351
100mm	9600311
150mm	9600361
3µm Column, 2.1mm	cat. #
30mm	9600332
50mm	9600352
100mm	9600312
150mm	9600362
3µm Column, 3.2mm	cat. #
30mm	9600333
50mm	9600353
100mm	9600313
150mm	9600363
3µm Column, 4.6mm	cat. #
30mm	9600335
50mm	9600355
100mm	9600315
150mm	9600365
5µm Column, 1.0mm	cat. #
30mm	9600531
50mm	9600551
100mm	9600511
150mm	9600561
200mm	9600521
250mm	9600571
5µm Column, 2.1mm	cat. #
30mm	9600532
50mm	9600552
100mm	9600512
150mm	9600562
200mm	9600522
250mm	9600572
5µm Column, 3.2mm	cat. #
30mm	9600533
50mm	9600553
100mm	9600513
150mm	9600563
200mm	9600523
250mm	9600573
5µm Column, 4.6mm	cat. #
30mm	9600535
50mm	9600555
100mm	9600515
150mm	9600565
200mm	9600525
250mm	9600575

Ultra II™ Biphenyl Columns (USP L11)

Physical Characteristics:

particle size: 2.2µm, 3µm or 5µm, spherical
pore size: 100Å
carbon load: 15%

endcap: fully endcapped
pH range: 2.5 to 7.5
temperature limit: 80°C

2.2µm Column, 3.0mm	cat. #
30mm	9609833
50mm	9609853
100mm	9609813
3µm Column, 1.0mm	cat. #
30mm	9609331
50mm	9609351
100mm	9609311
150mm	9609361
3µm Column, 2.1mm	cat. #
30mm	9609332
50mm	9609352
100mm	9609312
150mm	9609362
3µm Column, 3.2mm	cat. #
30mm	9609333
50mm	9609353
100mm	9609313
150mm	9609363
3µm Column, 4.6mm	cat. #
30mm	9609335
50mm	9609355
100mm	9609315
150mm	9609365
5µm Column, 1.0mm	cat. #
30mm	9609531
50mm	9609551
100mm	9609511
150mm	9609561
200mm	9609521
250mm	9609571
5µm Column, 2.1mm	cat. #
30mm	9609532
50mm	9609552
100mm	9609512
150mm	9609562
200mm	9609522
250mm	9609572
5µm Column, 3.2mm	cat. #
30mm	9609533
50mm	9609553
100mm	9609513
150mm	9609563
200mm	9609523
250mm	9609573
5µm Column, 4.6mm	cat. #
30mm	9609535
50mm	9609555
100mm	9609515
150mm	9609565
200mm	9609525
250mm	9609575

1.9µm coming soon!

Ultra II™ Aromax Columns (USP L11)

Physical Characteristics:

particle size: 3µm or 5µm, spherical
pore size: 100Å
carbon load: 17%

endcap: fully endcapped
pH range: 2.5 to 7.5
temperature limit: 80°C

3µm Column, 1.0mm	cat. #
30mm	9607331
50mm	9607351
100mm	9607311
150mm	9607361
3µm Column, 2.1mm	cat. #
30mm	9607332
50mm	9607352
100mm	9607312
150mm	9607362
3µm Column, 3.2mm	cat. #
30mm	9607333
50mm	9607353
100mm	9607313
150mm	9607363
3µm Column, 4.6mm	cat. #
30mm	9607335
50mm	9607355
100mm	9607315
150mm	9607365
5µm Column, 1.0mm	cat. #
30mm	9607531
50mm	9607551
100mm	9607511
150mm	9607561
200mm	9607521
250mm	9607571
5µm Column, 2.1mm	cat. #
30mm	9607532
50mm	9607552
100mm	9607512
150mm	9607562
200mm	9607522
250mm	9607572
5µm Column, 3.2mm	cat. #
30mm	9607533
50mm	9607553
100mm	9607513
150mm	9607563
200mm	9607523
250mm	9607573
5µm Column, 4.6mm	cat. #
30mm	9607535
50mm	9607555
100mm	9607515
150mm	9607565
200mm	9607525
250mm	9607575

1.9µm & 2.2µm coming soon!

ordering note

Guard cartridges are available, visit our website at www.restek.com for ordering information.

Visit us at www.restek.com/ultra2 for our most complete listing of Ultra II™ columns.

Ultra II™ C18 Columns (USP L1)

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 7.5
temperature limit: 80°C

1.9µm Column, 2.1mm	cat. #
30mm	9604232
50mm	9604252
100mm	9604212
2.2µm Column, 3.0mm	cat. #
30mm	9604833
50mm	9604853
100mm	9604813
3µm Column, 1.0mm	cat. #
30mm	9604331
50mm	9604351
100mm	9604311
150mm	9604361
3µm Column, 2.1mm	cat. #
30mm	9604332
50mm	9604352
100mm	9604312
150mm	9604362
3µm Column, 3.2mm	cat. #
30mm	9604333
50mm	9604353
100mm	9604313
150mm	9604363
3µm Column, 4.6mm	cat. #
30mm	9604335
50mm	9604355
100mm	9604315
150mm	9604365
5µm Column, 1.0mm	cat. #
30mm	9604531
50mm	9604551
100mm	9604511
150mm	9604561
200mm	9604521
250mm	9604571
5µm Column, 2.1mm	cat. #
30mm	9604532
50mm	9604552
100mm	9604512
150mm	9604562
200mm	9604522
250mm	9604572
5µm Column, 3.2mm	cat. #
30mm	9604533
50mm	9604553
100mm	9604513
150mm	9604563
200mm	9604523
250mm	9604573
5µm Column, 4.6mm	cat. #
30mm	9604535
50mm	9604555
100mm	9604515
150mm	9604565
200mm	9604525
250mm	9604575

Ultra II™ Aqueous C18 Columns (USP L1)

Physical Characteristics:

particle size: 2.2µm, 3µm or 5µm, spherical
pore size: 100Å
carbon load: 15%
endcap: no
pH range: 2.5 to 7.5
temperature limit: 80°C

2.2µm Column, 3.0mm	cat. #
30mm	9608833
50mm	9608853
100mm	9608813
3µm Column, 1.0mm	cat. #
30mm	9608331
50mm	9608351
100mm	9608311
150mm	9608361
3µm Column, 2.1mm	cat. #
30mm	9608332
50mm	9608352
100mm	9608312
150mm	9608362
3µm Column, 3.2mm	cat. #
30mm	9608333
50mm	9608353
100mm	9608313
150mm	9608363
3µm Column, 4.6mm	cat. #
30mm	9608335
50mm	9608355
100mm	9608315
150mm	9608365
5µm Column, 1.0mm	cat. #
30mm	9608531
50mm	9608551
100mm	9608511
150mm	9608561
200mm	9608521
250mm	9608571
5µm Column, 2.1mm	cat. #
30mm	9608532
50mm	9608552
100mm	9608512
150mm	9608562
200mm	9608522
250mm	9608572
5µm Column, 3.2mm	cat. #
30mm	9608533
50mm	9608553
100mm	9608513
150mm	9608563
200mm	9608523
250mm	9608573
5µm Column, 4.6mm	cat. #
30mm	9608535
50mm	9608555
100mm	9608515
150mm	9608565
200mm	9608525
250mm	9608575

1.9µm coming soon!

PATENTS & TRADEMARKS

Restek patents and trademarks are the property of Restek Corporation. Other trademarks appearing in Restek literature or on its website are the property of their respective owners.

Ultra II™ PFP Propyl Columns (USP L43)

Physical Characteristics:

particle size: 2.2µm, 3µm or 5µm, spherical
pore size: 100Å
carbon load: 11%
endcap: fully endcapped
pH range: 2.5 to 7.5
temperature limit: 80°C

2.2µm Column, 3.0mm	cat. #
30mm	9606833
50mm	9606853
100mm	9606813
3µm Column, 1.0mm	cat. #
30mm	9606331
50mm	9606351
100mm	9606311
150mm	9606361
3µm Column, 2.1mm	cat. #
30mm	9606332
50mm	9606352
100mm	9606312
150mm	9606362
3µm Column, 3.2mm	cat. #
30mm	9606333
50mm	9606353
100mm	9606313
150mm	9606363
3µm Column, 4.6mm	cat. #
30mm	9606335
50mm	9606355
100mm	9606315
150mm	9606365
5µm Column, 1.0mm	cat. #
30mm	9606531
50mm	9606551
100mm	9606511
150mm	9606561
200mm	9606521
250mm	9606571
5µm Column, 2.1mm	cat. #
30mm	9606532
50mm	9606552
100mm	9606512
150mm	9606562
200mm	9606522
250mm	9606572
5µm Column, 3.2mm	cat. #
30mm	9606533
50mm	9606553
100mm	9606513
150mm	9606563
200mm	9606523
250mm	9606573
5µm Column, 4.6mm	cat. #
30mm	9606535
50mm	9606555
100mm	9606515
150mm	9606565
200mm	9606525
250mm	9606575

1.9µm coming soon!



Lit. Cat.# GNTS1177-INT

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Biphenyl

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10

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Ultra II® Biphenyl Columns

Greater Versatility—Increased Method Performance



BIPHENYL

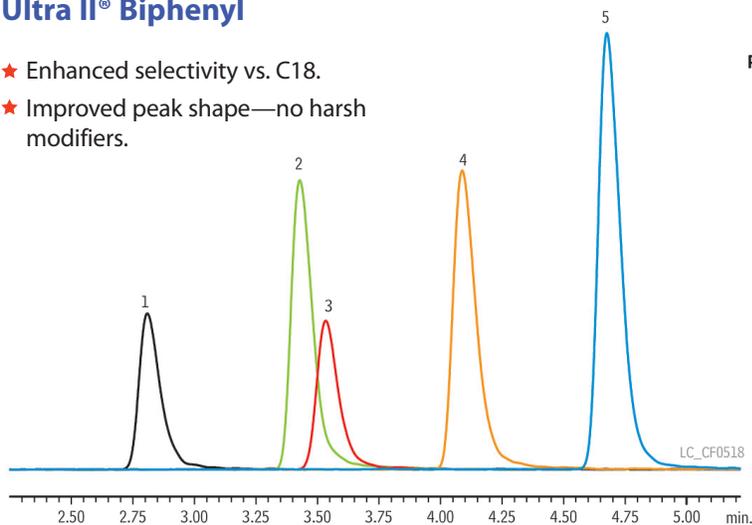
- Resolve a wider range of compound chemistries compared to a C18 or phenyl column.
- Easy separations with methanolic mobile phases—no acetonitrile needed.
- Perfect for drugs of abuse, pharmaceuticals, metabolites and more.
- Enhanced and alternate selectivity—ideal for method development and column switching.

Biphenyl columns are unique as they combine the performance of a traditional alkyl phase (C8 or C18) with that of a phenyl phase, providing unmatched versatility for method developers. Extensive research went into creating this new phase, which offers excellent retention for both polar and nonpolar compounds. The bonding of two phenyl groups end-to-end is what makes Biphenyl columns unique in structure and truly unparalleled in performance. Rather than using a straight chain hexyl linker, the Biphenyl phase incorporates an aryl linker, making it more hydrophobic than conventional phenyls. The overall result is a phase that offers the highest degree of aromatic selectivity and hydrophobic retention of any phenyl phase. Maximize method development success with versatile Biphenyl columns—**no other phase can provide both C18- and phenyl-like performance in a single column.**

Amphetamines (LC/MS ESI+)

Ultra II® Biphenyl

- ★ Enhanced selectivity vs. C18.
- ★ Improved peak shape—no harsh modifiers.



Peaks	Ultra II Biphenyl RT (min.)	Conventional C18 RT (min.)
1. Amphetamine	2.812	2.725
2. Methamphetamine	3.432	2.763
3. MDA	3.537	2.788
4. MDMA	4.092	2.808
5. MDEA	4.679	3.261

Columns Ultra II® Biphenyl (cat.# 9609552)
Conventional C18

Dimensions: 50 mm x 2.1 mm ID

Particle Size: 5 µm

Pore Size: 100 Å

Temp.: 30 °C

Sample

Diluent: mobile phase

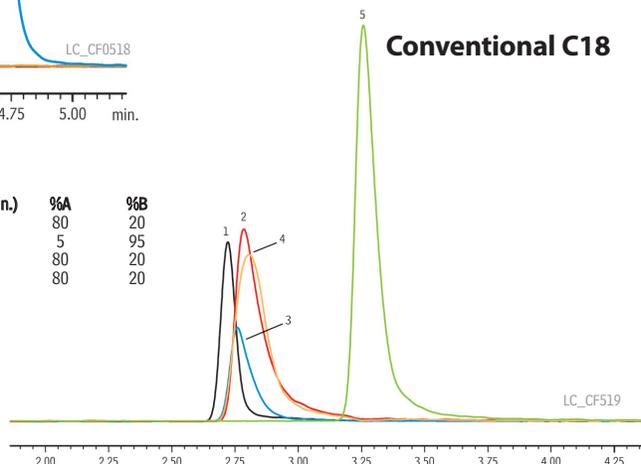
Conc.: 2 µg/mL

Inj. Vol.: 5 µL

Mobile Phase

Time (min.)	Flow (mL/min.)	%A	%B
0	0.3	80	20
10	0.3	5	95
10.1	0.3	80	20
12.0	0.3	80	20

A: 0.1% formic acid in water
B: 0.1% formic acid in **methanol**

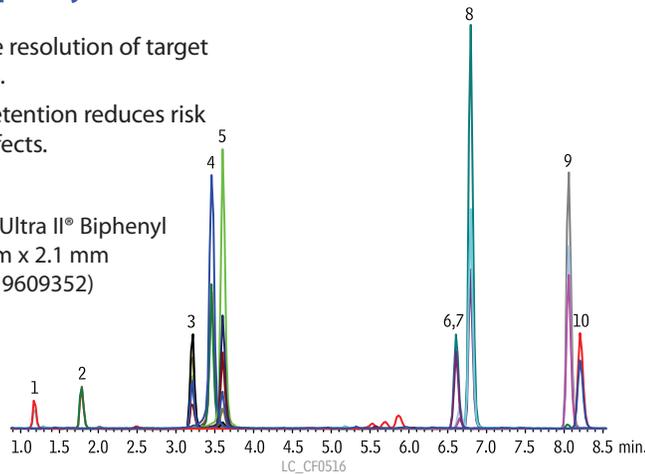


Pain Management Drugs in Urine

Ultra II® Biphenyl (ESI+)

- ★ Fast, reliable resolution of target compounds.
- ★ Improved retention reduces risk of matrix effects.

3 µm Ultra II® Biphenyl
50 mm x 2.1 mm
(cat.# 9609352)



Sample

Conc.: 50 ng/mL, diluted 10x in mobile phase

Inj. Vol.: 5 µL

Mobile Phase

A: 0.1% formic acid in water
B: 0.1% formic acid in methanol

Detector

Applied Biosystems/MDS Sciex LC/MS/MS, Model# API 5000™

Acknowledgement

Special thanks to Applied Biosystems for providing instrument time.

Time (min.)	Flow (mL/min.)	%A	%B
0	0.5	90	10
10	0.5	0	100
10.1	0.5	90	10
12	0.5	90	10

Peaks

- | | |
|------------------|------------------|
| 1. Acetaminophen | 6. Fentanyl |
| 2. Morphine | 7. Buprenorphine |
| 3. Codeine | 8. Lorazepam |
| 4. Oxycodone | 9. Diazepam |
| 5. Hydrocodone | 10. Methadone |

Phenomenex® Gemini® C6-Phenyl

- Poor retention, inadequate resolution from matrix.
- Isobaric interferences prevent quantification.

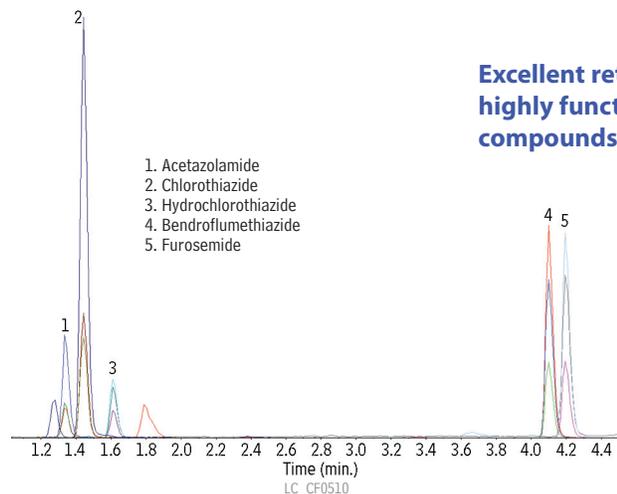
3 µm Phenomenex®
Gemini® C6-Phenyl
50 mm x 2.0 mm



(Same conditions as Ultra II® Biphenyl.)

Diuretics

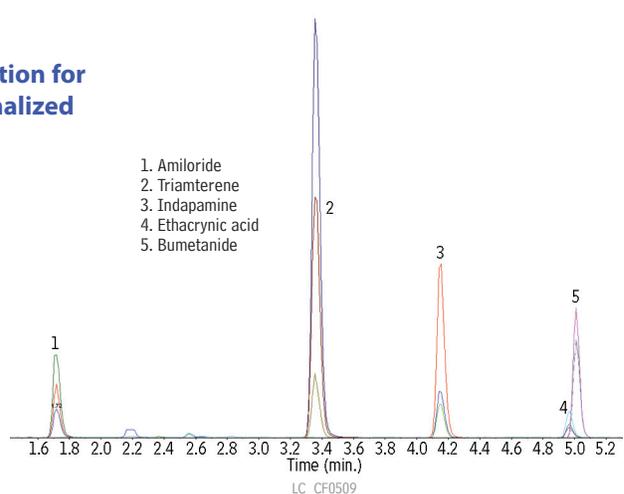
Ultra II® Biphenyl (ESI-)



1. Acetazolamide
2. Chlorothiazide
3. Hydrochlorothiazide
4. Bendroflumethiazide
5. Furosemide

Excellent retention for highly functionalized compounds!

Ultra II® Biphenyl (ESI+)



1. Amiloride
2. Triamterene
3. Indapamine
4. Ethacrynic acid
5. Bumetanide

Column Ultra II® Biphenyl (cat.# 9609352)

Dimensions: 50 mm x 2.1 mm ID
Particle Size: 3 µm
Temp.: 40°C

Sample

Conc.: 50 ng/mL, diluted 10x in mobile phase
Inj. Vol.: 5 µL

Mobile Phase A: 0.1% formic acid in water

B: 0.1% formic acid in methanol

Time (min.)	Flow (mL/min.)	%A	%B
0	0.5	90	10
6.00	0.5	0	100
6.1	0.5	90	10
8.00	0.5	90	10

Detector

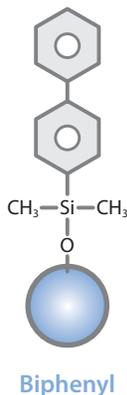
Applied Biosystems/MDS Sciex LC/MS/MS, Model# API 5000™

Acknowledgement

Special thanks to Applied Biosystems for providing instrument time.

For more information on reducing matrix effects, visit www.restek.com/adv005





Ultra II® Biphenyl Columns (USP L11)

Physical Characteristics:

particle size: 1.9µm, 2.2µm, 3µm, 5µm, or 10µm endcap: fully endcapped
 pore size: 100Å pH range: 2.5 to 7.5
 carbon load: 15% temperature limit: 80°C

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.

Length	1.0mm ID cat.#	2.1mm ID cat.#	3.0mm ID cat.#	3.2mm ID cat.#	4.6mm ID cat.#
1.9µm Columns					
30mm		9609232	9609233		
50mm		9609252	9609253		
100mm		9609212	9609213		
2.2µm Columns					
30mm		9609832	9609833		
50mm		9609852	9609853		
100mm		9609812	9609813		
3µm Columns					
30mm	9609331	9609332	—	9609333	9609335
50mm	9609351	9609352	—	9609353	9609355
100mm	9609311	9609312	—	9609313	9609315
150mm	9609361	9609362	—	9609363	9609365
5µm Columns					
30mm	9609531	9609532	—	9609533	9609535
50mm	9609551	9609552	—	9609553	9609555
100mm	9609511	9609512	—	9609513	9609515
150mm	9609561	9609562	—	9609563	9609565
200mm	9609521	9609522	—	9609523	9609525
250mm	9609571	9609572	—	9609573	9609575

HPLC Prep Columns, 5µm particles

- Easy scale-up from Restek analytical columns.
- 10µm particles also available.

Dimensions Length x ID	Ultra II Biphenyl cat.#
50 x 10mm	9609557
50 x 21.2mm	9609558
50 x 30mm	9609559
50 x 50mm	9609550
100 x 10mm	9609517
100 x 21.2mm	9609518
100 x 30mm	9609519
100 x 50mm	9609510
150 x 10mm	9609567
150 x 21.2mm	9609568
150 x 30mm	9609569
150 x 50mm	9609560
250 x 10mm	9609577
250 x 21.2mm	9609578
250 x 30mm	9609579
250 x 50mm	9609570

PATENTS & TRADEMARKS

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Ultra II® Prep Column Guard Cartridges

Dimensions (L x ID)	5µm	10µm
10 x 10mm	960950214	960900214

Prep Column Guard Cartridge Holders

Dimensions (L x ID)	qty.	cat.#
10 x 10mm	ea.	24991
10 x 21.2mm	ea.	24992



for more information visit
www.restek.com/biphenyl

RESTEK

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10

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 cert.# FM80397

Alcohol Metabolites on Ultra II™ Biphenyl

5µm

Sample:
 Inj.: 5µL
 Conc.: 5µg/mL each component
 Sample diluent: urine diluted 1:10 with mobile phase

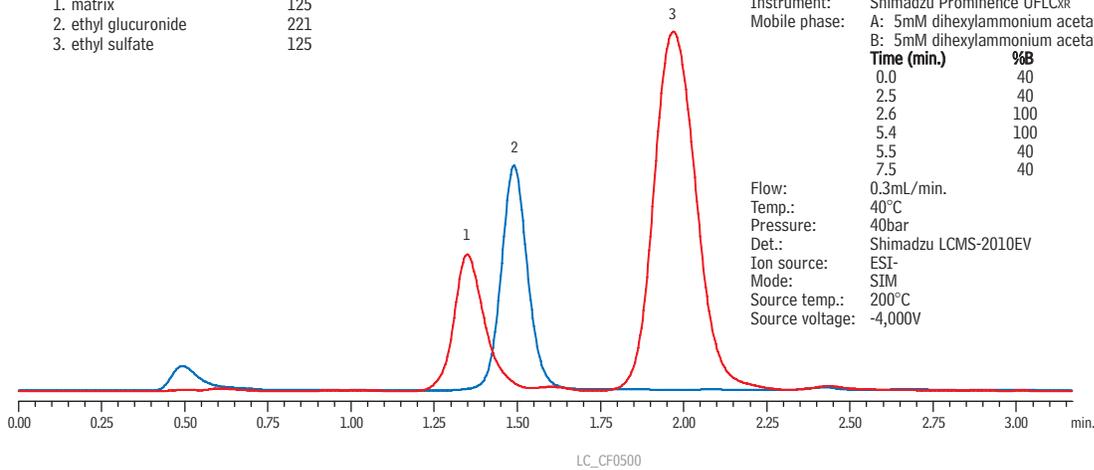
Column: Ultra II™ Biphenyl
 Cat.#: 9609552
 Dimensions: 50mm x 2.1mm
 Particle size: 5µm
 Pore size: 100Å

Conditions:
 Instrument: Shimadzu Prominence UFLCXR
 Mobile phase: A: 5mM dihexylammonium acetate in water
 B: 5mM dihexylammonium acetate in methanol

Peak List	m/z
1. matrix	125
2. ethyl glucuronide	221
3. ethyl sulfate	125

Time (min.)	%B
0.0	40
2.5	40
2.6	100
5.4	100
5.5	40
7.5	40

Flow: 0.3mL/min.
 Temp.: 40°C
 Pressure: 40bar
 Det.: Shimadzu LCMS-2010EV
 Ion source: ESI-
 Mode: SIM
 Source temp.: 200°C
 Source voltage: -4,000V



Cannabinoids on Ultra II™ Biphenyl

2.2µm

- Peak List:**
- cannabidiol
 - THC-COOH
 - cannabinol
 - Δ⁹-THC-d₃
 - Δ⁹-THC

Sample:
 Inj.: 20µL
 Conc.: 300ng/mL urine sample with 50ng/mL internal standard

Column: Ultra II™ Biphenyl
 Cat.#: 9609853
 Dimensions: 50mm x 3.0mm
 Particle size: 2.2µm
 Pore size: 100Å

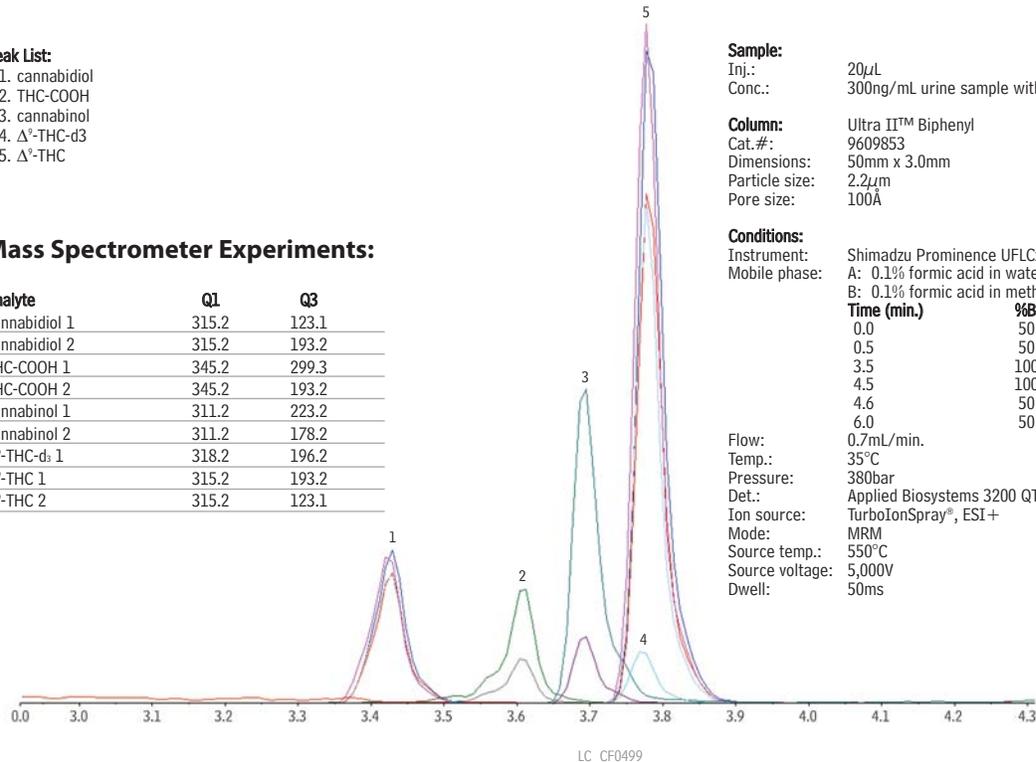
Conditions:
 Instrument: Shimadzu Prominence UFLCXR
 Mobile phase: A: 0.1% formic acid in water
 B: 0.1% formic acid in methanol

Mass Spectrometer Experiments:

Analyte	Q1	Q3
cannabidiol 1	315.2	123.1
cannabidiol 2	315.2	193.2
THC-COOH 1	345.2	299.3
THC-COOH 2	345.2	193.2
cannabinol 1	311.2	223.2
cannabinol 2	311.2	178.2
Δ ⁹ -THC-d ₃ 1	318.2	196.2
Δ ⁹ -THC 1	315.2	193.2
Δ ⁹ -THC 2	315.2	123.1

Time (min.)	%B
0.0	50
0.5	50
3.5	100
4.5	100
4.6	50
6.0	50

Flow: 0.7mL/min.
 Temp.: 35°C
 Pressure: 380bar
 Det.: Applied Biosystems 3200 QTRAP™ LC/MS/MS system
 Ion source: TurboIonSpray®, ESI+
 Mode: MRM
 Source temp.: 550°C
 Source voltage: 5,000V
 Dwell: 50ms



Ultra II™ Silica Columns (USP L3)

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 7.5
temperature limit: 80°C

Column	cat. #
1.9µm Column, 2.1mm	
30mm	9600232
50mm	9600252
100mm	9600212
2.2µm Column, 3.0mm	
30mm	9600833
50mm	9600853
100mm	9600813
3µm Column, 1.0mm	
30mm	9600331
50mm	9600351
100mm	9600311
150mm	9600361
3µm Column, 2.1mm	
30mm	9600332
50mm	9600352
100mm	9600312
150mm	9600362
3µm Column, 3.2mm	
30mm	9600333
50mm	9600353
100mm	9600313
150mm	9600363
3µm Column, 4.6mm	
30mm	9600335
50mm	9600355
100mm	9600315
150mm	9600365
5µm Column, 1.0mm	
30mm	9600531
50mm	9600551
100mm	9600511
150mm	9600561
200mm	9600521
250mm	9600571
5µm Column, 2.1mm	
30mm	9600532
50mm	9600552
100mm	9600512
150mm	9600562
200mm	9600522
250mm	9600572
5µm Column, 3.2mm	
30mm	9600533
50mm	9600553
100mm	9600513
150mm	9600563
200mm	9600523
250mm	9600573
5µm Column, 4.6mm	
30mm	9600535
50mm	9600555
100mm	9600515
150mm	9600565
200mm	9600525
250mm	9600575

Ultra II™ Biphenyl Columns (USP L11)

Physical Characteristics:

particle size: 2.2µm, 3µm or 5µm, spherical
pore size: 100Å
carbon load: 15%

endcap: fully endcapped
pH range: 2.5 to 7.5
temperature limit: 80°C

Column	cat. #
2.2µm Column, 3.0mm	
30mm	9609833
50mm	9609853
100mm	9609813
3µm Column, 1.0mm	
30mm	9609331
50mm	9609351
100mm	9609311
150mm	9609361
3µm Column, 2.1mm	
30mm	9609332
50mm	9609352
100mm	9609312
150mm	9609362
3µm Column, 3.2mm	
30mm	9609333
50mm	9609353
100mm	9609313
150mm	9609363
3µm Column, 4.6mm	
30mm	9609335
50mm	9609355
100mm	9609315
150mm	9609365
5µm Column, 1.0mm	
30mm	9609531
50mm	9609551
100mm	9609511
150mm	9609561
200mm	9609521
250mm	9609571
5µm Column, 2.1mm	
30mm	9609532
50mm	9609552
100mm	9609512
150mm	9609562
200mm	9609522
250mm	9609572
5µm Column, 3.2mm	
30mm	9609533
50mm	9609553
100mm	9609513
150mm	9609563
200mm	9609523
250mm	9609573
5µm Column, 4.6mm	
30mm	9609535
50mm	9609555
100mm	9609515
150mm	9609565
200mm	9609525
250mm	9609575

1.9µm coming soon!

Ultra II™ Aromax Columns (USP L11)

Physical Characteristics:

particle size: 3µm or 5µm, spherical
pore size: 100Å
carbon load: 17%

endcap: fully endcapped
pH range: 2.5 to 7.5
temperature limit: 80°C

Column	cat. #
3µm Column, 1.0mm	
30mm	9607331
50mm	9607351
100mm	9607311
150mm	9607361
3µm Column, 2.1mm	
30mm	9607332
50mm	9607352
100mm	9607312
150mm	9607362
3µm Column, 3.2mm	
30mm	9607333
50mm	9607353
100mm	9607313
150mm	9607363
3µm Column, 4.6mm	
30mm	9607335
50mm	9607355
100mm	9607315
150mm	9607365
5µm Column, 1.0mm	
30mm	9607531
50mm	9607551
100mm	9607511
150mm	9607561
200mm	9607521
250mm	9607571
5µm Column, 2.1mm	
30mm	9607532
50mm	9607552
100mm	9607512
150mm	9607562
200mm	9607522
250mm	9607572
5µm Column, 3.2mm	
30mm	9607533
50mm	9607553
100mm	9607513
150mm	9607563
200mm	9607523
250mm	9607573
5µm Column, 4.6mm	
30mm	9607535
50mm	9607555
100mm	9607515
150mm	9607565
200mm	9607525
250mm	9607575

1.9µm & 2.2µm coming soon!

ordering note

Guard cartridges are available, visit our website at www.restek.com for ordering information.

Visit us at www.restek.com/ultra2 for our most complete listing of Ultra II™ columns.

Ultra II™ C18 Columns (USP L1)

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 7.5
temperature limit: 80°C

1.9µm Column, 2.1mm	cat. #
30mm	9604232
50mm	9604252
100mm	9604212
2.2µm Column, 3.0mm	cat. #
30mm	9604833
50mm	9604853
100mm	9604813
3µm Column, 1.0mm	cat. #
30mm	9604331
50mm	9604351
100mm	9604311
150mm	9604361
3µm Column, 2.1mm	cat. #
30mm	9604332
50mm	9604352
100mm	9604312
150mm	9604362
3µm Column, 3.2mm	cat. #
30mm	9604333
50mm	9604353
100mm	9604313
150mm	9604363
3µm Column, 4.6mm	cat. #
30mm	9604335
50mm	9604355
100mm	9604315
150mm	9604365
5µm Column, 1.0mm	cat. #
30mm	9604531
50mm	9604551
100mm	9604511
150mm	9604561
200mm	9604521
250mm	9604571
5µm Column, 2.1mm	cat. #
30mm	9604532
50mm	9604552
100mm	9604512
150mm	9604562
200mm	9604522
250mm	9604572
5µm Column, 3.2mm	cat. #
30mm	9604533
50mm	9604553
100mm	9604513
150mm	9604563
200mm	9604523
250mm	9604573
5µm Column, 4.6mm	cat. #
30mm	9604535
50mm	9604555
100mm	9604515
150mm	9604565
200mm	9604525
250mm	9604575

Ultra II™ Aqueous C18 Columns (USP L1)

Physical Characteristics:

particle size: 2.2µm, 3µm or 5µm, spherical
pore size: 100Å
carbon load: 15%

endcap: no
pH range: 2.5 to 7.5
temperature limit: 80°C

2.2µm Column, 3.0mm	cat. #
30mm	9608833
50mm	9608853
100mm	9608813
3µm Column, 1.0mm	cat. #
30mm	9608331
50mm	9608351
100mm	9608311
150mm	9608361
3µm Column, 2.1mm	cat. #
30mm	9608332
50mm	9608352
100mm	9608312
150mm	9608362
3µm Column, 3.2mm	cat. #
30mm	9608333
50mm	9608353
100mm	9608313
150mm	9608363
3µm Column, 4.6mm	cat. #
30mm	9608335
50mm	9608355
100mm	9608315
150mm	9608365
5µm Column, 1.0mm	cat. #
30mm	9608531
50mm	9608551
100mm	9608511
150mm	9608561
200mm	9608521
250mm	9608571
5µm Column, 2.1mm	cat. #
30mm	9608532
50mm	9608552
100mm	9608512
150mm	9608562
200mm	9608522
250mm	9608572
5µm Column, 3.2mm	cat. #
30mm	9608533
50mm	9608553
100mm	9608513
150mm	9608563
200mm	9608523
250mm	9608573
5µm Column, 4.6mm	cat. #
30mm	9608535
50mm	9608555
100mm	9608515
150mm	9608565
200mm	9608525
250mm	9608575

1.9µm coming soon!

Ultra II™ PFP Propyl Columns (USP L43)

Physical Characteristics:

particle size: 2.2µm, 3µm or 5µm, spherical
pore size: 100Å
carbon load: 11%

endcap: fully endcapped
pH range: 2.5 to 7.5
temperature limit: 80°C

2.2µm Column, 3.0mm	cat. #
30mm	9606833
50mm	9606853
100mm	9606813
3µm Column, 1.0mm	cat. #
30mm	9606331
50mm	9606351
100mm	9606311
150mm	9606361
3µm Column, 2.1mm	cat. #
30mm	9606332
50mm	9606352
100mm	9606312
150mm	9606362
3µm Column, 3.2mm	cat. #
30mm	9606333
50mm	9606353
100mm	9606313
150mm	9606363
3µm Column, 4.6mm	cat. #
30mm	9606335
50mm	9606355
100mm	9606315
150mm	9606365
5µm Column, 1.0mm	cat. #
30mm	9606531
50mm	9606551
100mm	9606511
150mm	9606561
200mm	9606521
250mm	9606571
5µm Column, 2.1mm	cat. #
30mm	9606532
50mm	9606552
100mm	9606512
150mm	9606562
200mm	9606522
250mm	9606572
5µm Column, 3.2mm	cat. #
30mm	9606533
50mm	9606553
100mm	9606513
150mm	9606563
200mm	9606523
250mm	9606573
5µm Column, 4.6mm	cat. #
30mm	9606535
50mm	9606555
100mm	9606515
150mm	9606565
200mm	9606525
250mm	9606575

1.9µm coming soon!

PATENTS & TRADEMARKS

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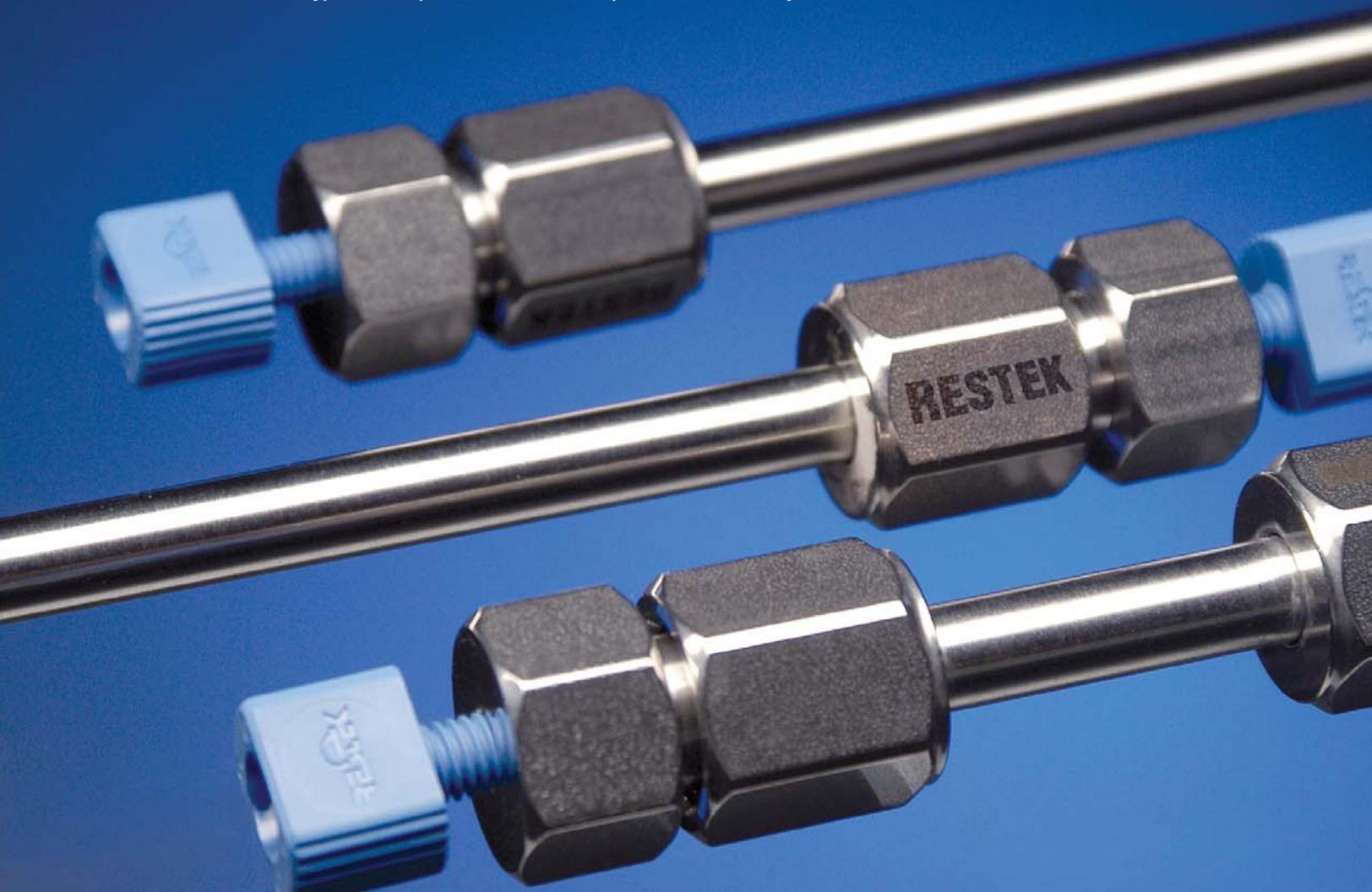


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Restek pHidelity™ C18

pH-Stable HPLC Columns

- Stable up to pH 12 – superior chromatography for basic compounds.
- Patented barrier technology protects silica particles.
- True C18 selectivity, for simpler and more reproducible analyses.



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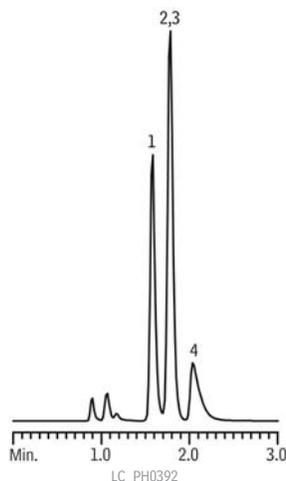
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Restek pHidelity™ C18 pH Stable HPLC Columns

We are pleased to introduce pHidelity™ pH-stable HPLC columns, designed for analyses that require, or benefit from, extreme pH conditions. pHidelity™ columns incorporate a proprietary barrier layer that protects the base silica particle, and a secondary layer that provides the functional stationary phase ligand. pHidelity™ columns can be used routinely up to pH 12 – a significant improvement over the typical pH 2.5 to 7.5 range for silica-based materials. pHidelity™ columns give you more control over analyte retention and resolution; mobile phase pH can be increased to enhance retention of basic analytes – without sacrificing column lifetime.

Using a high pH mobile phase is an easy way to improve peak retention, resolution, and symmetry in a test mix of compounds varying in pKa values.

A) Poor separation of bases under typical conditions on a conventional C18 column at pH 4



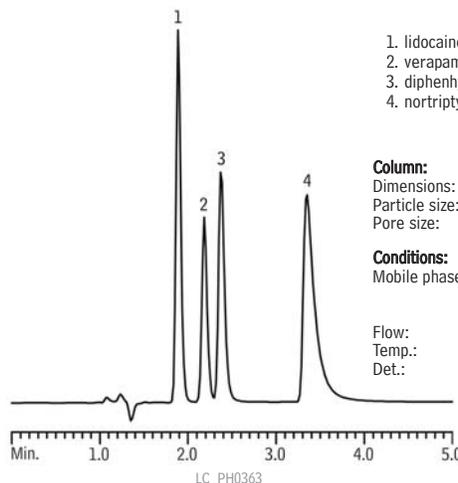
1. lidocaine
2/3. verapamil/diphenhydramine
4. nortriptyline

Sample:
Inj.: 10µL
Conc.: 100µg/mL each component
Sample diluent: acetonitrile

Column:
Dimensions: 150 x 4.6 mm
Particle size: 3µm
Pore size: 200Å

Conditions:
Mobile phase: 20mM ammonium acetate (pH 4):acetonitrile 50:50
Flow: 0.75mL/min.
Temp.: ambient
Det.: UV @ 254 nm

B) Complete separation of bases on a pHidelity™ column at pH 11

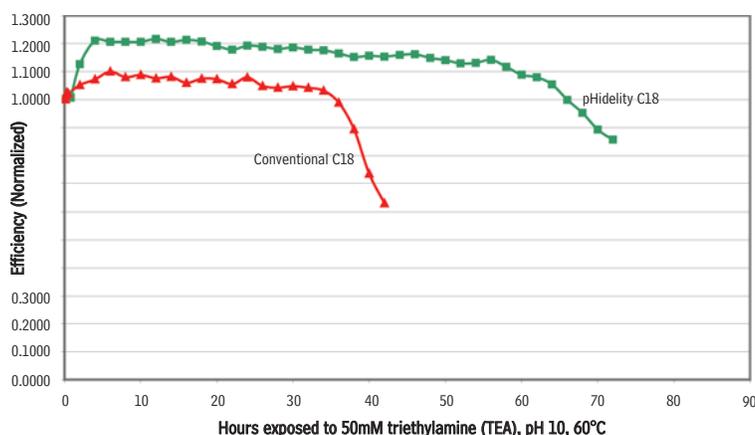


1. lidocaine
2. verapamil
3. diphenhydramine
4. nortriptyline

Column: pHidelity™ C18 (cat.# 9579365)
Dimensions: 150 x 4.6 mm
Particle size: 3µm
Pore size: 200Å

Conditions:
Mobile phase: 10mM ammonium bicarbonate (pH 11): acetonitrile: tetrahydrofuran, 35:55:10 (v/v/v)
Flow: 1.5mL/min.
Temp.: ambient
Det.: UV @ 254 nm

pHidelity™ C18 columns - exceptional performance under accelerated high pH stability testing conditions.



pHidelity™ C18 Columns

Physical Characteristics:

particle size: 3µm
pore size: 200Å

pH range: 1 to 12
temperature limit: 80°C

3µm Column, 4.6mm

	cat. #
30mm	9579335
50mm	9579355
100mm	9579315
150mm	9579365
30mm (with Trident™ Inlet Fitting)	9579335-700
50mm (with Trident™ Inlet Fitting)	9579355-700
100mm (with Trident™ Inlet Fitting)	9579315-700
150mm (with Trident™ Inlet Fitting)	9579365-700

pHidelity™ C18 Guard Cartridges

	qty.	cat. #
10 x 4.0mm	3-pk.	957930210
20 x 4.0mm	2-pk.	957930220

Restek Trademarks:
pHidelity, Trident, Restek logo.



Lit. Cat.# 580145

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Ultra II™ LC Columns

The Column Line Designed for Optimal Chromatography on **Any LC System**, Based on Highly Inert Restek Silica



Available Phases:

- C18
- Silica
- Biphenyl
- PFP Propyl
- Aromax
- Aqueous C18

Available Particle Sizes:

- 1.9µm for UHPLC
- 2.2µm for UFLC and RRLC
- 3µm and 5µm for HPLC

**More phases
coming soon!**



Chromatography Products

www.restek.com

New! 1.9 μ m Pinnacle™ DB C18

Small Particle HPLC Columns



- Pinnacle™ DB HPLC columns now available in a $<2\mu$ m particle size!
- High quality, Restek manufactured silica and bonded phases.
- Optimize your ultra high pressure separations.
- Additional phases available—please inquire.



Chromatography Products

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1.9µm Pinnacle™ DB C18 HPLC Columns

Restek's popular Pinnacle™ DB HPLC columns are now available in a <2µm particle size.

Ruggedness and reproducibility are guaranteed, as we control every step in the process, from base silica to bonded phase to final packed column. The silica particles are classified and selected to give an exceptionally tight distribution around 1.9µm, while eliminating <1µm particles that can contribute to a poorly packed bed. Highly base-deactivated Pinnacle™ DB stationary phases are an excellent choice when analyzing a wide range of compounds, from acidic to basic. To optimize your ultra high pressure HPLC methods, reach for Restek small particle HPLC columns!

1.9µm Pinnacle™ DB C18 HPLC Columns

Physical Characteristics:

particle size: 1.9µm	endcap: yes
pore size: 140Å	pH range: 2.5 - 10
carbon load: 11%	temperature limit: 80°C

Chromatographic Properties:

Highly base-deactivated spherical silica manufactured by Restek. Monomeric C18 bonding.

Length	2.1mm ID cat.#
1.9µm Columns	
30mm	9414232
50mm	9414252
100mm	9414212

also available

Pinnacle™ DB C18 Columns also are available in 3µm and 5µm particle sizes.

Pinnacle™ DB C18 Columns (USP L1)

Length	2.1mm ID cat.#
3µm Columns	
30mm	9414332
50mm	9414352
100mm	9414312
5µm Columns	
30mm	9414532
50mm	9414552
100mm	9414512

Figure 1—Pinnacle™ DB silica particle size distribution chart shows an exceptionally tight, symmetrical distribution around 1.9µm with no <1µm particles.

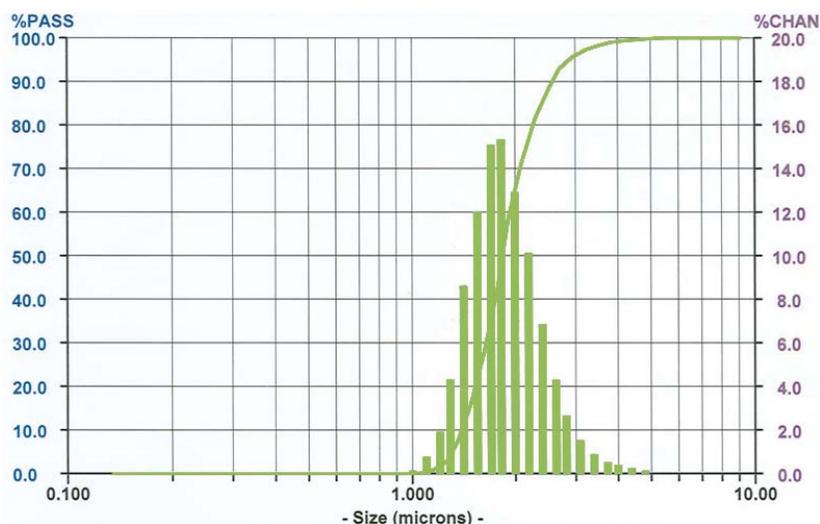
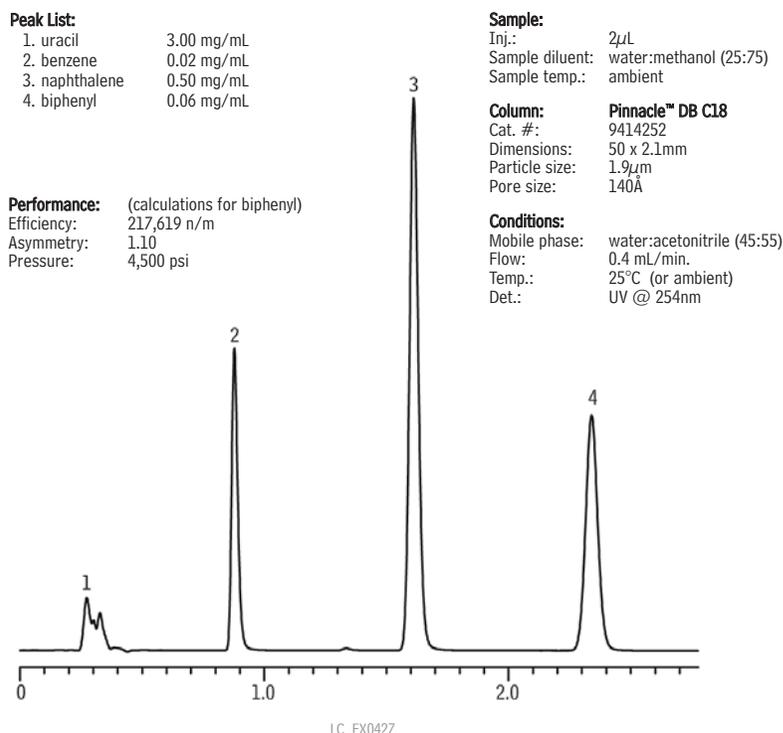


Figure 2—Excellent peak symmetry and efficiency on a 1.9µm Pinnacle™ DB C18 column, using a reversed phase test mix.



Restek Trademarks: Pinnacle, Restek logo.

Available from: LECO Australia Pty Ltd - Ph: 61 2 9894 5955 - Fx: 61 2 9894 5247 - Email: australia@leco.com

Rxi™-1ms Fused Silica Columns

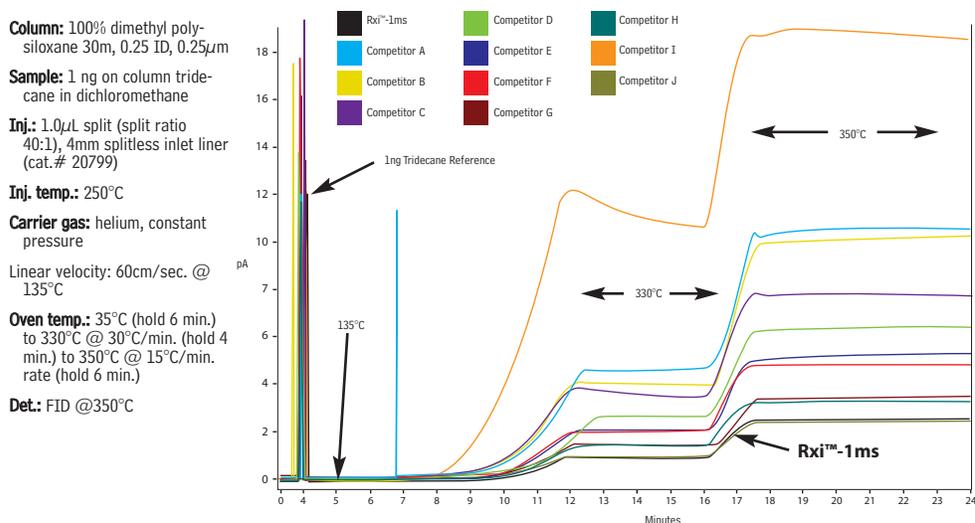
Restek's Exceptionally Inert (Rxi™) Fused Silica Capillary Columns

- Stable at high temperatures; improved signal to noise ratios.
- Excellent inertness for acids and bases; predictable column performance.
- Engineered to assure column-to-column reproducibility.

The combination of ultra-low bleed and unsurpassed inertness make the Rxi™-1ms the best column choice for analyses using a 100% polydimethyl siloxane stationary phase.

We compared the bleed profiles of ten competitor columns at both 330°C and 350°C to the Rxi™-1ms column. At both temperatures the Rxi™-1ms column exhibits the lowest bleed level or equivalent of all the columns tested.

Figure 1 The Rxi™-1ms column has the lowest bleed available, allowing better accuracy and lower detection limits for active compounds.



Columns included in the comparison are BP-1, DB-1, DB-1ms, EQ-1, HP-1, HP-1ms, Rtx-1, **Rxi-1ms**, VF-1ms, ZB-1, and ZB-1ms. The bleed profiles in Figure 1 are labeled randomly.

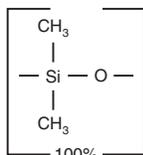
20% OFF

Rxi™-1ms (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.
- Ultra-low bleed – improved signal to noise ratio, for better sensitivity and mass spectral integrity.
- Equivalent to USP G2 phase.

similar phases

DB-1, DB-1ms, HP-1, HP-1ms, Ultra-1, SPB-1, Equity-1



ID	df (μ m)	temp. limits	15-Meter	30-Meter	60-Meter
0.25mm	0.25	-60 to 330/350°C	13320-R25	13323-R25	13326-R25
	0.50	-60 to 330/350°C	13335-R25	13338-R25	13341-R25
	1.00	-60 to 330/350°C	13350-R25	13353-R25	13356-R25
0.32mm	0.25	-60 to 330/350°C	13321-R25	13324-R25	13327-R25
	0.50	-60 to 330/350°C	13336-R25	13339-R25	13342-R25
	1.00	-60 to 330/350°C	13351-R25	13354-R25	13357-R25
0.53mm	0.50	-60 to 330/350°C		13396-R25	
	1.00	-60 to 330/350°C	13337-R25	13340-R25	
	1.50	-60 to 330/350°C	13352-R25	13355-R25	
0.18mm	0.18	-60 to 330/350°C	13367-R25	13370-R25	13373-R25
	0.20mm	0.18		13302-R25	
	0.20mm	0.33	-60 to 330/350°C	13397-R25	13398-R25

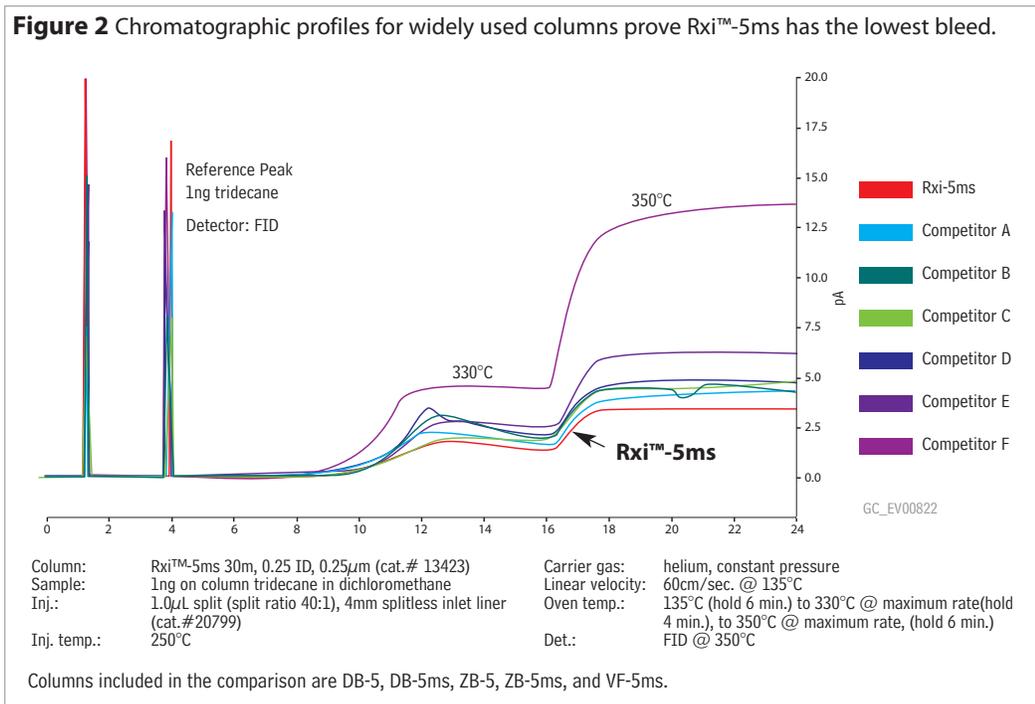
Rxi™-5ms Fused Silica Columns

Restek's Exceptionally Inert (Rxi™) Fused Silica Capillary Columns

- Unsurpassed inertness for low level basic and acidic compounds.
- Ultra-low bleed
- Reliable performance, guaranteed column-to-column reproducibility
- Guaranteed to work perfectly with retention time-locking software.

Ultra Low Bleed

Bleed from Rxi™-5ms columns is negligible, simplifying trace-level GC/MS analysis or detection by electron capture (ECD), nitrogen-phosphorus (NPD), or other sensitive methods. The graph below shows the bleed from 30m x 0.25mm, 0.25µm film columns. Compared to the other columns, including silarylene type phases, the Rxi™-5ms column exhibits the lowest bleed.



Rxi™-5ms (low-polarity phase, Crossbond® 5% diphenyl / 95% dimethyl polysiloxane)

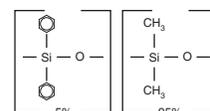
- General purpose columns for semivolatiles, phenols, amines, residual solvents, drugs of abuse, pesticides, PCB congeners or (e.g.) Aroclor® mixes, solvent impurities.
- Equivalent to USP G27 phase.

ID	df (µm)	temp. limits	15-Meter	30-Meter	60-Meter	
0.25mm	0.25	-60 to 330/350°C	13420-R25	13423-R25	13426-R25	
	0.40	-60 to 330/350°C		13481-R25		
	0.50	-60 to 330/350°C	13435-R25	13438-R25	13441-R25	
	1.00	-60 to 330/350°C	13450-R25	13453-R25	13456-R25	
0.32mm	0.25	-60 to 330/350°C	13421-R25	13424-R25	13427-R25	
	0.50	-60 to 330/350°C	13436-R25	13439-R25	13442-R25	
	1.00	-60 to 330/350°C	13451-R25	13454-R25	13457-R25	
0.53mm	0.25	-60 to 330/350°C	13422-R25	13425-R25		
	0.50	-60 to 330/350°C	13437-R25	13440-R25		
	1.00	-60 to 330/350°C	13452-R25	13455-R25		
	1.50	-60 to 330/350°C	13467-R25	13470-R25		
ID	df (µm)	temp. limits	12-Meter	20-Meter	25-Meter	50-Meter
0.18mm	0.18	-60 to 330/350°C		13402-R25		
	0.30	-60 to 330/350°C		13409-R25		
	0.36	-60 to 330/350°C		13411-R25		
0.20mm	0.33	-60 to 330/350°C	13497-R25		13498-R25	13499-R25

20% OFF

similar phases

DB-5, HP-5, HP-5ms, Ultra-2, SPB-5, Equity-5



20% DISCOUNT

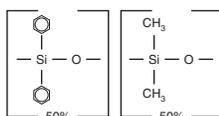
on any stock Rxi™-1ms, Rxi™-5ms, Rxi™-17 or Rxi™-50

Rxi™-17 (mid-polarity 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



ID	df (µm)	temp. limits	15-Meter	30-Meter
0.25mm	0.25	40 to 280/300°C	13520-R25	13523-R25
	0.50	40 to 280/300°C	13535-R25	13538-R25
	1.00	40 to 280/300°C	13550-R25	13553-R25
0.32mm	0.25	40 to 280/300°C	13521-R25	13524-R25
	0.50	40 to 280/300°C	13536-R25	13539-R25
	1.00	40 to 280/300°C	13551-R25	13554-R25
0.53mm	0.25	40 to 280/300°C	13522-R25	13525-R25
	0.50	40 to 280/300°C	13537-R25	13540-R25
	0.83	40 to 280/300°C		13569-R25
	1.00	40 to 280/300°C	13552-R25	13555-R25
	1.50	40 to 280/300°C	13567-R25	13570-R25

Rxi™-50 (mid-polarity phase; Crossbond® 100% methylphenyl polysiloxane)

- General purpose columns for pesticides, herbicides, rosin acids, phthalate esters, triglycerides, sterols.
- Temperature range: 0°C to 320°C.
- Equivalent to USP G3 phase.

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

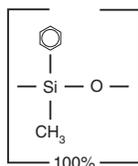
ID	df (µm)	temp. limits*	15-Meter	30-Meter	60-Meter
0.25mm	0.10	0 to 300/320°C	10505-R25	10508-R25	
	0.25	0 to 300/320°C	10520-R25	10523-R25	10526-R25
	0.50	0 to 290/310°C	10535-R25	10538-R25	10541-R25
	1.00	0 to 280/300°C	10550-R25	10553-R25	10556-R25
0.32mm	0.10	0 to 300/320°C	10506-R25	10509-R25	
	0.25	0 to 300/320°C	10521-R25	10524-R25	10527-R25
	0.50	0 to 290/310°C	10536-R25	10539-R25	10542-R25
	1.00	0 to 280/300°C	10551-R25	10554-R25	10557-R25
0.53mm	0.25	0 to 280/300°C	10522-R25		
	0.50	0 to 270/290°C	10537-R25	10540-R25	10543-R25
	0.83	0 to 270/290°C		10569-R25	
	1.00	0 to 260/280°C	10552-R25	10555-R25	10558-R25
	1.50	0 to 250/270°C	10567-R25	10570-R25	10573-R25
ID	df (µm)	temp. limits	10-Meter	20-Meter	40-Meter
0.18mm	0.20	0 to 310/330°C	40501-R25	40502-R25	40503-R25
	0.40	0 to 300/320°C	40510-R25	40511-R25	40512-R25

Restek Trademarks: Crossbond, Rtx, Rxi, Restek logo. For other trademark attributions, please refer to our catalog.



similar phases

HP-50



Offer cannot be combined with any other promotion or discount. **Expires October 31, 2007**



New Generation of Porous Layer Open Tubular (PLOT) Columns

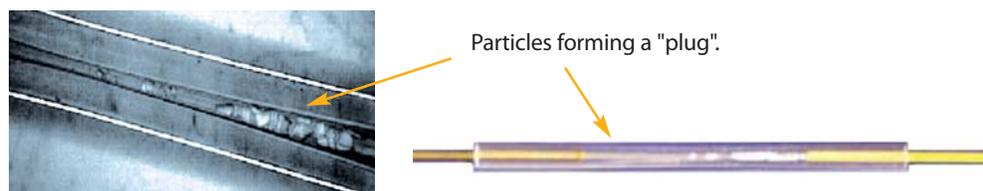
- Stabilized particle layers improve robustness and reproducibility of retention and flow.
- Fully compatible with valve switching and Deans switching systems.
- Highly efficient, reproducible analyses; ideal for permanent gases, solvents, and hydrocarbons.
- New manufacturing procedure reduces particle 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 5-50 μ m 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.



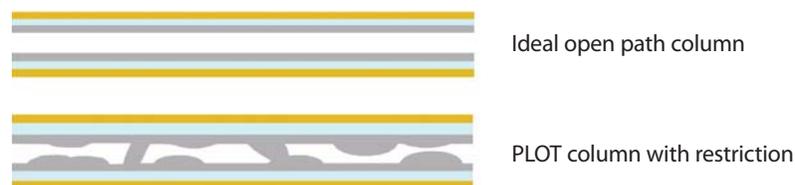
New Stabilized PLOT Columns Minimize Particle Release

Restek has developed new procedures to manufacture PLOT columns with concentric stabilized adsorption layers. The 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 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.

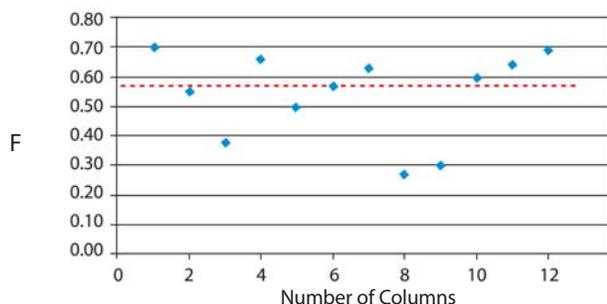
Figure 2 Inconsistent coating thicknesses result in restrictions that cause significant variation in flow.



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.



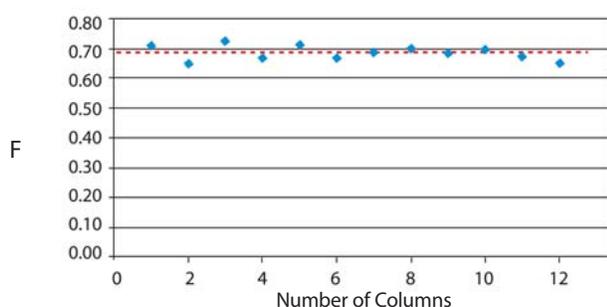
Equation 1 Flow restriction factor (F) is used to demonstrate coating consistency.

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

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 Restek's new stabilized PLOT columns 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.

PLOT Column Phase Cross-Reference: Similar Selectivity

Restek	Porous Layer	Agilent/J&W	Supelco	Alltech	Varian/Chrompack	Quadrex
Rt-Alumina BOND / Na ₂ SO ₄	Aluminum oxide	GS-Alumina, HP PLOT S, HP PLOT M	Alumina-PLOT	AT-Alumina	CP-Al ₂ O ₃ /NA ₂ SO ₄	—
Rt-Alumina BOND / KCl	Aluminum oxide	GC-Alumina KCl	—	—	CP-Al ₂ O ₃ /KCl	—
Rt-Msieve 5A	Molecular sieve 5A	GS-Molsieve, HP PLOT/Molesieve	Molsieve 5A PLOT	AT-Molesieve	CP-Molesieve 5A	PLT-5A
Rt-Q-BOND	DVB porous polymer	—	Supel-Q-PLOT	AT-Q	CP-PoraPlot Q, PoraBond Q	—
Rt-QS-BOND	Intermediate polarity porous polymer	GS-Q	—	—	—	—
Rt-S-BOND	DVB vinylpyridine polymer	—	—	—	CP-PoraPlot S	—
Rt-U-BOND	DVB ethyleneglycol-dimethylacrylate polymer	HP-UPLLOT	—	—	CP-PoraPlot U, PoraBond U	—

Rt®-Alumina BOND Columns

- Applications for C1-C10 volatile hydrocarbon separations at percent levels, as well as impurity analyses at ppm concentrations.
- High capacity and loadability give exceptionally symmetric peaks.
- Reproducible retention times and predictable flow behavior column-to-column.



Traces of water in the carrier gas and samples will affect the retention and 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.

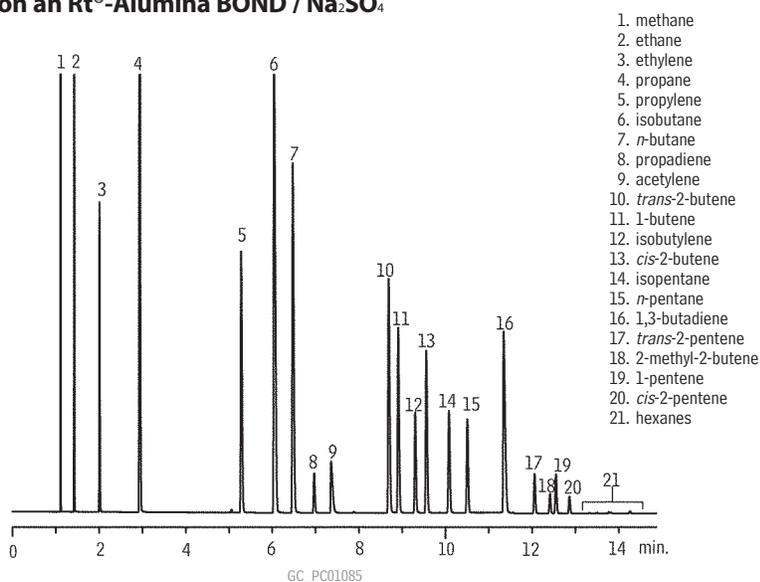
The maximum programmable temperature for an Rt®-Alumina BOND column is 200°C. Higher temperatures cause irreversible changes to the porous layer adsorption properties.

Rt®-Alumina BOND / Na₂SO₄

- 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 (µm)	temp. limits	30-Meter	50-Meter
0.32mm	5	to 200°C	19757	19758
0.53mm	10	to 200°C	19755	19756

Refinery gas on an Rt®-Alumina BOND / Na₂SO₄



Column: Rt®-Alumina BOND / Na₂SO₄, 50m, 0.53mm ID, 10µm (cat.# 19756)
 Sample: refinery gas
 Inj.: 10µL split (split vent flow 80mL/min.), 2mm single gooseneck liner (cat.# 20795)
 Inj. temp.: 200°C
 Carrier gas: hydrogen, constant pressure, 8.0psi
 Linear velocity: 74cm/sec. @ 45°C
 Oven temp.: 45°C (hold 1 min.) to 200°C @ 10°C/min. (hold 3.5 min.)
 Det.: FID @ 200°C



Rt®-Alumina BOND columns now available with KCl deactivation!

Rt®-Alumina BOND / KCl

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

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

Rt[®]-Msieve 5A PLOT Columns

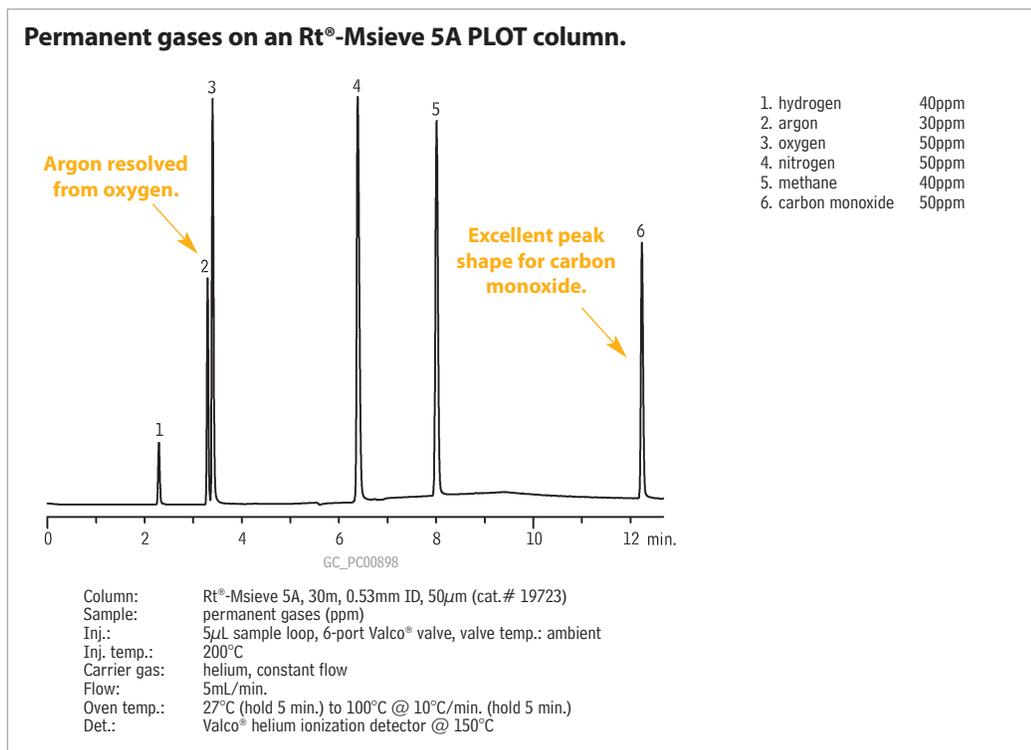
Rt[®]-Msieve 5A PLOT columns are designed for efficient separation of Ar/O₂ and other permanent gases, including CH₄, C₂H₆, and CO. Special coating and deactivation procedures ensure chromatographic efficiency and the integrity of the porous layer coating. Our deactivation technology also allows the CO peak to elute as a sharp peak. This is in contrast with other suppliers where CO often tails badly and cannot be quantified below % levels. Restek's 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/O₂ and H₂/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.



did you know?

Rt[®]-Msieve 5A PLOT columns are designed for efficient separation of Ar/O₂ and other permanent gases, including CH₄, C₂H₆, 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.

Rt[®]-Msieve 5A Columns (fused silica PLOT)

ID	df (μ m)	temp. limits	15-Meter	30-Meter
0.32mm	30	to 300°C	19720	19722
0.53mm	50	to 300°C	19721	19723

Metal PLOT Columns

MXT[®]-Msieve 5A (Siltek[®]-treated stainless steel PLOT)

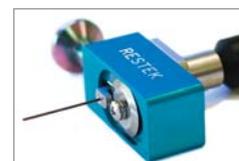
ID	df (μ m)	temp. limits	30-Meter
0.53mm	50	to 300°C	79723

Restek Tubing Scorer for MXT[®] Columns

- Makes perfect cuts every time.
- Easy to use.
- Leaves column entrance perfectly round.

Description	qty.	cat.#
Restek Tubing Scorer for MXT Columns (0.25-0.53mm ID & 0.5-0.8mm OD)	ea.	20523
Replacement Scoring Wheel	ea.	20522

Simple Solutions:
Perfect cuts every time!



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.



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 CO₂ simplifies gas analysis; CO₂ and methane separated from O₂/N₂/CO (Note: O₂/N₂/CO not separated at room temperature).
- Use for analysis of oxygenated compounds and solvents.
- Maximum temperature of 300°C.

ID	df (μm)	temp. limits	15-Meter	30-Meter
0.32mm	10	to 280/300°C	19743	19744
0.53mm	20	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 (μm)	temp. limits	15-Meter	30-Meter
0.32mm	10	to 250°C	19739	19740
0.53mm	20	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 (μm)	temp. limits	15-Meter	30-Meter
0.32mm	10	to 250°C	19747	19748
0.53mm	20	to 250°C	19745	19746

Rt[®]-U-BOND Columns (fused silica PLOT)

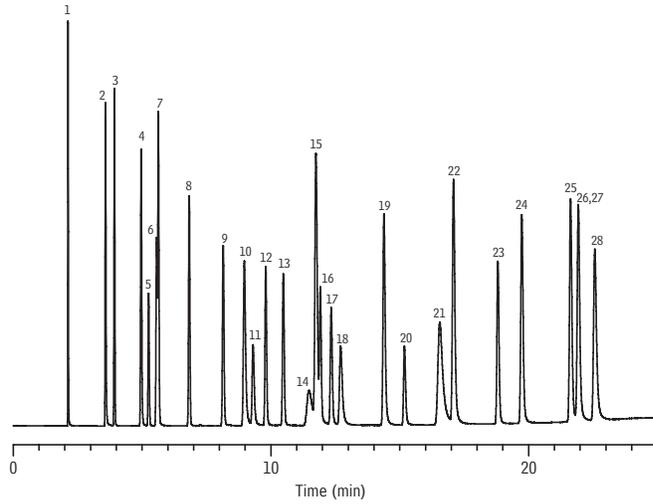
(divinylbenzene ethylene glycol/dimethylacrylate)

- Polar PLOT column, incorporating divinylbenzene ethylene glycol/dimethylacrylate.
- Use for the analysis of polar and nonpolar compounds.

ID	df (μm)	temp. limits	15-Meter	30-Meter
0.32mm	10	to 190°C	19751	19752
0.53mm	20	to 190°C	19749	19750



Solvent mixture on an Rt[®]-Q-BOND column.

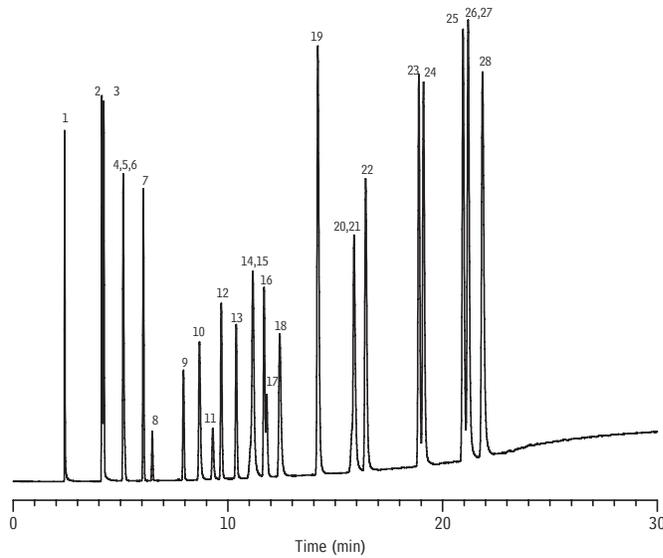


- | | |
|---------------------------------------|-------------------------|
| 1. methanol | 15. benzene |
| 2. ethanol | 16. 1,2-dimethoxyethane |
| 3. acetonitrile | 17. trichloroethylene |
| 4. acetone | 18. 1,4-dioxane |
| 5. dichloromethane | 19. pyridine |
| 6. 1,1-dichloroethene | 20. dimethylformamide |
| 7. nitromethane | 21. methylcyclohexane |
| 8. <i>trans</i> -1,2-dichloroethylene | 22. toluene |
| 9. <i>cis</i> -1,2-dichloroethylene | 23. 2-hexanone |
| 10. tetrahydrofuran | 24. chlorobenzene |
| 11. chloroform | 25. ethylbenzene |
| 12. ethyl acetate | 26. <i>m</i> -xylene |
| 13. 1,2-dichloroethane | 27. <i>p</i> -xylene |
| 14. 1,1,1-trichloroethane | 28. <i>o</i> -xylene |

Column: Rt[®]-Q-BOND, 30m, 0.53mm ID, 20 μ m (cat.# 19742)
 Sample: solvent mixture
 Inj.: 1.0 μ L, split (split vent flow 100mL/min.),
 4mm single gooseneck liner (cat.# 20798)
 Inj. temp.: 200°C
 Carrier gas: hydrogen, constant pressure, 4.2psi
 Linear velocity: 40cm/sec. @ 120°C
 Oven temp.: 120°C to 240°C @ 5°C/min. (hold 5.0 min.)
 Det.: FID @ 240°C

GC_PC01082

Solvent mixture on an Rt[®]-QS-BOND column.

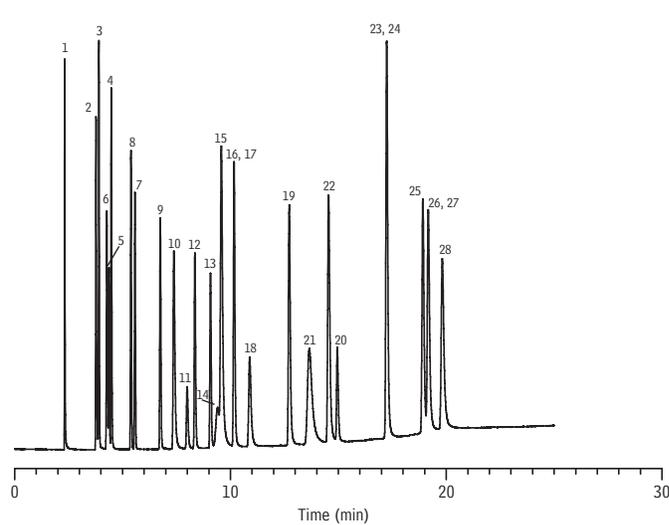


- | | |
|---------------------------------------|-------------------------|
| 1. methanol | 15. benzene |
| 2. ethanol | 16. 1,2-dimethoxyethane |
| 3. acetonitrile | 17. trichloroethylene |
| 4. acetone | 18. 1,4-dioxane |
| 5. dichloromethane | 19. pyridine |
| 6. 1,1-dichloroethene | 20. dimethylformamide |
| 7. nitromethane | 21. methylcyclohexane |
| 8. <i>trans</i> -1,2-dichloroethylene | 22. toluene |
| 9. <i>cis</i> -1,2-dichloroethylene | 23. 2-hexanone |
| 10. tetrahydrofuran | 24. chlorobenzene |
| 11. chloroform | 25. ethylbenzene |
| 12. ethyl acetate | 26. <i>m</i> -xylene |
| 13. 1,2-dichloroethane | 27. <i>p</i> -xylene |
| 14. 1,1,1-trichloroethane | 28. <i>o</i> -xylene |

Column: Rt[®]-QS-BOND, 30m, 0.53mm ID, 20 μ m (cat.# 19738)
 Sample: solvent mixture
 Inj.: 1.0 μ L, split (split vent flow 100mL/min.),
 4mm single gooseneck liner (cat.# 20798)
 Inj. temp.: 200°C
 Carrier gas: hydrogen, constant pressure, 4.2psi
 Linear velocity: 40cm/sec. @ 120°C
 Oven temp.: 120°C to 240°C @ 5°C/min. (hold 5.0 min.)
 Det.: FID @ 240°C

GC_PC01081

Solvent mixture on an Rt[®]-S-BOND column.



- | | |
|---------------------------------------|-------------------------|
| 1. methanol | 15. benzene |
| 2. ethanol | 16. 1,2-dimethoxyethane |
| 3. acetonitrile | 17. trichloroethylene |
| 4. acetone | 18. 1,4-dioxane |
| 5. dichloromethane | 19. pyridine |
| 6. 1,1-dichloroethene | 20. dimethylformamide |
| 7. nitromethane | 21. methylcyclohexane |
| 8. <i>trans</i> -1,2-dichloroethylene | 22. toluene |
| 9. <i>cis</i> -1,2-dichloroethylene | 23. 2-hexanone |
| 10. tetrahydrofuran | 24. chlorobenzene |
| 11. chloroform | 25. ethylbenzene |
| 12. ethyl acetate | 26. <i>m</i> -xylene |
| 13. 1,2-dichloroethane | 27. <i>p</i> -xylene |
| 14. 1,1,1-trichloroethane | 28. <i>o</i> -xylene |

Column: Rt[®]-S-BOND, 30m, 0.53mm ID, 20 μ m (cat.# 19746)
 Sample: solvent mixture
 Inj.: 1.0 μ L, split (split vent flow 100mL/min.),
 4mm single gooseneck liner (cat.# 20798)
 Inj. temp.: 200°C
 Carrier gas: hydrogen, constant pressure, 4.2psi
 Linear velocity: 40cm/sec. @ 120°C
 Oven temp.: 120°C to 220°C @ 5°C/min. (hold 5.0 min.)
 Det.: FID @ 220°C

GC_PC01080



Restek Capillary Column Installation Guide

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Why Read This Guide?

This guide helps chromatographers prevent costly mistakes that could potentially damage a Restek column. Section I describes a brief capillary column installation procedure. Section II provides in-depth installation information necessary to ensure the best performance from your column. The third section provides operational hints that will help extend column lifetime and the last section outlines warranty and return procedures.

Have Questions or Need Help Troubleshooting?

Whether your problem is straightforward or complex, contact our [technical service](#) chemists online, or call 800-356-1688, ext. 4, Monday through Friday, 8am-6pm EST.

Satisfaction Guaranteed! Our quality is the best and we back our claim! Please contact [Customer Service](#) or call 800-356-1688 (or one of our [distributors](#)) if any Restek product does not meet your expectations or is not better than or equivalent to a competitive product.



Restek Capillary Column Installation Guide

Section I: Brief Installation Procedure

The following procedure is a quick, easy, trouble-free sequence for installing a capillary column. For more in-depth installation information, refer to [Section II](#).

1. Cool all heated zones.
2. Replace spent oxygen and moisture traps.
3. Clean and/or deactivate injector and detector sleeves if necessary.
4. Replace critical injector and detector seals.
5. Replace septum.
6. Set make-up and detector gas flow rates.
7. Carefully inspect the column for damage or breakage.
8. Cut 10 centimeters from each end of the column.
 - o use a sapphire scribe (cat.# 20115) or ceramic scoring wafer (cat.# 20116) to cut fused silica capillary columns.
 - o use the serrated edge of a ceramic scoring wafer (cat.# 20116) or the edge of a sharp file to cut metal capillary columns.
9. Install a nut and ferrule on each end of the column.
10. Cut an additional 10 centimeters from each end of the column to remove ferrule fragments.
11. Mount the capillary column in the oven using a bracket that protects the column from becoming scratched or abraded.
12. Insert column the appropriate distance into the inlet as indicated in the instrument manual.
13. Set the approximate column flow rate by adjusting the head pressure to the value listed on the test chromatogram included with the column.
14. Set split vent, septa purge, and any other applicable inlet gases according to the instrument specifications.
15. Confirm the flow by immersing the column outlet in a vial of solvent (acetone or isopropyl alcohol).
16. Insert column the appropriate distance into the detector as indicated in the instrument manual.
17. Check for inlet and outlet leaks using a thermal conductivity leak detector (cat.#'s 21607, 20130, or 21609). Do not use soaps or liquid-based leak detectors or the column may be damaged.
18. Set injector and detector temperatures. Turn the detector on when the temperatures have equilibrated. Caution - do not exceed the phase's maximum operating temperature!
19. To set the proper dead time (linear velocity), inject methane (cat.# 20197) or a non-retained substance compatible with the detector being used.
20. Verify system integrity by checking the dead volume peak. It should not tail.
21. Condition the column at its maximum operating temperature to stabilize the baseline. (See the test chromatogram included with the column for the maximum

temperature.)

22. Set oven to appropriate temperature and inject methane (cat.# 20197) or an appropriate unretained substance, again to set the proper linear velocity.
23. Inject a duplicate of the original test mixture or your specific test mixture to confirm proper installation, system, and column performance.
24. Calibrate the instrument and inject samples.

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Restek Capillary Column Installation Guide

Section II: In-depth Installation Information

The following section provides in-depth information on instrument preparation procedures for installing and operating fused silica and stainless steel capillary columns.

I. **Instrument preparation**

- A. Gas purification
- B. Carrier gas selection
- C. Using hydrogen as a carrier gas
- D. Flow regulated/back pressure pneumatic systems
- E. Head pressure regulated pneumatic systems
- F. Injector maintenance
- G. Protection against dirty samples
- H. Replacing critical seals
- I. Changing septa
- J. Setting gas flow rates

II. **Column Mounting and Installation**

- A. Installation preparation
- B. Inlet installation
- C. Establishing flow
- D. Good operating practice
- E. Outlet installation
- F. Leak-checking techniques

III. **Setting Optimum Flow Rates**

IV. **Confirming Installation Integrity**

- A. Dead volume peak shape test
- B. Solvent peak shape test

V. **Conditioning**

VI. **Test Mixtures**

I. **Instrument Preparation**

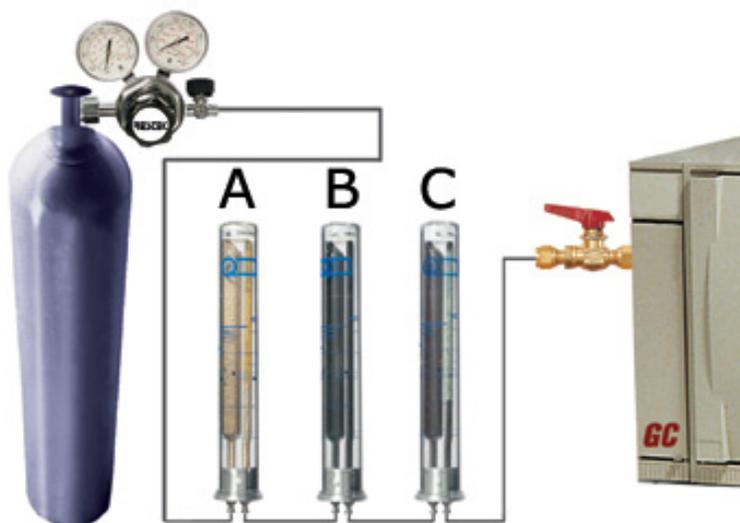
Gas Purification

Make sure the carrier gas is clean. The carrier gas **MUST** contain less than 1ppm of oxygen, moisture, or any other trace contaminants to prevent column degradation, decreased column lifetime, and increased stationary phase bleed. Contaminants such as trace hydrocarbons cause ghost peaks to appear during temperature programming and compromise the validity of analytical data. Make-up gas should also be contaminant-free or baseline fluctuations and excessive detector noise can occur. Detector gases, such as hydrogen and compressed air, should be free of water and hydrocarbons or excessive baseline noise can result.

We highly recommend installing a High Capacity Indicating Oxygen Trap on both the carrier and make-up gas lines. Because moisture reacts with most oxygen traps, we suggest installing a Moisture Trap in front of the oxygen trap. *(Install purifiers as closely as possible to the GC's bulkhead fitting, not system-wide. If purifiers are installed system-wide, a leaky fitting downstream of the trap could allow oxygen and moisture to*

enter the gas stream and degrade column performance.) The Moisture Trap can also be used on the FID air line or the ECD make-up gas line to eliminate noisy, rolling baselines when operating at high detector sensitivities. If hydrocarbon contamination is suspected, install a Hydrocarbon Trap between the moisture and oxygen traps. To prevent spontaneous breakage, coil the line leading to and from the purifiers to relieve strain and isolate instrument vibrations.

A note on equipment: Because oxygen, moisture, and elastomeric contaminants can migrate through rubber or elastomeric diaphragms and enter the carrier gas, all regulators should be equipped with stainless steel diaphragms.



Traps shown:

A. Moisture Trap:

Super-Clean™ Ultra-High Capacity Moisture Filter ([cat.# 22028](#))

B. Hydrocarbon Trap:

Super-Clean™ Ultra-High Capacity Hydrocarbon Filter ([cat.# 22030](#))

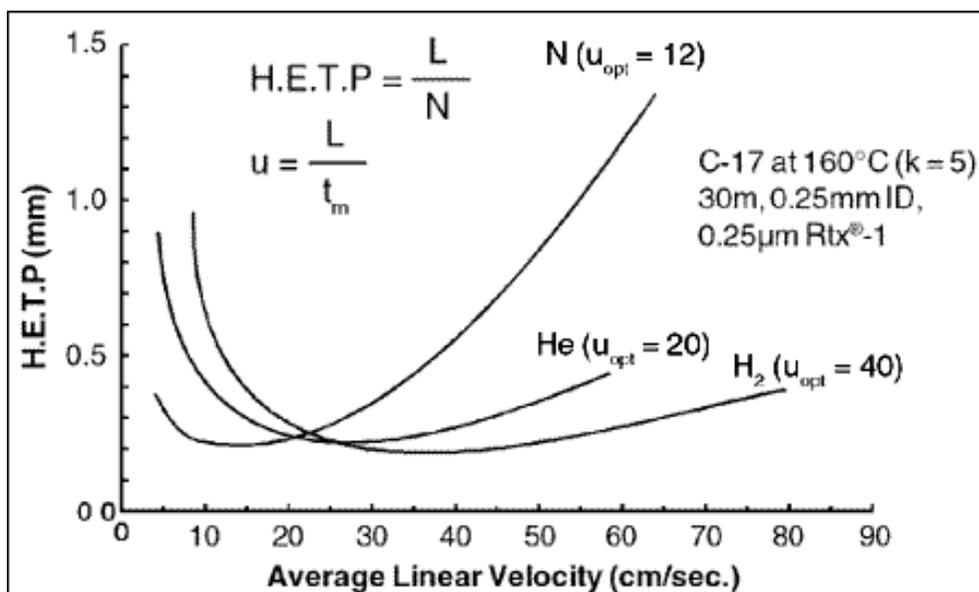
C. High Capacity Indicating Oxygen Trap:

Super-Clean™ Ultra-High Capacity Oxygen Filter ([cat.# 22029](#))

Carrier Gas Selection

A fast carrier gas that exhibits a flat van Deemter profile is essential in obtaining optimum capillary column performance. Because capillary columns average over 30 meters in length (compared to 2 meters for packed columns), a carrier gas that minimizes the effect of dead time is important. In addition, because capillary columns are head pressure controlled, not flow-controlled like most packed columns, the carrier gas flow decreases by 40 percent when programming from ambient to 300°C. Therefore, a carrier gas that retains high efficiency over a wide range of flow rates is essential for obtaining good resolution throughout a temperature-programmed analysis.

Figure A shows the van Deemter profile for hydrogen, helium, and nitrogen carrier gases. The curves were generated by plotting the Height Equivalent to a Theoretical Plate (H.E.T.P., the length of the column divided by the total number of theoretical plates) against the column's average linear velocity. The lowest point on the curve indicates the carrier gas velocity at which the highest column efficiency is reached.



Hydrogen is the fastest carrier gas (u_{opt}: 40cm/sec.) and exhibits the flattest van Deemter profile. Helium is the next best choice (u_{opt}: 20cm/sec.). The head pressures at optimum flow rates are similar for hydrogen and helium because hydrogen has half the viscosity and double the linear velocity of helium. Nitrogen's performance is inferior for capillary columns and is usually not recommended because of the slow optimum linear velocity (u_{opt}: 12cm/sec.) and steep van Deemter profile.

Figure B compares hydrogen to helium in an isothermal analysis using optimum linear velocities. The resolution is similar, but the analysis time is reduced by 50 percent when using hydrogen. However, helium does improve the separation of very low boiling or early eluting compounds since they allow more interaction with the stationary phase. Temperature programming usually provides similar analysis times between hydrogen and helium since the elution of most compounds strongly depends on the oven temperature. Therefore, the savings in analysis times are not as noticeable as when using isothermal oven conditions.

Figure C illustrates that hydrogen is only slightly faster than helium when both carrier gases are operated under the same temperature-programmed conditions. Also, note that helium improves the resolution of the early eluting compounds (peaks 1 & 2).

Exert Caution when using Hydrogen as a Carrier Gas

Hydrogen is explosive when concentrations exceed 4 percent in air and should only be used by individuals who have received proper training and understand the potential hazards. Proper safety precautions should be taken to prevent an explosion in the oven chamber. Some gas chromatographs are designed with spring loaded doors, perforated or corrugated metal oven chambers, and back pressure/flow controlled pneumatics which minimize the hazards when using hydrogen carrier gas. Additional precautions include:

- Frequently checking for leaks using a thermal conductivity leak detector (cat.# 22451).
- Minimizing the amount of carrier gas that could be expelled in the oven chamber if a leak were to occur by installing a needle valve, restrictor, or flow controller prior to the carrier inlet bulkhead fitting (only necessary for head pressure controlled systems).
- Purging an inert gas (N₂) into the oven chamber to displace oxygen and prevent an explosive atmosphere from forming.

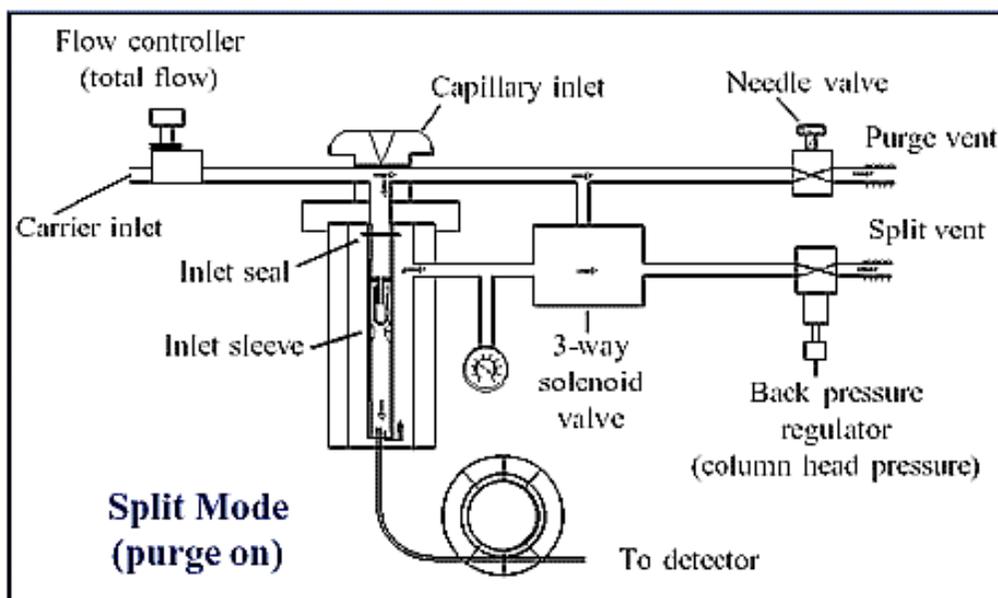
Hydrogen is expelled from both the split vent and septum purge when it is used as a carrier gas. Because of hydrogen's fast diffusivity, an explosion in a laboratory setting is highly unlikely. However, a spark from static electricity can ignite the hydrogen exiting from a septum purge or split vent which could cause a flame. Precautions to minimize

the problems with hydrogen exiting the split vent or septum purge include:

- Plumbing the exit lines to a hood or venting the escaping gas outside.
- Plumbing the lines to exit into a vial of water.
- Plumbing the exit lines to a position where analysts could not get burned if inadvertent ignition occurred.

Flow Regulated/Back Pressure Pneumatic Systems

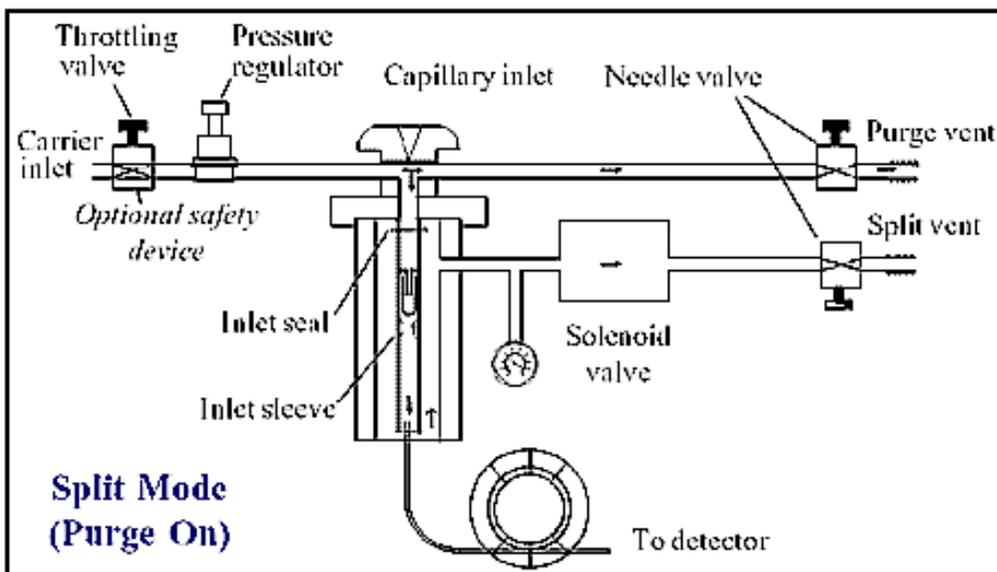
Figure D illustrates a flow regulated/back pressure system commonly used for split/splitless inlets (HP-5890, Varian 3300, 3500, & 3600 GCs). A flow controller positioned upstream of the injector controls the total amount of carrier gas that is expelled from the split vent, septum purge, and column (knob labeled "Total Flow" on HP 5890 GCs). The back pressure regulator (knob labeled "Column Head Pressure" on HP 5890 GCs) stops or reduces the flow from exiting the split vent until the desired column head pressure is reached. The flow controller provides the increase of pressure necessary to meet the requirements of the back pressure regulator. It is the back pressure regulator, located downstream of the split point, that actually controls the capillary column flow rate. One of the primary benefits of a flow controlled/back pressure regulated system is that adjustments to the capillary column flow rate (via head pressure changes) do not affect the amount of carrier gas exiting the splitter vent. Once the desired split vent flow rate is achieved, the flow controller setting should not have to be changed when installing different columns.



Flow regulated/back pressure systems prevent a drastic carrier gas loss that can happen if an inlet fitting or column leak occurs. Leaks are indicated by a failure to obtain the proper operating pressure with the capillary column. A common mistake is to increase the total system flow by turning the flow controller up when a proper head pressure cannot be obtained rather than checking for inlet leaks.

Head Pressure Regulated Pneumatic Systems

Figure E illustrates a head pressure regulated inlet system used in some split/splitless inlet systems (PE Autosystem, 8500, and Shimadzu 9A and 14A GCs). A single-stage pressure regulator is used to control the flow rate in the capillary column by increasing or decreasing the upstream inlet pressure. The split vent and septum purge flow rates are controlled by a needle valve or variable restrictor located downstream of the pressure regulator. Head pressure systems require adjustment of the needle valve controlling the septum purge or split vent every time a change is made in the column's head pressure.



We recommend placing a throttling valve (needle valve or restrictor) on the carrier gas inlet bulkhead fitting of pressure-regulated systems to prevent a catastrophic carrier gas loss should an inlet leak occur. If several GCs are attached to a common carrier gas source, a leak in one GC could drain the carrier gas from all other GCs, causing a loss of flow and subsequent damage to all capillary columns in the entire system. To prevent this from happening, limit the flow of carrier gas to each gas chromatograph (via a throttling valve) until it matches the flow requirements of the inlet system. This can be detected when the column's head pressure starts to decrease if the throttling valve is closed any further.

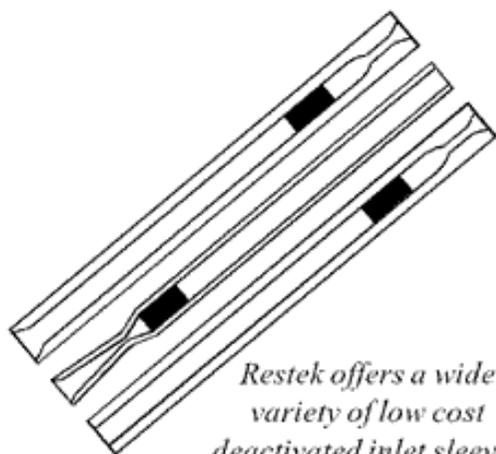
Injector Maintenance

Perform injector maintenance prior to installing a capillary column. Periodic maintenance is required after installation, depending on the number of injections and the cleanliness of the samples. Maintenance includes cleaning and deactivating inlet sleeves, replacing critical inlet seals, and replacing the septum. Review the instrument manual inlet diagram prior to disassembly.

Cleaning and Deactivating Injector Sleeves

Don't install a new Restek column with a dirty injector sleeve! For optimum column performance, the inlet sleeve needs to be free of septum particles, sample residue, and ferrule fragments. Use deactivated inlet sleeves when analyzing samples with active functional groups or compounds prone to decomposition or adsorption onto untreated glass surfaces.

If the sleeve is deactivated and not excessively dirty, cleaning with organic solvents will not affect the integrity of the deactivation layer. First, use non-swelling organic solvents such as methanol or isopropyl alcohol to remove septum particles that adhere to the sleeve wall. Next, use solvents such as pentane, methylene chloride, or toluene to remove sample residue. Nylon tube brushes and pipe cleaners (cat.# 20108) are ideal for cleaning sleeves. Do not use laboratory detergents, acids, or bases to clean sleeves because they will remove the deactivation layer and require sleeve resilanization. Sleeves that are very dirty or contain pyrolyzed residue can be difficult to clean. Heating borosilicate or quartz sleeves overnight in a muffle furnace at 550°C will remove most contaminants. Etching with a 1:1:1 mixture of hydrofluoric acid, sulfuric acid, and deionized water for ten seconds is also very effective. However, heating to



Restek offers a wide variety of low cost deactivated inlet sleeves to fit most instruments.

550°C or using the acid-etch procedure will remove the deactivation layer and require sleeve resilanization. Caution - Exert extreme caution when using hydrofluoric acid. Hydrofluoric acid can cause severe burns and nerve damage if it is ingested, inhaled, or brought into contact with the skin. Only properly trained professionals equipped with the appropriate safety devices should attempt to handle strong acids.

Most new sleeves received from instrument manufacturers are not deactivated. Before optimum column performance can be achieved, sleeves must be deactivated. Restek has developed a unique, high temperature silanization procedure for sleeve deactivation that ensures a highly inert surface. These sleeves can be purchased from Restek at a cost below many instrument manufacturer's cost.

Refer to Restek's Chromatography Products Catalog to obtain the part number for your specific instrument. For more information on inlet sleeves, request a copy of Restek's bulletin Operating Hints for Split/Splitless Injectors or Guide to Direct/On-column Flash Vaporization Injection.

Protection Against Dirty Samples

Sleeve packing materials such as fused silica wool (cat.# 20790), glass wool (cat.# 20789), or fused silica beads (cat.# 20791) act as filters when analyzing samples containing high molecular weight residue or particulates. However, both wool and beads greatly increase the surface area that the sample contacts and can be a source of adsorption or breakdown. It is critical that the wool or beads be properly deactivated. If you plan to use wool, be careful inserting it into the sleeve because active sites can be created as the fibers break. We do not recommend using packings coated with stationary phases. (For more information on protection against dirty samples, request a copy of Restek's bulletin A Guide When Injecting Dirty Samples.) Alternative sleeve designs that minimize sample interaction with non-volatile residue are also available.

Replacing Critical Seals

Replace the critical seal prior to installing an inlet sleeve (see instrument manual for seal location). Most capillary injection ports use a rubber o-ring or graphite ferrule to seal the sleeve inside the injection port body. The seal must fit tightly around the sleeve to prevent the carrier gas from leaking around the outside of the sleeve. If your GC uses a ferrule as the inlet seal, always pre-swage the ferrule to fit the sleeve before tightening it in the inlet (especially Varian inlets).



Changing Septa

Always use a high quality, low bleed septa. We recommend replacing the septum frequently to prevent leaks and fragmentation. Otherwise, multiple injections and continuous exposure to a hot injection port will decompose the septum, causing particles to fall into the sleeve. Septum particles are a potential source of ghost peaks, loss of inertness, and carrier gas flow occlusion as shown in **Figure F**. It is best to install a new septum at the end of an analytical sequence so that it can condition in the injector and reduce the incidence of ghost peaks. Always use clean forceps when handling septa to avoid contamination.

Setting Detector and Make-up Gas Flow Rates

Confirm that the make-up gas, detector fuel, and oxidant flow rates are set according to the instrument's specifications (**Table I**, below). Make-up gas flow rates set too low will cause tailing solvent peaks, baseline disturbances, decreased sensitivity, and detector noise. Some instruments do not have leak-tight detector cavities and require flow rate verification before the column is installed into the detector. However, for GCs with leak-tight detector cavities, it is usually easier to check detector and make-up gas flow rates after the column is installed. We highly recommend using the Restek Flowmeter 6000 (cat.# 21622).

Table I Typical FID Flow Rates

Instrument	H ₂ (ml/min.)	Make-up (ml/min.)	Air (ml/min.)
Hewlett-Packard	30	20	400
Varian	30	20	300
Shimadzu	30-60	40	500
PerkinElmer	45	--	450

II. Column Mounting and Installation



Do not remove the high-temperature string holding the fused silica capillary column inside the Restek cage. The high-temperature string is capable of withstanding more than 400°C and does not decompose during continuous operation at oven temperatures used in capillary chromatography.

When hanging the column on the oven support rod, be careful that fused silica tubing does not contact any metal parts. Stainless steel

columns can be placed directly on the oven support rod. If there is not an oven support rod, one can be made by inserting a temperature resistant pegboard hook into the corrugated oven wall or by hanging a 1/16-inch "S" hook from the oven ceiling. Be careful not to damage the oven thermocouple or interfere with the fan operation when installing homemade brackets.

Position the column so that it is midway between the injector and detector. This reduces thermal gradients and enhances retention time reproducibility. Uncoil one or two loops of tubing. When using fused silica columns, be careful not to scratch the column surface against the metal cross bars when removing loops. This abrasion of the polyimide coating could lead to spontaneous breakage.

Caution - When removing loops from 0.53mm ID columns, pull the tubing from the cage at the point with the widest gap between the metal crossbars. Avoid sharp bends that will break the tubing.

Choosing Ferrules



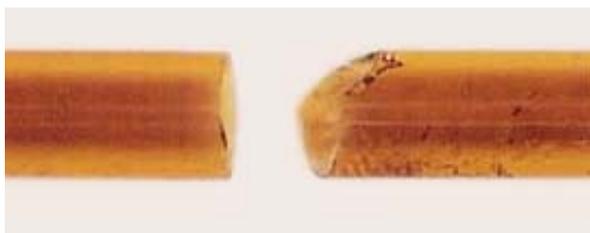
Graphite or Vespel®/graphite ferrules are used to seal the column to the injector and detector in capillary gas chromatography. Both ferrule types have advantages and disadvantages. Graphite ferrules are the easiest to use, and they are leak-free, universal

for most systems, and preferred by most beginning capillary chromatographers. Because graphite ferrules are soft, they easily conform to column outside diameters and different types of instrument fittings. However, they can flake or fragment upon removal, causing particles to lodge in the injector or detector sleeves, and they will not hold a seal under vacuum. Vespel®/graphite ferrules are hard and they must match the column and fitting dimensions closely to seal properly. In addition, because Vespel®/graphite ferrules can deform during initial heating, they need to be re-tightened or leakage will occur. Vespel®/graphite ferrules do not fragment, can be reused many times, and are preferred by mass spectroscopists since they do not contaminate the ion source with particles and maintain their seal under vacuum. In all cases, it is best to choose a ferrule that fits snugly or is slightly larger than the capillary tubing OD (see table below). This minimizes the need for excessive torque to properly seal the ferrule to the column.

Nominal Tubing ID	Nominal Tubing OD			
	MXT		Fused Silica	
0.05mm	---	---	0.363mm	+/-0.012mm
0.10mm	0.23mm	+/- 0.0254mm	0.363mm	+/-0.012mm
0.15mm	0.41mm	+/- 0.0254mm	0.363mm	+/-0.012mm
0.18mm	0.36mm	+/- 0.0254mm	0.34mm	+/-0.01mm
0.25mm	0.41mm	+/- 0.0254mm	0.37mm	+/-0.04mm
0.28mm	0.56mm	+/- 0.0254mm	---	---
0.32mm	0.41mm	+/- 0.0254mm	0.45mm	+/-0.04mm
0.53mm	0.74mm	+/- 0.0254mm	0.69mm	+/-0.05mm
0.75mm	0.93mm	+/- 0.0254mm	---	---

Installation Preparation

Cut each column end squarely, approximately 10 centimeters from the end seals. To obtain a square cut with fused silica columns, place the column end against the forefinger and score the polyimide layer lightly and rapidly with a sapphire scribe (cat.# 20115) or a ceramic scoring wafer (cat.# 20116). Score only one side of the column. Point the column end down to prevent polyimide or fused silica shards from falling inside, and quickly flick the column just above the score.



Proper and improper fused silica cuts.

Cut metal capillary tubing by scoring the tubing wall (without cutting completely through) with the edge of a sharp file or ceramic scoring wafer. Wipe any filings off the tubing and bend it away from the score. Once the score opens, bend the tubing in the opposite direction (toward the score) until it snaps into two pieces. If the hole is not round or there is a burr on the tubing, try the procedure again. The flat side of a ceramic scoring wafer can be used to polish or round the column end into a smooth conical shape. We do not recommend using high speed wheels or grinders to cut the metal tubing since they may introduce metal filings into the tubing or ruin the polymer near the cut from the high temperatures created.



Proper and improper MXT® column cuts.

Next, install the nut and ferrule to the inlet in the manner described in the instrument manual. Use a pin vise and drill (cat.# 20103) to enlarge the ferrule ID if it does not slide easily onto the column. Prevent shards from falling into the column bore by pointing the column end down when installing the ferrule. Slide the connecting nut and ferrule approximately 20cm down the length of the column to make installation easier. Cut an additional 10cm from the column end after the nut and ferrule have been installed to remove any ferrule fragments that might have been forced into the column bore. Examine the quality of the cut with a small 10x pocket magnifier (cat.# 20124) and make sure that the cut is square. Jagged silica edges or exposed polyimide cause adsorption and tailing peaks, so it is very important that the column ends are cut uniformly. It may take several times, but once a square cut has been obtained, proceed with the installation. (Use an old column to practice making consistently square cuts.)

Inlet Installation

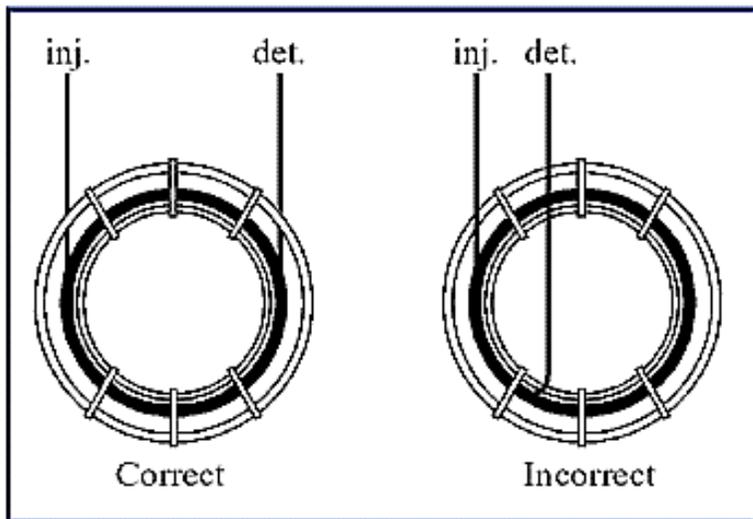
Consult the instrument manual to determine the correct insertion distance for the injector. It is important to install the column at the exact distance recommended by the injector manufacturer or poor peak symmetry and quantitation could occur. Lay the column end beside a ruler and position the nut and ferrule to the exact distance required for installation. Next, mark the insertion distance. This can be done one of three ways: with a pair of Slide-Lok Tweezers (cat.# 20101), with typewriter correction fluid, or by positioning a septum on the column to hold the nut and ferrule. If using a septum, slide it away from the nut after the fitting is tightened and leave it in the oven cavity while performing the analysis.

Gently insert the column end into the inlet fitting, making sure that the end is not crushed or scraped against the metal injection port fittings. While maintaining the correct distance, use a capillary wrench to tighten the nut approximately one-half turn past finger-tight until the column is held firmly. The ferrule is tight if the column cannot be pulled from the fitting while applying gentle pressure.



Various ways to mark the insertion distance

Make sure the fused silica tubing is not sharply bent when installing the column (**Figure G**). The tubing should gently bend from the cage to the fitting in angles greater than 90° or in diameters greater than 15cm. Sharp bends weaken the fused silica and eventually cause spontaneous breakage during use. If the tubing cannot be positioned to avoid sharp bends, then repeat the installation process and uncoil the appropriate amount of tubing from the cage.



Establishing Flow

Turn the carrier gas on and set the column head pressure to the values indicated in **Table II** *. These values represent approximate head pressures and flow rates. The exact optimum pressures and flow rates for a particular column will be set at a later time.

Table II Approximate Column Head Pressure (He or H₂ carrier gas)

length (m)	0.18mm ID	0.25mm ID	0.32mm ID	0.53mm ID
15	—	6psig	3psig	2psig
20	14psig	—	—	—
30	—	12psig	8psig	4psig
40	30psig	—	—	—
60	—	24psig	16psig	8psig
105	—	40psig	30psig	14psig
Septum Purge Flow: between 2 and 5 cc/min.				

* If you are having difficulty establishing the appropriate column head pressure for back pressure regulated systems, then suspect septum or inlet ferrule leaks.

The split ratio is the amount of carrier gas exiting the split vent vs. the amount of carrier gas entering the capillary column. The split ratio should be adjusted so the sample amount reaching the column does not exceed the column's capacity. Typically, a split ratio of 50 to 1 is used. **Table III** lists common split vent flow rates found using hydrogen or helium carrier gases. Use the equation below to calculate the split ratio.

$$\text{Split ratio} = \frac{\text{Split vent flow \& column flow}}{\text{Column flow rate (cm}^3\text{/min.)}}$$

While the flow rate exiting the split vent is easy to measure with conventional bubble meters, the low flow rate exiting a capillary column can be difficult to measure. The following equation can be used to approximate the column flow rate.

$$\text{Flow} = \frac{(\pi) (\text{column radius cm})^2 (\text{column length cm})}{\text{dead volume time (min.)}}$$

where pi = 3.1459, column radius and length are in centimeters, and time is in minutes.

For example, a 30 meter x 0.53mm ID column operated at 20cm/sec. linear velocity with helium has a flow rate of 2.65cm³/min.

$$\text{Flow} = \frac{(3.14159) (.0265\text{cm})^2 (3000\text{cm})}{2.50\text{min.}} = 2.65\text{cm}^3/\text{min.}$$

Table III Typical Split Vent Flow Rates (50 to 1 split ratio)

Carrier gas	0.18mm ID	0.25mm ID	0.32mm ID	0.53mm ID
helium	15cc/min.	35cc/min.	80cc/min.	125cc/min.
hydrogen	30cc/min.	70cc/min.	160cc/min.	250cc/min.

Safety Tip: Always use a split vent trap when injecting hazardous or carcinogenic chemicals into a split/splitless inlet system.

Good Operating Practice

Operating a column without carrier gas flow causes irreparable damage to the stationary phase. Confirm flow by inserting the column outlet into a vial of solvent such as acetone or isopropyl alcohol prior to installing it into the detector. The appearance of bubbles at the column outlet confirms carrier gas flow. Allow the column to purge with carrier gas for fifteen minutes before installing the column outlet into the detector to remove any room air that may have diffused inside the column.

Outlet Installation

Install the nut and ferrule to the detector in the manner described in the instrument manual. Gently insert the column end into the outlet fitting making sure that it is not crushed or scraped against the metal detector parts. Regardless of the GC manufacturer, a higher degree of inertness and better peak symmetry results if the column end can be installed 1 to 3mm from the detector jet orifice. Be careful not to push the column beyond the jet orifice or the column end will burn in the flame. Some jets are too narrow to insert the column close to the jet orifice. If this is the case, pull the column end approximately 2mm away from the narrowed point to prevent flow occlusion or loss of inertness. While maintaining the correct insertion distance, use a capillary wrench to tighten the nut approximately one-half turn past finger-tight until the column is held firmly. The ferrule is tight when the column cannot be pulled from the fitting while applying gentle pressure.

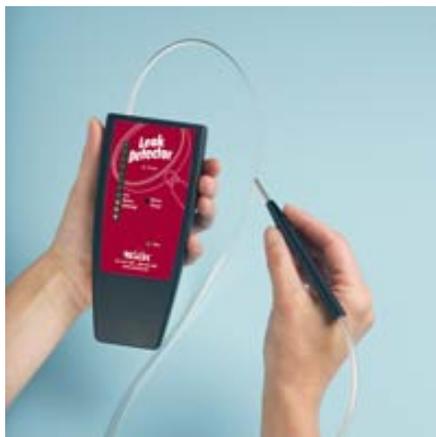
Note — Be cautious when using stainless steel or aluminum-clad columns in gas chromatographs or GC/MS systems with electrically energized detector jets or orifices. These columns will conduct electricity and cause a short if the end of the column is installed too far into the energized detector. Always turn off the electrometer with Varian, PerkinElmer, and Shimadzu FIDs (since the detector is not grounded) when installing stainless steel or aluminum clad columns.

Leak-Checking Techniques

The best way to leak-check a capillary column system is to use a thermal conductivity leak detector (cat.#22451)*. These portable devices detect minute traces of helium or hydrogen carrier gas without contaminating the system. Leaks in mass spectrometers can easily be determined by monitoring for Mass 28 (N₂) or 32 (O₂).*

Never use liquid leak detectors that contain soaps or surfactants in capillary chromatography. Leaks draw these materials inside the system and contaminate the column, making high sensitivity operation difficult. In addition, liquid leak detectors can cause permanent damage to the capillary column by depolymerizing the silicone stationary phase.

Once the system is leak-free, set the injector and detector temperatures approximately 20°C above the final operating temperature of the analysis or at the column's maximum operating temperature. Then light or turn on the detector. Caution: Do NOT exceed the maximum operating temperature of the



column.

* Spraying argon gas and monitoring for Mass 39 is also effective for mass spectrometers.

III. Setting Optimum Flow Rates

The most accurate and reproducible way to set the capillary column flow is by injecting a non-retained substance (see table IV) to determine the linear velocity (dead volume time) and adjusting the head pressure until the linear velocity is at its optimum value. Measuring the flow rate at the column outlet is not recommended because it does not account for column-to-column variations. Relying on head-pressure readings is not recommended due to instrument and column variations. Exact flow rate values for a particular column can only be determined after the linear velocity is set at its optimum value.

Because most capillary columns are operated in a pressure (not flow) controlled mode, the temperature at which the linear velocity is set is critical. To obtain the optimum performance, linear velocity should always be set at the operating temperature for an isothermal analysis. For a temperature-programmed analysis, the column's linear velocity should be optimized at an oven temperature where a hard to separate peak pair elutes. If there are no critical peak pairs, raise the oven temperature to the temperature reached midway through the programmed run. Always document which non-retained compound was used and the temperature at which the linear velocity was set in order to easily reproduce the analysis.

To set dead time, inject 2.0µl of a non-retained substance that is compatible with the detector (**Table IV**). Accurately mark the injection starting time and peak elution time with an electronic integrator.

Table IV

Detector Type	Recommended Dead Volume Compound
FID/TCD	CH ₄
NPD	acetonitrile vapors
ECD	methylene chloride vapors or air
ELCD	dichlorodifluoromethane vapors
MS	O ₂ or N ₂ (air)
PID	ethylene or acetylene

The compounds listed above may be slightly retained on thick film phases (1.0 to 7.0µm) giving erroneous dead volume times. However, they are reproducible for similar column types on subsequent analyses.

Adjust the column head pressure until the correct dead time is obtained for the appropriate column length and carrier gas (**Table V**). Once the dead volume time has been finalized, check the split vent and septa purge flow to make sure they did not change significantly. (Head pressure regulated capillary systems require adjustment of the split vent flow if the pressure changed significantly. Back pressure regulated capillary systems should not require adjustment.)

The values in **Table V** were obtained using the formula for average linear velocity (u). The optimum u is 40cm/sec. for hydrogen, 20cm/sec. for helium, and 12cm/sec. for nitrogen*. Insert the appropriate values in the equation below to obtain the required dead volume time for column lengths not listed.

$$\text{Dead volume time} = \frac{\text{Column length (cm)}}{u \text{ of carrier gas (cm/sec.)}}$$

Table V Dead Volume Times (for commonly used capillary columns)

length (m)	hydrogen	helium
15	0.63 min./TCD	1.25 min.
30	1.25 min.	2.5 min.
60	2.5 min.	5.0 min.
105	4.38 min.	8.75 min.

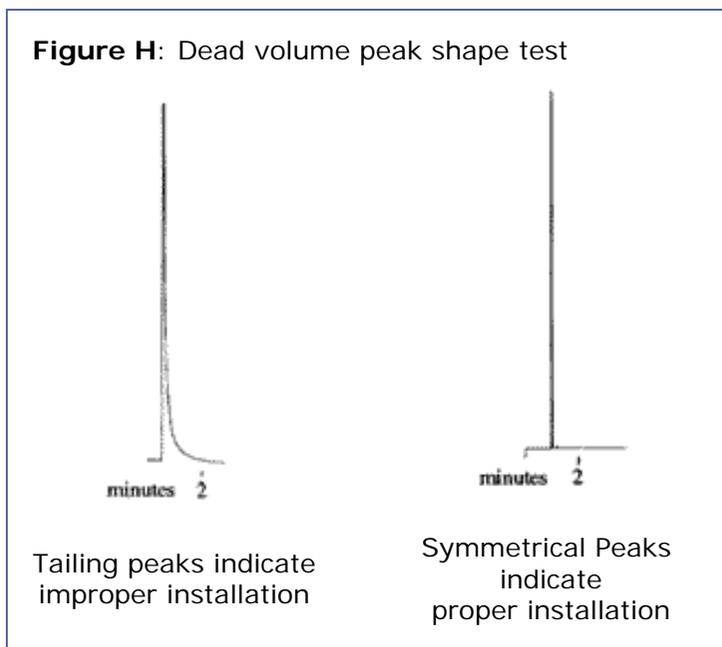
* Nitrogen is not recommended as a carrier gas for most capillary columns because inadequate resolution and longer analysis times result.

IV. Confirming Installation Integrity

We highly recommend using the dead volume peak shape test and the solvent peak shape test to confirm installation integrity.

Dead Volume Peak Shape Test

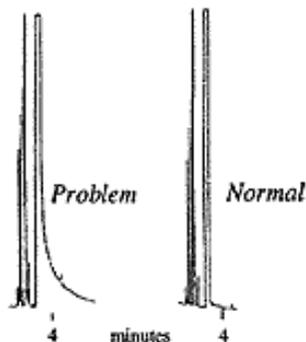
Examine the dead volume peak. A sharp, narrow peak that shows no sign of tailing indicates an unobstructed sample pathway and correct installation (**Figure H**). Tailing peaks indicate improper column installation, gross contamination of the splitter sleeve, a cracked splitter sleeve, improper sweeping of the column end by make-up gas, a crushed column end, or a column that has degraded. The cause of a tailing non-retained peak must be corrected before using the column analytically.



Solvent Peak Shape Test

The solvent peak shape test is an additional indicator of proper column installation in the inlet and outlet. Since compounds used to set the dead volume are usually gases at

The solvent peak shape is a good indicator of system integrity



room temperature (methane), they are not extremely sensitive indicators of system or installation problems. A 1 μ l injection of a liquid solvent, such as methylene chloride, expands to over 500 μ l of gas volume, making any potential installation or system problem readily apparent. A tailing solvent peak is a sensitive indicator of broken, undeactivated, or contaminated inlet sleeves. Tailing solvents also indicate problems with inadequate make-up gas or improper column insertion into the detector.

To perform the test, inject 1 μ l of a solvent in the split mode at 40°C isothermal and examine the peak shape (**Figure I**). The solvent peak should be symmetrical and show minimal tailing. If tailing appears, suspect an

installation or system problem. The cause of a tailing

solvent peak must be corrected before using the column analytically.

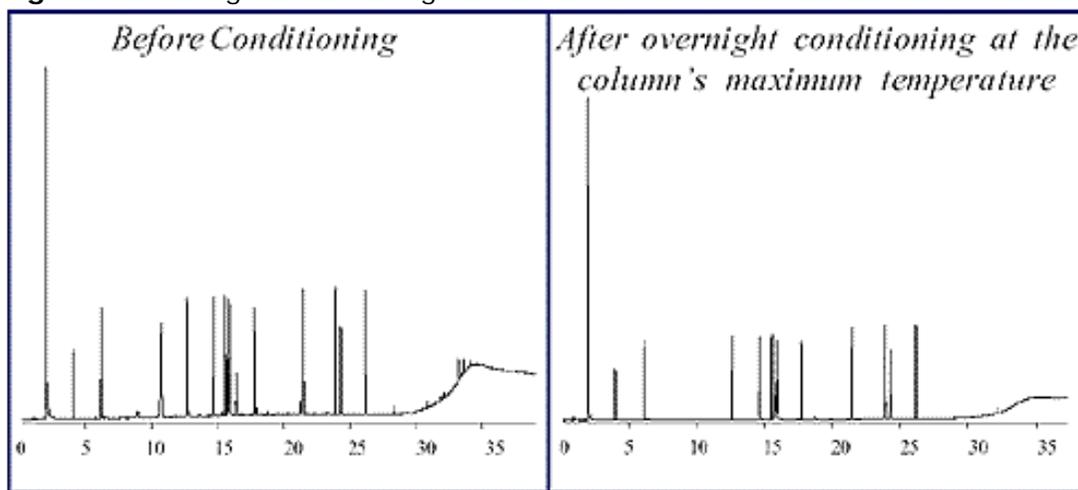
V. Conditioning

Before conditioning a column at an elevated temperature, make sure there is proper flow, there are no leaks present, and there is an ample supply of oxygen-free carrier gas for the conditioning period. Conditioning at elevated temperatures without flow permanently damages or destroys the performance of the capillary column.

Conditioning with an oxygen leak present causes the column to exhibit permanent high bleed and destroys its utility at high operating temperatures.

To condition the column, set the GC oven at 40°C, hold fifteen minutes, then program at 10°C/min. to the maximum operating temperature (see the test chromatogram included with the column). Alternatively, the column can be conditioned 25°C below the maximum operating temperature if it is going to be used at relatively low temperatures. Hold the column at this temperature for two hours or until the baseline stabilizes. Overnight conditioning is not necessary with Restek capillary columns operated at moderate detector sensitivities (approx. 8×10^{-11} AFS). Overnight conditioning is necessary when the column is going to be operated at high detector sensitivities ($< 4 \times 10^{-11}$ AFS) and at oven temperatures close to the maximum operating temperature (see **Figure J**). Extra conditioning may be required if operating the column at high sensitivity ($< 1 \times 10^{-11}$ AFS) or using thick films ($> 1\mu\text{m}$). The column should not be installed in very sensitive or hard-to-clean detectors such as ECDs, NPDs, FPDs, PIDs, ELCDs, or Mass Spectrometers during the initial conditioning period. This practice is particularly important with very thick film columns ($> 3\mu\text{m}$) which produce more stationary phase bleed. (Before conditioning thick film columns, cap the detector.) The Crossbond® procedure used by Restek produces columns with very low bleed levels. If your column is experiencing higher bleed than shown on the test chromatogram, contact us immediately at 800-356-1688 (ext. 4).

Figure J: Overnight conditioning reduces column bleed



VI. Test Mixtures

Restek tests every column with a stringent test mix to determine that the column and GC systems are performing correctly. It is good analytical practice to run the test mixture before analyzing samples to assess system problems or chemical incompatibilities that may be present. It is also good practice to inject the test mix weekly to monitor column performance and to indicate when maintenance procedures are needed. Refer to the "[Column Maintenance and Rinsing](#)" section in this guide.

Inject a column test mixture according to the test chromatogram conditions. Review the test chromatogram to determine peak identities for your specific column. Carefully compare Restek's test chromatogram and your analytical run, noting changes in peak shapes. In general, tailing hydrocarbon and Fatty Acid Methyl Ester (FAME) peaks indicate dead volume or contamination in the inlet or detector. Check the inlet and outlet sleeves for ferrule or septa fragments and reinstall the column. Excessively tailing solvent peaks and tailing or adsorbed peaks such as 2,3-butanediol, octanol, 2-

ethylhexanoic acid, or dicyclohexylamine indicate the need for cleaning and reactivating the split/splitless sleeve or that there is a problem with the make-up gas system. **Figure K** shows the Grob mix run on a relatively non-polar stationary phase.

SRI CTR1 Replacement Column for Fixed Gas analysis

May 2013

Separation of Oxygen, Nitrogen, Methane, CO and CO₂ has always been difficult since there is no single column material which is good for all these molecules at room temperature or above.

For example In the past, one column vendor (ALLTECH) sold a "column in a column" called a CTR1 which is shown at right.

This is a large bulky column consisting of an outer 1/4" OD column and an inner 1/8" OD column.

This column is no longer manufactured, or is not easily available, so SRI offers an equivalent or better column for the convenience of our customers.

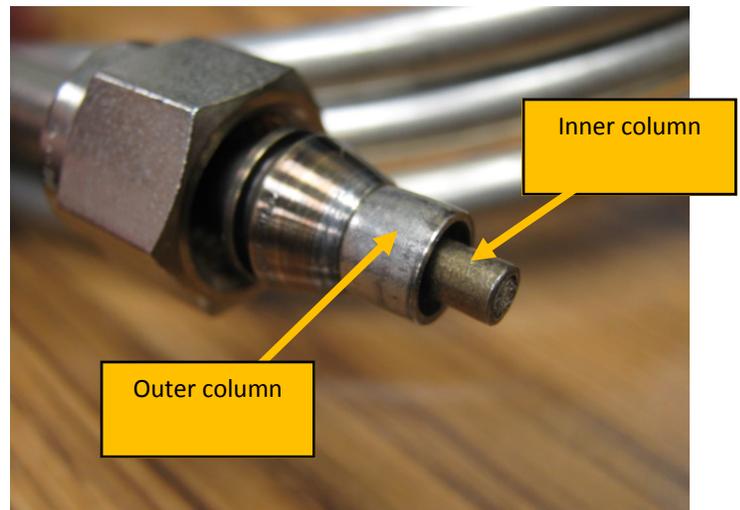
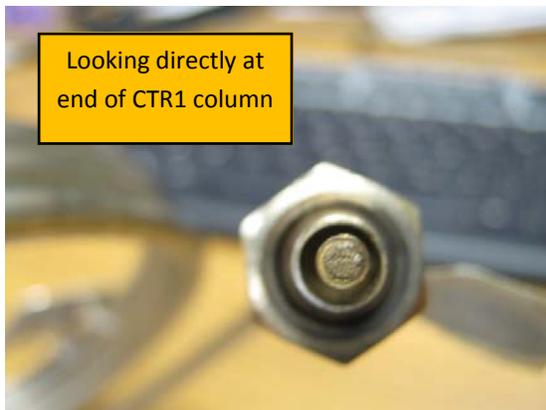
8600- PKC6 "Fixed Gas Column"

AUD\$880.00 April13 (price may change)

For a more robust method of separating these gas molecules as well as others like propane, propylene, butanes, pentane etc

Please see the *MultipleGas#3* document on www.srigc.com/ . . . OR as Modified www.chromtech.net.au/pdf2/MGA#3-CT.pdf

. . . for a more Complex and UNIQUE Natural Gas / Sulfur compound separation see . . . <http://www.srigc.com/MG3+SulfurFeb2013.pdf>



SRI Tech Support: 310-214-5092

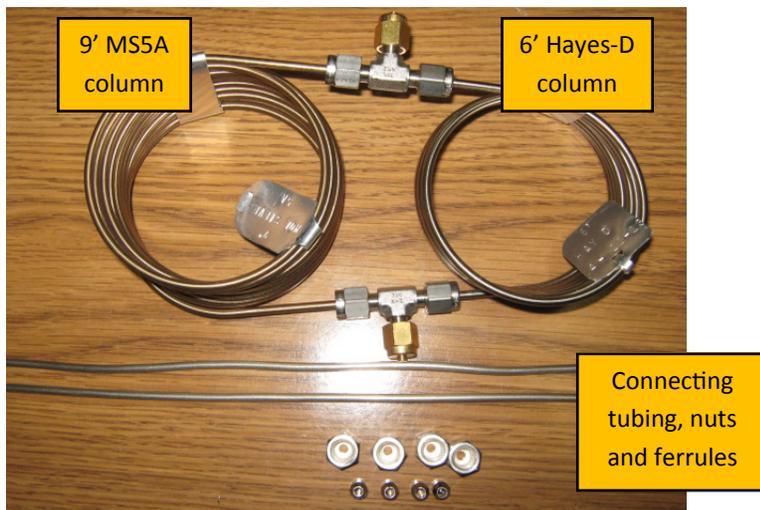
CTR1 Replacement Column for Fixed Gas analysis

May 2013

The SRI " Fixed Gas Column" (FG) consists of two side by side columns rather than one column inside another. This arrangement is superior because the columns have different bake out temperatures and having them separable makes it easier to bake out the Molecular Sieve column (300C+)without damaging the lower temperature Hayesep-D (270C max) column.

The column is supplied with two 12" lengths of flexible 1/8"od nickel tubing to make connecting it easier and extra nuts and ferrules. We like the soft graphite ferrules for this application because they seal well and do not deteriorate at the 300C bake-out temperature. However metal ferrules or Vespel/Graphite can also be used.

The " Fixed Gas Column" is shown installed in an SRI 8610C GC column oven AND there is still room for other columns.



SRI Tech Support: 310-214-5092

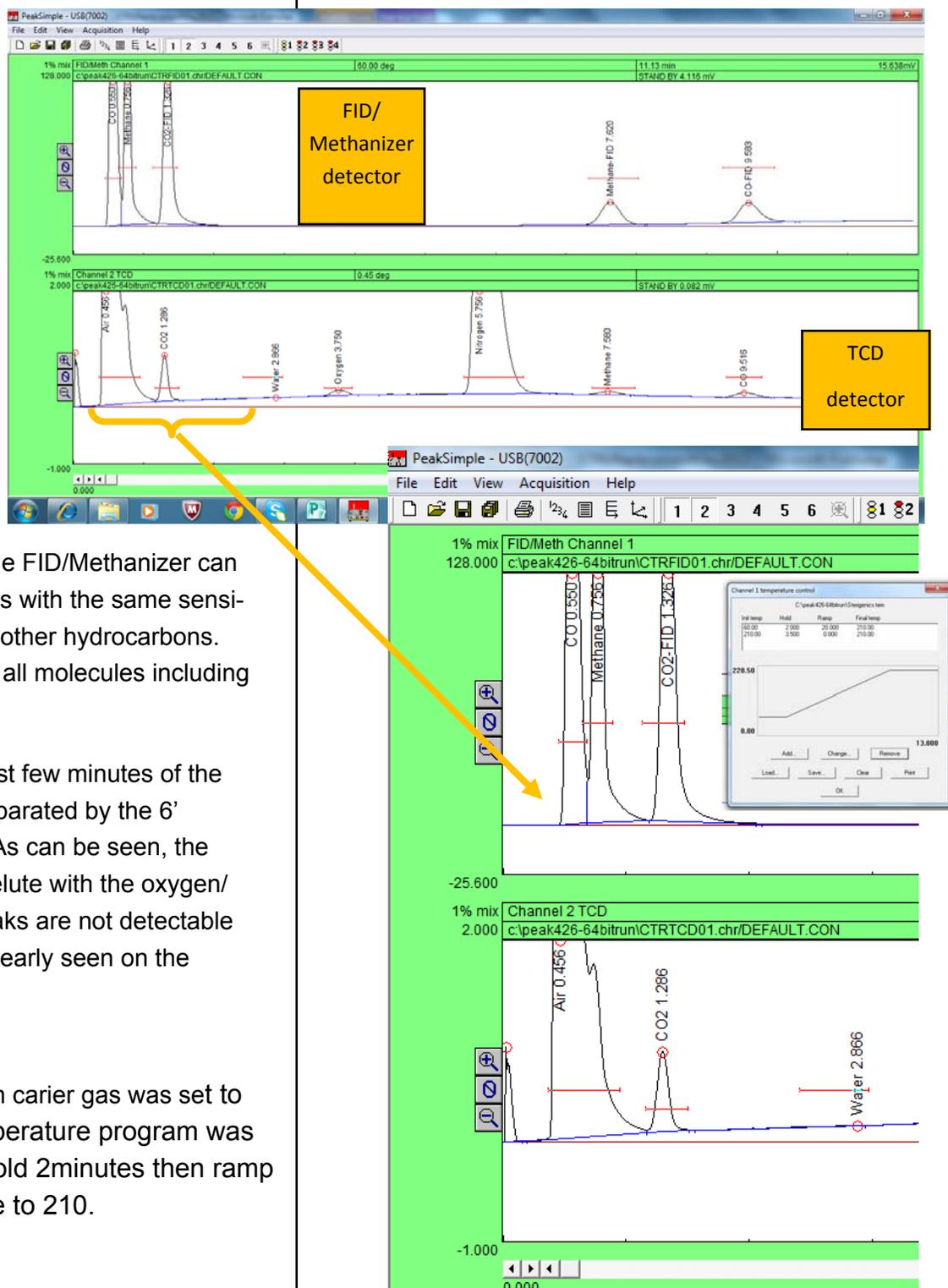
CTR1 Replacement Column for Fixed Gas analysis

May 2013

The FG column was installed in an SRI 8610C GC equipped with a TCD detector and FID/Methanizer (FIDM) detector. The two detectors were plumbed in series so some peaks are detected by both detectors. The methanizer part of the FID detector converts CO and CO₂ to methane so the FID/Methanizer can detect those molecules with the same sensitivity as methane and other hydrocarbons. The TCD responds to all molecules including water.

All the peaks in the first few minutes of the chromatogram are separated by the 6' Hayesep-D column. As can be seen, the CO and Methane co-elute with the oxygen/nitrogen, so these peaks are not detectable by the TCD, but are clearly seen on the FID.

In this case the helium carrier gas was set to 20 PSI and the temperature program was set to start @60C hold 2minutes then ramp at 20degrees/minute to 210.



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CTR1 Replacement Column for Fixed Gas analysis

May 2013

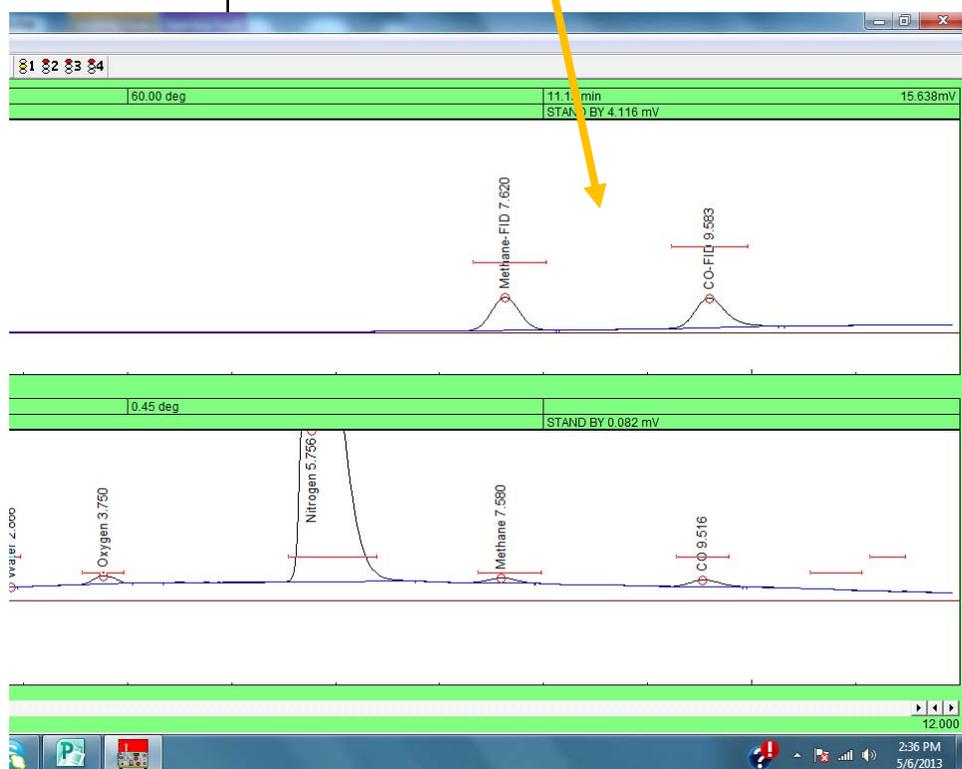
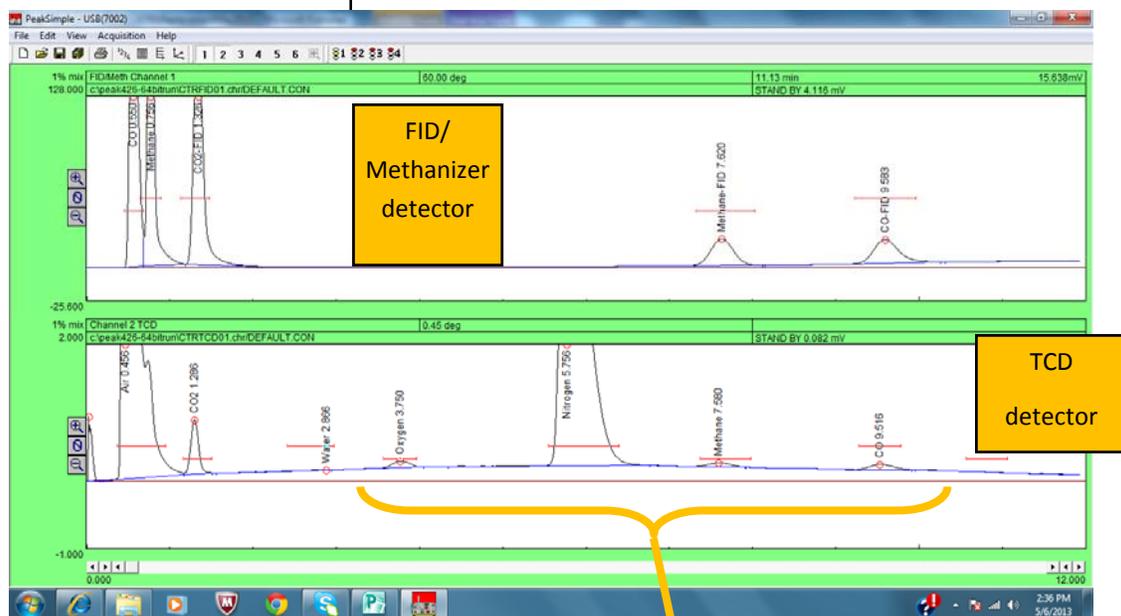
The peaks in the last minutes of the chromatogram are from the 9' Mole-Sieve 5A column.

This column separates oxygen from Nitrogen as well as methane and CO.

CO₂ however and water are permanently absorbed by this column which must be baked out periodically to remove the CO₂ and water.

You can tell the MS5A column needs to be baked out when the oxygen and nitrogen peaks start to blend into each other.

Remove the entire Fixed Gas column assembly from the oven and then remove the MS5A column from the assembly. Install the MS5A column in the column oven and with carrier flowing, heat the MS5A column for 16 hours at 300C.



SRI Tech Support: 310-214-5092

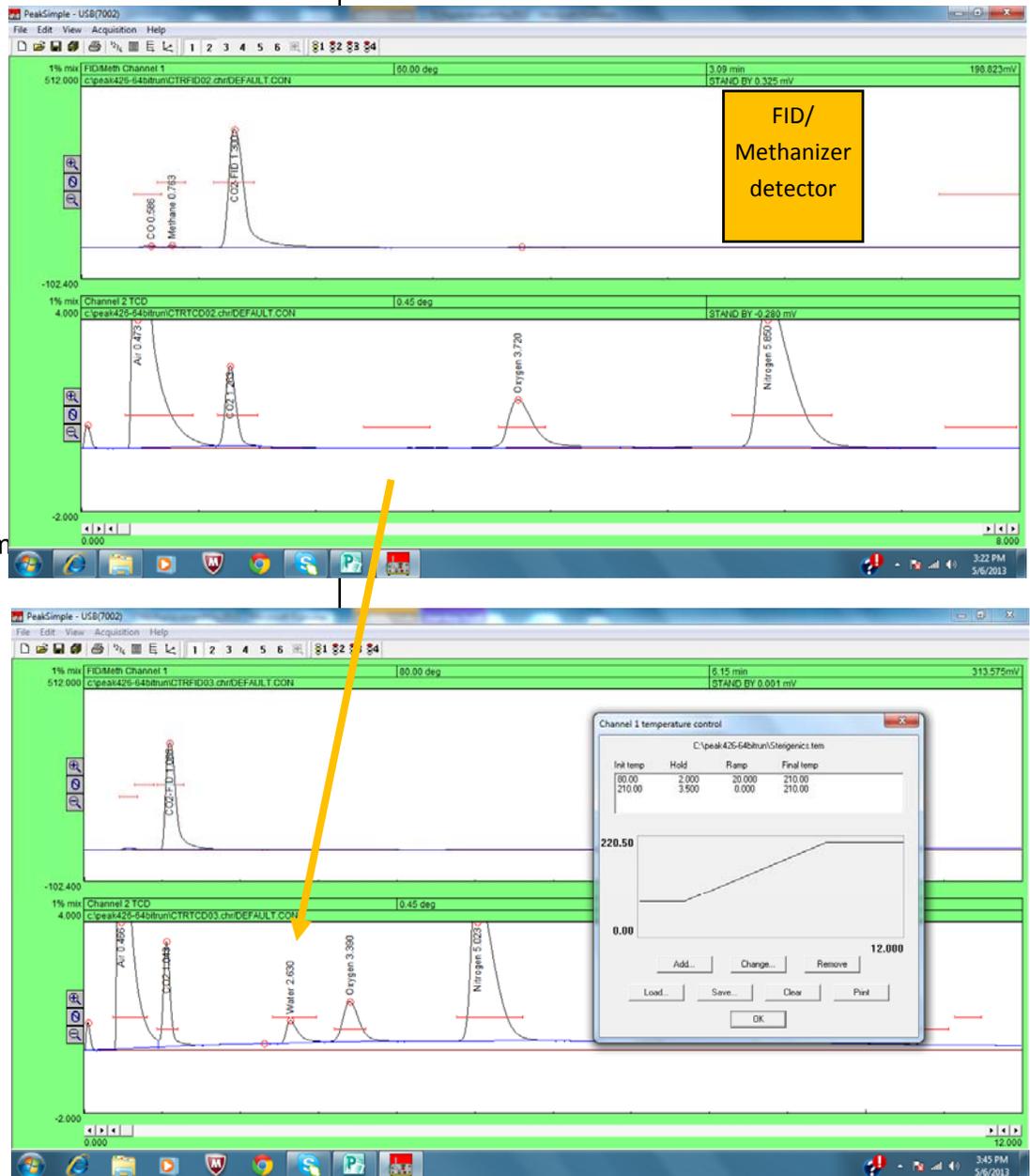
CTR1 Replacement Column for Fixed Gas analysis

May 2013

Shown at right is a chromatogram of 1ml exhaled breath using the 60C starting temperature.

Compare this chromatogram to the one below at a 80C starting temperature. The water peak in the top chromatogram co-elutes with the oxygen while at the 80C starting temperature, the lower chromatogram shows the water nicely separated from the oxygen.

There is less separation however between the CO2 and the air peak.



SRI Tech Support: 310-214-5092

CTR1 Replacement Column for Fixed Gas analysis

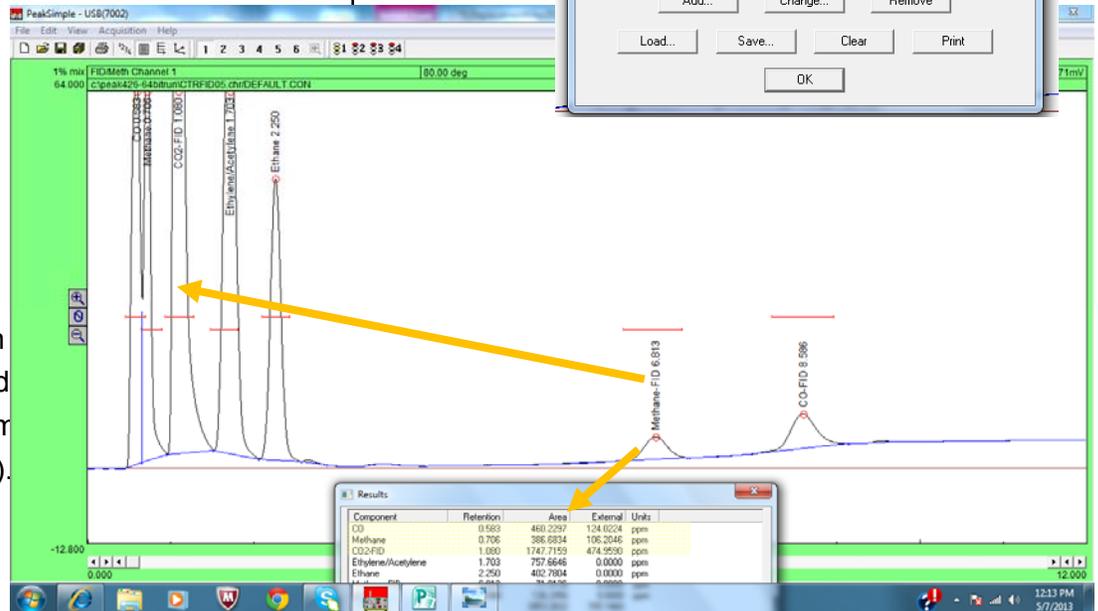
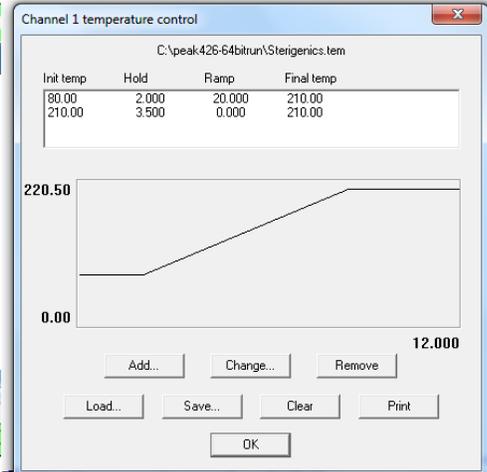
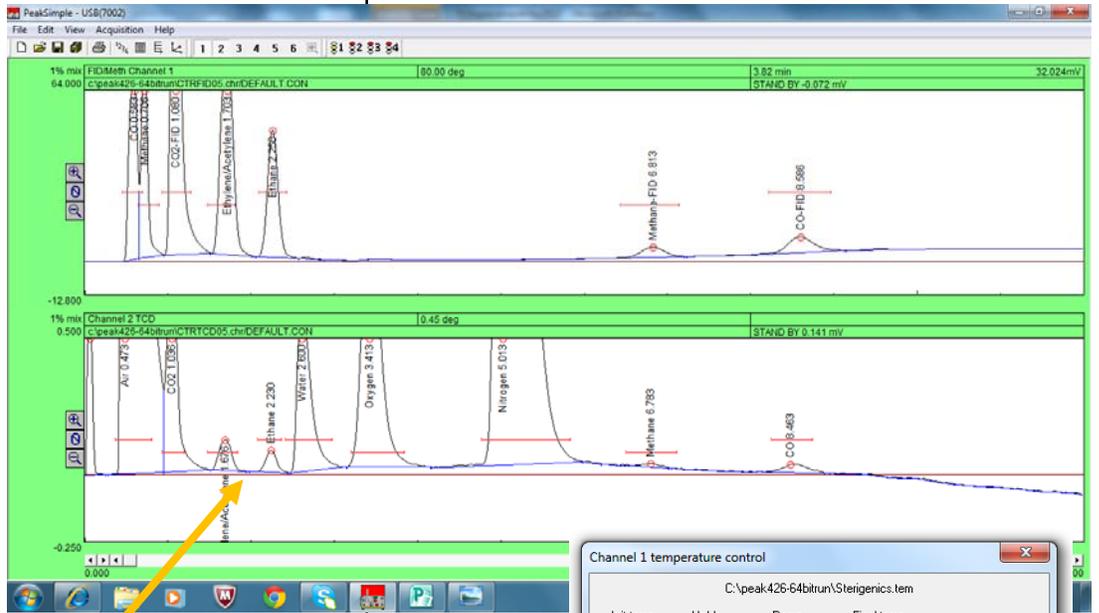
May 2013

Shown at right is a chromatogram of 1ml 1% gas mix including ethylene/acetylene and ethane using the 80C starting temperature oven program.

Between the TCD and FID/ Methanizer CO, CH₄, CO, Ethane, Ethylene/Acetylene, Water, Oxygen and Nitrogen are all resolved.

Ethylene and acetylene co-elute, but are separated from ethane and also water.

Note also that the split ratio between the columns is about 4:1 judging by the area counts of CO₂ (which elutes from the 6'Hayesep-D column and the methane and CO (which elute from the 9'MS5A column).

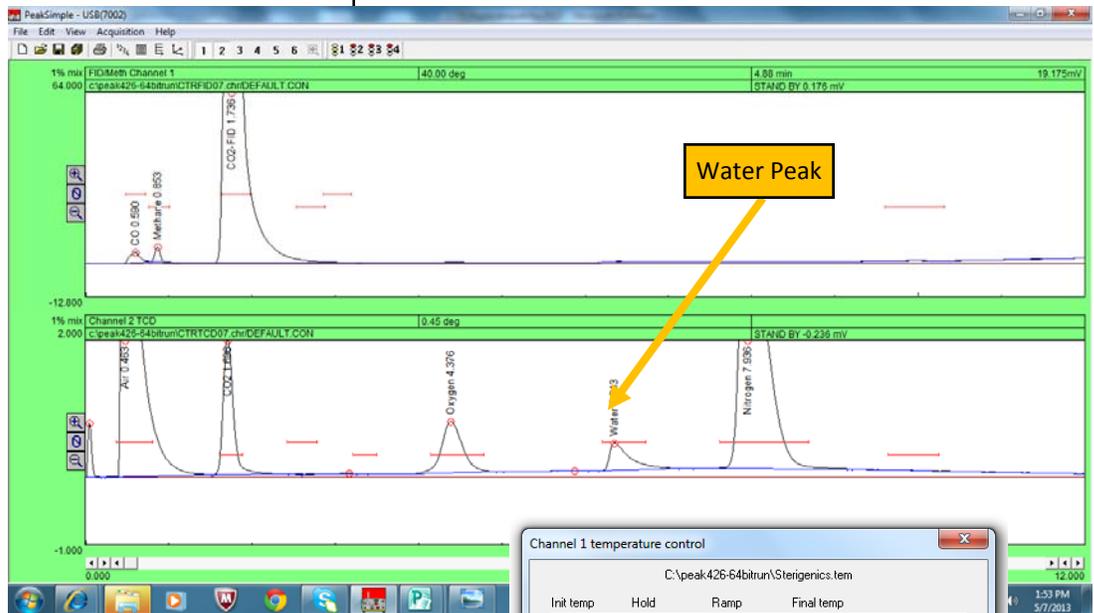


SRI Tech Support: 310-214-5092

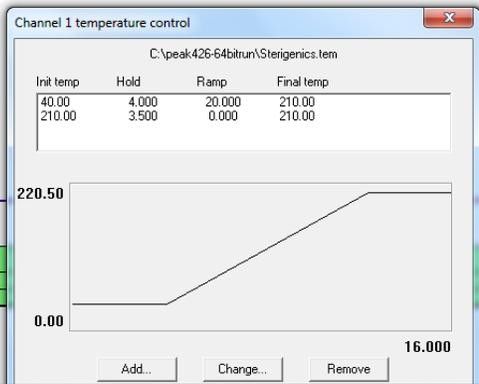
CTR1 Replacement Column for Fixed Gas analysis

May 2013

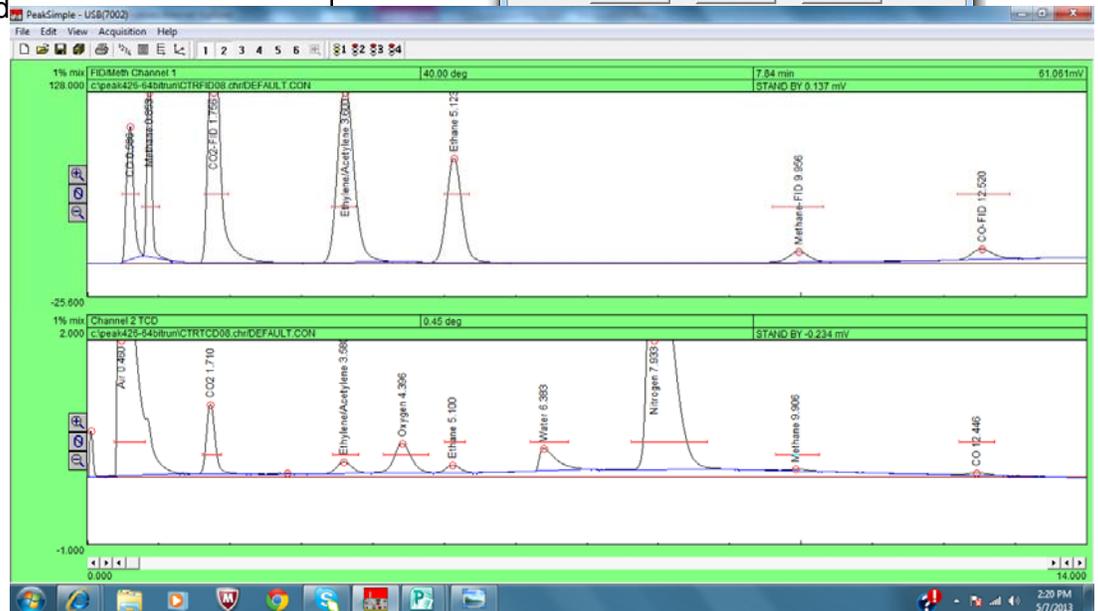
Shown at right is a chromatogram of exhaled breath starting at 40C. You can see the water peak has shifted to the right and elutes between oxygen and nitrogen.



A mix of: O₂, N₂, CO, CO₂, methane, ethane and ethylene/acetylene plus water is shown starting at 40C. You can see the peaks from the Hayesep-D column are interspersed with the peaks from the MS5A column.



You can experiment with different temperature programs to best suit your particular mix of gases.



SRI Tech Support: 310-214-5092



Capillary GC Column Selection Guide

Restek offers fused silica or stainless steel capillary columns in more than 900 stock combinations of stationary phase, stationary phase film thickness, column ID, and column length. If you are not sure about how to choose the best combination for your application, column selection can be a frustrating, hit-or-miss decision. The information in this guide can help you choose the proper column for your particular need. Further, it can help you to determine whether a column you already are using is the best choice, or if you might improve resolution, speed of analysis, and/or analyte quantification by using a different column.

Parameters

- **Tubing Material**
- **Stationary Phase**
- **Stationary Phase Film Thickness**
- **Column Internal Diameter (ID)**
- **Column Length**



As always, your satisfaction with Restek chromatography columns is guaranteed. Please contact our **Technical Service Group** (or call 800-356-1688 or 814-353-1300, ext. 4), or your **Restek**



Restek Capillary GC Column Selection Guide

Tubing Material



In either fused silica or stainless steel format, Restek columns offer excellent inertness, consistent column-to-column performance and, when installed and operated according to recommendations, long column lifetimes.

Fused silica Rxi®, Rtx®, or Rt™ columns are your best choice for most applications. They offer the highest coating efficiencies, ensuring the best resolution of closely eluting

compounds. Also, many Restek fused silica columns can be ordered with an **Integra-Guard™ integral guard column**.

Rxi® columns, in particular, provide unmatched performance and exceptionally reliable column-to-column consistency. In developing these columns, we focused on achieving unsurpassed inertness, and the lowest bleed and the highest reproducibility possible. To achieve these goals, we hired the world's best polymer chemists and built a new state-of-the-art research facility. We established rigorous controls on tubing dimensions and surface activity, and we treat this highly uniform tubing with a unique deactivation chemistry, producing a consistent, inert surface on which to apply a polymer. We reformulated our polymers, ensuring neutrality and fine tuning

selectivity for retention time locking.

The resulting exceptionally low-bleed columns are ideal for trace-level GC/MS analysis: with an Rxi® column, you can chromatograph sub-nanogram levels of active acidic or basic compounds on the same column — often under the same conditions.

To ensure reproducibility, we redeveloped our manufacturing process to maximize column-to-column consistency. Every Rxi® column is individually tested and proven to meet our stringent specifications for coating efficiency, selectivity, film thickness, inertness, and bleed. We guarantee every Rxi® column you receive will be the best column you have ever used.

Under harsh operating conditions, choose stainless steel MXT® columns:

- Rough handling (e.g., field instruments or process GC).
- Portable instruments / other small ovens requiring tightly coiled columns.
- High temperature chromatography.

When the potential for breakage is high, MXT® columns are your best choice — they present little risk of spontaneous breakage when used at high temperatures or when coiled into small diameters. While fused silica columns generally cannot be used above 360°C, because the polyimide outer coating becomes brittle over time at high temperatures, MXT® columns function well at temperatures exceeding 450°C. With an MXT® column, the only limitation to oven temperature is the operating limit of the stationary phase.

To prepare MXT® columns, we treat the internal surface of the stainless steel tubing with our exclusive Siltek® surface treatment, making the surface as inert as deactivated fused silica. The Siltek® layer permeates the surface, rather than simply coating it, making the layer

exceptionally flexible, so the tubing can be coiled to very small diameters. Coating efficiencies for MXT® columns are slightly lower than for fused silica columns, because the metal tubing has a larger surface area. We offer MXT® columns with a wide variety of stationary phases, in 0.18mm, 0.25mm, 0.32mm, and 0.53mm ID. The minimum coil diameter for 0.25mm ID or 0.53mm ID MXT® columns is 1.5 inches or 2.5 inches, respectively.

Restek Capillary GC Column Selection Guide

Stationary Phase

The stationary phase is the single most important consideration when you are choosing a column. The interactions between the analytes and the functional groups of the stationary phase contribute more to the overall results of the analysis than any other factor.

Table 1 summarizes the characteristics, chemical structures and, broadly, suggested uses for Restek general-purpose stationary phases. Change selectivity by choosing a stationary phase with a different percentage of substitution of a particular functional group (e.g., by switching from a 5% diphenyl/95% dimethyl polysiloxane stationary phase to a 20% diphenyl/80% dimethyl polysiloxane stationary phase) or by choosing a stationary phase with different functional groups (e.g., by switching from a diphenyl/dimethyl polysiloxane stationary phase to a polyethylene glycol stationary phase). Note that a stationary phase's selectivity for sample components follows the general chemical principle of "like prefers like": a nonpolar stationary phase, such as the Rxi®-1 methyl polysiloxane stationary phase, will preferentially retain and separate nonpolar compounds, such as straight-chain hydrocarbons, relative to polar compounds, such as alcohols. As methyl groups are replaced with more polar functionalities, such as phenyl or cyanopropyl groups, selectivity shifts toward more polar compounds. Polar phases, such as polyethylene glycol phases (e.g., Stabilwax®), are highly selective toward alcohols or other polar compounds.

Table 2 lists Restek special-purpose stationary phases. Columns with these phases are our first recommendations for the applications noted.

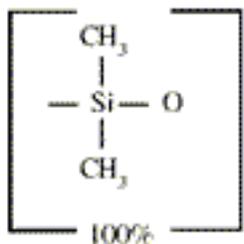
Table 3 lists stationary phases we recommend for environmental analyses by US EPA methods.

Table 4 lists retention indices for test compounds on the stationary phases characterized in Table 1. A retention index is a mathematical derivation indicating the elution position of a compound with respect to normal (straight chain) hydrocarbons. For example, a retention index of 650 for benzene on a particular stationary phase indicates benzene will elute mid-way between n-hexane (RI=600) and n-heptane (RI=700). The longer a particular compound is held by a stationary phase, the greater the retention index will be for that compound. Similarly, the greater the separation between two compounds, the greater the difference between their retention indices. To review retention indices for a wide variety of compounds on a range of Restek stationary phases, see the [retention index tables](#) in our on-line Expert Center.

Note that if you will be using a selective detector, background levels in your chromatograms can be high if the stationary phase contains elements the detector is designed to respond to. For example, avoid using a cyanopropyl (CN)-containing stationary phase with a nitrogen-phosphorus detector, or a fluorine-containing stationary phase with an electron capture detector.

Table 1 Stationary Phase Structures and Properties.

Structure Diagram	Properties
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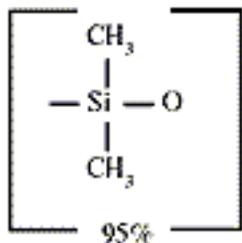
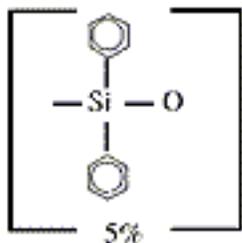
Rxi®-1ms/Rtx®-1MS

100% dimethyl polysiloxane

Stable to 360°C

Polarity: non-polar

Uses: solvents, petroleum products, pharmaceutical samples, waxes



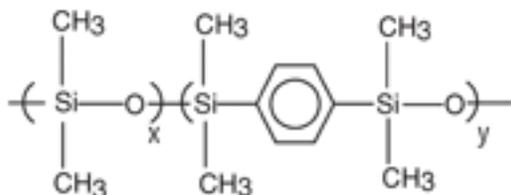
Rxi®-5ms/Rtx®-5/Rtx®-5MS

5% diphenyl - 95% dimethyl polysiloxane

Stable to 360°C

Polarity: slightly polar

Uses: flavors, environmental samples, aromatic hydrocarbons



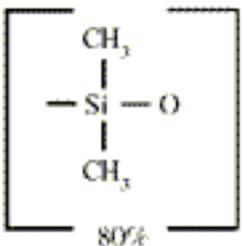
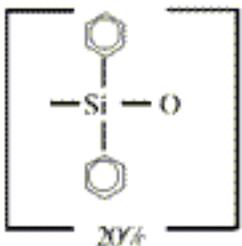
Rxi®-5Sil MS/Rtx®-5Sil MS

proprietary

Stable to 360°C

Polarity: slightly polar

Uses: flavors, environmental samples, pesticides, PCBs, aromatic hydrocarbons



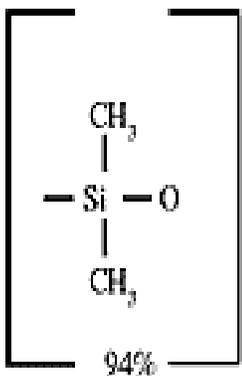
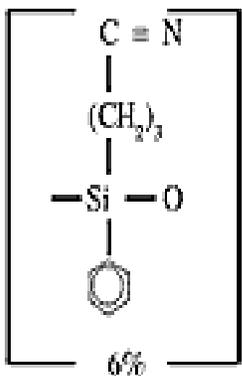
Rtx®-20

20% diphenyl - 80% dimethyl polysiloxane

Stable to 310°C

Polarity: slightly polar

Uses: volatile compounds, alcohols



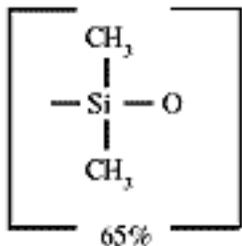
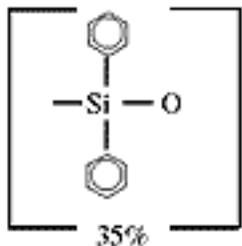
Rtx®-1301, Rtx®-624, Rtx®-G43

6% cyanopropylphenyl - 94% dimethyl polysiloxane

Stable to 280°C

Polarity: slightly polar

Uses: volatile compounds, insecticides, residue solvents in pharmaceutical products



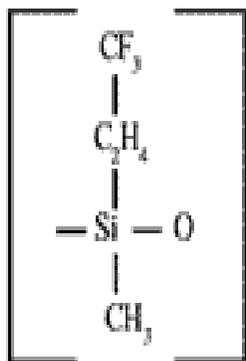
Rtx®-35

35% diphenyl - 65% dimethyl polysiloxane

Stable to 300°C

Polarity: intermediately polar

Uses: pesticides, Aroclor PCBs, amines, nitrogen-containing herbicides



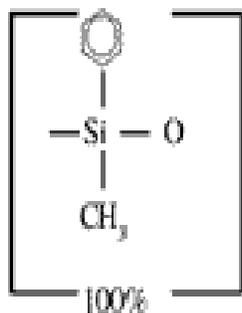
Rtx®-200

trifluoropropylmethyl polysiloxane

Stable to 360°C

Polarity: selective for lone pair electrons

Uses: environmental samples, solvents, Freon® gases, drugs, ketones, alcohols



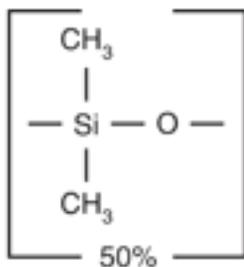
Rtx®-50

100% methylphenyl polysiloxane

Stable to 340°C

Polarity: intermediately polar

Uses: FAMES, carbohydrates



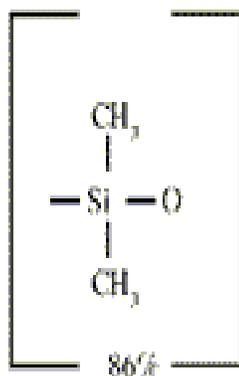
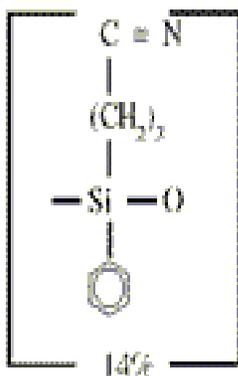
Rxi®-17

50% diphenyl - 50% dimethyl polysiloxane

Stable to 300°C

Polarity: intermediately polar

Uses: triglycerides, phthalate esters, steroids, phenols



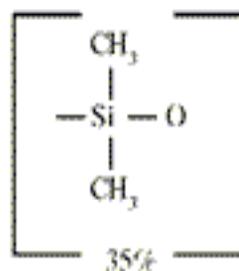
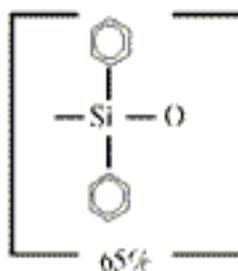
Rtx®-1701

14% cyanopropylphenyl - 86% dimethyl polysiloxane

Stable to 280°C

Polarity: intermediately polar

Uses: pesticides, Aroclor PCBs, alcohols, oxygenates



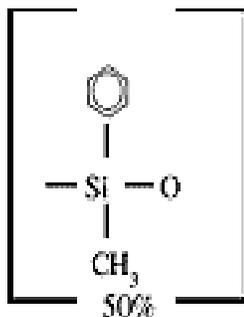
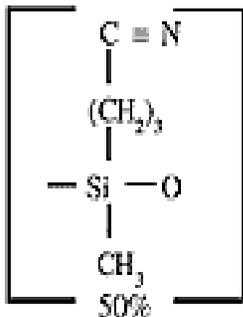
Rtx®-65TG

65% diphenyl - 35% dimethyl polysiloxane

Stable to 370°C

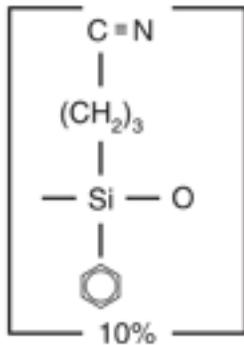
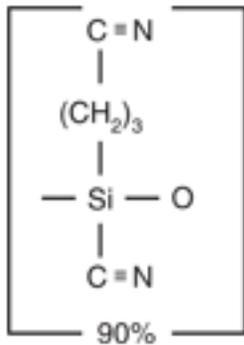
Polarity: intermediately polar

Uses: triglycerides, rosin acids, free fatty acids



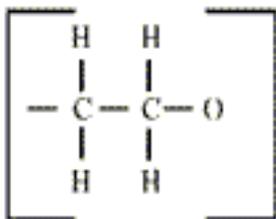
Rtx®-225

50% cyanopropylmethyl - 50% phenylmethyl polysiloxane
 Stable to 260°C
 Polarity: polar
 Uses: FAMES, carbohydrates



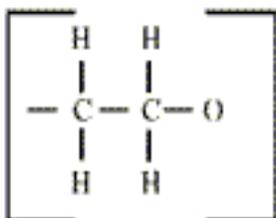
Rt™-2330

90% bis(cyanopropyl) - 10% cyanopropylphenyl polysiloxane
 Stable to 275°C
 Polarity: very polar
 Uses: *cis/trans* FAMES, dioxin isomers, rosin acids



Stabilwax®

Carbowax® PEG
 Stable to 250°C
 Polarity: polar
 Uses: FAMES, flavors, acids, amines, solvents, xylene isomers



Rtx®-Wax

Carbowax® PEG
 Stable to 250°C
 Polarity: polar
 Uses: FAMES, solvents, BTEX aromatics, flavors

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Table 2 Restek special-purpose stationary phases.

Application	Stationary Phase
acids (underivatized)	Stabilwax®-DA
amines (underivatized); other basic compounds	Stabilwax®-DB
amines; other basic compounds	Rtx®-5 Amine Rtx®-35 Amine

blood alcohol; glycols	Rtx®-BAC1 Rtx®-BAC2
chiral compounds	Rt™-βDEX Rt™-γDEX
detailed hydrocarbon analysis (ASTM/CGSB)	Rtx®-IPONA
dioxin and furan congeners	Rtx®-Dioxin Rtx®-Dioxin2
fatty acid methyl esters (FAMES)	FAMEWAX
flavor and fragrance components	Rtx®-1 F&F Rt™-CW20M F&F
nitroaromatic explosives e.g.: US EPA method 8095	Rtx®-TNT Rtx®-TNT2
organochlorine pesticides e.g.: US EPA methods 8081, 608, CLP Pesticides	Rtx®-CLPesticides Rtx®-CLPesticides2 Stx™-CLPesticides Stx™- CLPesticides2
organophosphorus pesticides e.g.: US EPA method 8141A	Rtx®-OPPesticides Rtx®-OPPesticides2
PCB congeners	Rtx®-PCB Stx™-500
residual solvents in pharmaceuticals	Rtx®-G27 Rtx®-G43
simulated distillation	MXT®-500 Sim Dist
simulated distillation: ASTM test method D2887	Rtx®-2887
volatile organic compounds e.g.: US EPA methods 502.2, 524.2,601, 602, 624, 8010, 8020, 8260	Rtx®-VGC Rtx®-VMS Rtx®-VRX Rtx®-Volatiles Rtx®-502.2 Rtx®-624

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Table 3 Stationary phases we recommend for environmental analyses.

For example chromatograms, click on the name of the stationary phase.

US EPA Method	Stationary Phase
502.2 (volatile organics)	Rtx®-502.2
504.1 (dibromoethane/dibromochloropropane)	Rtx®-CLPesticides Rtx®-CLPesticides2
506 (phthalate & adipate esters)	Rxi®-5Sil MS/Rtx®-5Sil MS Rxi®-1ms
515/515.1 (chlorophenoxyacid herbicides)	Rtx®-440 Rtx®-50 Rtx®-CLPesticides Rtx®-CLPesticides2
524.2, Rev. IV (volatile organics)	Rtx®-VMS
525.2 (semivolatile organics)	Rxi®-5ms
526 (semivolatile organics)	Rxi®-5Sil MS/Rtx®-5Sil MS
528 (phenols)	Rxi®-5Sil MS/Rtx®-5Sil MS
551.1 (chlorinated disinfection byproducts)	Rtx®-5 Rtx®-200 Rtx®-1301

552.2 (haloacetic acids)	Rtx@-5 Rtx@-200 Rtx@-CLPesticides Rtx@-CLPesticides2
601 (volatile organics)	Rtx@-CLPesticides Rtx@-CLPesticides2 Stx™-CLPesticides Stx™-CLPesticides2
602 (volatile organics)	Rtx@-VMS Rtx@-VGC
604 (phenols)	Rtx@-5 Rtx@-50 Rtx@-200
608 (organochlorine pesticides & PCBs)	Rtx@-CLPesticides Rtx@-CLPesticides2 Rtx@-PCB Stx™-500 (PCBs)
610 (polynuclear aromatic hydrocarbons)	Rxi@-5ms Rxi@-5Sil MS/Rtx@-5Sil MS Rtx@-440
615 (chlorophenoxyacid herbicides)	Rtx@-35 Rtx@-5
619 (organonitrogen/organophosphorus pesticides)	Rtx@-CLPesticides Rtx@-CLPesticides2 Rtx@-50 Rtx@-200
624 (volatile organics)	Rtx@-VMS , Rtx@-VGC
1671 (volatile organics)	Stabilwax@ Stabilwax@-DB
8010 (volatile organics)	Rtx@-VMS Rtx@-VGC
8020 (volatile organics)	Rtx@-VMS Rtx@-VGC
8021 (volatile organics)	Rtx@-VGC Rtx@-VRX
8081/8081A (organochlorine pesticides)	Rtx@-CLPesticides Rtx@-CLPesticides2 Stx™-CLPesticides Stx™-CLPesticides2 Rtx@-440 Rtx@-XLB
8095 (nitroaromatic explosives)	Rtx@-TNT Rtx@-TNT2
8100 (polynuclear aromatic hydrocarbons)	Rtx@-5
8140/8141/8141A (organophosphorus pesticides)	Rtx@-OPPesticides Rtx@-OPPesticides2 Rtx@-CLPesticides Rtx@-CLPesticides2
8151/8151A (organochlorine pesticides)	Rtx@-CLPesticides Rtx@-CLPesticides2 Rtx@-440
8240 (volatile organics)	Rtx@-VMS Rtx@-VGC
8260/8260B (volatile organics)	Rtx@-VMS
8270/8270D (semivolatile organics)	Rxi@-5Sil MS/Rtx@-5Sil MS Rxi@-5ms Rtx@-XLB
Appendix IX (semivolatile organics)	Rxi@-5Sil MS/Rtx@-5Sil MS MS
CLP (semivolatile organics)	Rtx@-5ms

TO-14/TO-15 (air toxins)	Rtx®-1 Rtx®-502.2
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Table 4 Retention indices for Restek general purpose stationary 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

Restek Capillary GC Column Selection Guide

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Stationary Phase Film Thickness

Stationary phase film thickness affects the retention and elution temperature for each compound in the sample. A thicker film retains compounds longer, increasing the length of time each compound spends in the column (**Table 1**). A thinner film retains compounds less, reducing the length of time each compound spends in the column. Very volatile compounds should be analyzed on a thick film column, to increase the time they spend in the column and allow them to separate. High molecular weight compounds must be analyzed on a thin film column, to reduce analysis time to a practical interval, and help minimize bleed at the higher temperatures required to elute such compounds.

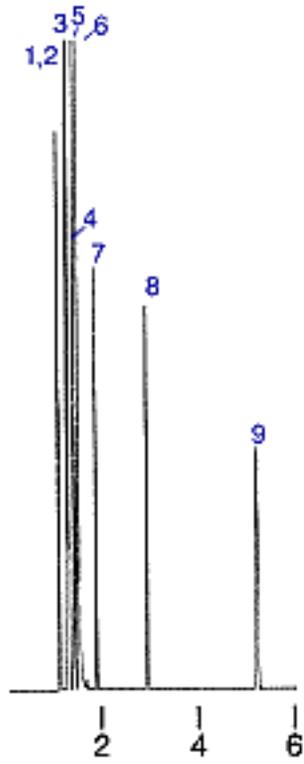
A comparative analysis of low boiling compounds on a 0.25 μ m, a 1.0 μ m, and a 5.0 μ m film of stationary phase, with all other variables held constant, shows the influence of film thickness (**Figure 1**). The 0.25 μ m film does not resolve butanol from benzene (peaks 1 & 2). The 1.0 μ m film provides about 80% resolution of this pair, but retention times are more than double those for the 0.25 μ m film. The 5.0 μ m film does not improve resolution between butanol and benzene, relative to the 1.0 μ m film, and retention times are increased by a factor of six relative to the 0.25 μ m film. So, for this particular sample, the 1.0 μ m phase film is best: resolution is suitable for quantifying the analytes, analysis time is acceptable, and a thicker film does not offer notable improvements. On the other hand, if we wanted to resolve very volatile C2 or C3

compounds, which would elute prior to peak 1, the 5.0 μ m film would be required.

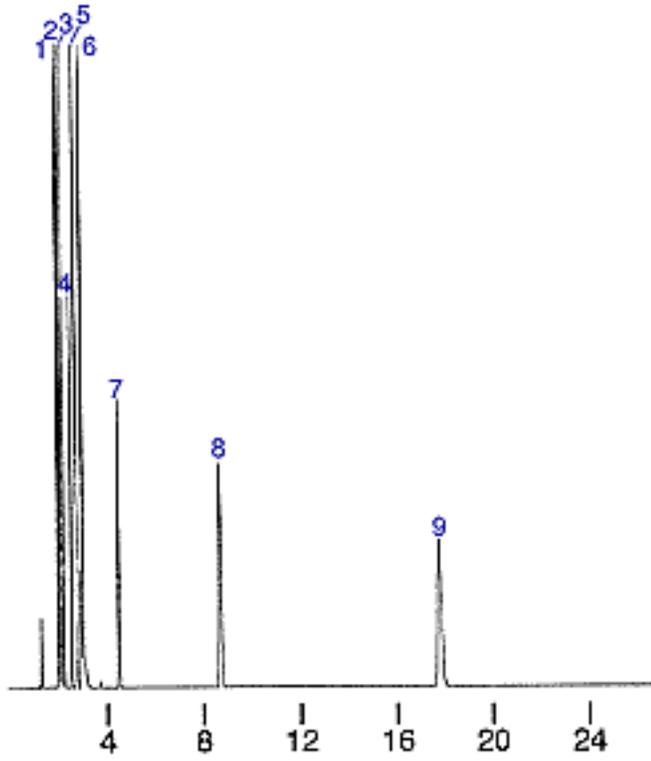
Both sample capacity and bleed increase as stationary phase film thickness is increased.

Changes in the column ID/stationary phase film thickness ratio, β , are an important consideration when you want to make a change in column internal diameter or in stationary phase film thickness. Analyte retention increases as column internal diameter is decreased, and analyte retention decreases as stationary phase film thickness is decreased. When other column parameters and analysis conditions are held constant, a column with a smaller β value will be more retentive for a given analyte. To assure similar retention and resolution when you increase the column ID, you also must increase the stationary phase film thickness. Similarly, if you wish to reduce the column ID, but keep retention and resolution similar, you also must reduce the stationary phase film thickness. **Table 2** lists β values for common combinations of column ID and stationary phase film thickness; where β values for different combinations are similar, elution patterns will be similar. To find β values for other column ID/stationary phase film combinations, use the **Beta Calculator**.

Figure 1 A sample containing low boiling components shows the differences in resolution among 0.25, 1.0, and 5.0 μ m columns. The 1.0 μ m column offers better resolution than the 0.25 μ m column, and the 5.0 μ m column does not offer any further improvements for compounds eluting after C6.

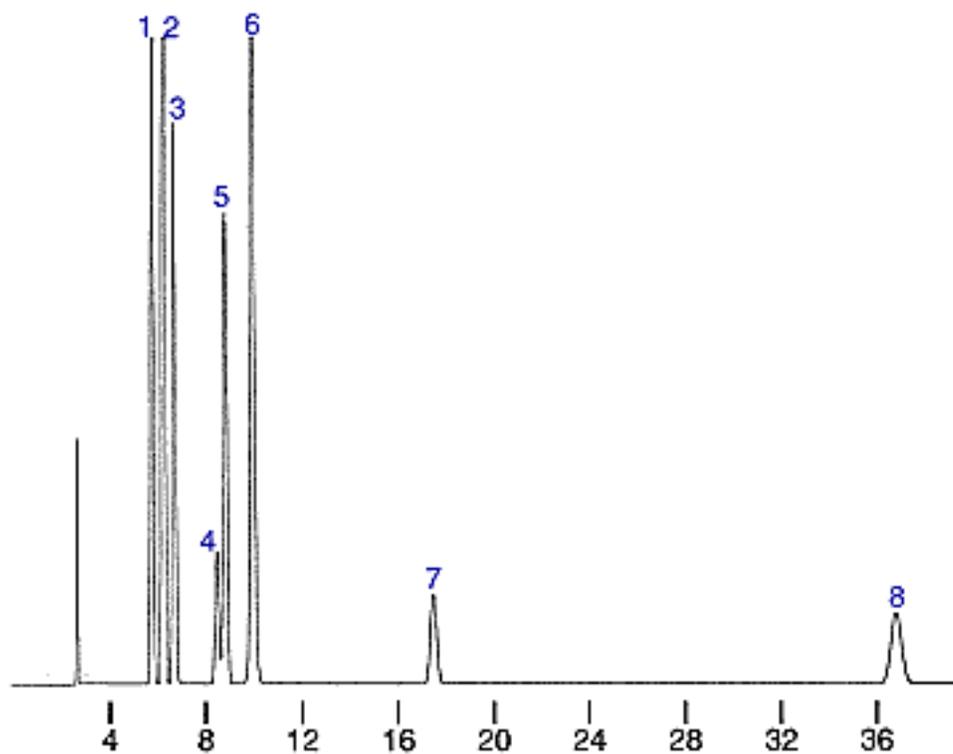


0.25µm, Rtx®-1



1.0µm, Rtx®-1

5.0µm, Rtx®-1



1. butanol
2. benzene
3. 2-pentanone
4. C7
5. 1-nitropropane
6. pyridine
7. C8
8. C9
9. C10

(Peak 9 elutes @ 117 minutes on the 5.0 μ m)

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Table 1 Characteristics of thick film and thin film stationary phases.

Thick Films	Thin Films
higher sample capacity	lower sample capacity
less efficient	more efficient
longer retention times	shorter retention times
effectively retain lower molecular weight analytes	efficiently release higher molecular weight analytes
higher bleed	lower bleed

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Table 2 Column ID: phase film ratio (β) value calculation for film thickness vs. column IDs

Column ID	phase film thickness (df) / β value						
	0.10 μ m	0.25 μ m	0.50 μ m	1.00 μ m	1.50 μ m	3.00 μ m	5.00 μ m
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

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Restek Capillary GC Column Selection Guide

Column Internal Diameter (ID)

Your need for **resolution**, the **concentrations of analytes** you anticipate in your samples, and the **sample introduction and analyte detection** instrumentation you are using will influence your choice of column internal diameter.

When all other column parameters and analysis conditions are held constant, analyte retention increases, and resolution improves, as column internal diameter is decreased. Sample capacity increases as internal diameter is increased. Bleed also increases as column diameter is increased and film thickness is held constant, because there is more stationary phase in the column, however for most applications the difference in bleed will be insignificant.

Columns with an ID of 0.25mm or less offer the highest column efficiencies, and therefore the greatest resolution, but have limited sample capacities, relative to wider ID columns. If concentrations of analytes in your samples exceed the capacity of the column, the analysis will be characterized by peak distortion, poor resolution, and poor reproducibility. For many applications a 0.32mm ID column offers the best balance of resolution and sample capacity.

0.53mm ID columns are best for high flow situations, such as accommodating incoming samples

from a purge and trap unit. Alternatively, columns with an ID of 0.25mm or less are the best choice for GC/MS applications — they provide optimal performance with small flows of carrier gas, and thus can be connected directly to the vacuum source of a mass spectrometer, eliminating the complications associated with a jet separator.

Use **Table 1** to compare typical column characteristics according to column ID, then select the ID that best matches your needs.

Table 1 Characteristics of thick film and thin film stationary phases.

Select Column ID:

Column Parameters	Values
Typical Spitless Purge Time	
He split vent flow rate (50:1 split ratio)	
H2 split vent flow rate (50:1 split ratio)	
Column OD (Ferrule ID)	
Column Flow Rate (He @ 20cm/sec.)	
Column Flow Rate (H2 @ 40cm/sec.)	
Approximate Sample Capacity	
Typical Effective Plates/m (80% CE)	

Approximate column head pressure (He or H2 carrier gas)	
Column (m):	6101215202530406075105150
Head Pressure (psig):	

Always optimize the column flow rate by using linear velocity.

Phase Ratio Calculations

Changes in the column ID/stationary phase film thickness ratio, beta, are an important consideration when you want to make a change in column internal diameter or in stationary phase film thickness. Analyte retention increases as column internal diameter is decreased, and analyte retention decreases as stationary phase film thickness is decreased. When other column parameters and analysis conditions are held constant, a column with a smaller beta value will be more retentive for a given analyte. To assure similar retention and resolution when you increase

the column ID, you also must increase the stationary phase film thickness. Similarly, if you wish to reduce the column ID, but keep retention and resolution similar, you also must reduce the stationary phase film thickness. **Table 2** lists beta values for common combinations of column ID and stationary phase film thickness; where beta values for different combinations are similar, elution patterns will be similar. To find beta values for other column ID/stationary phase film combinations, use the [Beta Calculator](#).

Table 2 Column ID: phase film ratio (beta) values for commonly used column dimensions.

Column ID	phase film thickness (df) / beta value						
	0.10µm	0.25µm	0.50µm	1.00µm	1.50µm	3.00µm	5.00µm
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

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Column Length

Longer columns provide more resolving power, but increase analysis time and column purchase costs. As you consider whether the increase in resolution is worth the extra time and expense, remember that the benefit of using a longer column is much greater if you are performing a temperature programmed analysis than if you are performing an isothermal analysis. In an **isothermal analysis**, retention time varies directly with column length: if column length is doubled, analysis time will double as well. The increase in resolution will be only approximately 40%, however, because resolution is related to the square root of column length, as shown in the equation below. In a **temperature programmed analysis**, retention times are more dependent on temperature than on column length. As column length is increased, the increase in resolution will be the same as for an isothermal analysis, but there will be only a marginal increase in analysis time.

Length Effects

Length affects resolution and speed of analysis.

$$\text{Resolution} = \frac{1}{4} \sqrt{\frac{L}{h}} \times \frac{k}{k+1} \times \frac{\alpha-1}{\alpha}$$

L = length h = HETP k = capacity factor α = selectivity

HPLC Column Selection Guide



The uniform spherical shape of Restek silica allows optimal packing, for better reproducibility and lower back pressure, resulting in extended column life.

Restek Corporation manufactures a variety of columns for reversed phase or normal phase applications. The Allure™ and Ultra column product lines contain 19 different phases, and we continue to develop additional unique HPLC products. Pinnacle II™ and Pinnacle™ DB columns are based on silica we manufacture in our own laboratories, so you can be assured of their quality, from raw material synthesis through packing and testing.

We pack bonded phases into a wide range of column dimensions, including standard analytical columns in lengths of 30 to 250mm, internal diameters of 1.0 to 4.6mm, and particle sizes of 3 or 5µm. Preparative and semi-preparative columns are available, as well. These hundreds of column choices can make column selection overwhelming. The chart below, and the information on the back of the chart, are general guidelines to help simplify the column selection process.



Restek HPLC Column	End Cap?	Pore Size (Å)	Carbon Load (%)	Applications	Chromatographic Properties	Similar Phases	USP Code
Pinnacle™ DB C18	Y	140	11	Hydrophobic C18 phase suitable for a wide range of compounds, neutral through weakly basic.	Highly base-deactivated spherical silica manufactured by Restek Corp. Monomeric C18 bonding.	Hypersil® BDS C18	L1
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.	Highly base-deactivated spherical silica manufactured by Restek Corp. Monomeric C8 bonding. Similar to Pinnacle™ DB C18, but the shorter alkyl chain provides less hydrophobic retention.	Hypersil® BDS C8	L7
Pinnacle™ DB Cyano	Y	140	4	Suitable for a wide range of compounds, from acidic through weakly basic. Also useful for confirmation of analyses on C18 or C8. Can be used in normal phase or reversed phase mode of separation.	Cyano bonding on highly base-deactivated spherical silica manufactured by Restek Corp.	Hypersil® BDS Cyano	L10
Pinnacle™ DB Silica	NA	140	NA	Normal phase separations.	Highly base-deactivated spherical silica manufactured by Restek Corp.	Hypersil® BDS	L3
Pinnacle II™ C18	Y	110	13	Superior general purpose C18 for neutral and acidic analytes.	Intermediate carbon load and surface area, suitable for a wide range of neutral to acidic compounds. Silica manufactured by Restek Corp.	Hypersil® ODS; Spherisorb® ODS	L1
Pinnacle II™ PAH	Y	110	P	Maximum resolution of polynuclear aromatic hydrocarbons.	Proprietary stationary phase; resolves 16 PAHs in US EPA Method 610. Silica manufactured by Restek Corp.	Unique	
Pinnacle II™ C8	Y	110	7	Superior general purpose C8 for neutral and acidic analytes.	Provides shorter retention times for hydrophobic compounds than C18. Silica manufactured by Restek Corp.	Hypersil® C8	L7
Pinnacle II™ Cyano	Y	110	4	Superior general purpose cyano for weakly basic analytes. Can be used in normal phase or reversed phase mode of separation.	More rugged than bare silica for normal phase analyses. Silica manufactured by Restek Corp.	Hypersil® Cyano; Spherisorb® Cyano	L10
Pinnacle II™ Phenyl	Y	110	6	Superior general purpose phenyl for neutral to weakly basic analytes.	Offers unique selectivity versus traditional alkyl chain phases, especially for aromatic compounds. Silica manufactured by Restek Corp.	Hypersil® Phenyl; Spherisorb® Phenyl	L11
Pinnacle II™ Amino	N	110	2	Excellent general purpose amino phase. Excellent choice for carbohydrate analysis.	Silica manufactured by Restek Corp.	Hypersil® Amino; Spherisorb® Amino	L8
Pinnacle II™ Silica	NA	110	NA	Superior value phase for normal phase separation of polar analytes.	Lower retention than Ultra C18. Silica manufactured by Restek Corp.	Hypersil® Silica	L3
Allure™ C18	Y	60	27	Ideal for MS and light-scattering detection of neutral to slightly polar non-ionic solutes. Excellent for basic compounds, explosives, or steroids.	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. Extensive deactivation.	Ultracarb® C18; Betamax® Neutral	L1
Allure™ Aqueous C18	N	60	P	Ideal for analyses that require >90% water in the mobile phase. Excellent for highly water soluble or poorly organic soluble compounds, water-soluble vitamins, organic acids. More retention than Ultra Aqueous columns.	Highly retentive and selective for reversed phase separations of polar analytes. Highly base deactivated. Compatible with highly aqueous (up to 100%) mobile phases.		L1
Allure™ Basix	Y	60	12	Ideal for LC/MS of basic solutes. Excellent for basic pharmaceuticals or other amine-containing compounds.	Highly retentive phase for analytes containing amino functionality.	Betamax® Base; Maxsil® CN	L10
Allure™ PFP Propyl	Y	60	17	Excellent for beta-blockers, halogenated compounds, nucleosides, nucleotides, pyridines, pyrimidines, or tricyclic antidepressants. Ideal for MS, ELSD, or NPD detection.	A pentafluorophenyl phase with a propyl spacer. Highly retentive for basic analytes.	Discovery HS F5	
Allure™ Organic Acids	N	60	P	Excellent resolution of challenging organic acids.	Single 30cm column performs equally to two C18 columns in series. (AOAC Method 986.13)	Unique	
Allure™ Silica	NA	60	NA	Highly retentive phase for polar analytes by normal phase separation.	High purity, very high surface area.	Maxsil® Si	L3
Ultra C18	Y	100	20	Ideal for anilines, barbiturates, carbonyls, fat-soluble vitamins, fatty acids, glycerides, phthalates, PTH amino acids, steroids, other acids.	Very retentive, high-purity packing material exhibits excellent peak shape for a wide range of compounds. Excellent first choice general purpose reversed phase column.	Discovery C18; Symmetry C18; Luna® C18; Zorbax® C18; Kromasil® C18; Lichrospher® RP-18; Inertsil® ODS-2; Develosil® C18	L1
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, water-soluble vitamins, organic acids.	Highly retentive and selective for reversed phase separations of polar analytes. Extensively base deactivated. Compatible with highly aqueous (up to 100%) mobile phases.	ODS-AQ; Aquasil C18; Zorbax® SB-AQ	L1
Ultra IBD	N	100	12	A polar group assists in deactivating surface silanols and contributes to unique selectivities for acids, bases, zwitterions, and polar compounds.	Intrinsically base-deactivated (IBD) phase, with a polar group embedded in the alkyl bonded phase. Provides unique selectivity while reducing or eliminating the need for mobile phase additives.	Symmetry Shield; Discovery ABZ & ABZ+; Prism®; HyPurity Advance	
Ultra C8	Y	100	12	Excellent peak shape for a wide range of compounds. Selectivity and peak shape similar to Ultra C18, but less hydrophobic retention.	Very retentive, high-purity, base-deactivated reversed phase packing.	Luna® C8; Symmetry C8; Kromasil® C8	L7
Ultra C4	Y	100	9	Ideal for peptides, small proteins, hormones.	Exceptionally stable C4 packing, with high bonding coverage and silanol base-deactivation. Shorter retention than C18 or C8.	Supelcosil Butyl (C4); Delta-Pak® C4	L26
Ultra C1	NA	100	5	Alternative selectivity to Ultra C18 or C8, especially for polar analytes. Shortest chain alkyl phase available for reversed phase separations.	Exceptionally stable C1 packing resists hydrolysis, even under acidic mobile phase conditions. Least retentive reversed phase hydrocarbon packing.	Spherisorb® C1	L13
Ultra Cyano	Y	100	8	Excellent for basic pharmaceuticals, steroids (normal or reversed phase conditions), or other basic compounds.	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 separations.	Platinum® CN; Develosil® Cyano; Luna® CN	L10
Ultra Phenyl	Y	100	10	Ideal for fatty acids, polynuclear aromatic hydrocarbons, purines and pyrimidines, polar aromatics.	High-purity, highly retentive, base-deactivated phase with alternate selectivity to hydrocarbon phases, especially for aromatic analytes.	Platinum® Phenyl; Supelcosil Phenyl	L11
Ultra Amino	N	100	2	Superior general purpose amino phase. Ideal for carbohydrates.	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® NH ₂	L8
Ultra PFP	Y	100	7	Ideal for taxol and precursors, halogenated compounds, amines, esters, or ketones.	A pentafluorophenyl phase. Unique selectivity by interaction with functional groups of organohalogen or other basic analytes.	Fluophase® PFP; Fluosep-RP® Phenyl	L43
Ultra Silica	NA	100	NA	Ideal for normal phase applications.	High purity, high surface area.	Unique	L3
Ultra Carbamate	P	100	P	Rapid analysis of carbamates.	Proprietary stationary phase can process up to twice as many samples per hour, compared to a conventional C18 phase.	Unique	
Ultra Quat	P	100	P	Proprietary phase for paraquat, diquat, and other quaternary amines.	High purity silica. Requires a reagent solution.	Unique	—
Viva™ Wide Pore C18	Y	300	6	Proteins and other higher molecular weight compounds.	Silica manufactured by Restek Corp.	Symmetry® 300 C18; Jupiter® 300 C18; BioBasic® C18; Zorbax® 300 SB-C18	
Viva™ Wide Pore Silica	NA	300	NA	Higher molecular weight compounds by normal phase mode.	Silica manufactured by Restek Corp.	Symmetry® 300 silica; Jupiter® 300 silica; Zorbax® 300 silica	

P= proprietary
 NA= not applicable
 All columns: recommended pH range is 2.5–7.5; temp. limit 80°C.
 Column lifetimes can be shortened by operating at pH and/or temperature extremes.

Call Restek Now for the Right Column for Your Tough Analysis 1-800-356-1688

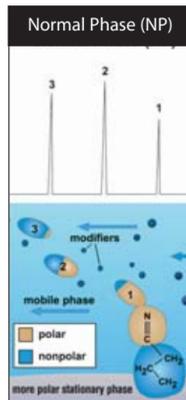
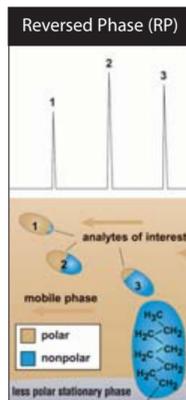
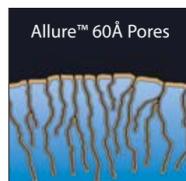


Choosing a Stationary Phase

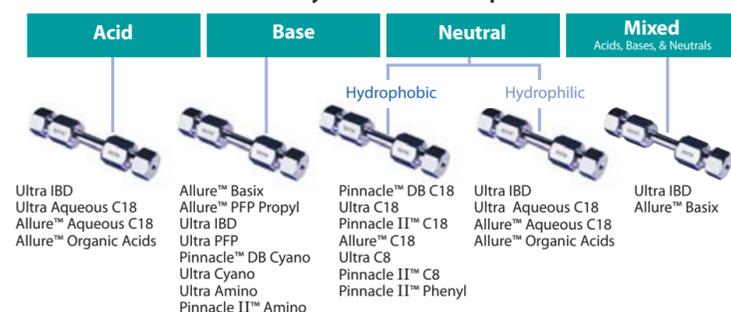
- Most critical decision in column selection.
- Based on analyte solubility and chemical differences among analytes.
- Analyte solubility dictates mode of separation: Reversed phase - analytes soluble in water and/or polar organic solvent (e.g., acetonitrile, methanol). Mobile phase more polar than stationary phase. Normal phase - analytes soluble in nonpolar solvent (e.g., hexane). Mobile phase less polar than stationary phase.

Pore Size

- Small molecules (<2000mw) generally analyzed on material with pore size $\leq 200\text{\AA}$ (typical size: 60 \AA –180 \AA).
- Large molecules (>2000mw) generally analyzed on material with pore size $\geq 300\text{\AA}$.
- Surface area inversely related to pore size (the smaller the pores the larger the surface area).
- Stationary phase loading directly related to surface area (the larger the surface area the higher the stationary phase loading).



Analyte Functional Group



Choosing a Mode

Sample Characteristics

Sample soluble in:	Ionic Strength	Analytes primarily differ by:	Recommended Mode:
water and/or polar organics	nonionic	hydrophobicity/hydrophilicity	RP
	weakly ionic	hydrophobicity/hydrophilicity	RP with ion suppression
	nonionic/weakly ionic	size (>2000MW)	SEC (GPC)
nonpolar organics	strongly ionic	hydrophobicity/hydrophilicity	RP-IP, IEX
	nonionic	hydrophobicity/hydrophilicity	NP
	weakly ionic	hydrophobicity/hydrophilicity	NP with ion suppression
	nonionic/weakly ionic	size (>2000MW)	SEC (GPC)

RP - reversed phase
SEC - size exclusion chromatography
GFC - gel filtration chromatography
RP-IP - reversed phase-ion pair ion exchange
NP - normal phase
GPC - gel permeation chromatography
IEX - ion exchange

Column Dimensions

ID

- Theoretically, resolution and pressure are independent of ID, if the mobile phase flow rate is adjusted to maintain the same linear velocity.
- Smaller column ID can increase sensitivity if sample is limited.
- Smaller column ID can reduce / eliminate need for flow splitting in LC/MS.
- Column ID <3.2mm requires reducing extra column volume (tubing, injector, detector flow cell).

Length

- If all else is equal: shorter columns provide faster analyses and less backpressure; longer columns provide greater resolution
- Efficiency (N) is directly related to column length, but is a square root factor in resolution: therefore, a 4-fold increase in length is needed to double resolution

$$[R = \frac{1}{4} (\alpha - 1 / \alpha) (\sqrt{N}) (k' / k' + 1)]$$

α : selectivity k' : capacity

Particle Size

- Analytical separations generally are on 5 μm or smaller particles.
- Semi-preparative and preparative analyses generally are on 7 μm or larger particles.
- Smaller particles provide greater efficiency (N) than larger particles (a 3 μm particle provides ~50% greater efficiency than a 5 μm particle).
- Smaller particles create higher backpressure.

Steps in Scouting a Method

1. Choose stationary phase based on chemistry of analytes.
2. Use a 150 x 4.6mm, 5 μm column; determine appropriate mobile phase strength needed ($2 < k < 5$) by using a gradient test run.
3. If resolution is close to requirements, optimize column dimensions and conditions. If large gain in resolution is needed change mobile phase composition or stationary phase.

Optimum Flow Rate

ID (mm)	5 μm Particles Flow Rate (mL/min.)	3 μm Particles Flow Rate (mL/min.)
4.6	1.00	1.5
3.2	0.50	0.73
2.1	0.20	0.31
1.0	0.05	0.07

Trident™ Direct Guard Column System

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 the following 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. Use 4.0mm ID guard with 4.6 or 4.0mm ID analytical column, 2.1mm ID guard with 2.1 - 3.2mm ID analytical column.

Trident™ Direct Guard Column System

Description	qty.	cat.#
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, 2.0 μm	5-pk.	25022
Replacement cap frits: 4mm, 0.5 μm	5-pk.	25023
Replacement cap frits: 2mm, 2.0 μm	5-pk.	25057

*The standard PEEK® tip in Trident™ Direct systems is compatible with Parker®, Upchurch®, Valco®, and other CPI-style fittings. To use Trident™ Direct systems with Waters®-style end fittings, the tip must be replaced with cat.# 25088.

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Other Trademarks: Aqasil, Betamax, BioBasic, Fluophase, Hypersil, Prism, HyPurity Advance (Thermo Electron Corp.); Delta-Pak, Spherisorb, Symmetry, Waters (Waters Corp.); Develosil, Jupiter, Luna, Maxsil, Ultracarb (Phenomenex, Inc.); Discovery, Supelcosil (Sigma-Aldrich Co.); Fluosep-RP (ES Industries); Inertsil (GL Sciences, Inc.); Kromasil (Eka Chemicals); LiChrospher (Merck KGaA); Parker (Parker Instrumentation Division); PEEK (Vitrex plc); Platinum (Alltech Associates, Inc.); Upchurch (Upchurch Scientific); Valco (Valco Instruments Co., Inc.); Zorbax (Agilent Technologies, Inc.).

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INNOVATIVE PRODUCTS

HPLC Column Selection Guide



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Restek Capillary Column Installation Guide

Section III: Operational Information

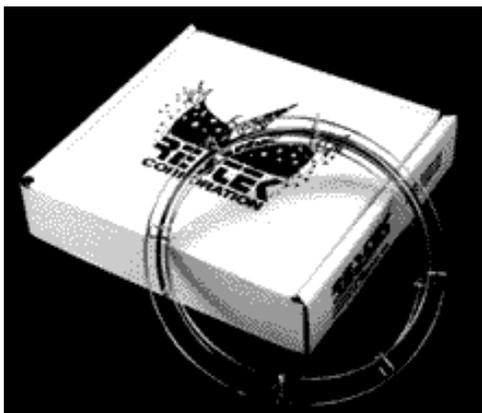
- A. Standby operation
- B. Column removal and storage
- C. Protection against dirty samples
- D. Connecting fused silica tubing
- E. Connecting stainless steel tubing
- F. Column maintenance and rinsing
- G. Injecting water and other solvents

A. Standby Operation

If the column is not going to be used for several days but the instrument must remain on standby, reduce the splitter vent flow rate to 10cc/min. (to conserve carrier gas) and maintain an oven temperature between 100°C and 150°C. Keeping the oven slightly hot minimizes septa bleed from accumulating at the head of the column and reduces the need for excessive conditioning when the column is used. Make sure there is a sufficient carrier gas supply when leaving the column in standby operation. If the column will be unused for three or more days, it is best to shut down all heated zones and leave the column in the GC with a low flow of carrier gas. Never leave the column in the GC without carrier gas flowing.

B. Column Removal and Storage

Remove the column from the GC. Make sure that there are no ferrule fragments in the injector or detector fittings. If a graphite ferrule sticks in the fitting, remove it by using a tapered needle file (cat.# 20106). Insert the file and spin it slightly until it is latched inside the ferrule. Then move the file slightly from side-to-side, while applying force, until the ferrule slips out of the fitting. If the ferrule does not come out in one piece, disassemble the fitting and inspect all parts to make sure that all fragments are removed.



Seal the column ends with a high temperature (2000°C) Microflame™ torch (cat.# 20125) immediately after removing the column from the GC. If a Microflame™ torch is not available, or when using stainless steel columns, insert the column ends into a septum to prevent phase oxidation during storage. Always store the column in the original box, away from sunlight or fluorescent lights, to avoid polymer damage. In particular, Stabilwax®, Rtx®-1301, and Rtx®-1701 columns (polyethylene glycol and cyanosilicone polymers) are especially susceptible to uv induced degradation and should be shielded from light.

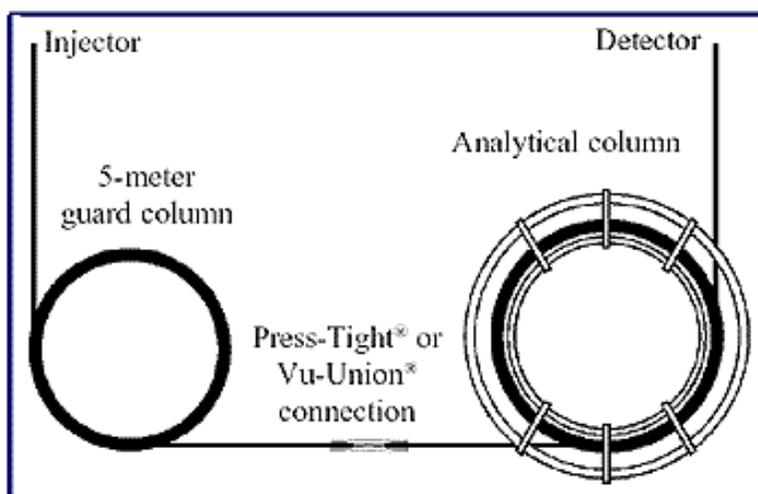
C. Protection Against Dirty Samples

Samples that contain non-volatile or high molecular weight residue can contaminate the stationary phase, decrease quantitative accuracy, and cause a loss of peak resolution after a limited number of injections. Packing the inlet sleeve and using a guard column are two specific precautions recommended to help increase the number of analyses performed before column and inlet sleeve maintenance is required.

The first precaution involves the use of an inlet sleeve packed with silanized fused silica or glass wool (cat.# 20790, 20789) or highly inert silica beads (cat.# 20791) to trap sample residue and prevent it from entering the capillary column. Insert a loosely packed 2cm wool plug approximately 1cm below the maximum penetration distance of the syringe needle. Too much packing material can detrimentally affect the performance of the column. Refer to the instrument manual for specific inlet packing instructions.

Stationary phase coated packings are not recommended since they tend to be adsorptive and can bleed stationary phase onto the column. This problem is particularly damaging if a methyl silicone inlet packing is used with a Carbowax® PEG-type capillary column.

The second precaution involves using a 5-meter deactivated, uncoated guard column at the analytical column inlet (**Figure L**). The guard column prolongs column life by trapping non-volatile contaminants before they enter the analytical column. Sample components travel at the same rate as the carrier gas on the uncoated guard column inlet, but slow down considerably when they reach the analytical column's stationary phase. Because the

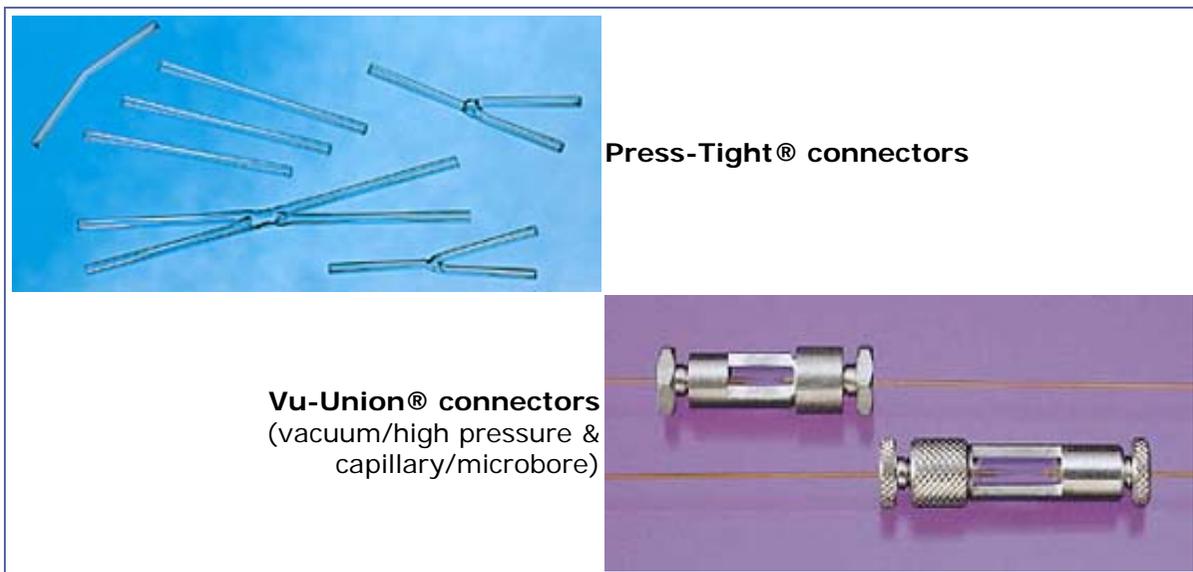


sample's rate of travel is faster through a guard column, the sample has a limited interaction time with residue and, therefore, is not as affected by its presence. Without a guard column, sample residue affects chromatographic performance more rapidly due to increased interaction times. A 5-meter guard column also allows contaminated segments to be removed without having to reconnect the column each time. Restek's Integra-Guard™ is a built-in guard column configuration that eliminates connectors. For more information on protection against dirty samples, request Restek's bulletin A Guide When Injecting Dirty Samples.

D. Connecting Fused Silica Tubing

Connectors are necessary to attach guard columns and restrictors, or to repair broken analytical columns. Both Press-Tight® connectors and Vu-Union® connectors are effective at making low dead volume, inert connections. Press-Tight® connectors are best for standard applications at temperatures below 325°C. Polyimide resin (cat.# 20445) can be used to strengthen and create permanent press-tight connections, preventing the possibility of premature separation. Vu-Union® connectors are appropriate for high temperature or high pressure applications, or when attaching an analytical column to a mass spectrometer transfer line. Call Restek's Technical Service at (800) 356-1688 (ext. 4) for more information on the use of these two connectors.





Press-Tight® connectors

Vu-Union® connectors
(vacuum/high pressure &
capillary/microbore)

Connecting Columns with Press-Tight® Connectors

1. Cut the column ends squarely.
2. Wipe the column ends with methanol to lubricate and clean.
3. Carefully insert the ends into the Press-Tight® Connector.
4. Visually inspect (see photo).
5. Leak-check using a thermal conductivity leak detector.

E. Connecting Stainless Steel Tubing

In order to connect MXT® columns, special connectors must be used. The MXT® Low Dead Volume connector (cat.# 20397, 20394) and MXT® Low Dead Volume "Y" connector (cat.# 20396, 20395) are Silcosteel®-treated and deactivated to make them inert to active compounds. They will not cause peak tailing or affect system inertness and can be used up to 400°C without degrading the deactivation layer. Stainless steel replacement ferrules are available to fit 0.28mm ID MXT columns (cat. # 20398) and 0.53mm ID MXT columns (cat. # 20399).

MXT® tubing can be connected to fused silica tubing by using a capillary Vu-Union® connector (cat.# 20418) provided the end of the MXT® column is properly burnished into a conical shape. The flat side of a ceramic scoring wafer can be used to polish or round the column end into a conical taper. An MXT® connector with a special ferrule (cat. # 20259) can also be used with a fused silica column. A fused silica Press-Tight® connector cannot be used with MXT® columns because without polyimide coating on the outside of the tubing, a leak-free connection cannot be obtained.

F. Column Maintenance and Rinsing

Maintenance is necessary if a column experiences high bleed (that cannot be decreased by overnight conditioning), adsorption of active components, peak tailing, or changes in relative retention times. Cutting two loops (approximately one meter) from the column inlet is often sufficient to restore a contaminated column. However, high molecular weight residue carried deep into the column bore can only be removed by solvent rinsing. To remove pyrolyzed contaminants that are not solvent-soluble, cut two loops from the column's inlet and one loop from the outlet. Closely examine the inlet end of the column to make sure that all contaminated tubing has been removed. Occasionally, it becomes necessary to remove more than two loops from a heavily contaminated column to restore it to acceptable performance. Solvent rinsing removes only soluble contaminants and may not always restore a bonded phase capillary column to its original performance. **Figure M** illustrates the performance of a column that has been successfully solvent-rinsed. Choose a series of polar and non-polar volatile solvents that will solubilize the suspected contamination. Only use solvents shown in **Table VII** to rinse Restek columns. If you are

using a solvent that is not listed, call Restek BEFORE rinsing to prevent permanent damage to your capillary column.

Figure M: Solvent rinsing removes soluble contaminants

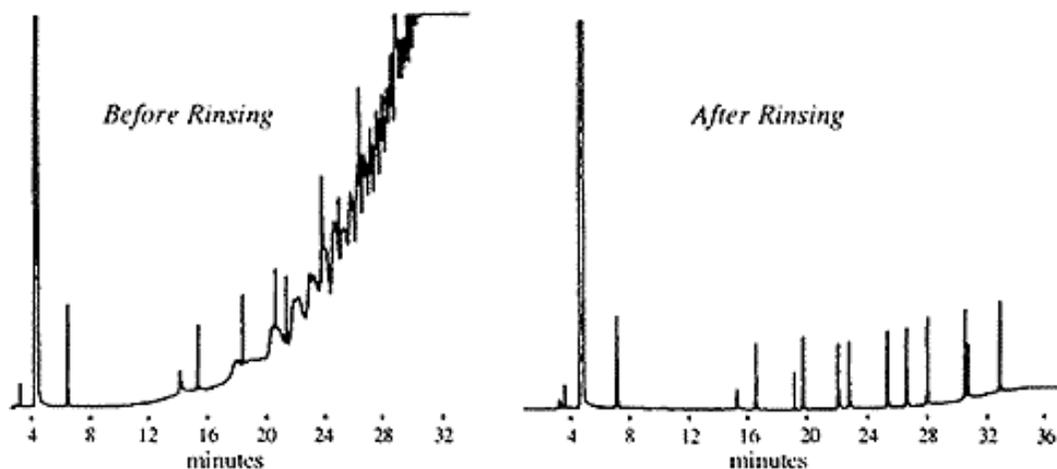


Table V Dead Volume Times (for commonly used capillary columns)

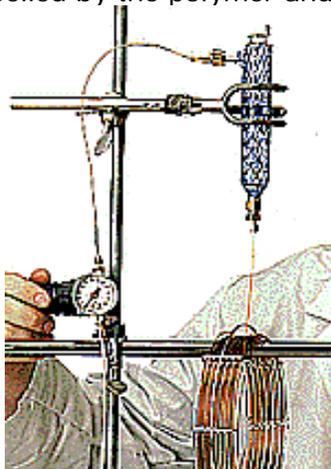
Phase	Magic Mix	Water	Methanol	CH ₂ Cl ₂	CHCl ₃	Acetone	Toluene	Pentane
MXT/Rtx-1	OK	OK	OK	OK	OK	OK	OK	OK
MXT/Rtx/XTI-5 & Rtx-5MS	OK	OK	OK	OK	OK	OK	OK	OK
Rtx-5 Amine	OK	OK	OK	OK	OK	OK	OK	OK
MXT/Rtx-Volatiles	OK	OK	OK	OK	OK	OK	OK	OK
MXT/Rtx-502.2	OK	OK	OK	OK	OK	OK	OK	OK
MXT/Rtx-20	OK	OK	OK	OK	OK	OK	OK	OK
MXT/Rtx-35	OK	OK	OK	OK	OK	OK	OK	OK
MXT/Rtx-50,-56, & 65TG	OK	OK	OK	OK	OK	OK	OK	OK
MXT/Rtx-1301 & 624	OK	OK	OK	OK	OK	OK	OK	OK
MXT/Rtx-1701	OK	OK	OK	OK	OK	OK	OK	OK
MXT/Rtx-200	OK	OK	OK	OK	OK	OK	OK	OK
Rtx-225	OK	OK	OK	OK	OK	OK	OK	OK
MXT/Rtx-BAC1 & BAC2	OK	OK	OK	OK	OK	OK	OK	OK
MXT/Rtx-WAX & Stabilwax	Avoid	Avoid	OK	OK	OK	OK	OK	OK
Stabilwax DB	Avoid	Avoid	Avoid	OK	OK	OK	OK	OK
Stabilwax DA	Avoid	Avoid	OK	OK	OK	OK	OK	OK

Magic Mix = 20% DI H₂O, 60% CH₃OH, 20% CH₂Cl₂

Do not rinse the following columns because they are either partially or not bonded: Rtx-2330, Rt-2330, Rt-2340, Rt-BDEX, Rt-γDEX, Rt-TCEP & Micropacked

Restek's chemists have found that a mixture of 60% methanol, 20% DI H₂O, and 20% methylene chloride (i.e. magic mix) is ideal for rinsing and cleaning most bonded stationary phases. (Do not use this mixture unless these solvents are recommended for rinsing.) The methylene chloride tends to swell the polymer which allows the methanol/DI H₂O to deeply penetrate into the swollen polymer lattice to remove polar contamination.

Without the addition of methylene chloride, polar solvents such as water or methanol are repelled by the polymer and do not clean deeply inside the polymer lattice.



Always rinse the column from the back (detector side) to the front (inlet side) to prevent contaminants lodged on the inlet side from being carried deeper inside the column bore (backflushing). Columns can be rinsed by either forcing solvent through the column under pressure or by pulling solvent through under vacuum. Restek offers a convenient Capillary Column Rinsing Kit (cat.# 20612, shown at left) to rinse columns. This kit contains a glass reservoir with a fritted disk to prevent particulates from damaging the capillary column. The amount of solvent used to rinse a column should equal approximately three to five times the column's internal volume. **Table VII** lists typical solvent volumes and pressures used to rinse each column ID.

Table VII Typical Solvent Volumes and Pressure Used for Rinsing

Column ID	Solvent Volume	Reservoir Pressure
0.18mm	10ml/TCD	50psig
0.25mm	15ml	40psig
0.32mm	25ml	30psig
0.53mm	50ml	15psig

Use non-swelling solvents such as methanol or acetone to minimize swelling while solvent-rinsing thick film columns. Sometimes very thick films (>3 μ m) can swell shut and occlude the column flow while being solvent-rinsed. Do not try to remove the blockage by increasing the rinsing pressure. Attach both column ends to a vacuum system for 24 hours. The vacuum evaporates the solvent and opens the column bore.

After rinsing, allow the column to purge with a dry carrier gas for 4-6 hours to decrease polymer swelling after solvent exposure. If the column is installed in a GC and heated rapidly before the solvent swelling has diminished, extensive damage to the polymer occurs. After purging, install the column in the GC at 40°C and hold for 30 minutes. Then, program slowly (4°C/min.) to the column's maximum operating temperature and condition for two hours before using.

G. Injecting Water and Other Solvents

In general, injecting water and other solvents will not damage bonded or non-bonded phase capillary columns provided that the solvent is vaporized before it reaches the front of the column (i.e. when split, splitless, or direct injections are performed). However, if operating the capillary column in cold or heated on-column modes, some damage may occur. To reduce the risk of damage, avoid water and methanol with Stabilwax®, Stabilwax®-DB, Stabilwax®-DA, Rtx®-2330, and Rtx®-225 phases when using cold or heated on-column injection techniques. Alternatively, avoid damage from water and methanol by attaching a 5-meter Hydroguard™ guard column to the capillary column inlet. This allows the solvent to vaporize before reaching the capillary column. Injecting water, methanol, or other solvents will not damage the other phases Restek offers, regardless of the injection mode.



Restek Capillary Column Installation Guide

Section IV: Column Troubleshooting & Return Procedure

- A. Pinpointing Performance Problems
- B. Contacting Restek for Technical Service
- C. Return Authorization Procedure

Many problems associated with capillary chromatography are due to sample contamination or instrument variables. Our technical service chemists may suggest some troubleshooting procedures to isolate these variables. Preliminary troubleshooting efforts by you help us identify the cause of the problem faster and can save you valuable down time.

A. Please follow these steps to pinpoint performance problems:

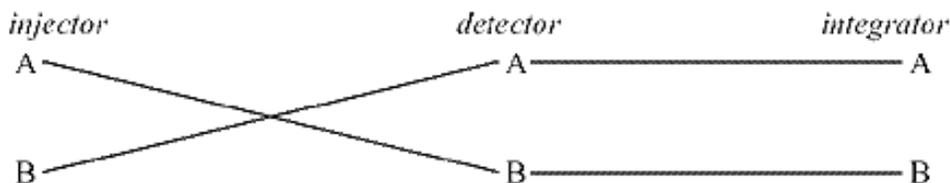
Isolate the Column From Instrument Variables:

The first step is to isolate the column from instrument variables. To do this, simply install a new column into the same GC without changing any GC related variables. We highly recommend keeping a spare column on hand at all times, but if you do not have a spare column, then install the questionable column in another GC that is working properly. If the problem does not seem to follow the column, (i.e. the new column does not work in the same GC, or the old column works fine in another GC), then we suggest performing routine maintenance on the injection port and detector as described in Section II of this installation guide. If the problem seems to follow the column, then it is time to perform routine maintenance on the column as described in Section III of this installation guide.

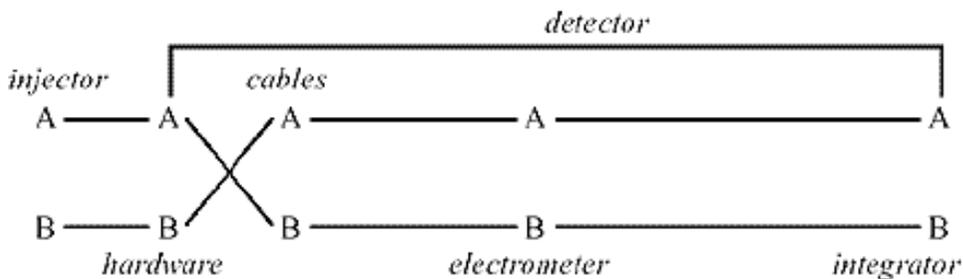
Begin Diagramming and Documenting

Document the procedures in chronological order listing times, dates, and important instrument parameters. Label all troubleshooting chromatograms. These steps help to inform anyone else that may be working on the system of the troubleshooting procedures that have been completed.

Start with a simple instrument diagram and try switching column A to detector B and vice versa. If the problem moves to detector B, then the problem is most likely occurring in the injector.



If the problem stays on Detector A when the column outlet is switched, then suspect a detector problem. Begin isolating detector problems by switching hardware, cables, electrometers, integrators, or any suspect part in the pathway. If the problem goes away from the A side, then that detector is most likely the cause and should be replaced.



B. If you are unable to pinpoint the problem:

Contact our [technical service group](#) at 800-356-1688 (ext. 4). Save all chromatograms and notes on any operating parameters.

Provide Restek's Technical Service Chemists with This Information:

1. The column's catalog and serial numbers.
2. Where and when the column was purchased and the invoice or purchase order number.
3. Instrument parameters:
 - a. instrument manufacturer and model number
 - b. injection mode
 - c. attenuation and range setting
 - d. oven temperature profile
 - e. injector and detector temperatures
 - f. detector type
4. Sample parameters:
 - a. sample size, list of sample components, and concentrations
 - b. description of the sample components that work and those that are problematic
 - c. derivatization agents, inorganics, or high molecular weight residue which may be present
 - d. number of injections made with the sample on this particular column and the length of time the column has been in service
5. Concise description of the problem:
 - a. observed symptoms
 - b. variables affecting the symptoms
 - c. steps taken to solve the problem
 - d. if the problem has been observed before

Before you call, obtain chromatograms generated when the column was working properly and chromatograms that illustrate the problem you are having.

C. Return Authorization Procedure:

Procedure for Returning Capillary GC Columns

If a phone call does not resolve the problem satisfactorily, we will evaluate the column in our lab to identify the problem source. Before returning the column, obtain an RA# (return authorization number) from a technical service chemist.

Important Note: If you purchased the column through a distributor, you must obtain return authorization through that distributor.

To send the column back, place it in its original box and tape. Send it prepaid to this address:

Restek Corporation
 110 Benner Circle
 Bellefonte, PA 16823-8812
 Attn: RA# _____

[*Note: information provided here is specific to Capillary GC Columns. Refer to the current Chromatography Products Guide for return authorization information on other types of products, or call Technical Service at 800-356-1688 (ext. 4).*]

After receiving the column, it is retested in our QA lab and rinsed if necessary. In most cases, the column evaluation is completed within three working days. A technical service chemist will call and discuss the results and give suggestions. If we determine the column is working satisfactorily or was contaminated and simply required solvent rinsing, it will be returned to your lab with our recommendations to help you avoid this problem in the future. If the column is defective, it will be replaced immediately with a new column. There is no charge for retesting or troubleshooting column problems.

When column problems are suspected and you need the product immediately, we can send you a new column, but we must invoice you for it. Credit is issued to your account if the returned column can be restocked or is found defective. If the problem was system-related or was caused by improper handling, the column will be returned to you and the replacement item invoice is due. We cannot restock damaged or used items.

A new High Temperature Carbowax Column stable up to 300°C for FAST-GC and GCxGC use.

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Introduction

Carbowax polar stationary phases are the most used in GC separations in conjunction with 5% phenyl apolar columns. For example PEG columns are very often used in Essential Oil, FAMES and Aromatic Compounds analyses. In recent years growth and development of techniques such as Fast-GC and GCxGC showed the need to have polar phases that can reach high temperatures. In fact, using Fast-GC systems with high temperature rates, the elution temperature of the compounds analyzed rises accordingly. In the same way, in the GCxGC, having a second dimension column such polar as a carbowax one that in the meantime allows to reach higher temperatures greatly expands the application possibilities of the technique.

For these reasons MEGA has developed a new Carbowax based column called MEGA-Wax HT, able to reach over 300°C and maintain the temperature of 300°C in isothermal mode.

The MEGA-Wax columns have a special deactivation treatment of the tubing surface that ensures a better coating of the phase. Beyond that a particular treatment on the PEG polymer is designed to allow the phase to reach high temperatures with a low bleeding and keeping the performances in time. The temperature range of this new column is extremely wide compared to other Carbowax columns, starting from 40°C reaching up to 300°C.

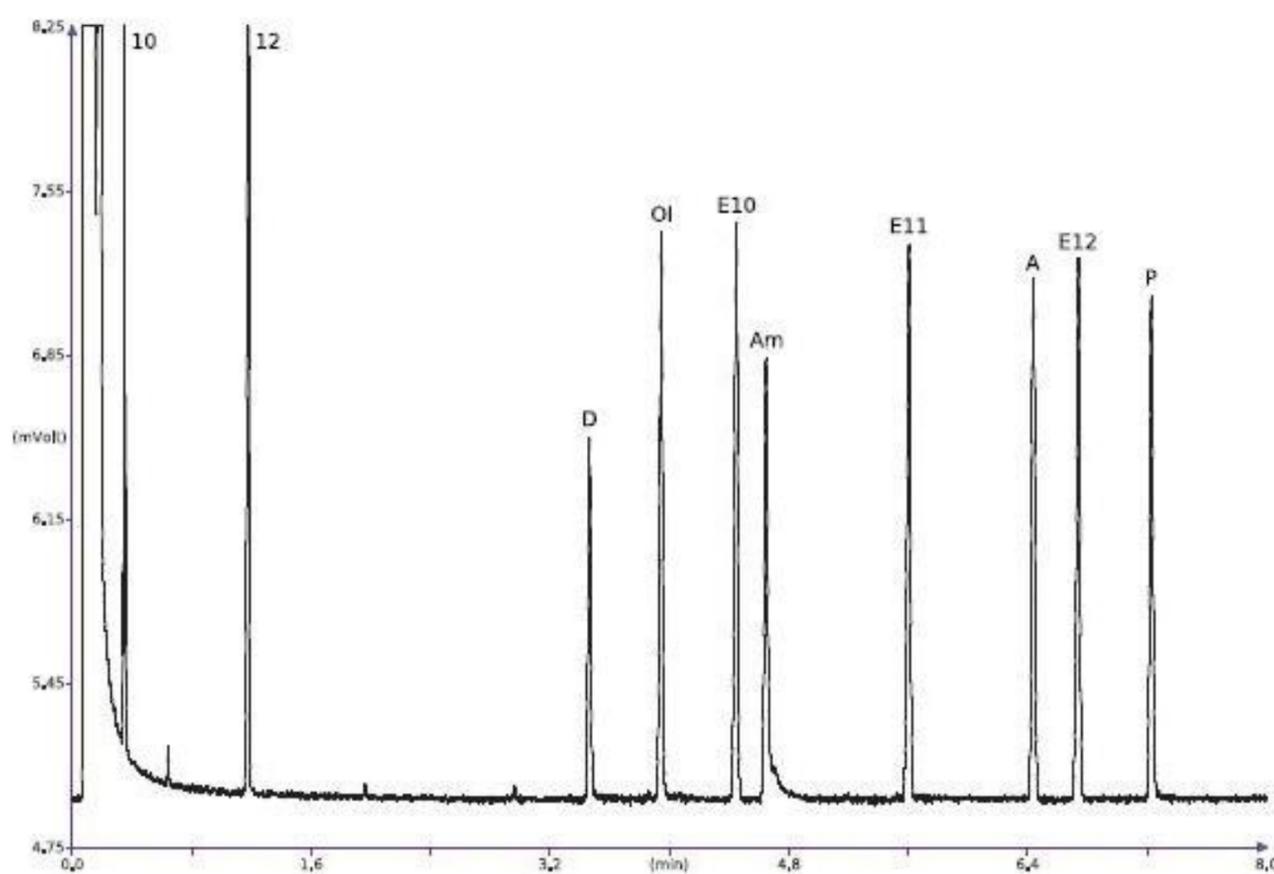


Figure 1. Grob Test (Test Mixture n. 2, Fluka Cat. # 86501) on a 0.10 mm ID x 4.5 m L (0.5 m incorporated retention gap) x 0.10 μ m FT, MEGA-Wax HT Fast column. Conditions: 40°C to 200°C @ 15° C/min, Hydrogen carrier gas @ 150 kPa (constant pressure), SSL 250°C, FID 310°C. Identification: decane (10), dodecane (12), 2,3-butanediol (D), 1-octanol (Ol), methyl decanoate (E10), dicyclohexylamine (Am), methyl undecanoate (E11), methyl laurate (E12), 2,6-dimethylaniline, 2,6-dimethylphenol.

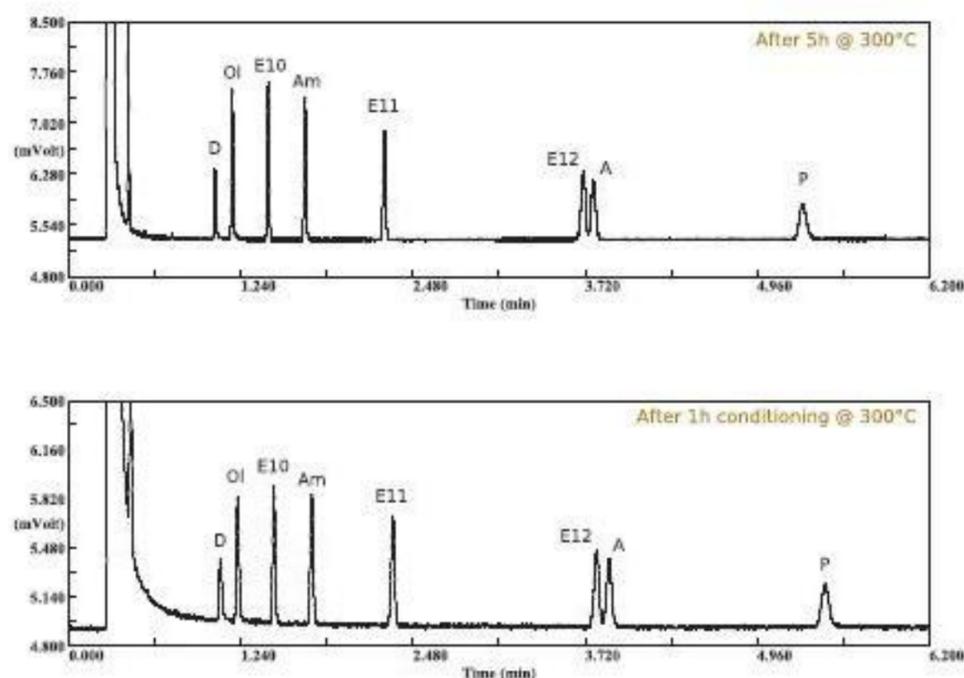


Figure 2.

Two isothermal runs to calculate the theoretical plates number (N) are here shown. All our narrow-bore Fast-GC 100 μ m ID columns have $N/m > 9000$, even for this new Carbowax stationary phase. The first value is obtained after one hour of initial column conditioning, while after keeping the column 5h @ 300°C a loss of less 5% than previous N value was noted, thus showing a very good resistance at high temperatures. The N values were calculated at 110°C in isothermal mode on a 0.10 mm ID x 8 m L x 0.10 μ m FT, MEGA-Wax HT Fast.

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Experimental Results

1. BIODIESEL Analysis on MEGA-Wax HT.

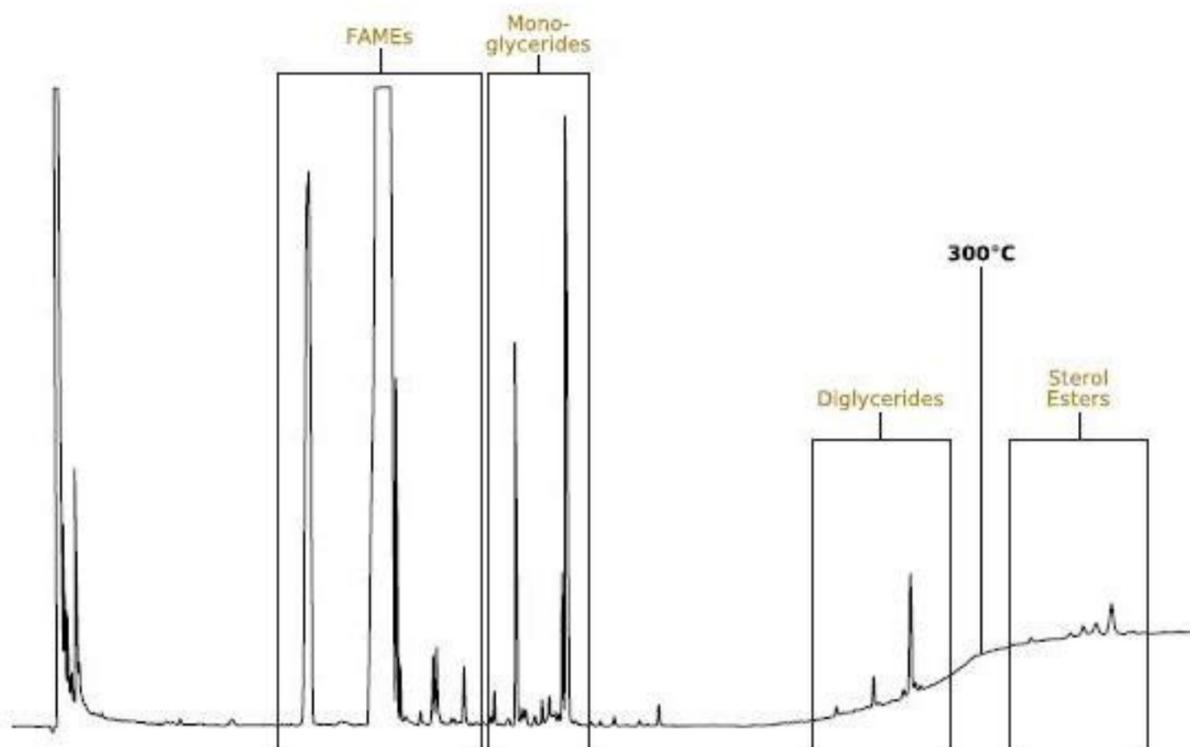


Figure 3. A real Biodiesel sample analysis is shown above. The Biodiesel sample was prepared according to the EN-14105 procedure. The column used is a 0.32 mm ID x 10 m L (1 m incorporated retention gap) x 0.05 µm FT, MEGA-Wax HT column. Conditions: 60°C to 300°C @ 10°C/min, Hydrogen carrier gas @ 35 kPa (constant pressure), On-Column Injection.

Biodiesel presents a significant challenge from the analytical point of view. There are many implemented methods regarding the GC Biodiesel analysis to determine free and total Glycerine, ester and linoleic acid methyl esters and Mono, Di and Tri-glycerides content. We injected a Biodiesel real sample on the new MEGA-Wax HT column. The results in Figure 3 show the possibility to extend the use of a polar Carbowax phase also for this kind of high temperature analysis. The MEGA-Wax HT works very well at high temperature, resolving sterol esters at 300°C in isothermal mode, while keeping an high polarity necessary to solve a typical FAMES separation that is made on a Carbowax column according to the EN-14103 method (see the Figure 4 below). The aim of this example is to demonstrate the possible use of the MEGA-Wax HT for high temperature Gas-Chromatography. The column could of course be applied to the GCxGC technique in order to have a second dimension column that allows to maintain an high orthogonality while reaching high temperatures needed for these applications.

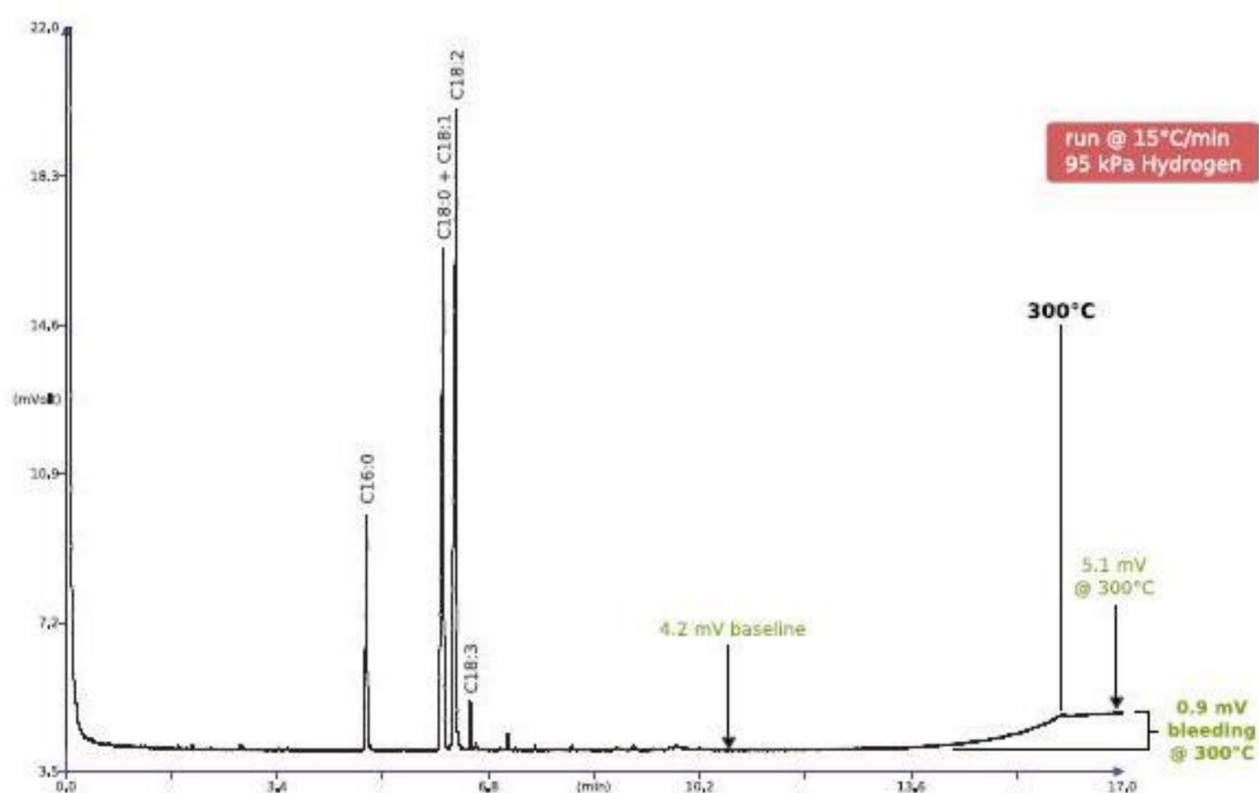


Figure 4. A FAST-GC separation example of Biodiesel FAMES performed on 0.10 mm ID x 2.5 m L (0.5 m incorporated retention gap) x 0.10 µm FT, MEGA-Wax HT Fast column. The extreme low bleeding is here also displayed; 0.9 mV bleeding only even under "aggressive" run conditions (15°C/min and 95 kPa Hydrogen constant pressure).

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2. POLYWAX 500 Analysis on MEGA-Wax HT.

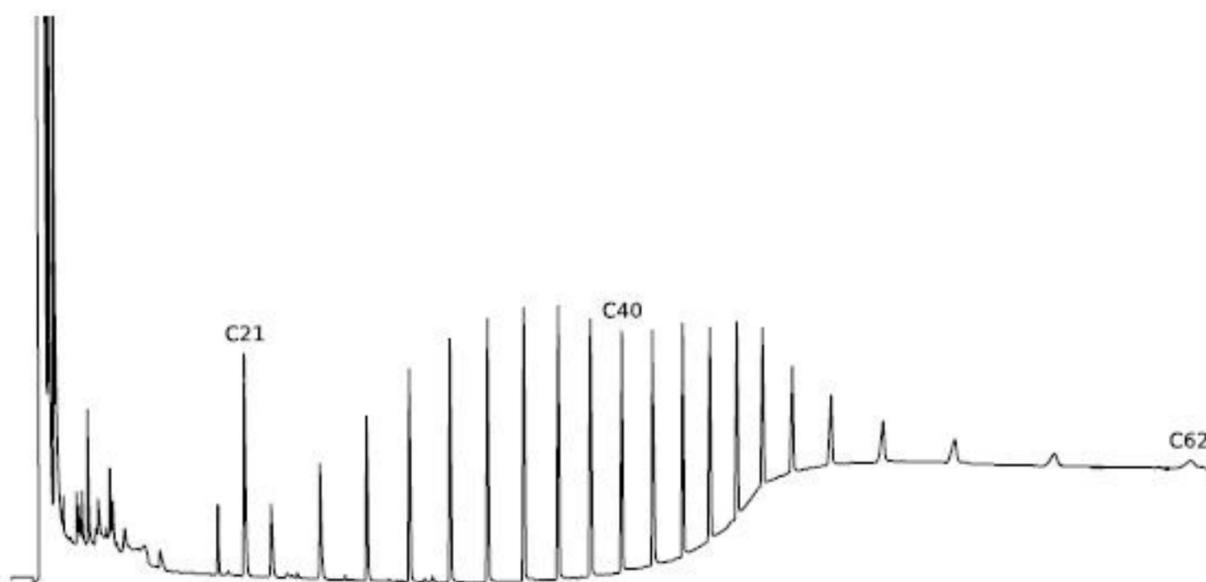


Figure 5. A Polywax 500 analysis on a 0.32 mm ID x 10 m L (1 m incorporated retention gap) x 0.05 µm FT, MEGA-Wax HT column. Another example of the use of the new Wax HT stationary phase for high temperature works. The sample introduction was made in On-Column mode.

Conclusions

The new MEGA-Wax column HT represents a novelty in the panorama of high polarity phases Carbowax. We think that the examples show the suitability of this new phase to meet the needs of having polar phases with an extended temperature range, especially to meet the modern needs of FAST-GC and GCxGC. At the present time in the Comprehensive 2DGC you are forced to find the best compromise between temperature limit of the column system and orthogonality between the two dimensions because of temperature limits given by more polar (and used) phases like Carbowax. We can move these limits a bit higher with the new Wax-HT column.

Furthermore, this column may be well used for conventional GC e.g. in combination with an apolar phase for a classic double-column configuration for MS systems. These systems, very often used in F&F labs for example, currently have big limitations because the usable temperature range of the apolar columns (like 5% phenyl phase) is reduced by the temperature limit of the normal Carbowax based phases.

We are still performing applications on this new stationary phase to find the maximum effective operating limits in temperature programmed mode with the best compromise of column lifetime. We are going on with the investigation on the possibility to use the Wax-HT for triglycerides analysis with the advantage to elute these heavy compounds below their decomposition temperature.

You can see other performances of the new MEGA-Wax HT columns on the "LC-GC Europe" (February 2010 Issue) magazine, GC Connections section. Here applications of MEGA-Wax HT are shown both on Fast-GC and GCxGC use for Essential Oil analysis. We wish to thank the authors of this paper for their work and their cooperation.

[Click here and read the LCGC article about the new MEGA-Wax HT column.](#)

Acknowledgments

We wish to thank Prof. Carlo Mariani (SSOG "Stazione Sperimentale per le industrie degli Oli e Grassi" - Via G. Colombo, 79 - 20133 Milano - Italy) for his knowledge support and for providing us the Biodiesel and sample standards.