



GC Columns

Detailed Table of Contents.....	9–11
Selecting a GC Column	12–17
GC Column Cross-References.....	18–19
Guard/Retention Gap Columns Overview	20–21

Fused Silica Capillary

Guard/Retention Gap Columns	23–25
High-Performance Rxi Columns	26–37
General Purpose Columns	38–49
GCxGC Columns.....	50–52
Fast GC	53
Application-Specific Columns	54–89

Metal MXT® Capillary

Overview	91
Guard/Retention Gap Columns	92
Tubing Scorer.....	92
General-Purpose Columns.....	93–96
Application-Specific Columns	97–101

PLOT

PLOT Column Selection	103–105
Alumina BOND Columns	106–109
Molecular Sieve 5A Columns.....	110
Porous Polymer Columns.....	111–112
PLOT Column Particle Trap	112
Metal MXT® PLOT Columns.....	113
Tubing Scorer.....	113

Packed/Micropacked

Bonded Stationary Phases.....	115–116
Packed Column Tubing	117
Stock Packed Columns.....	118–119
Stock Micropacked Columns.....	120
Application-Specific Columns	121–124
Packed/Micropacked Column Installation Kits	125
Packed Column Packing Materials	126–129
Liquid Phases for Custom Columns.....	130
USP Cross-Reference	131
Custom Coated Packing Materials	132
Custom Packed/Micropacked Columns.....	133–134
Column Configurations	135



GC Columns

Selecting a GC Column	12-17
GC Column Cross-References	18-19
Guard/Retention Gap Columns Overview	20-21

Fused Silica Capillary Columns (WCOT)

Guard/Retention Gap Columns

Overview	20-21
Rxi, Intermediate-Polarity, Polar, Base, Hydroguard Water-Resistant, Integrated	23-25

High-Performance Rxi Columns

Overview	26-30
Guard Columns	30
Rxi-1ms	31
Rxi-5ms	31
Rxi-5Sil MS	32-33, 57, 64, 66, 73
Rxi-XLB	34, 60
Rxi-35Sil MS	34
Rxi-17	34
Rxi-17Sil MS	35, 65
Rxi-PAH	35, 72
Rxi-624Sil MS	36, 70, 80
Rxi-1HT	37
Rxi-5HT	37

General-Purpose Columns

Rtx-1	39
Rtx-5, Rtx-5MS	40, 82
Rtx-20	41
Rtx-35	41
Rtx-50	42
Rtx-65	42
Rtx-440	43
Rtx-200, Rtx-200MS	44
Rtx-1301	45
Rtx-624	45
Rtx-1701	46
Rtx-225	46
Rtx-2330	47
Rt-2560	47, 71
Rtx-Wax	48
Stabilwax	49, 81

GCxGC Columns

GCxGC	50-52
-------------	-------

Fast GC

Fast GC	53
---------------	----

Application-Specific Columns

Clinical, Forensic & Toxicology

Blood Alcohol Analysis	55
Rtx-BAC Plus 1, Rtx-BAC Plus 2	

Environmental

Brominated Flame Retardants Analysis	56
Rtx-1614	
Dioxin & Furan Analysis	57-58
Rxi-5Sil MS, Rtx-Dioxin2	
PCB Congeners Analysis	59-60
Rtx-PCB, Rxi-XLB	
Pesticides Analysis (Organophosphorus)	61
Rtx-OPPesticides, Rtx-OPPesticides2	
Pesticides Analysis (Chlorinated)	62-63
Rtx-CLPesticides, Rtx-CLPesticides2	
Polycyclic Aromatic Hydrocarbons (PAHs) Analysis	64-65
Rxi-5Sil MS, Rxi-17Sil MS	
Semivolatiles Analysis	66
Rxi-5Sil MS	
Volatile Organics Analysis	67-70
Rtx-VMS, Rtx-VRX, Rtx-502.2, Rtx-Volatiles, Rxi-624Sil MS	

Continued on next page.



Can't find the
column you're
looking for?

Check out our website at

www.restek.com



Table of Contents for
GC Chromatograms

See **page 570**.



For an alphabetical listing of phases,
please see the Alphabetical Index
on pages 756-767.

Table of Contents for GC Chromatograms

See **page 570**.



For an alphabetical listing of phases,
please see the Alphabetical Index
on pages 756–767.

Foods, Flavors & Fragrances	
FAME Analysis (<i>cis/trans</i>).....	71
Rt-2560	
FAME Analysis (Polyunsaturated).....	71
FAMEWAX	
PAHs in Foods Analysis.....	72
Rxi-PAH	
Pesticides in Food Residues Analysis.....	73
Rxi-5Sil MS	
Triglycerides in Foods Analysis.....	74
Rtx-65TG	
Petroleum & Petrochemical	
Aromatics & Oxygenates in Gasoline Analysis.....	75
Rt-TCEP	
Biodiesel Fuels Analysis.....	76
Rtx-Biodiesel TG	
Detailed Hydrocarbon Analysis (DHA).....	77
Rtx-DHA, Rtx-5DHA (Tuning Column)	
Mineral Oils/Extractable Petroleum Hydrocarbon Analysis.....	78
Rtx-Mineral Oil	
Simulated Distillation Analysis (C5-C44).....	79
Rtx-2887	
Pharmaceutical	
Organic Volatile Impurities (OVI) Analysis.....	80–83
Rxi-624Sil MS, Stabilwax, Rtx-5, Rtx-G27, Rtx-G43	
Specialty Deactivated	
Acidic Compounds Analysis.....	84
Stabilwax-DA	
Basic Compounds Analysis.....	85–88
Rtx-Volatile Amine, Rtx-5 Amine, Rtx-35 Amine, Stabilwax-DB	
Chiral Analysis.....	89
Rt-γDEXsa, Rt-βDEXm, Rt-βDEXsm, Rt-βDEXse, Rt-βDEXsp, Rt-βDEXsa, Rt-βDEXcst	

Metal MXT® Capillary Columns (WCOT)

Overview.....	91
Guard/Retention Gap Columns	92
Tubing Scorer for MXT Columns.....	92
General-Purpose Columns	
MXT-1.....	93
MXT-5.....	94
MXT-20.....	94
MXT-35.....	95
MXT-50.....	95
MXT-65.....	95
MXT-1301.....	95
MXT-1701.....	96
MXT-200.....	96
MXT-WAX.....	96
Application-Specific Columns	
Environmental	
Volatile Organics Analysis.....	97
MXT-502.2, MXT-Volatiles, MXT-624	
Foods, Flavors & Fragrances	
Triglycerides in Foods Analysis.....	98
MXT-65TG	
Petroleum & Petrochemical	
Biodiesel Fuels Analysis.....	99
MXT-Biodiesel TG	
Simulated Distillation Analysis (C5-C44).....	99
MXT-2887	
Simulated Distillation Analysis (C5-C110).....	100–101
MXT-1HT SimDist, MXT-1 SimDist, MXT-500 SimDist	



PLOT Columns

PLOT Column Selection.....	103–105
Alumina BOND Columns	106–109
Rt-Alumina BOND/Na ₂ SO ₄ , Rt-Alumina BOND/KCl, Rt-Alumina BOND/CFC, Rt-Alumina BOND/MAPD	
Molecular Sieve 5A Columns	110
Rt-MSieve 5A	
Porous Polymer Columns	111–112
Rt-Q-BOND, Rt-QS-BOND, Rt-S-BOND, Rt-U-BOND	
PLOT Column Particle Trap.....	112
Metal MXT PLOT Columns.....	113
MXT-MSieve 5A, MXT-Alumina BOND/Na ₂ SO ₄ , MXT-Alumina BOND/MAPD, MXT-Q-BOND, MXT-S-BOND	
Tubing Scorer for MXT Columns.....	113

Packed/Micropacked Columns & Packing Materials

Bonded Stationary Phases.....	115–116
Packed Column Tubing	117
Stock Packed Columns	118–119
Bonded, Chromosorb-Based, Porous Polymers, CarboBlack, Molecular Sieves	
Stock Micropacked Columns	120
Application-Specific Packed/Micropacked Columns	
Aromatics Analysis	121
D3606 Application Column Set	
Light Hydrocarbon Analysis	122
<i>n</i> -Octane on Res-Sil C, OPN on Res-Sil C, 2abc Refinery Gas Set	
Permanent Gases & Hydrocarbon Analysis.....	123
ShinCarbon ST	
Sulfur Analysis.....	124
Rt-XLSulfur	
Packed/Micropacked Column Installation Kits.....	125
Packed Column Packing Materials	126–129
Silcoport, CarboBlack, Res-Sil C, Chromosorb, Porapak, HayseSep, Tenax	
Liquid Phases for Custom Columns	130
USP Liquid Phase & Solid Support Cross-Reference	131
Custom Packed/Micropacked Columns	
Custom Coated Packing Materials.....	132
Custom Packed/Micropacked Columns	133
Packed/Micropacked Column Custom Order Form	134
Column Configurations.....	135

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—separation factor, retention (capacity) factor, and efficiency—simplifies the decision. Separation factor determines which stationary phase is most appropriate. Once the phase has been chosen, physical dimensions (inner diameter, film thickness, length) can be selected based on retention factor and efficiency. Understanding how separation factor, retention factor, and efficiency influence separations allows analysts to make effective, informed choices and quickly select the best column for specific separations.

$$R = \frac{1}{4} \sqrt{N} \times \left(\frac{k}{k+1} \right) \times (\alpha - 1)$$

A measure of **Efficiency**.
This term is affected by:

- Length
- Inner diameter
- Carrier gas type and linear velocity

A measure of **Retention**.
This term is affected by:

- Inner diameter
- Film thickness
- Temperature

A measure of **Peak Separation**.
This term is affected by:

- Stationary phase composition
- Temperature

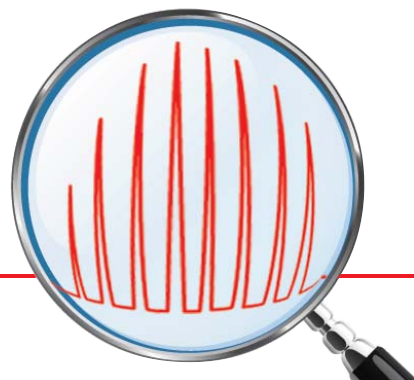
$N = L/H$ = Effective theoretical plate number
 L = Column length
 H = HETP = Height equivalent to a theoretical plate

k = Retention factor
 α = Separation factor
 Baseline resolution ($R = 1.5$) is the goal.

Chromatogram Search Tool

Search by **compound name**,
synonym, **CAS #**, or **keyword**

www.restek.com/chromatograms



Separation Factor (α)

Choosing the right stationary phase is the first step toward optimizing your GC separation. It is the most important decision you will make because separation factor (α) has the greatest impact on resolution, and it is strongly affected by stationary phase polarity and selectivity.

Stationary phase polarity is determined by the type and amount of functional groups in the stationary phase. Structures for Restek stationary phases are presented in order of polarity on page 17. When choosing a column, consider the polarity of both the stationary phase and your target analytes. If the stationary phase and analyte polarities are similar, then the attractive forces are strong and more retention will result. Greater retention often results in increased resolution. Stationary phase polarity strongly influences column selectivity and separation factor, making it a useful consideration when selecting a column.

Stationary phase selectivity is defined by IUPAC as the extent to which other substances interfere with the determination of a given substance. Selectivity is directly related to stationary phase composition and how it interacts with target compounds through intermolecular forces (e.g., hydrogen bonding, dispersion, dipole-dipole interactions, and shape selectivity). As methyl groups in the stationary phase are replaced by different functionalities, such as phenyl or cyanopropyl pendant groups, compounds that are more soluble with those functional groups (e.g., aromatics or polar compounds, respectively) will interact more and be retained longer, often leading to better resolution and increased selectivity. In another example of the effect of stationary phase-analyte interactions, an Rtx®-200 stationary phase is highly selective for analytes containing lone pair electrons, such as halogen, nitrogen, or carbonyl groups, due to interactions with the fluorine pendant group in this phase. Selectivity can be approximated using existing applications or retention indices (Table I), making these useful tools for comparing phases and deciding which is most appropriate for a specific analysis.

Table I: Kovat's retention indices for GC phases can be used to approximate selectivity.

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	1,158	998	1,230

Stationary phase polarity and selectivity also affect how much sample loading capacity the column will have for a particular analyte; the more soluble an analyte is in the stationary phase, the greater the sample loading capacity will be for that analyte. For example, a nonpolar stationary phase will have higher sample loading capacity for a nonpolar compound (e.g., pentane) than for a polar compound (e.g., ethanol).

The relationship between polarity, selectivity, and sample loading capacity can be illustrated using an example. Consider the analysis of benzene and butanol, which have nearly the same boiling point, on an Rtx®-20 column (diphenyl dimethyl polysiloxane stationary phase). Since the benzene molecule is structurally more similar to the diphenyl phase than butanol is, benzene will solvate into the stationary phase more readily than butanol based on the concept that “like dissolves like.” Since benzene solvates more readily with the stationary phase, it has more interaction with the stationary phase as it elutes through the column and will be retained longer. Since butanol solvates less with the stationary phase, it has fewer interactions with the stationary phase and less will be retained. Therefore, the elution order of these two compounds on an Rtx®-20 column will be butanol first and benzene second. In addition, since benzene is more soluble in the diphenyl phase, the column has more capacity for benzene. This results in a more symmetrical peak shape for benzene than for butanol. A more polar column, such as a polyethylene glycol (PEG) column, will provide retention and better peak shape for butanol compared to benzene.

Due to their influence on separation factor, polarity and selectivity are primary considerations when selecting a column. However, temperature limits must also be considered. In general, highly polar stationary phases have lower maximum operating temperatures, so choosing a column with the appropriate maximum operating temperature, as well as optimal polarity and selectivity for the type of compounds being analyzed is crucial.

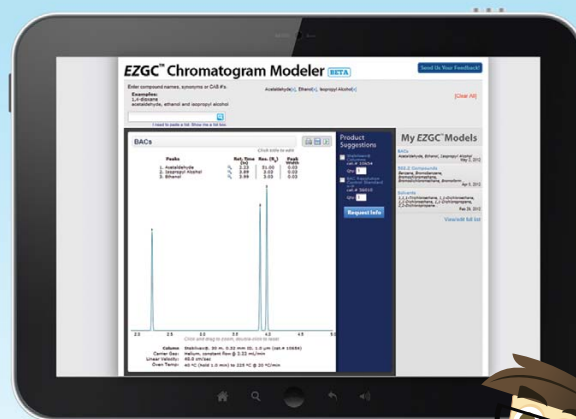
Retention Factor (k)

The retention factor (k) of a column is based on the time an analyte spends in the stationary phase relative to the time it spends in the carrier gas. It is influenced primarily by column inner diameter (ID), phase film thickness, and temperature. Retention factor is sometimes referred to as capacity factor, which should not be confused with sample loading capacity. As a general rule, the thicker the film and the smaller the inner diameter, the more an analyte will be retained. Note that as temperature increases, k decreases; therefore, at higher temperatures analytes stay in the carrier gas longer and are less retained.

Now Online!

Our EZGC™ Web App Will Kick-Start Your GC Method Development

- **EZ to Use** – Just enter your target compounds, and in seconds, the EZGC™ system gives you a customized method, including column, conditions, and model chromatogram.
- **EZ to Analyze** – Model chromatograms are fully interactive. Zoom in, view chemical structures, and even overlay mass spectra.
- **EZ to Save** – Print your chromatogram and custom settings, or save them for future reference.



Start developing incredible GC methods today! www.restek.com/ezgc



When selecting column ID, consider the type of injection, the detector being used, and the concentration of sample (amount on-column). The injection technique is important because the column ID may need to be selected based on whether a split, splitless, direct, cool on-column injection, or other sample transfer method is being used. For example, 0.53 mm ID columns are ideal for cool on-column injections since the syringe needle (26 gauge) will fit into the large column ID. In addition to column ID, the detector and its flow requirements must be considered. For example, some MS detectors can only operate under 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 MS work. Table II shows typical column characteristics for columns of various inner diameters.

Table II: General column characteristics based on ID.

Characteristic	Column Inner Diameter (mm)					
	0.10	0.15	0.18	0.25	0.32	0.53
Nitrogen flow (mL/min)	0.2	0.3	0.3	0.4	0.6	0.9
Helium flow (mL/min)	0.6	0.8	1.0	1.4	1.8	3.0
Hydrogen flow (mL/min)	0.7	1.1	1.3	1.8	2.3	3.7
Sample loading capacity (ng)	2.5	10	20	50	125	500
Theoretical plates/meter	11,000	7,000	6,000	4,000	3,000	2,000

Note: Flows listed are for maximum efficiency. Sample loading capacities are estimates only. Actual sample loading capacity varies with film thickness and analyte.

Film thickness 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, which allows them to better separate. High molecular weight compounds must be analyzed on thinner film columns. This reduces the length of time that the analytes stay in the column and minimizes phase bleed at higher elution temperatures. Film thickness also affects the amount of material that can be injected onto the column without overloading it. A thicker film column can be used for higher concentration samples.

Fused Silica, PLOT, & MXT® Capillary GC Column Ferrule Guide

GC Column ID	Ferrule ID
0.10 mm	0.4
0.15 mm	0.4
0.18 mm	0.4
0.25 mm	0.4
0.28 mm	0.4
0.32 mm	0.5
0.45 mm	0.8
0.53 mm	0.8

Technical Service

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: 1-814-353-1568

e-mail: support@restek.com

Hours of operation (Eastern Time):

Monday - Thursday, 8:00 a.m. to 6:00 p.m.

Friday, 8:00 a.m. to 5:00 p.m.

Outside the U.S.? Contact your Restek representative.



Scott Grossman, Applications Chemist
Checking for leaks, using a thermal
conductivity leak detector.

Film thickness also directly affects phase ratio (β), which must be accounted for when changing to a column with a different inner diameter. When inner diameter increases, film thickness (d_f) must also increase in order to provide comparable resolution and retention. Table III shows β values for common column dimensions; similar values indicate similar separations on different ID columns.

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

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

* $\beta = r/2d_f$ (r =internal radius of tubing; d_f = phase film thickness)

Efficiency (N)

Column efficiency (N) is the column length divided by the height equivalent of a theoretical plate (HETP). The effective number of theoretical plates is affected by how well the phase has been coated onto the column walls, and it is measured by how narrow the peaks are when they elute out of the column. Higher column efficiency (N) results in greater resolution between peaks. Inner diameter also influences efficiency; a simple rule of thumb is the smaller the column ID, the more efficient the column.

Capillary columns are made in various lengths, typically 10, 15, 30, 60, and 105 meters. Longer columns provide more resolving power, but will also increase analysis time and cost more. When column length is doubled, analysis time will increase by as much as a factor of two. However, doubling the column length increases resolution by only approximately 40% since the column length term is under the square root function in the resolution equation. When selecting column length, the increase in resolution obtained in a longer column must be weighed against the increase in cost and analysis time.

Conclusion

A basic understanding of the resolution equation allows analysts to make more effective column choices. Phase choice should be influenced primarily by separation factor, which can be approximated by considering the structures of both the phase and the analyte, as well as by referencing retention indices or existing applications. Retention factor and efficiency also affect peak separations and should be considered when choosing column inner diameter, film thickness, and length. By better understanding these factors, analysts can simplify the column selection process, optimize separations, and increase lab productivity.

What do the Temperature Limits Mean?

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.

Rxi®-5Sil MS Columns (fused silica)

ID	d_f (μm)	temp. limits
0.25 mm	0.25	-60 to 320/350 °C
0.32 mm	0.50	-60 to 320/350 °C
0.53 mm	1.50	-60 to 320/330 °C

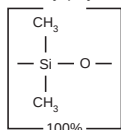
The second temperature is the **maximum temperature-programmed operating temperature**, the temperature to which the column can be heated for short periods of time (i.e., during a temperature-programmed analysis). If only one temperature is listed, it is both the isothermal and the maximum temperature.

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.

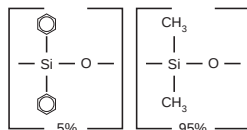
Many phases list two maximum operating temperatures. The first temperature is the **maximum isothermal operating temperature**. This is the temperature to which the columns are guaranteed to meet the minimum performance specification (i.e., low baseline noise).



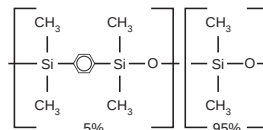
Structures, polarities, properties, and uses for Restek capillary column phases, in order of increasing polarity

**Rxi®-1ms,
Rxi®-1HT, Rtx®-1**
Dimethyl polysiloxane

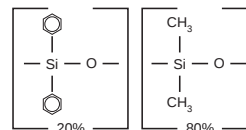
Similar to: (100%-methyl)-polysiloxane
Polarity: nonpolar
Uses: solvents, petroleum products, pharmaceutical samples, waxes
[G1]

**Rxi®-5ms, Rxi®-5HT,
Rtx®-5, Rtx®-5MS**
Diphenyl dimethyl polysiloxane

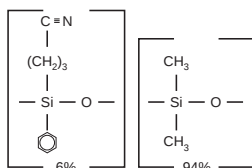
Similar to: (5%-phenyl)-methylpolysiloxane
Polarity: slightly polar
Uses: flavors, environmental, aromatic hydrocarbons
[G27]

Rxi®-5Sil MS
1,4-bis(dimethylsiloxy)phenylene
dimethyl polysiloxane

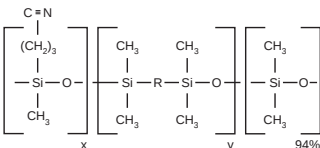
Similar to: (5%-phenyl)-methylpolysiloxane
Polarity: slightly polar
Uses: flavors, environmental, pesticides, PCBs, aromatic hydrocarbons

Rtx®-20
Diphenyl dimethyl polysiloxane

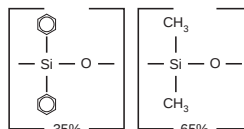
Similar to: (20%-phenyl)-methylpolysiloxane
Polarity: slightly polar
Uses: volatile compounds, alcohols
[G32]

**Rtx®-1301, Rtx®-624,
Rtx®-G43**
Cyanopropylphenyl dimethyl polysiloxane

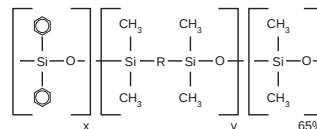
Similar to: (6%-cyanopropylphenyl)-methylpolysiloxane
Polarity: intermediately polar
Uses: volatile compounds, insecticides
[G43]

Rxi®-624Sil MS

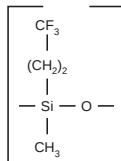
Similar to: (6%-cyanopropylphenyl)-methylpolysiloxane
Polarity: intermediately polar
Uses: volatile compounds, insecticides, residue solvents in pharmaceutical products

Rtx®-35
Diphenyl dimethyl polysiloxane

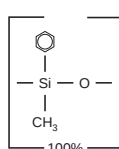
Similar to: (35%-phenyl)-methylpolysiloxane
Polarity: intermediately polar
Uses: pesticides, PCBs, amines, nitrogen-containing herbicides
[G42]

Rxi®-35Sil MS

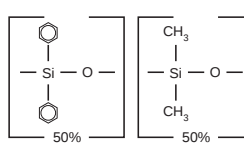
Similar to: (35%-phenyl)-methylpolysiloxane
Polarity: intermediately polar
Uses: pesticides, PCBs, amines, nitrogen-containing herbicides

Rtx®-200
Trifluoropropylmethyl polysiloxane

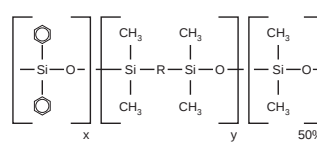
Similar to: (trifluoropropyl)-methylpolysiloxane
Polarity: selective for lone pair electrons
Uses: environmental, solvents, Freon® gases, drugs, ketones, alcohols
[G6]

Rtx®-50
Phenyl methyl polysiloxane

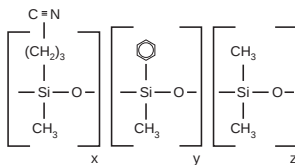
Similar to: (50%-phenyl)-methylpolysiloxane
Polarity: intermediately polar
Uses: FAMES, carbohydrates
[G3]

Rxi®-17
Diphenyl dimethyl polysiloxane

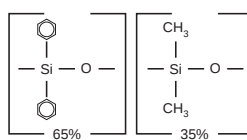
Similar to: (50%-phenyl)-methylpolysiloxane
Polarity: intermediately polar
Uses: triglycerides, phthalate esters, steroids, phenols
[G3]

Rxi®-17Sil MS

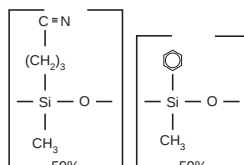
Similar to: (50%-phenyl)-methylpolysiloxane
Polarity: intermediately polar
Uses: triglycerides, phthalate esters, steroids, phenols

Rtx®-1701

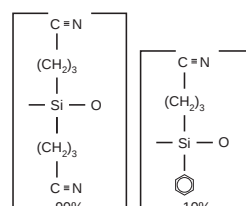
Similar to: (14%-cyanopropylphenyl)-methylpolysiloxane
Polarity: intermediately polar
Uses: pesticides, PCBs, alcohols, oxygenates
[G46]

Rtx®-65, Rtx®-65TG
Diphenyl dimethyl polysiloxane

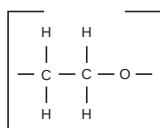
Similar to: (65%-phenyl)-methylpolysiloxane
Polarity: intermediately polar
Uses: triglycerides, rosin acids, free fatty acids

Rtx®-225
Cyanopropylmethyl phenylmethyl
polysiloxane

Similar to: (50%-cyanopropylmethyl)-methylphenylpolysiloxane
Polarity: polar
Uses: FAMES, carbohydrates
[G7]

Rtx®-2330
Biscyanopropyl cyanopropylphenyl polysiloxane

Similar to: (95%-cyanopropyl)-phenyl polysiloxane
Polarity: polar
Uses: cis/trans FAMES, dioxin isomers, rosin acids
[G48]

Stabilwax®, Rtx®-Wax
Polyethylene glycol

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	SGE	Phenomenex	Macherey- Nagel	Supelco	Alltech	Quadrex
Rtx-1 (p. 39) MXT-1 (p. 93)	dimethyl polysiloxane	G1, G2, G38	HP-1, DB-1, CP Sil 5 CB	BP1	ZB-1	OPTIMA 1	SPB-1	007-1AT-1, EC-1	007-1
Rxi-1HT (p. 37)	dimethyl polysiloxane		DB-1ht		ZB-1HTInferno			AT-1ht	
Rxi-1ms (p. 31)	dimethyl polysiloxane (low bleed)		HP-1, HP-1ms, HP-1msUI, DB-1, DB-1ms, DB-1msUI, Ultra-1, VF-1ms, CP-Sil 5 CB	BP1	ZB-1, ZB-1ms	OPTIMA 1 MS, OPTIMA 1 MS Accent	SPB-1, Equity-1	AT-1ms	007-1
Rtx-5 (p. 40) MXT-5 (p. 94)	diphenyl dimethyl polysiloxane	G27, G36	HP-5, DB-5, CP Sil 8 CB	BP5	ZB-5	OPTIMA 5	SPB-5	EC-5, AT-5	007-5
Rxi-5HT (p. 37)	diphenyl dimethyl polysiloxane		DB-5ht, VF-5ht	HT5	ZB-5HTInferno	OPTIMA 5HT			
Rxi-5ms (p. 31)	diphenyl dimethyl polysiloxane	G27, G36	HP-5, HP-5ms, DB-5, Ultra-2, CP-Sil 8 CB	BP5ms	ZB-5, ZB-5ms	OPTIMA 5, OPTIMA 5 MS	SPB-5, Equity-5	AT-5ms	007-5
Rxi-5Sil MS (p. 32, 57, 64, 66, 73)	1,4-bis(dimethylsiloxy)phenyl- ene dimethyl polysiloxane		DB-5ms, DB-5msUI, VF-5ms, CP-Sil 8 CB	BPX5	ZB-5msi	OPTIMA 5MS Accent	SLB-5ms		007-5MS
Rxi-XLB (p. 34, 60)	unique phase		DB-XLB, VF-XMS		MR1, ZB-XLB	OPTIMA XLB			
Rtx-20 (p. 41) MXT-20 (p. 94)	diphenyl dimethyl polysiloxane	G28, G32					SPB-20	EC-20, AT-20	007-20
Rtx-35 (p. 41) MXT-35 (p. 95)	diphenyl dimethyl polysiloxane	G42	HP-35, DB-35	BPX35, BPX608	ZB-35		SPB-35, SPB-608	AT-35, AT-35ms	007-35
Rxi-35Sil MS (p. 34)	unique phase		DB-35ms, DB35msUI, VF-35ms	BPX35	MR2	OPTIMA 35 MS			
Rtx-50 (p. 42) MXT-50 (p. 95)	phenyl methyl polysiloxane	G3					SPB-50	AT-50	007-17
Rxi-17 (p. 34)	diphenyl dimethyl polysiloxane		HP-50+, DB-17, DB-17ht, DB-608, CP-Sil 24 CB		ZB-50	OPTIMA 17	SPB-17		
Rxi-17Sil MS (p. 35, 65)	unique phase		DB-17ms, VF-17ms, CP-Sil 24 CB	BPX50	ZB-50	OPTIMA 17 MS			
Rtx-65 (p. 42) MXT-65 (p. 95)	diphenyl dimethyl polysiloxane	G17							007-65HT
Rxi-624Sil MS (p. 36, 70, 80)	unique phase		DB-624, VF-624ms, CP-Select 624 CB	BP624	ZB-624	OPTIMA 624 LB			
Rtx-1301 (p. 45) Rtx-624 (p. 45) MXT-1301 (p. 95)	cyanopropylphenyl dimethyl polysiloxane	G43	DB-1301, DB-624, VF-1301ms, VF-624ms, CP-1301	BP624	ZB-624	OPTIMA 1301, OPTIMA 624	SPB-624	AT-624, AT-1301	007-1301, 007-624
Rtx-1701 (p. 46) MXT-1701 (p. 96)	cyanopropylphenyl dimethyl polysiloxane	G46	DB-1701R, DB-1701, CP Sil 19 CB, VF-1701ms, VF-1701 Pesticides	BP10	ZB-1701, ZB-1701P	OPTIMA 1701	Equity-1701	AT-1701	007-1701
Rtx-200 (p. 44) MXT-200 (p. 96)	trifluoropropylmethyl polysiloxane	G6	DB-210, DB-200, VF-200ms			OPTIMA 210		AT-210	
Rtx-200MS (p. 44)	trifluoropropylmethyl polysiloxane (low bleed)		VF-200ms						
Rtx-225 (p. 46)	cyanopropylmethyl phenylmethyl polysiloxane	G7, G19	DB-225ms, CP Sil 43 CB	BP225		OPTIMA 225	SPB-225	AT-225	007-225
Rtx-440 (p. 43)	unique phase		Restek innovation						
Rtx-2330 (p. 47)	biscyanopropyl cyanopropylphenyl polysiloxane	G48	VF-23ms	BPX70			SP-2330, SP-2331, SP-2380	AT-Silar90	007-23
Rt-2560 (p. 47, 71)	bicyanopropyl polysiloxane		HP-88, CP Sil 88				SP-2560		
Rtx-Wax (p. 48)	polyethylene glycol	G14, G15, G16, G20, G39	DB-Wax, CP Wax 52 CB	BP20	ZB-Wax	OPTIMA WAX		AT-WAXms, EC-WAX	007-CW
Stabilwax (p. 49, 81) MXT-WAX (p. 96)	polyethylene glycol	G14, G15, G16, G20, G39	HP-INNOWax, CP Wax 52 CB, VF-WAX MS		ZB-WAXplus	OPTIMA WAXplus	Supelcowax-10	AT-WAX	

See page 103 for Restek PLOT Column Phase Cross-Reference chart.

*See page 131 for our USP Liquid Phase and Solid Support Cross-Reference.



Columns by Application/Industry

Restek	Applications	Agilent	Supelco	Macherey-Nagel	SGE	Alltech	Phenomenex
Chiral Columns							
Rt-βDEXm, Rt-βDEXsm, Rt-βDEXse, Rt-βDEXsp, Rt-βDEXsa, Rt-βDEXcst, Rt-γDEXsa (p. 89)	Chiral compounds						
Clinical, Forensic, & Toxicology							
Rtx-BAC Plus 1 (p. 55)	Blood alcohol testing	DB-ALC1					ZB-BAC1
Rtx-BAC Plus 2 (p. 55)		DB-ALC2					ZB-BAC2
Environmental							
Rxi-5Sil MS (p. 57, 64, 66)	Semivolatiles - EPA Methods 8270, 625, 525	DB-5ms, DB-5msUI, VF-5ms, CP-Sil 8 CB	SLB-5ms	OPTIMA 5MS Accent	BPX5		ZB-5msi
Rtx-VMS (p. 67)	Volatiles - EPA Methods 8260, 624, 524	Restek innovation					
Rxi-624Sil MS (p. 70)	Volatiles - EPA Method 624	DB-624, VF-624ms, CP-Select 624 CB		OPTIMA 624 LB	BP624		ZB-624
Rtx-502.2 (p. 69)	Volatiles - EPA Methods 8010, 8020, 502.2, 601, 602	DB-502.2	VOCOL			AT-502.2	
Rtx-Volatiles (p. 69)			VOCOL				
Rtx-VRX (p. 68)			DB-VRX				
Rtx-CLPesticides (p. 62)	Organochlorine pesticides -	DB-CLP1					
Rtx-CLPesticides2 (p. 62)	EPA Methods 8081, 8082, 608, 505, 508	DB-CLP2					
Rtx-1614 (p. 56)	Brominated flame retardants	Restek innovation					
Rtx-PCB (p. 59)	Polychlorinated biphenyl -	Restek innovation					
Rxi-XLB (p. 60)	EPA Methods 8082, 608, PCB congeners	DB-XLB, VF-XMS					MR1, ZB-XLB
Rtx-OPPesticides (p. 61)	Organophosphorus pesticides -	Restek innovation					
Rtx-OPPesticides2 (p. 61)	EPA Method 8141	Restek innovation					
Rtx-Dioxin2 (p. 58)	Dioxin & Furans - EPA Methods	Restek innovation					
Rxi-17Sil MS (p. 65)	Polycyclic aromatic hydrocarbons	DB-17ms, VF-17ms, CP-Sil 24 CB		OPTIMA 17 MS	BPX50		ZB-50
Foods, Flavors, & Fragrances							
Rt-2560 (p. 71)	cis/trans FAMES	HP-88	SPB-2560				
FAMEWAX (p. 71)	Marine oils	Select FAME	Omegawax			AT-AquaWax, AT-FAME	
Rxi-PAH (p. 72)	PAHs	Restek innovation					
Rtx-65 TG (p. 74)	Triglycerides	Restek innovation					
Petroleum & Petrochemical							
Rt-Alumina BOND/CFC (p. 108)	Chlorinated fluorocarbons (CFCs)						
Rtx-DHA (p. 77)	Detailed hydrocarbon analysis	HP-PONA, DB-Petro, CP Sil PONA CB	Petrocol DH		BP1PONA		
Rtx-2887 (p. 79)	Hydrocarbons - ASTM 2887	DB-2887	Petrocol 2887, Petrocol EX2887			AT-2887	
MXT-2887 (p. 99)							
D3606 (p. 121)	Ethanol - ASTM 3606	Restek innovation					
Rt-TCEP (p. 75)		CP-TCEP	TCEP				
Rtx-Mineral Oil (p. 78)	DIN ENISO 9377-2	Select Mineral Oil	Select Mineral Oil	Select Mineral Oil	Select Mineral Oil		
MXT-1HT SimDist (p. 100)	Simulated distillation	DB-HT-SimDis, CP-SimDist, CP-SimDst Ultimetel			BPX1	AT-3710	ZB-1XT SimDist
MXT-1 SimDist (p. 101)		DB-HT-SimDis, CP-SimDist, CP-SimDst Ultimetel	CP-SIMDIST	CP-SIMDIST	CP-SIMDIST		
MXT-500 SimDist (p. 101)		Restek innovation					
Rtx-Biodiesel TG (p. 76)	Triglycerides in biodiesel	Biodiesel, Select Biodiesel		OPTIMA Biodiesel			ZB-Bioethanol
MXT-Biodiesel TG (p. 99)							
Pharmaceutical							
Rtx-G27 w/IntegraGuard (p. 83)	Organic volatile impurities (OVI) - USP 467						
Rtx-G43 w/IntegraGuard (p. 83)			OVI-G43				
Rxi-624Sil MS (p. 80)		DB-624, VF-624ms, CP-Select 624 CB		OPTIMA 624 LB	BP624		ZB-624
Rtx-5 (G27) (p. 83)		HP-5, DB-5, CP Sil 8 CB	SPB-5	OPTIMA 5	BP5	EC-5, AT-5	ZB-5
Stabilwax (G16) (p. 81)		HP-INNOWax, CP Wax 52 CB, VF-WAX MS	Supelcowax-10	OPTIMA WAXplus		AT-WAX	ZB-WAXplus
Specialty deactivated phases							
Rtx-Volatile Amine (p. 85)	Volatile amines	CP-VolAmine					
Rtx-5Amine (p. 86)	Amines	CP-Sil 8 CB		OPTIMA 5 Amine			
Rtx-35Amine (p. 87)		Restek innovation					
Stabilwax-DB (p. 88)		CAM, CP WAX 51	Carbowax Amine	FS-CW 20 M-AM		AT-CAM	
Stabilwax-DA (p. 84)	Free fatty acids	HP-FFAP, DB-FFAP, VF-DA, CP WAX58 CB, CP-FFAP CB	Nukol	PERMABOND FFAP, OPTIMA FFAP, OPTIMA FFAP Plus	BP-21	AT-AquaWax DA, AT-1000	ZB-FFAP

did you know?

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

please note

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

See page 25 for details.

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.

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

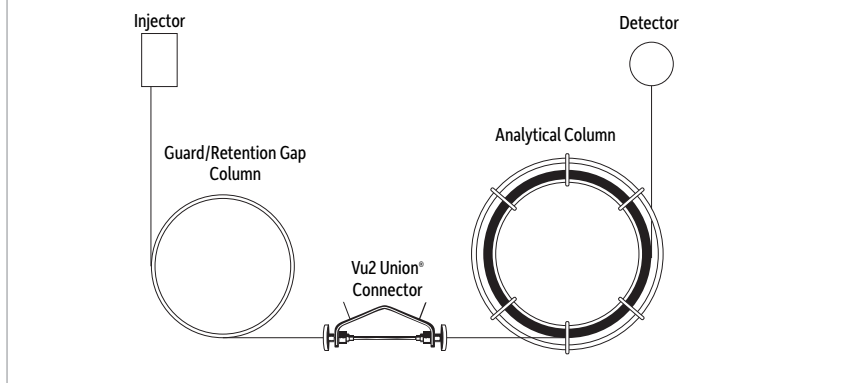


Figure 2 Retention gaps are used to focus components in a tight band at the beginning of the analytical column.



- Sample introduction: a liquid film of solvent and sample is deposited in the first length of capillary.
- As oven temperature increases, the solvent evaporates and the target compounds elute unretained through the retention gap until they contact the analytical column.
- When target compounds come in contact with the stationary phase, they are refocused on the analytical column, resulting in a narrow initial band width.

Analyte Focusing

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

For cool on-column injection, the purpose of a retention gap is to help focus the sample components when introducing a liquid sample directly into the retention gap. The cool on-column injection is performed by inserting the syringe needle into the retention gap (this can be accomplished with a 0.53 mm 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.

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 non-volatile material, usually in the first 10-20 cm, and not allow it 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 from being introduced onto the column. Contaminants 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 provides an inert pathway, 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. 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 208 to 214 for information about these connectors.

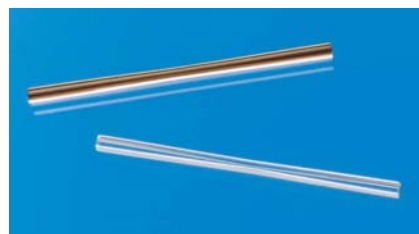
it's a fact

To eliminate connections that may leak and to ensure longer column lifetime, use our unique Integra-Guard® column. See **page 25**.

Connectors for Fused Silica Columns



Vu2 Union® Connector
(See page 210.)



Press-Tight® Connectors
(See pages 208–209.)



MXT® Union Connector Kit
for Fused Silica
(See page 212.)

GC Columns

Fused Silica Capillary Columns

Guard/Retention Gap Columns23–25

Rxi® Columns26–37

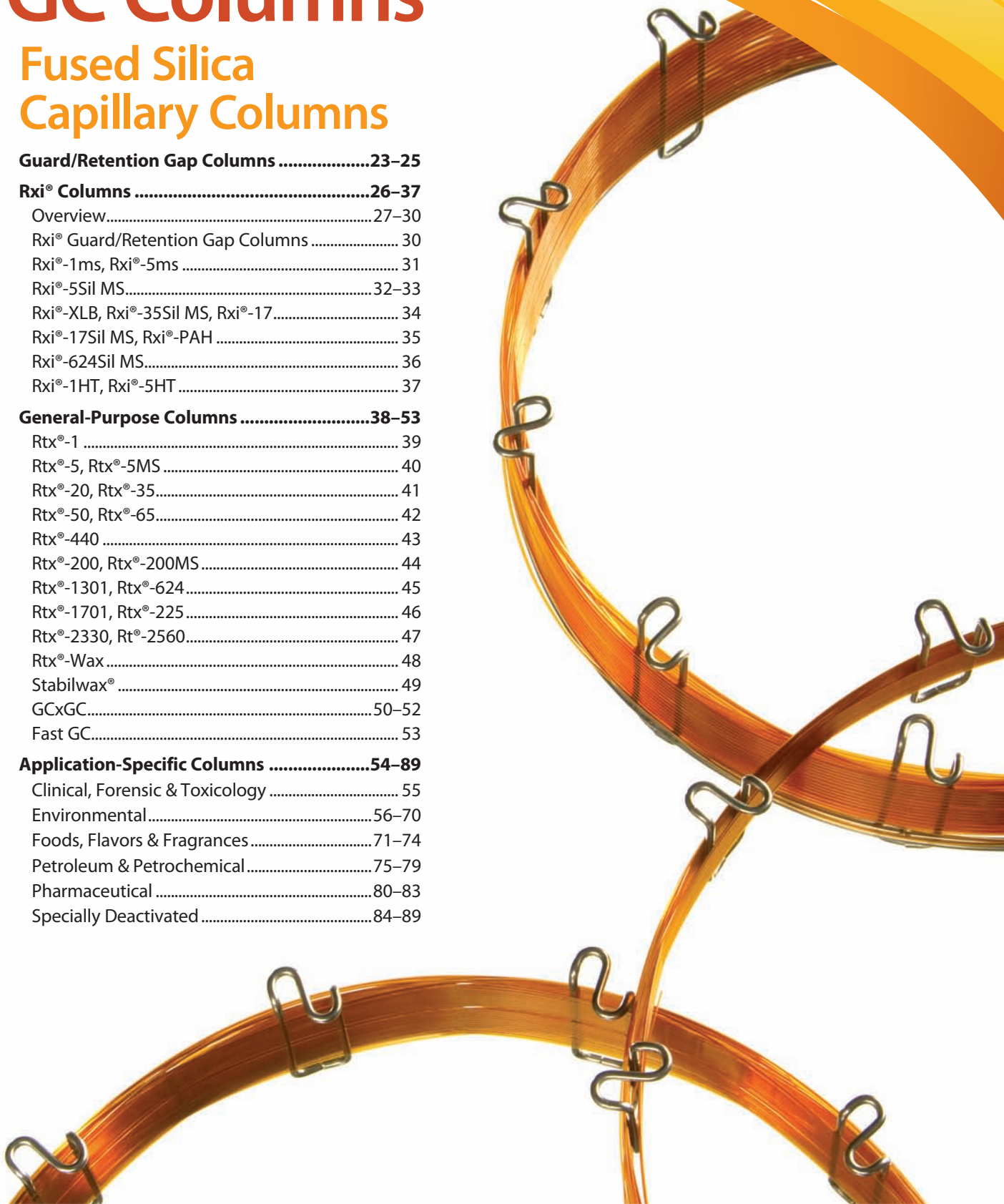
Overview.....	27–30
Rxi® Guard/Retention Gap Columns	30
Rxi®-1ms, Rxi®-5ms	31
Rxi®-5Sil MS.....	32–33
Rxi®-XLB, Rxi®-35Sil MS, Rxi®-17.....	34
Rxi®-17Sil MS, Rxi®-PAH	35
Rxi®-624Sil MS.....	36
Rxi®-1HT, Rxi®-5HT	37

General-Purpose Columns38–53

Rtx®-1	39
Rtx®-5, Rtx®-5MS	40
Rtx®-20, Rtx®-35.....	41
Rtx®-50, Rtx®-65.....	42
Rtx®-440	43
Rtx®-200, Rtx®-200MS.....	44
Rtx®-1301, Rtx®-624.....	45
Rtx®-1701, Rtx®-225.....	46
Rtx®-2330, Rtx®-2560.....	47
Rtx®-Wax	48
Stabilwax®	49
GCxGC.....	50–52
Fast GC.....	53

Application-Specific Columns54–89

Clinical, Forensic & Toxicology	55
Environmental.....	56–70
Foods, Flavors & Fragrances	71–74
Petroleum & Petrochemical.....	75–79
Pharmaceutical	80–83
Specially Deactivated.....	84–89



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.
0.25 mm	0.37 ± 0.04 mm	10029	10029-600	10059	10059-600
0.32 mm	0.45 ± 0.04 mm	10039	10039-600	10064	10064-600
0.53 mm	0.69 ± 0.05 mm	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.	
0.025 mm	0.363 ± 0.012 mm	10097			
0.05 mm	0.363 ± 0.012 mm	10098			
0.075 mm	0.363 ± 0.012 mm	10099			
0.10 mm	0.363 ± 0.012 mm	10100	10041		
0.15 mm	0.363 ± 0.012 mm	10101	10042		
0.18 mm	0.37 ± 0.04 mm	10102	10046	10046-600	
0.25 mm	0.37 ± 0.04 mm		10043	10043-600	
0.32 mm	0.45 ± 0.04 mm		10044	10044-600	
0.53 mm	0.69 ± 0.05 mm		10045	10045-600	
Nominal ID	Nominal OD	10-Meter	10-Meter/6-pk.	30-Meter*	60-Meter*†
0.25 mm	0.37 ± 0.04 mm	10049	10049-600	10012	10013
0.32 mm	0.45 ± 0.04 mm	10048	10048-600	10022	10023
0.53 mm	0.69 ± 0.05 mm	10047		10032	10033

*30- and 60-meter lengths are banded in 5-meter sections.

†Recommendation: Cut 60 m guard columns into shorter lengths. Using full length may cause peak distortion.

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

(polar polyethylene glycol deactivation)

- 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*†
0.25 mm	0.37 ± 0.04 mm	10065	10068	10014	10015
0.32 mm	0.45 ± 0.04 mm	10066	10069		
0.53 mm	0.69 ± 0.05 mm	10067	10070	10034	

*30- and 60-meter lengths are banded in 5-meter sections.

†Recommendation: Cut 60 m 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 25**.

also available**Metal MXT® Guard/Retention Gap Columns**

Rugged, flexible, Siltek®-treated stainless steel tubing for use with MXT® columns; inertness comparable to fused silica tubing.



See **page 92**.

it's a fact

Use guard columns to:

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

**did you know?**

Fused silica guard columns are held together in a band with high temperature string that can withstand normal column operating temperatures. To prevent the tubing from coming unwound, do not remove the string!

Fused Silica, PLOT, & MXT® Capillary GC Column Ferrule Guide

GC Column ID	Ferrule ID
0.10 mm	0.4
0.15 mm	0.4
0.18 mm	0.4
0.25 mm	0.4
0.28 mm	0.4
0.32 mm	0.5
0.45 mm	0.8
0.53 mm	0.8

also available

Base-deactivated inlet liners

See page 185.

did you know?

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

also available

Metal MXT® Guard/
Retention Gap Columns

Rugged, flexible, Siltek®-treated stainless steel tubing for use with MXT® columns; inertness comparable to fused silica tubing.

See page 92.



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.
0.25 mm	0.37 ± 0.04 mm	10000	10000-600
0.32 mm	0.45 ± 0.04 mm	10001	10001-600
0.53 mm	0.69 ± 0.05 mm	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-and-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—Hydroguard® deactivated tubing. 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.
- Purge-and-trap systems.

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

*30- and 60-meter lengths are banded in 5-meter sections.

†Recommendation: Cut 60 m guard columns into shorter lengths. Using full length may cause peak distortion.

also available

Column connector kits & ferrules

See page 213.



Innovative Integra-Guard® Columns

Get the protection without the connection!

- 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 here. 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.#
Rtx-1		
30 m, 0.25 mm ID, 0.25 µm Rtx-1 w/5 m Integra-Guard Column	ea.	10123-124
30 m, 0.53 mm ID, 1.00 µm Rtx-1 w/5 m Integra-Guard Column	ea.	10155-126
30 m, 0.53 mm ID, 5.00 µm Rtx-1 w/5 m Integra-Guard Column	ea.	10179-126
Rtx-5		
30 m, 0.25 mm ID, 0.25 µm Rtx-5 w/5 m Integra-Guard Column	ea.	10223-124
30 m, 0.25 mm ID, 0.25 µm Rtx-5 w/10 m Integra-Guard Column	ea.	10223-127
30 m, 0.25 mm ID, 1.00 µm Rtx-5 w/5 m Integra-Guard Column	ea.	10253-124
30 m, 0.32 mm ID, 0.25 µm Rtx-5 w/5 m Integra-Guard Column	ea.	10224-125
30 m, 0.32 mm ID, 1.00 µm Rtx-5 w/5 m Integra-Guard Column	ea.	10254-125
30 m, 0.53 mm ID, 5.00 µm Rtx-5/Rtx-G27 w/5 m Integra-Guard Column	ea.	10279-126
60 m, 0.32 mm ID, 0.25 µm Rtx-5 w/5 m Integra-Guard Column	ea.	10227-125
Rtx-5MS		
15 m, 0.25 mm ID, 0.25 µm Rtx-5MS w/5 m Integra-Guard Column	ea.	12620-124
15 m, 0.25 mm ID, 0.50 µm Rtx-5MS w/10 m Integra-Guard Column	ea.	12635-127
30 m, 0.25 mm ID, 0.10 µm Rtx-5MS w/5 m Integra-Guard Column	ea.	12608-124
30 m, 0.25 mm ID, 0.25 µm Rtx-5MS w/5 m Integra-Guard Column	ea.	12623-124
30 m, 0.25 mm ID, 0.25 µm Rtx-5MS w/10 m Integra-Guard Column	ea.	12623-127
30 m, 0.25 mm ID, 0.50 µm Rtx-5MS w/5 m Integra-Guard Column	ea.	12638-124
30 m, 0.25 mm ID, 0.50 µm Rtx-5MS w/10 m Integra-Guard Column	ea.	12638-127
30 m, 0.32 mm ID, 0.25 µm Rtx-5MS w/5 m Integra-Guard Column	ea.	12624-125
30 m, 0.32 mm ID, 1.00 µm Rtx-5MS w/5 m Integra-Guard Column	ea.	12654-125
Rxi-5Sil MS		
15 m, 0.25 mm ID, 0.25 µm Rxi-5Sil MS w/10 m Integra-Guard Column	ea.	13620-127
30 m, 0.25 mm ID, 0.25 µm Rxi-5Sil MS w/5 m Integra-Guard Column	ea.	13623-124
30 m, 0.25 mm ID, 0.25 µm Rxi-5Sil MS w/10 m Integra-Guard Column	ea.	13623-127
15 m, 0.25 mm ID, 0.50 µm Rxi-5Sil MS w/5 m Integra-Guard Column	ea.	13635-124
30 m, 0.25 mm ID, 0.50 µm Rxi-5Sil MS w/5 m Integra-Guard Column	ea.	13638-124
30 m, 0.25 mm ID, 0.50 µm Rxi-5Sil MS w/10 m Integra-Guard Column	ea.	13638-127
30 m, 0.32 mm ID, 0.50 µm Rxi-5Sil MS w/5 m Integra-Guard Column	ea.	13639-125
30 m, 0.32 mm ID, 1.00 µm Rxi-5Sil MS w/5 m Integra-Guard Column	ea.	13654-125
Rtx-624		
30 m, 0.25 mm ID, 1.40 µm Rtx-624 w/5 m Integra-Guard Column	ea.	10968-124
30 m, 0.32 mm ID, 1.80 µm Rtx-624 w/5 m Integra-Guard Column	ea.	10970-125
30 m, 0.53 mm ID, 3.00 µm Rtx-624 w/5 m Integra-Guard Column	ea.	10971-126
Rtx-1301		
30 m, 0.53 mm ID, 3.00 µm Rtx-1301 w/5 m Integra-Guard Column	ea.	16085-126
Rtx-1701		
30 m, 0.25 mm ID, 0.25 µm Rtx-1701 w/5 m Integra-Guard Column	ea.	12023-124
Stabilwax		
30 m, 0.25 mm ID, 0.25 µm Stabilwax w/5 m Integra-Guard Column	ea.	10623-124
30 m, 0.32 mm ID, 1.00 µm Stabilwax w/5 m Integra-Guard Column	ea.	10654-125
30 m, 0.53 mm ID, 1.00 µm Stabilwax w/5 m Integra-Guard Column	ea.	10655-126

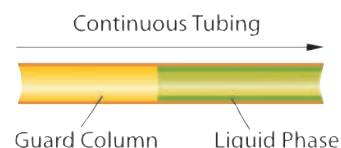
Integra-Guard® columns are available for all phases listed for columns with 0.25, 0.32 or 0.53 mm ID. If you don't see what you need here, contact Customer Service.

restek innovation!

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

similarp hases

DuraGuard, EZ-Guard, Guardian

Integra-Guard® Built-In Guard Column

String indicates where the analytical column begins.



Tag indicates guard column end.

Rxi® GC Columns

Overview	27–30
Rxi® Guard/Retention Gap Columns.....	30
Rxi®-1 ms, Rxi®-5ms.....	31
Rxi®-5Sil MS	32–33
Rxi®-XLB, Rxi®-35Sil MS, Rxi®-17	34
Rxi®-17Sil MS, Rxi®-PAH.....	35
Rxi®-624Sil MS	36
Rxi®-1HT, Rxi®-5HT.....	37



Lower Detection Limits with Ground-Breaking Rxi® 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.

www.restek.com/rxi



Lower Detection Limits with Ground-Breaking Column Technology

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

Highest Inertness

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

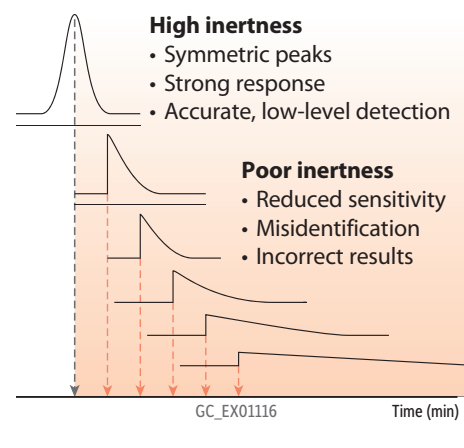
- Increased signal-to-noise ratios to improve low-level detection.
- Reproducible retention times for positive identifications.
- Improved response for polar, acidic, and basic compounds.

Increased Signal and Reproducible Retention Times

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

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

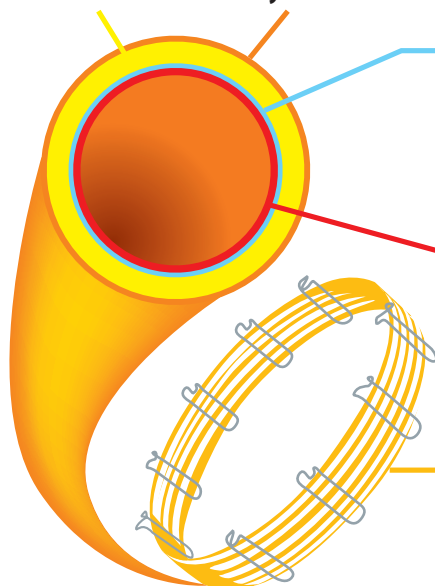
Figure 1: As column activity increases, signal decreases and retention time shifts.



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

We've optimized phase chemistry, column deactivation, and our manufacturing process to ensure exceptional performance.

Fused Silica Polyimide



Rxi® Deactivation

- Effectively shields reactive silanols.
- Ensures comprehensive inertness (acids, bases, and diols).
- Provides symmetric peaks for higher sensitivity.

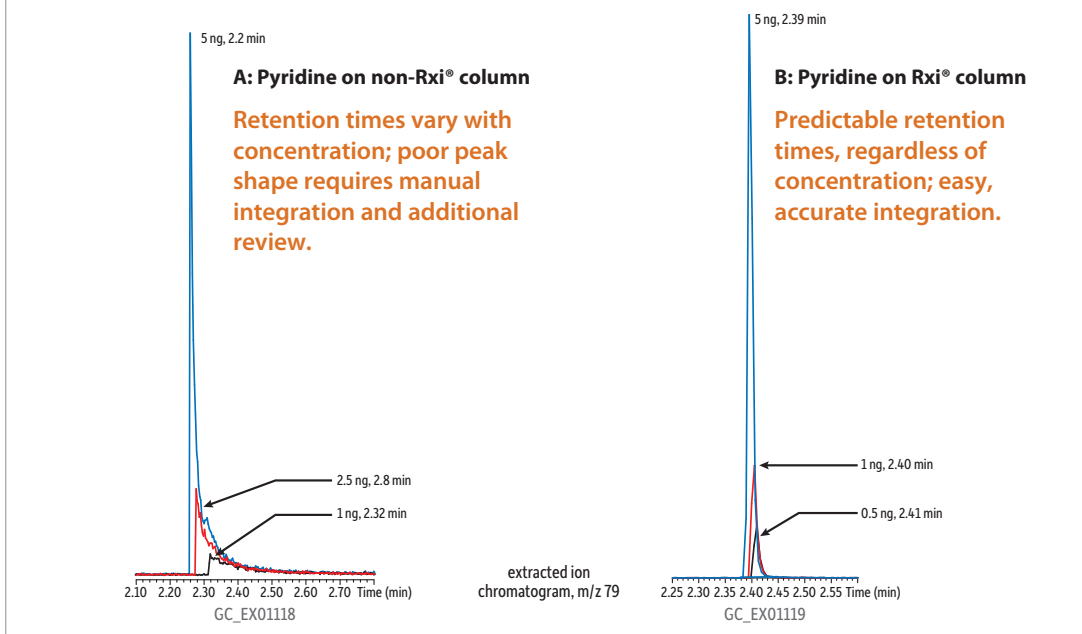
Rxi® Phase Chemistry

- Enhances selectivity for challenging separations.
- Increases thermal stability, widening the application range.
- Lowers bleed for MS compatibility.
- Surface bonding increases durability and ensures reproducible retention times.

Rxi® Manufacturing

Tighter quality controls for better performance and reliable column-to-column reproducibility.

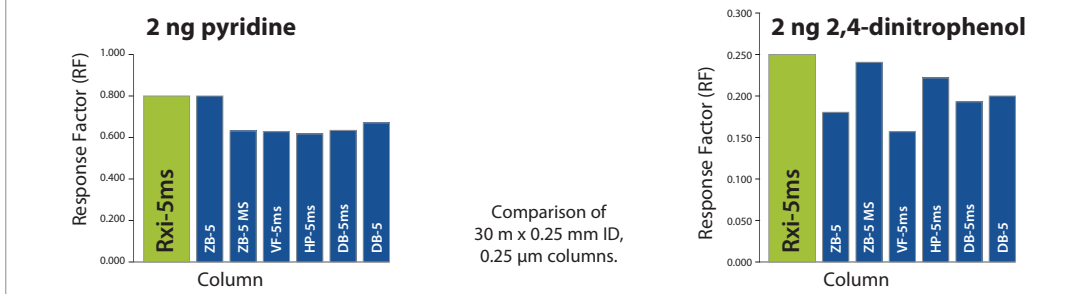
Figure 2: Compared to conventional GC columns, Rxi® columns show excellent inertness and produce good peak shape and reproducible retention for challenging compounds.



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).

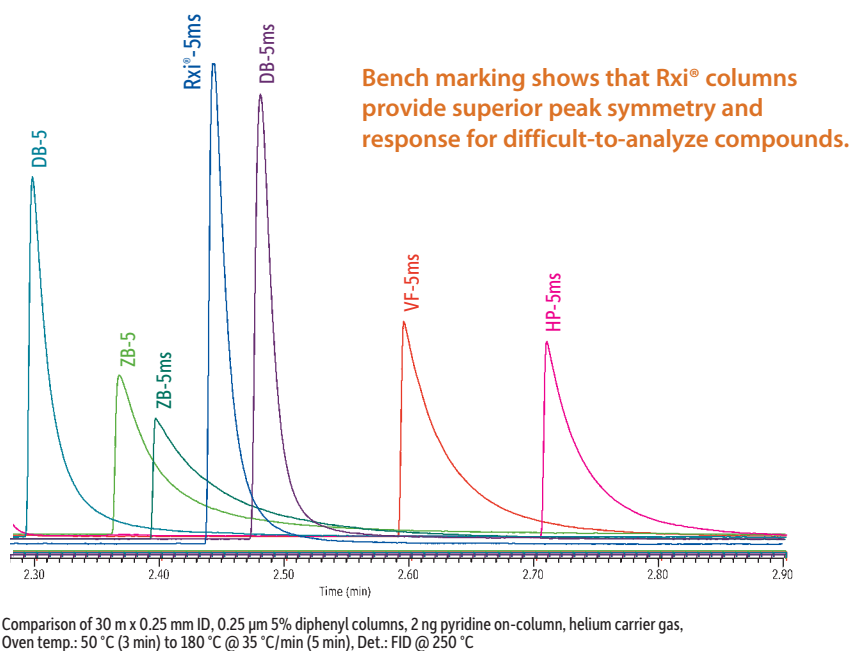
Figure 3: An Rxi® column gives the best overall performance for both basic and acidic compounds.



What are “Sil” Rxi® Columns?

By combining arylene chemistry with Rxi® technology, Restek has developed a subgroup of Rxi® columns with exceptional thermal stability. These columns are produced by incorporating phenylene groups into the polysiloxane backbone, forming silarylene copolymers. As a result of this modification, these columns, which are distinguished by a “Sil” naming convention, have greater thermal stability than their conventional counterparts. Four Sil columns are currently available: Rxi®-5Sil MS, Rxi®-624Sil MS, Rxi®-35Sil MS, and Rxi®-17Sil MS; these columns have the same polarity as their conventional counterparts, but differ in selectivity. Higher thermal stability results in lower bleed, which can make these columns useful for MS applications or when increased sensitivity is required.

Figure 4: Peak shape comparison of a basic compound on various brands of GC columns.



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?

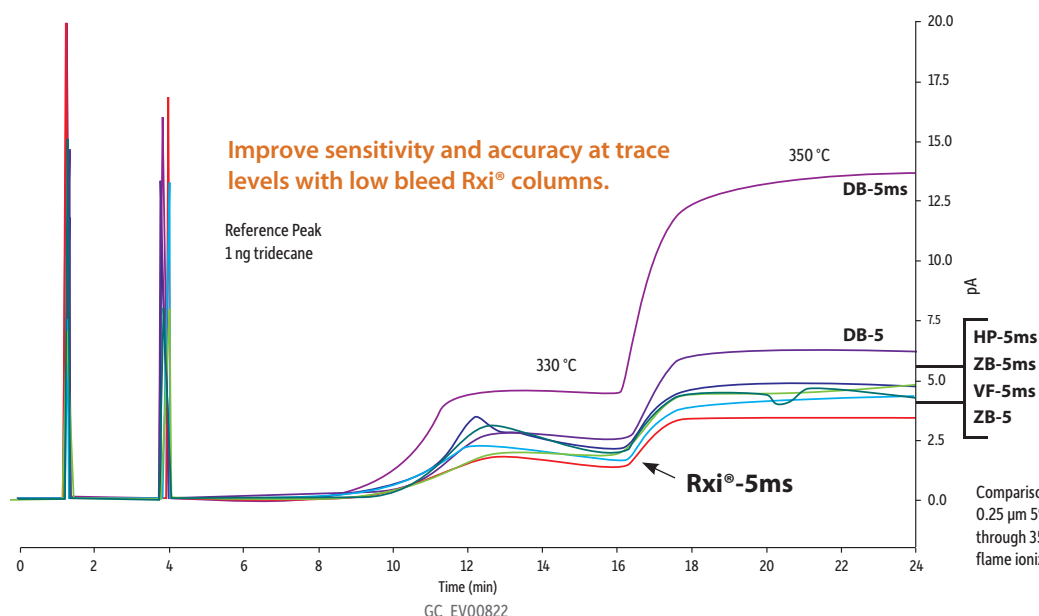
Contact support@restek.com
or your local Restek representative for helpful, knowledgeable technical support.

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:

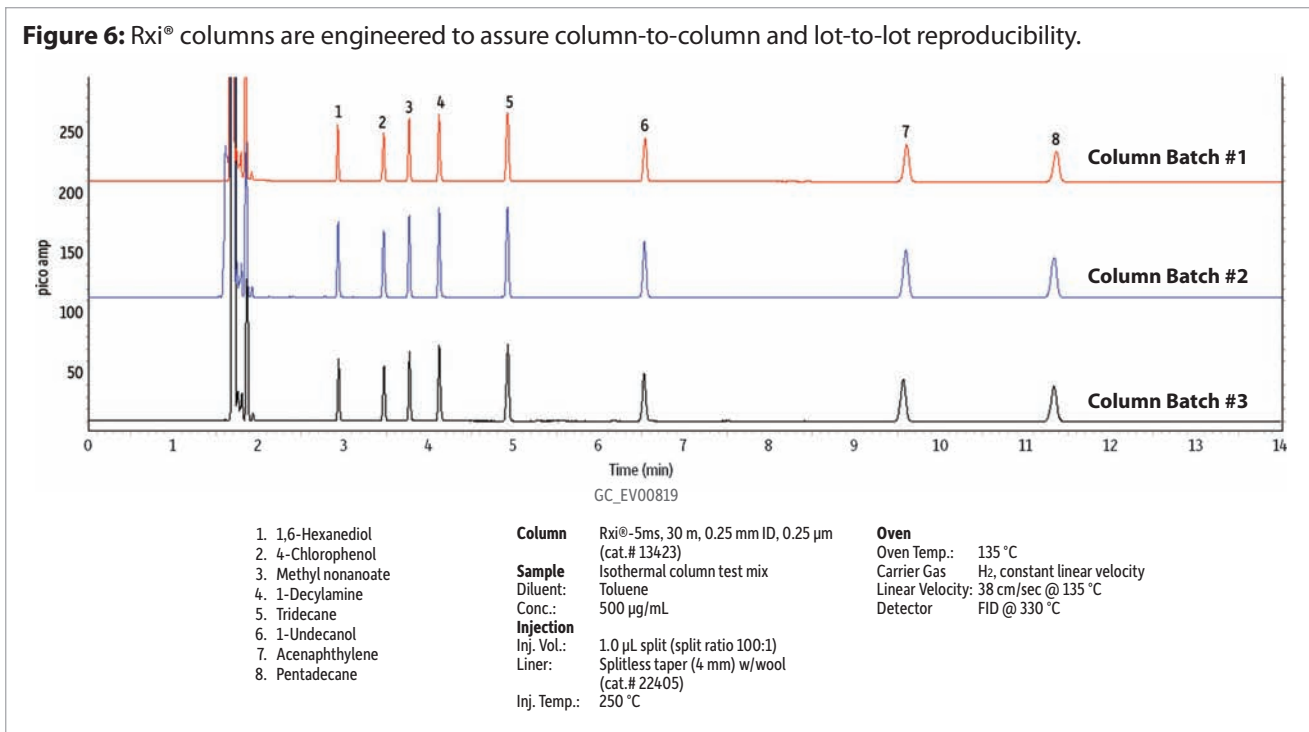
- Increased sensitivity, for lower detection limits and better matches to mass spectral libraries.
- Faster system stabilization.
- Reduced detector contamination results in less downtime for maintenance.

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



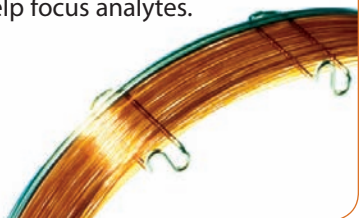
Exceptional Reproducibility

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).



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.
0.25 mm	0.37 ± 0.04 mm	10029	10029-600	10059	10059-600
0.32 mm	0.45 ± 0.04 mm	10039	10039-600	10064	10064-600
0.53 mm	0.69 ± 0.05 mm	10054	10054-600	10073	10073-600

Rxi®-1ms Columns (fused silica)

(nonpolar phase; Crossbond® dimethyl polysiloxane)

- General-purpose columns for arson accelerants, 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. mits	li	15-Meter	30-Meter	60-Meter
0.25 mm	0.25 µm	-60 to 330/350 °C		13320	13323	13326
	0.50 µm	-60 to 330/350 °C		13335	13338	13341
	1.00 µm	-60 to 330/350 °C		13350	13353	13356
0.32 mm	0.25 µm	-60 to 330/350 °C		13321	13324	13327
	0.50 µm	-60 to 330/350 °C		13336	13339	13342
	1.00 µm	-60 to 330/350 °C			13354	13357
	4.00 µm	-60 to 330/350 °C			13396	
0.53 mm	0.50 µm	-60 to 330/350 °C		13337	13340	
	1.00 µm	-60 to 330/350 °C		13352	13355	
	1.50 µm	-60 to 330/350 °C		13367	13370	13373

ID	df	temp. limits	10-Meter	12-Meter	20-Meter	25-Meter	50-Meter
0.15 mm 0.15 µm	-60 to 330/350 °C	43800			43801		
2.0 µm	-60 to 330/350 °C				43802		
0.18 mm 0.18 µm	-60 to 330/350 °C				13302		
0.36 µm	-60 to 330/350 °C				13311		
0.20 mm 0.33 µm	-60 to 330/350 °C		13397			13398	13399

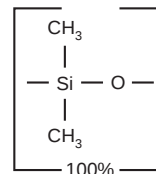
Rxi®-5ms Columns (fused silica)

(low polarity phase; Crossbond® diphenyl 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
0.25 mm	0.25 µm	-60 to 330/350 °C	13420	13423	13426
	0.40 µm	-60 to 330/350 °C		13481	
	0.50 µm	-60 to 330/350 °C	13435	13438	13441
	1.00 µm	-60 to 330/350 °C	13450	13453	13456
0.32 mm	0.25 µm	-60 to 330/350 °C	13421	13424	13427
	0.50 µm	-60 to 330/350 °C	13436	13439	13442
	1.00 µm	-60 to 330/350 °C	13451	13454	13457
0.53 mm	0.25 µm	-60 to 330/350 °C	13422	13425	
	0.50 µm	-60 to 330/350 °C	13437	13440	
	1.00 µm	-60 to 330/350 °C	13452	13455	
	1.50 µm	-60 to 330/350 °C	13467	13470	

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

Rxi®-1ms Structure

Similar to: (100%-methyl)-polysiloxane

similar phases

HP-1, HP-1ms, HP-1msUI, DB-1, DB-1ms, DB-1msUI, Ultra-1, VF-1ms, CP-Sil 5 CB, ZB-1, ZB-1ms

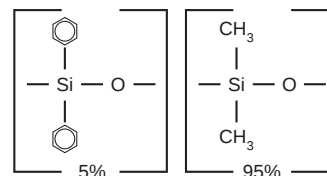
free literature**Why Derivatize?**

Improve GC Separations
with Derivatization

Download your
free copy from

www.restek.com

lit. cat.#
CFTS1269

**Rxi®-5ms Structure**

Similar to: (5%-phenyl)-methylpolysiloxane

similar phases

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

free literature**Rxi® Columns**

Lower Detection Limits with Ground-
Breaking Column Technology

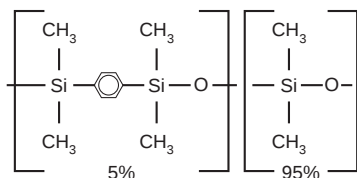
Download your
free copy from

www.restek.com

lit. cat.#
GNFL1173A



Rxi®-5Sil MS Structure



similarp hases

DB-5ms, DB-5msUI, VF-5ms, CP-Sil 8 CB,
ZB-5msi, Rtx-5Sil MS

free literature

Rxi® Columns
Assured Performance
for Forensic
Applications

lit. cat.#
CFFL1302



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

lit. cat.#
GNFL1061A



Developing New Methods
for Pesticides in Dietary
Supplements

lit. cat.#
PHAN1242A



Download your free copies from

www.restek.com

Rxi®-5Sil MS Columns (fused silica)

(low polarity phase; Crossbond® 1,4-bis(dimethylsiloxy)phenylene dimethyl polysiloxane)

- Engineered to be a low-bleed GC-MS column.
- Excellent inertness for active compounds.
- General-purpose columns—ideal for GC-MS analysis of semivolatiles, 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
0.25 mm	0.10 µm	-60 to 320/350 °C	13605	13608	
	0.25 µm	-60 to 320/350 °C	13620	13623	13626
	0.50 µm	-60 to 320/350 °C	13635	13638	
	1.00 µm	-60 to 320/350 °C	13650	13653	13697
0.32 mm	0.25 µm	-60 to 320/350 °C	13621	13624	
	0.50 µm	-60 to 320/350 °C		13639	
	1.00 µm	-60 to 320/350 °C		13654	
0.53 mm	1.50 µm	-60 to 320/330 °C		13670	

ID	df	temp. limits	10-Meter	20-Meter	40-Meter	60-Meter
0.15 mm	0.15 µm	-60 to 320/350 °C	43815	43816		
	2.0 µm	-60 to 320/350 °C		43817		
0.18 mm	0.10 µm	-60 to 320/350 °C				43607
	0.18 µm	-60 to 320/350 °C		43602	43605	
	0.36 µm	-60 to 320/350 °C		43604		

Rxi®-5Sil MS with Integra-Guard®

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

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

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 25 for more information.

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

Semivolatiles by EPA Method 8270 on Rxi®-5Sil MS (30 m, 0.25 mm ID, 0.25 µm) w/Drilled Uniliner® Inlet Liner

Column Rxi®-5Sil MS, 30 m, 0.25 mm ID, 0.25 µm (cat.# 13623)

Sample 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)
10 µg/mL (IS 40 µg/mL)

Conc.:

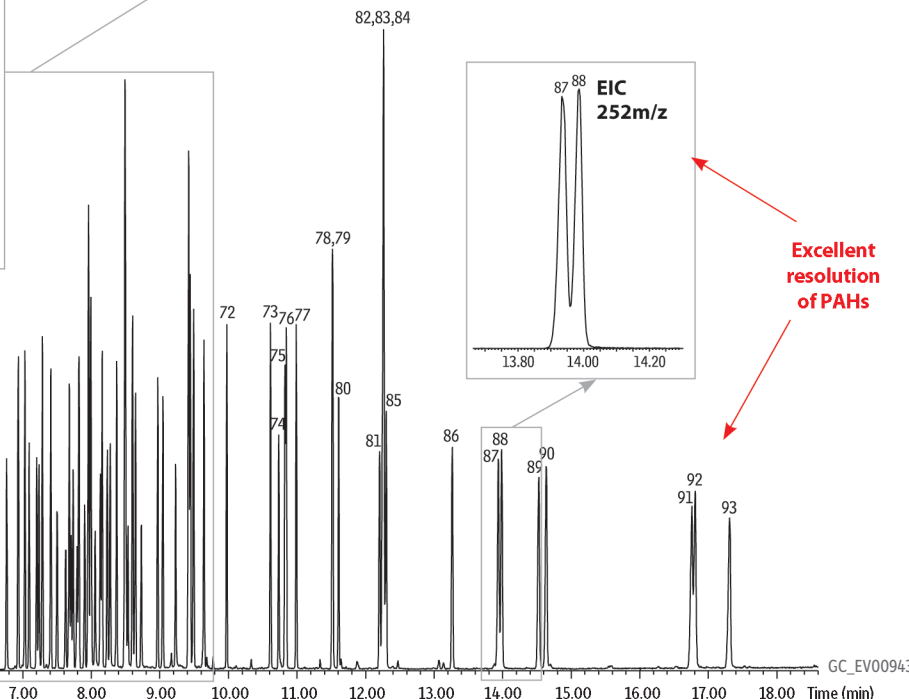
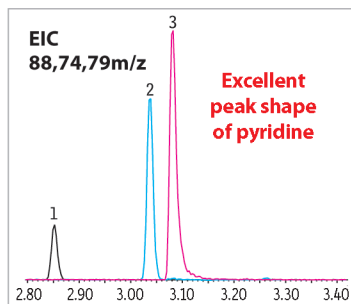
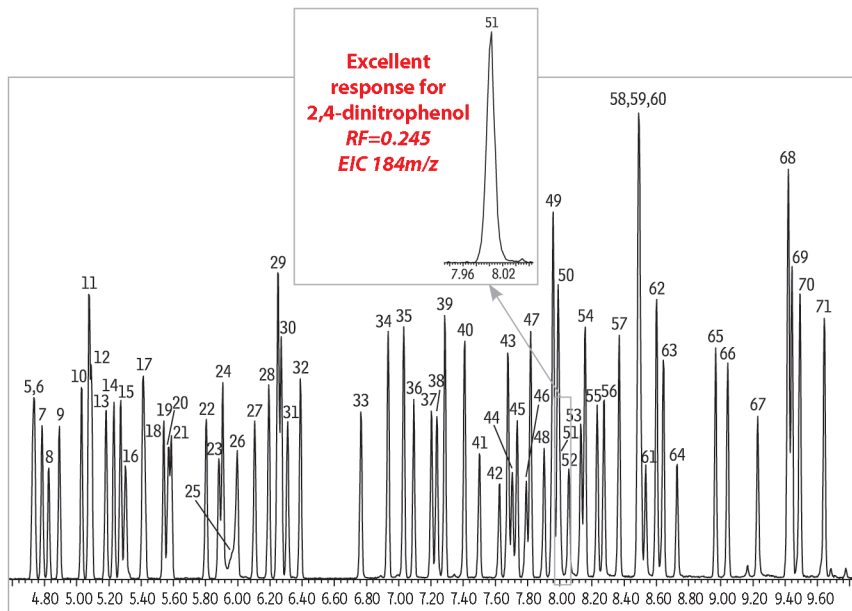
Injection
Inj. Vol.: 1.0 µL pulsed splitless (hold 0.15 min)
Liner: 4 mm drilled Uniliner® (hole near bottom) (cat.# 20756)

Inj. Temp.: 250 °C
Pulse Pressure: 25 psi (172.4 kPa)
Pulse Time: 0.2 min
Purge Flow: 60 mL/min

Oven
Oven Temp.: 40 °C (hold 1.0 min) to 280 °C at 25 °C/min to 320 °C at 5 °C/min (hold 1 min)
He, constant flow

Carrier Gas
Flow Rate: 1.2 mL/min

Detector
MS
Mode: Scan
Transfer Line
Temp.: 280 °C
Ionization Mode: EI
Scan Range: 35–550 amu



Peaks	17. 4-Methylphenol/3-methylphenol	33. 4-Chloro-3-methylphenol	51. 2,4-Dinitrophenol	65. 4-Bromophenyl phenyl ether	83. Bis(2-ethylhexyl)phthalate
1. 1,4-Dioxane	2. 2-Nitrosodimethylamine	35. 1-Methylnaphthalene	52. 4-Nitrophenol	66. Hexachlorobenzene	84. Chrysene-d12 (IS)
3. Pyridine	19. Hexachloroethane	36. Hexachlorocyclopentadiene	53. 2,4-Dinitrotoluene	67. Pentachlorophenol	85. Chrysene
4. 2-Fluorophenol (SS)	20. Nitrobenzene-d5 (SS)	37. 2,4,6-Trichlorophenol	54. Dibenzofuran	68. Phenanthrene-d10 (IS)	86. Di-n-octyl phthalate
5. Phenol-d6 (SS)	21. Nitrobenzene	38. 2,4,5-Trichlorophenol	55. 2,3,5,6-Tetrachlorophenol	69. Phenanthrene	87. Benzo[b]fluoranthene
6. Phenol	22. Isophorone	39. 2-Fluorobiphenyl (SS)	56. 2,3,4,6-Tetrachlorophenol	70. Anthracene	88. Benzo[k]fluoranthene
7. Aniline	23. 2-Nitrophenol	40. 2-Chloronaphthalene	57. Diethyl phthalate	71. Carbazole	89. Benzo[a]pyrene
8. Bis(2-chloroethyl) ether	24. 2,4-Dimethylphenol	41. 2-Nitroaniline	58. 4-Chlorophenyl phenyl ether	72. di-n-Butyl phthalate	90. Perylene-d12 (IS)
9. 2-Chlorophenol	25. Benzoic acid	42. 1,4-Dinitrobenzene	59. Fluorene	73. Fluoranthene	91. Indeno[1,2,3-cd]pyrene
10. 1,3-Dichlorobenzene	26. Bis(2-chloroethoxy) methane	43. Dimethyl phthalate	60. 4-Nitroaniline	74. Benzidine	92. Dibenzo[a,h]anthracene
11. 1,4-Dichlorobenzene-d4 (IS)	27. 2,4-Dichlorophenol	44. 1,3-Dinitrobenzene	61. 4,6-Dinitro-2-methylphenol	75. Pyrene-d10 (SS)	93. Benzo[ghi]perylene
12. 1,4-Dichlorobenzene	28. 1,2,4-Trichlorobenzene	45. 2,6-Dinitrotoluene	62. n-Nitroso-diphenylamine (diphenylamine)	76. Pyrene	c = contaminant (toluene)
13. Benzyl alcohol	29. Naphthalene-d8 (IS)	46. 1,2-Dinitrobenzene	63. 1,2-Diphenylhydrazine (as azobenzene)	77. p-Terphenyl-d14 (SS)	
14. 1,2-Dichlorobenzene	30. Naphthalene	47. Acenaphthylene	64. 2,4,6-Tribromophenol (SS)	78. 3,3'-Dimethylbenzidine	
15. 2-Methylphenol	31. 4-Chloroaniline	48. 3-Nitroaniline		79. Butyl benzyl phthalate	
16. Bis(2-chloroisopropyl) ether	32. Hexachlorobutadiene	49. Acenaphthene-d10 (IS)		80. Bis(2-ethylhexyl) adipate	
		50. Acenaphthene		81. 3,3'-Dichlorobenzidine	
				82. Benzo[a]anthracene	

similar phases

DB-XLB, VF-Xms, MR1, ZB-XLB

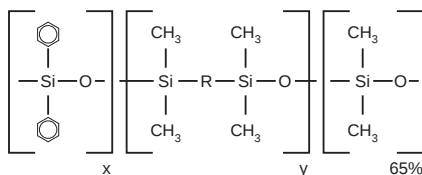
tech tip

Rxi®-XLB columns for Method 525.2

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®-35Sil MS Structure

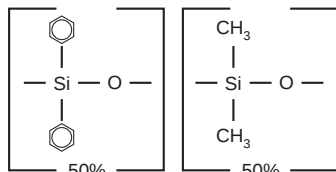


Similar to: (35%-phenyl)-methylpolysiloxane

similar phases

DB-35ms, DB-35msUI, VF-35ms, MR2

Rxi®-17 Structure



Similar to: (50%-phenyl)-methylpolysiloxane

similar phases

HP-50+, DB-17, DB-17ht, DB-608, CP-Sil 24
CB, ZB-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
0.25 mm	0.10 µm	30 to 340/360 °C	13705	13708	
	0.25 µm	30 to 340/360 °C	13720	13723	13726
	0.50 µm	30 to 340/360 °C		13738	
	1.00 µm	30 to 340/360 °C		13753	
0.32 mm	0.25 µm	30 to 340/360 °C		13724	13727
	0.50 µm	30 to 340/360 °C		13739	
	1.00 µm	30 to 340/360 °C		13754	
0.53 mm	0.50 µm	30 to 320/360 °C		13740	
	1.50 µm	30 to 320/340 °C	13767	13770	

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

*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

Rxi®-35Sil MS Columns (fused silica)

(midpolarity Crossbond® phase)

- 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
0.25 mm	0.25 µm	50 to 340/360 °C	13820	13823
	0.50 µm	50 to 340/360 °C	13835	13838
	1.00 µm	50 to 320/340 °C	13850	13853
0.32 mm	0.25 µm	50 to 340/360 °C	13821	13824
	0.50 µm	50 to 340/360 °C	13836	13839
	1.00 µm	50 to 320/340 °C	13851	13854
0.53 mm	0.50 µm	50 to 340/360 °C	13837	13840
	1.00 µm	50 to 325/340 °C	13852	13855
	1.50 µm	50 to 310/330 °C	13856	13857
	3.00 µm	50 to 280/300 °C	13858	13859

*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

Rxi®-17 Columns (fused silica)

(midpolarity phase; Crossbond® diphenyl 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
0.25 mm	0.25 µm	40 to 280/320 °C	13520	13523
	0.50 µm	40 to 280/320 °C		13538
	1.00 µm	40 to 280/320 °C		13553
0.32 mm	0.25 µm	40 to 280/320 °C	13521	13524
	0.50 µm	40 to 280/320 °C		13539
	1.00 µm	40 to 280/320 °C		13554
0.53 mm	0.25 µm	40 to 280/320 °C		13525
	0.50 µm	40 to 280/320 °C		13540
	0.83 µm	40 to 280/320 °C		13569
	1.00 µm	40 to 280/320 °C	13552	13555
	1.50 µm	40 to 280/320 °C		13570

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

Rxi®-17Sil MS Columns (fused silica)

(midpolarity Crossbond® phase)

- 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.

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

ID	df	temp. limits	10-Meter	20-Meter
0.15 mm	0.15 µm	40 to 340/360 °C	43820	43821
0.18 mm	0.18 µm	40 to 340/360 °C		14102
	0.36 µm	40 to 340/360 °C		14111

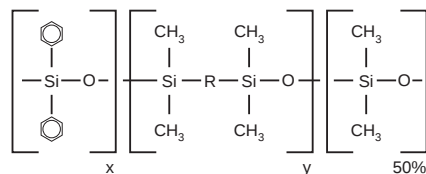
*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

Rxi®-PAH Columns (fused silica)

(midpolarity proprietary phase)

- Ideal for EFSA PAH4 analysis—separates all priority compounds: benz[a]anthracene, chrysene, benzo[b]fluoranthene, and benzo[a]pyrene.
- Best resolution of chrysene from interfering PAHs, triphenylene, and cyclopenta[cd]pyrene.
- Complete separation of benzo [b], [k], [j], and [a] fluoranthenes.
- 360 °C thermal stability allows analysis of low volatility dibenzo pyrenes.

ID	df	temp. limits	30-Meter	40-Meter	60-Meter
0.18 mm	0.07 µm	to 360 °C		49316	
0.25 mm	0.10 µm	to 360 °C	49318		49317

Rxi®-17Sil MS Structure

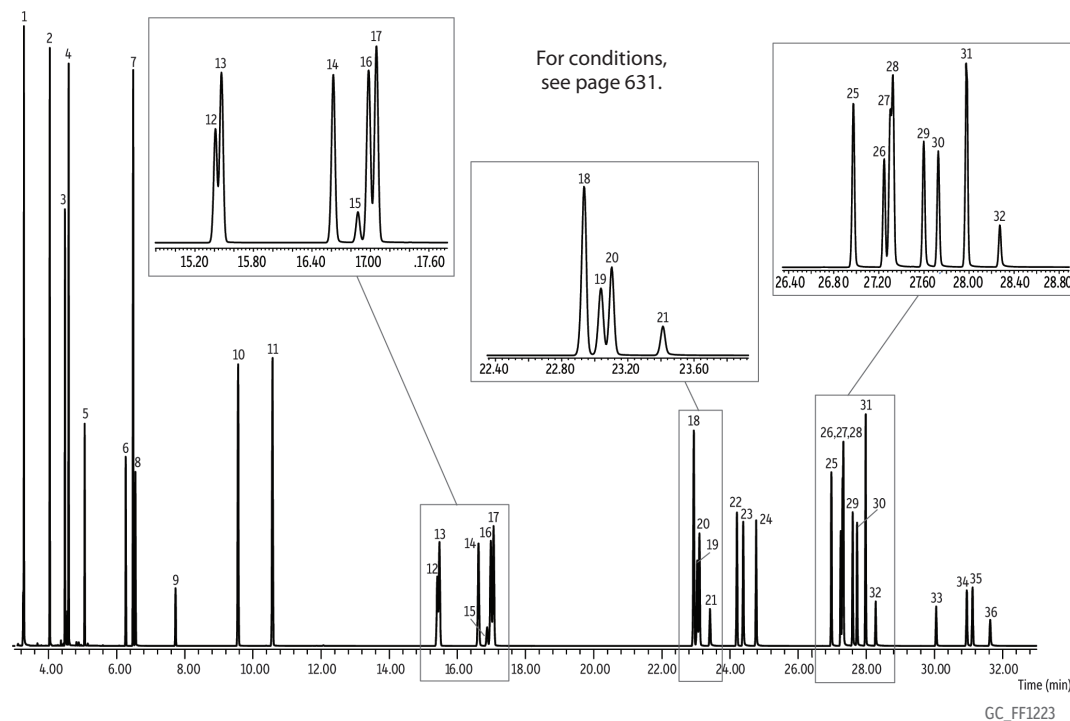
Similar to: (50%-phenyl)-methylpolysiloxane

similarp hases

DB-17ms, VF-17ms, CP-Sil 24 CB, ZB-50

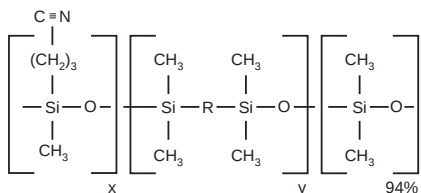


See pages 179–184.

NIST SRM 2260a PAH Mix on Rxi®-PAH**Peaks**

1. Naphthalene
2. Biphenyl
3. Acenaphthylene
4. Acenaphthene
5. Fluorene
6. Dibenzothiophene
7. Phenanthrene
8. Anthracene
9. 4H-Cyclopenta[def]phenanthrene
10. Fluoranthene
11. Pyrene
12. Benzo[ghi]fluoranthene
13. Benzo[c]phenanthrene
14. Benzo[a]anthracene
15. Cyclopenta[cd]pyrene
16. Triphenylene
17. Chrysene
18. Benzo[b]fluoranthene
19. Benzo[k]fluoranthene
20. Benzo[j]fluoranthene
21. Benzo[a]fluoranthene
22. Benzo[e]pyrene
23. Benzo[a]pyrene
24. Perylene
25. Dibenz[a,j]anthracene
26. Dibenz[a,c]anthracene
27. Indeno[1,2,3-cd]pyrene
28. Dibenz[a,h]anthracene
29. Benzo[b]chrysene
30. Picene
31. Benzo[ghi]perylene
32. Anthanthrene
33. Dibenz[b,k]fluoranthene
34. Dibenz[a,e]pyrene
35. Coronene
36. Dibenz[a,h]pyrene

Rxi®-624Sil MS Structure



similar phases

DB-624, VF-624ms, CP-Select 624 CB, ZB-624

Rxi®-624Sil MS Columns (fused silica)

(midpolarity Crossbond® phase)

- Low-bleed, high-thermal stability column—maximum temperatures up to 320 °C.
- Inert—excellent peak shape for a wide range of compounds.
- Selective—highly selective for volatiles analysis and 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	75-Meter	105-Meter
0.18 mm	1.00 µm	-20 to 300/320 °C	13865				
0.25 mm	1.40 µm	-20 to 300/320 °C		13868	13869		
0.32 mm	1.80 µm	-20 to 300/320 °C		13870	13872		
0.53 mm	3.00 µm	-20 to 280/300 °C		13871	13873	13874	13875



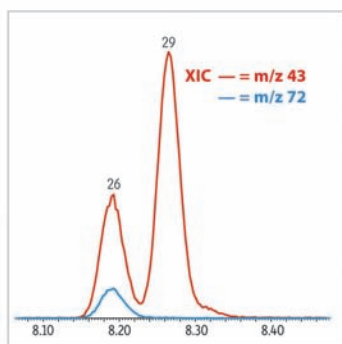
free literature

Rxi®-624Sil MS Columns: Exceptionally Inert, Low-Bleed Columns for Volatiles Analysis

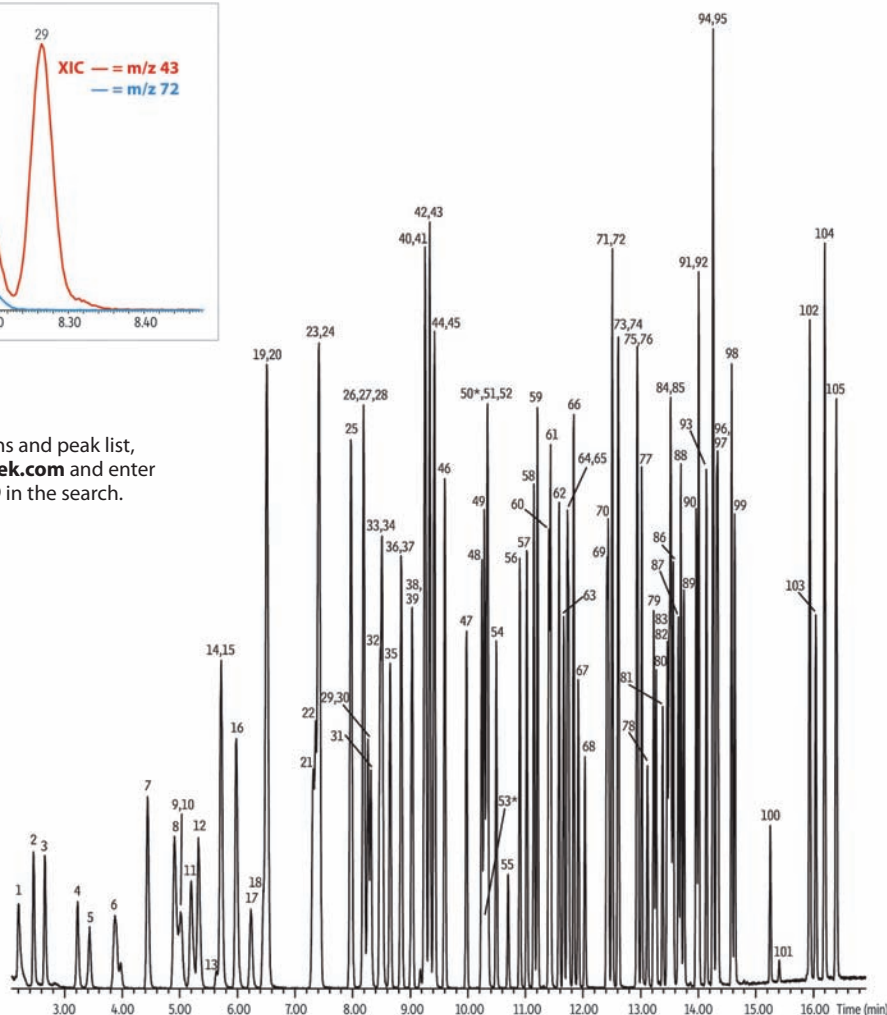
Download your free copy from www.restek.com

lit. cat.# GNBR1334A-UNV

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



For conditions and peak list, visit www.restek.com and enter GC_EV1169 in the search.



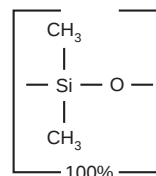
GC_EV1169

Rxi®-1HT Columns (fused silica)

(nonpolar phase; dimethyl polysiloxane)

- Columns processed for high-temperature applications, such as high molecular weight hydrocarbons.
- Temperature range: -60 to 400 °C.

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

Rxi®-1HT Structure

Similar to: (100%-methyl)-polysiloxane

similar phases

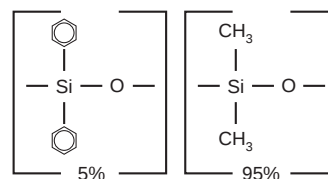
DB-1ht, ZB-1HTinferno

Rxi®-5HT Columns (fused silica)

(low polarity phase; diphenyl dimethyl polysiloxane)

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

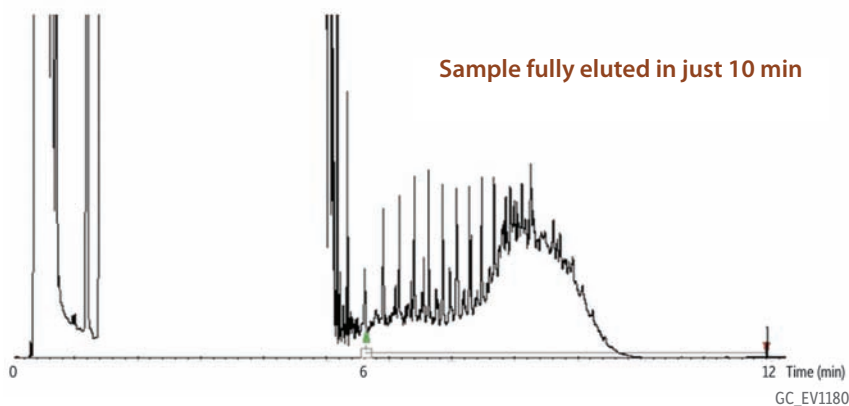
ID	df	temp. limits	15-Meter	30-Meter
0.25 mm	0.10 µm	-60 to 400 °C	13905	13908
	0.25 µm	-60 to 400 °C		13923
0.32 mm	0.10 µm	-60 to 400 °C	13906	13909
	0.25 µm	-60 to 400 °C		13924
0.53 mm	0.15 µm	-60 to 380/400 °C		13910

Rxi®-5HT Structure

Similar to: (5%-phenyl)-methylpolysiloxane

similar phases

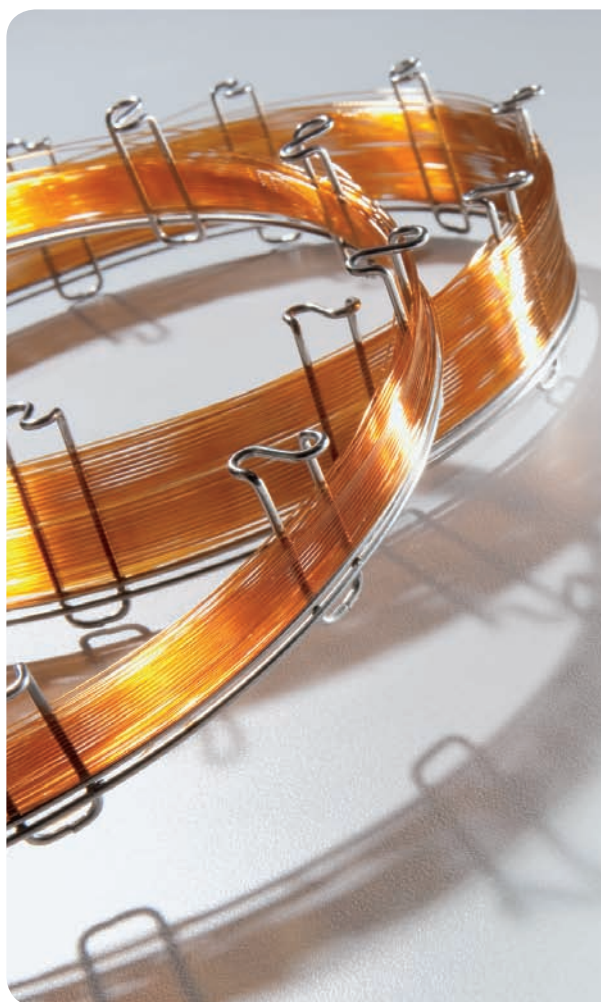
DB-5ht, VF-5ht, ZB-5HTinferno

Mineral Oil on Rxi®-5HT by EN9377-2 (PTV large volume injection)

Column Rxi®-5HT, 15 m, 0.32 mm ID, 0.10 µm (cat.# 13906)
Sample Mineral oil
Diluent: Hexane
Conc.: 25 ppm
Injection
Inj. Vol.: 100 µL pvtv splitless
Inlet Temp. Program: 45 °C (hold 0.45 min) to 350 °C at 200 °C/min (hold 10 min)
Oven
Oven Temp: 35 °C (hold 4 min) to 150 °C at 60 °C/min to 250 °C at 50 °C/min to 350 °C at 30 °C/min
Carrier Gas He, constant flow
Flow Rate: 2 mL/min
Detector FID @ 360 °C
Instrument Varian 450
Acknowledgement Ambiente Analisi S.r.l., Italy

General-Purpose Columns

Rtx®-1	39
Rtx®-5, Rtx®-5MS	40
Rtx®-20, Rtx®-35	41
Rtx®-50, Rtx®-65	42
Rtx®-440	43
Rtx®-200, Rtx®-200MS	44
Rtx®-1301, Rtx®-624	45
Rtx®-1701, Rtx®-225	46
Rtx®-2330, Rtx®-2560	47
Rtx®-Wax	48
Stabilwax®	49
GCxGC	50-52
Fast GC	53



Chemically bonded capillary columns

- Reliable, rugged GC columns.
- 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 0.15 mm and 0.18 mm 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 Columns (fused silica)(nonpolar phase; Crossbond[®] dimethyl polysiloxane)

- General-purpose columns for solvent impurities, PCB congeners (e.g. Aroclor mixes), simulated distillation, arson accelerants, 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.

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

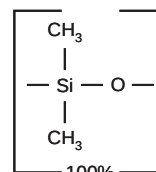
ID	df	temp. limits	10-Meter	20-Meter	40-Meter
0.18 mm	0.20 µm	-60 to 330/350 °C	40101	40102	40103
	0.40 µm	-60 to 330/340 °C	40110	40111	40112

*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

Rtx[®]-1 with Integra-Guard[®] Column

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

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

Rtx[®]-1 Structure

Similar to: (100%-methyl)-polysiloxane

similar phases

HP-1, DB-1, CP-Sil 5 CB, ZB-1

also available

**Metal MXT[®] Columns**

Rugged, flexible, Siltek[®]-treated stainless steel tubing; inertness comparable to fused silica tubing.

See **page 93**.

Rtx[®]-1 with Integra-Guard[®] Column

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

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

crossbond[®] technology

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

free literature

Analyze ppb Level Sulfur Compounds Using an Rt[®]-XL Sulfur Micropacked GC Column or an Rtx[®]-1 Thick Film Capillary GC Column

Download your free copy from

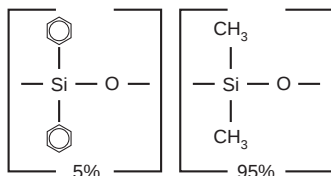
www.restek.com

lit. cat.#
PCAN1499-UNV

Fused Silica, PLOT, & MXT[®] Capillary GC Column Ferrule Guide

GC Column ID	Ferrule ID
0.10 mm	0.4
0.15 mm	0.4
0.18 mm	0.4
0.25 mm	0.4
0.28 mm	0.4
0.32 mm	0.5
0.45 mm	0.8
0.53 mm	0.8

Rtx®-5/Rtx®-5MS Structure

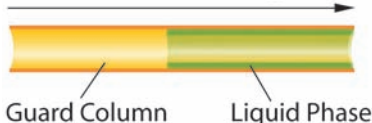


Similar to: (5%-phenyl)-methylpolysiloxane

similar phases

HP-5, DB-5, CP-Sil 8 CB, ZB-5

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

Integra-Guard® Built-In Guard Column
Continuous Tubing

Get the protection without the connection!
See **page 25** for Rtx®-5 and Rtx®-5MS columns with built-in Integra-Guard® guard columns.

also available

Metal MXT® Columns

Rugged, flexible, Siltek®-treated stainless steel tubing; inertness comparable to fused silica tubing.

MXT®-5 columns**page 94**

it's a fact

For exceptional inertness, ultra-low bleed, and unsurpassed performance, choose Rxi®-5ms columns! See **page 31**.

also available

Rtx®-5 Amine columns.....**page 86**

Rtx®-5/Rtx®-5MS (fused silica)

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

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

Rtx®-5 Columns (fused silica)

(low polarity phase; Crossbond® diphenyl dimethyl polysiloxane)

ID	df	temp. limits*	15-Meter	30-Meter	60-Meter	105-Meter
0.25 mm	0.10 µm	-60 to 330/350 °C	10205	10208	10211	
	0.25 µm	-60 to 330/350 °C	10220	10223	10226	10229
	0.50 µm	-60 to 330/350 °C	10235	10238	10241	10244
	1.00 µm	-60 to 325/340 °C	10250	10253	10256	10259
0.32 mm	0.10 µm	-60 to 330/350 °C	10206	10209	10212	
	0.25 µm	-60 to 330/350 °C	10221	10224	10227	
	0.50 µm	-60 to 330/350 °C	10236	10239	10242	
	1.00 µm	-60 to 325/340 °C	10251	10254	10257	10260
	1.50 µm	-60 to 310/330 °C	10266	10269	10272	10275
0.53 mm	3.00 µm	-60 to 280/300 °C	10281	10284	10287	10290
	0.10 µm	-60 to 320/340 °C	10207	10210		
	0.25 µm	-60 to 320/340 °C	10222	10225	10228	
	0.50 µm	-60 to 320/330 °C	10237	10240	10243	
	1.00 µm	-60 to 320/330 °C	10252	10255	10258	
	1.50 µm	-60 to 310/330 °C	10267	10270	10273	
	3.00 µm	-60 to 270/290 °C	10282	10285	10288	
	5.00 µm	-60 to 270/290 °C	10277	10279	10283	

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

*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

30-meter	6-pack cat.#
0.25 mm ID, 0.25 µm	10223-600
0.25 mm ID, 0.50 µm	10238-600
0.32 mm ID, 1.00 µm	10254-600
0.53 mm ID, 1.50 µm	10270-600

Six columns for the price of five!

Other phases and configurations available on request.

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

(low polarity phase; Crossbond® diphenyl dimethyl polysiloxane)

Column specifically tested for low-bleed performance.

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

*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

Rtx®-20 Columns (fused silica)

(low to midpolarity phase; Crossbond® diphenyl 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 mono-modal distribution and extremely low bleed.

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

Rtx®-35 Columns (fused silica)

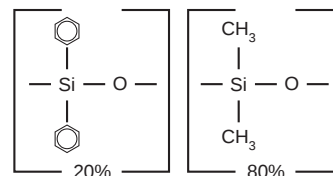
(midpolarity phase; Crossbond® diphenyl dimethyl polysiloxane)

- 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
0.25 mm	0.25 µm	40 to 320 °C	10420	10423
	0.50 µm	40 to 310 °C	10435	10438
	1.00 µm	40 to 290 °C		10453
0.32 mm	0.25 µm	40 to 320 °C	10421	10424
	0.50 µm	40 to 310 °C	10436	10439
	1.00 µm	40 to 290 °C		10454
0.53 mm	0.50 µm	40 to 300 °C	10437	10440
	1.00 µm	40 to 290 °C		10455
	1.50 µm	40 to 280 °C		10470
	3.00 µm	40 to 240/260 °C		10485

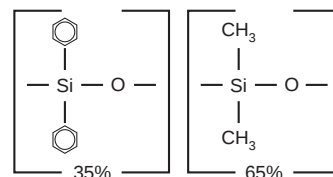
ID	df	temp. limits	10-Meter	20-Meter
0.18 mm	0.20 µm	40 to 300/320 °C		40402
	0.40 µm	40 to 290/310 °C	40410	40411

Rtx®-20 Structure

Similar to: (20%-phenyl)-methylpolysiloxane

similar phases

SPB-20, EC-20, AT-20, 007-20

Rtx®-35 Structure

Similar to: (35%-phenyl)-methylpolysiloxane

similar phases

HP-35, DB-35, ZB-35

**also available****Metal MXT® Columns**

Rugged, flexible, Siltek®-treated stainless steel tubing; inertness comparable to fused silica tubing.

MXT®-20 columnspage 94

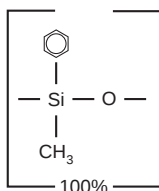
MXT®-35 columnspage 95

also available

Rtx®-35 Amine columnspage 87

See pages 179–184 or visit www.restek.com/sky

Rtx®-50 Structure



Similar to: (50%-phenyl)-methylpolysiloxane

similarp hases

SPB-50, AT-50, 007-17

also
available

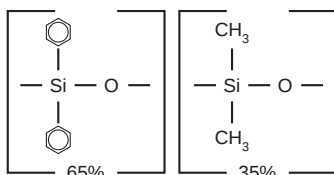
Metal MXT® Columns

Rugged, flexible, Siltek®-treated stainless steel tubing; inertness comparable to fused silica tubing.

MXT®-50 columnspage 95

MXT®-65 columnspage 95

Rtx®-65 Structure



Similar to: (65%-phenyl)-methylpolysiloxane

similarp hase

007-65HT

crossbond® technology

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

Rtx®-50 Columns (fused silica)

(midpolarity phase; Crossbond® phenyl methyl polysiloxane)

- General-purpose columns for pesticides, herbicides, rosin acids, phthalate esters, 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®-1 or Rtx®-5MS.

ID	df	temp. limits	15-Meter	30-Meter	60-Meter
0.25 mm	0.25 µm	40 to 300/320 °C	10520	10523	10526
	0.50 µm	40 to 290/310 °C	10535	10538	10541
	1.00 µm	40 to 280/300 °C	10550	10553	10556
0.32 mm	0.25 µm	40 to 300/320 °C	10521	10524	10527
	0.50 µm	40 to 290/310 °C	10536	10539	10542
	1.00 µm	40 to 280/300 °C	10551	10554	10557
0.53 mm	0.25 µm	40 to 280/300 °C	10522		
	0.50 µm	40 to 270/290 °C	10537	10540	10543
	0.83 µm	40 to 270/290 °C		10569	
	1.00 µm	40 to 260/280 °C	10552	10555	10558
	1.50 µm	40 to 250/270 °C	10567	10570	10573

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

Rtx®-65 Columns (fused silica)

(mid to high polarity phase; Crossbond® diphenyl dimethyl polysiloxane)

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

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

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

also available

Rtx®-65TG Columns

Tested specifically for triglycerides.

See page 74.

Rtx®-440 Columns (fused silica)

(midpolarity proprietary Crossbond® phase)

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

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

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

restek innovation!

**Organochlorine Pesticides by EPA Method 8081A on Rtx®-440 (dual column w/ Rtx®-CLPesticides2)****Column
Sample**

Rtx®-440, 30 m, 0.32 mm ID, 0.50 µm (cat.# 12939)
 Organochlorine pesticide mix AB #2, 8-80 µg/mL in ethyl acetate (cat.# 32292)
 Chlorobenzilate, 1,000 µg/mL in methanol (cat.# 32211)
 Hexachlorobenzene, 1,000 µg/mL in acetone (cat.# 32231)
 Hexachlorocyclopentadiene, 1,000 µg/mL in methanol (cat.# 32232)
 2,4'-DDD, 1,000 µg/mL in methanol (cat.# 32098)
 2,4'-DDE, 1,000 µg/mL in methanol (cat.# 32099)
 2,4'-DDT, 1,000 µg/mL in methanol (cat.# 32200)
 2,4,5,6-Tetrachloro-*m*-xylene, 200 µg/mL in acetone (cat.# 32027)
 Decachlorobiphenyl (BZ #209), 200 µg/mL in acetone (cat.# 32029)
 Diallylate (*cis* & *trans*), 1,000 µg/mL in hexane (cat.# custom)
 Isodrin, 1,000 µg/mL in hexane (cat.# custom)
 Kepone, 1,000 µg/mL in hexane (cat.# custom)
 Mirex, 1,000 µg/mL in hexane (cat.# custom)

Injection

Inj. Vol.: 1.0 µL splitless (hold 0.75 min)
 Liner: Siltek® single taper (cat.# 20961-214.1)
 Inj. Temp.: 275 °C

Oven

Oven Temp: 140 °C (hold 1 min) to 240 °C at 30 °C/min (hold 2 min) to 330 °C at 30 °C/min (hold 4 min)

Carrier Gas

H₂, constant pressure

Linear Velocity: 51 cm/sec @ 140 °C

Detector

ECD @ 330 °C

Instrument

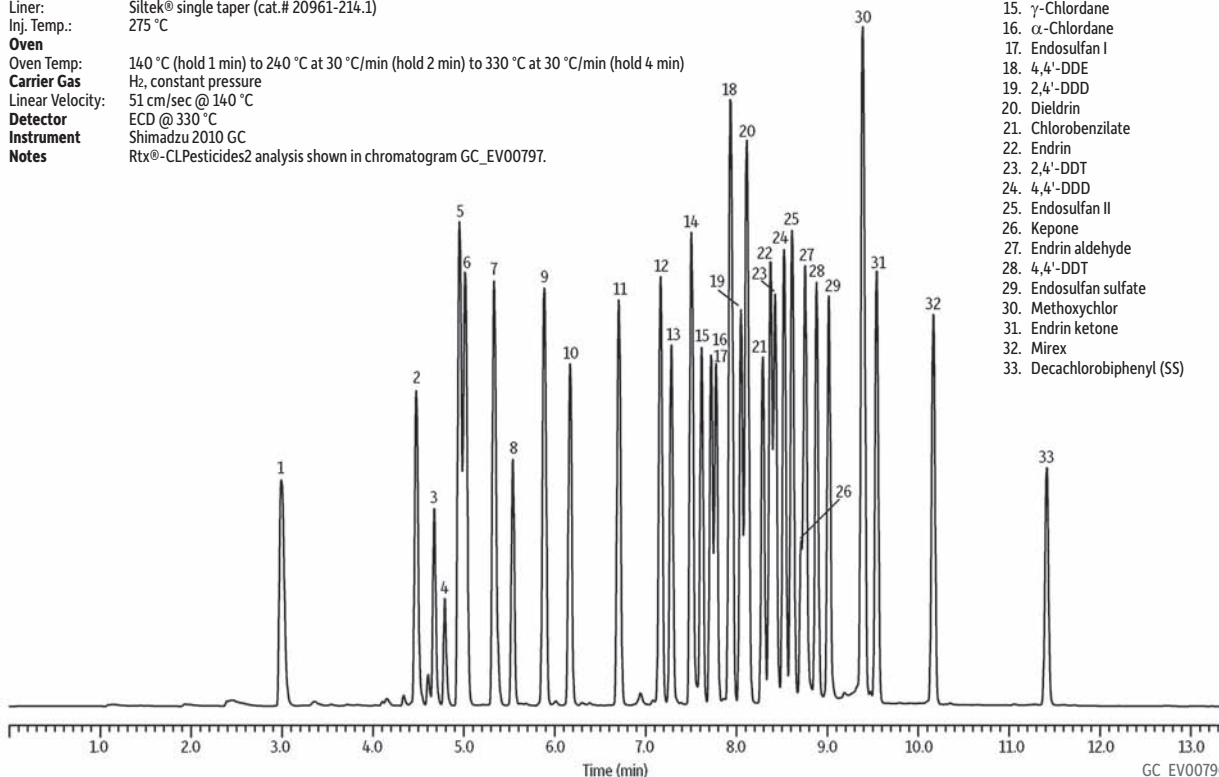
Shimadzu 2010 GC

Notes

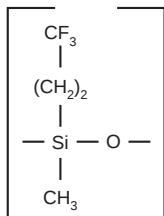
Rtx®-CLPesticides2 analysis shown in chromatogram GC_EV00797.

Peaks

1. Hexachlorocyclopentadiene
2. 2,4,5,6-Tetrachloro-*m*-xylene (SS)
3. *cis*-Diallylate
4. *trans*-Diallylate
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 to: (trifluoropropyl)-methylpolysiloxane

similar phases

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

Now Online!

Our EZGC™ Web App
Will Kick-Start Your GC
Method Development



www.restek.com/ezgc

Rtx®-200/Rtx®-200MS (fused silica)

- General-purpose columns for solvents, Freon® fluorocarbons, alcohols, ketones, silanes, glycols, and drugs of abuse. 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 trifluoropropylmethyl polysiloxane 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
0.25 mm	0.25 µm	-20 to 320/340 °C	15020	15023	15026	15029
	0.50 µm	-20 to 310/330 °C	15035	15038	15041	15044
	1.00 µm	-20 to 290/310 °C	15050	15053	15056	15059
0.32 mm	0.25 µm	-20 to 320/340 °C	15021	15024	15027	
	0.50 µm	-20 to 310/330 °C	15036	15039	15042	15045
	1.00 µm	-20 to 290/310 °C	15051	15054	15057	15060
	1.50 µm	-20 to 280/300 °C	15066	15069	15072	15075
0.53 mm	0.25 µm	-20 to 310/330 °C	15022	15025	15028	
	0.50 µm	-20 to 300/320 °C	15037	15040	15043	
	1.00 µm	-20 to 290/310 °C	15052	15055	15058	
	1.50 µm	-20 to 280/300 °C	15067	15070	15073	
	3.00 µm	-20 to 260/280 °C	15082	15085	15088	15091

ID	df	temp. limits	10-Meter	20-Meter	40-Meter
0.15 mm	0.15 µm	-20 to 320/340 °C	43835	43836	
0.18 mm	0.20 µm	-20 to 310/330 °C	45001	45002	45003
	0.40 µm	-20 to 310/330 °C	45010	45011	45012

*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

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
0.25 mm	0.10 µm	-20 to 320/340 °C	15608
	0.25 µm	-20 to 320/340 °C	15623
	0.50 µm	-20 to 310/330 °C	15638
	1.00 µm	-20 to 290/310 °C	15653
0.32 mm	0.10 µm	-20 to 320/340 °C	15609
	0.25 µm	-20 to 320/340 °C	15624
	0.50 µm	-20 to 310/330 °C	15639
	1.00 µm	-20 to 290/310 °C	15654

also
available



Metal MXT® Columns

Rugged, flexible, Siltek®-treated stainless steel tubing; inertness comparable to fused silica tubing.

MXT®-200 columns.....page 96

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

(low to midpolarity phase; Crossbond® cyanopropylphenyl dimethyl polysiloxane)

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

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

ID	df	temp. limits*	15-Meter	30-Meter	60-Meter	75-Meter	105-Meter
0.25 mm	0.25 µm	-20 to 280 °C	16020	16023	16026		
	0.50 µm	-20 to 270 °C		16038			
	1.00 µm	-20 to 260 °C		16053	16056		
	1.40 µm	-20 to 240 °C			16016		
0.32 mm	0.25 µm	-20 to 280 °C	16021	16024			
	0.50 µm	-20 to 270 °C		16039	16042		
	1.00 µm	-20 to 260 °C		16054	16057		
	1.50 µm	-20 to 250 °C	16066	16069	16072		
	1.80 µm	-20 to 240 °C		16092	16093		
0.53 mm	0.25 µm	-20 to 280 °C		16025			
	0.50 µm	-20 to 270 °C		16040	16043		
	1.00 µm	-20 to 260 °C	16052	16055	16058		
	1.50 µm	-20 to 250 °C		16070			
	3.00 µm	-20 to 240 °C		16085	16088	16076	16091

*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

Rtx®-624 Columns (fused silica)

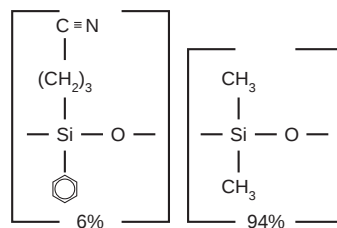
(low to midpolarity phase; Crossbond® cyanopropylphenyl dimethyl polysiloxane)

- Application-specific columns for volatile organic pollutants. Recommended in U.S. 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 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
0.25 mm	1.40 µm	-20 to 240 °C	10968	10969		
0.32 mm	1.80 µm	-20 to 240 °C	10970	10972		
0.45 mm	2.55 µm	-20 to 240 °C			10982	
0.53 mm	3.00 µm	-20 to 240 °C	10971	10973	10974	10975

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

Rtx®-1301 Structure

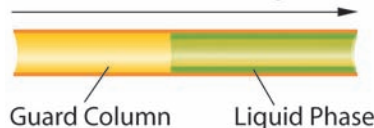
Similar to: (6%-cyanopropylphenyl)-methylpolysiloxane

similar phases

DB-1301, DB-624, VF-1301ms, VF-624ms, CP-1301, ZB-624

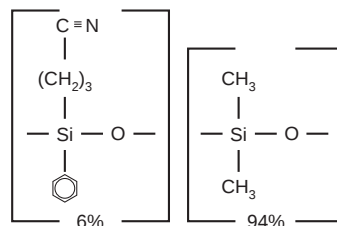
Integra-Guard® Built-In Guard Column

Continuous Tubing



Get the protection without the connection!

See **page 25** for Rtx®-1301 and Rtx®-624 columns with built-in Integra-Guard® guard columns.

Rtx®-624 Structure

Similar to: (6%-cyanopropylphenyl)-methylpolysiloxane

similar phases

DB-1301, DB-624, VF-1301ms, VF-624ms, CP-1301, ZB-624

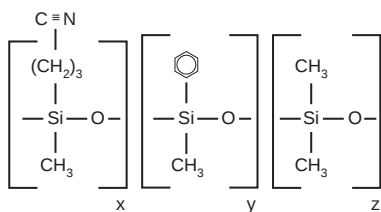
also available

**Metal MXT® Columns**

Rugged, flexible, Siltek®-treated stainless steel tubing; inertness comparable to fused silica tubing.

MXT®-1301 columnspage 95

MXT®-624 columns.....page 97

Rtx®-1701 Structure

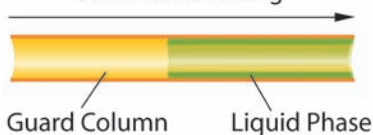
Similar to: (14%-cyanopropylphenyl)-methylpolysiloxane

similarp hases

DB-1701R, DB-1701, CP Sil 19 CB, VF-1701ms, VF-1701 Pesticides, ZB-1701, ZB-1701P

Integra-Guard® Built-In Guard Column

Continuous Tubing

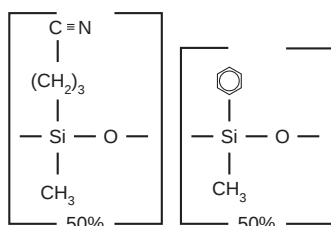


Get the protection without the connection!
See **page 25** for Rtx®-1701 columns with built-in Integra-Guard® guard columns.

also available**Metal MXT® Columns**

Rugged, flexible, Siltek®-treated stainless steel tubing; inertness comparable to fused silica tubing.

MXT®-1701 columnspage 96

Rtx®-225 Structure

Similar to: (50%-cyanopropylmethyl)-methylphenylpolysiloxane

similarp hases

DB-225ms, CP-Sil 43 CB

Rtx®-1701 Columns (fused silica)

(midpolarity Crossbond® phase)

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

ID	df	temp. limits	10-Meter	20-Meter	40-Meter
0.18 mm	0.20 µm	-20 to 280 °C	42001	42002	42003
	0.40 µm	-20 to 280 °C		42011	42012

*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

Rtx®-225 Columns (fused silica)

(polar phase; Crossbond® cyanopropylmethyl 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
0.25 mm	0.25 µm	40 to 220/240 °C	14020	14023	14026
	0.50 µm	40 to 220/240 °C		14038	
0.32 mm	0.25 µm	40 to 220/240 °C	14021	14024	
	0.50 µm	40 to 220/240 °C		14039	
	1.00 µm	40 to 200/220 °C	14051	14054	14057
0.53 mm	0.25 µm	40 to 200/220 °C	14022	14025	
	0.50 µm	40 to 200/220 °C		14040	
	1.00 µm	40 to 200/220 °C	14052	14055	

*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

Rtx®-2330 Columns (fused silica)

(highly polar phase; biscyanopropyl cyanopropylphenyl polysiloxane)

- General-purpose columns for *cis/trans* FAMES, dioxin isomers.

- Temperature range: 0 °C to 275 °C.

- Equivalent to USP G8 and G48 phase.

Rtx®-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 Rtx®-2330 phase. In addition, our improved polymer produces columns with better column efficiency and lower bleed.

Because the Rtx®-2330 stationary phase is not 100% bonded, it should not be solvent rinsed.

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

ID	df	temp. limits	10-Meter	20-Meter	40-Meter
0.18 mm	0.10 µm	0 to 260 °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)

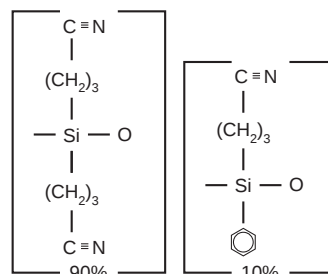
(highly polar phase; biscyanopropyl polysiloxane—not bonded)

- 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
0.25 mm	0.20 µm	20 to 250 °C	13199

Rtx®-2330 Structure

Similar to: (95%-cyanopropyl)-phenyl polysiloxane

similarp hase

VF-23ms

**tech tip**

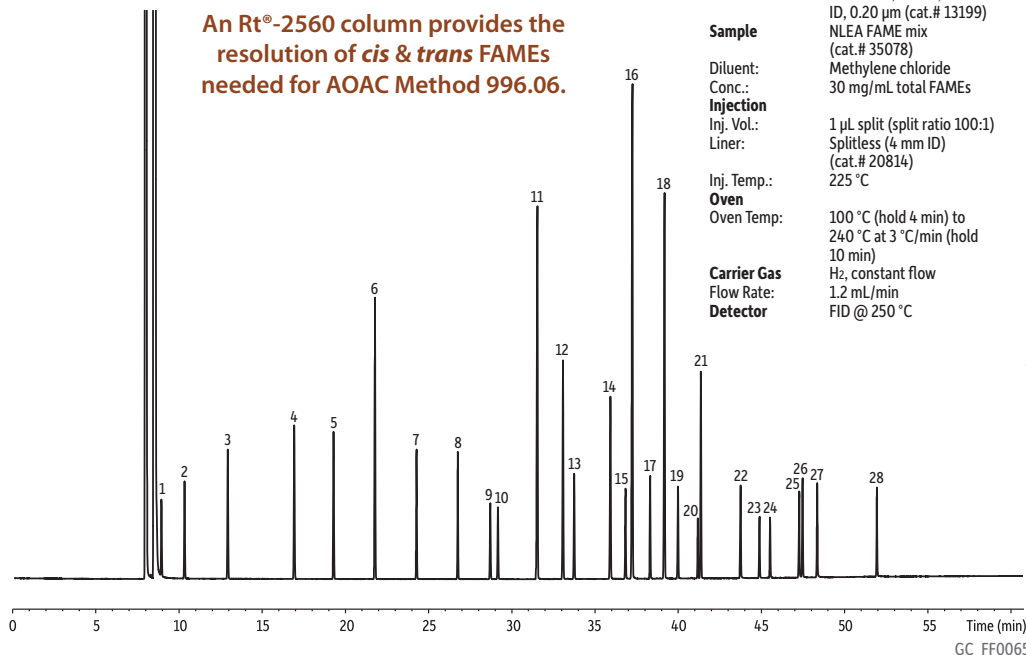
Do not solvent rinse Rtx®-2330 and Rt®-2560 columns. These columns are not fully bonded and solvent rinsing will remove the stationary phase.

similar phases

HP-88, CP Sil 88

FAMES (NLEA Mix) on Rt®-2560

An Rt®-2560 column provides the resolution of *cis* & *trans* FAMES needed for AOAC Method 996.06.

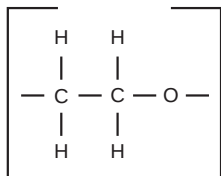


Column Rt®-2560, 100 m, 0.25 mm ID, 0.20 µm (cat.# 13199)
Sample NLEA FAME mix (cat.# 35078)
Diluent: Methylene chloride
Conc.: 30 mg/mL total FAMES
Injection 1 µL split (split ratio 100:1)
Inj. Vol.: Splitless (4 mm ID) (cat.# 20814)
Liner: 225 °C
Inj. Temp.: 225 °C
Oven 100 °C (hold 4 min) to 240 °C at 3 °C/min (hold 10 min)
Oven Temp: 100 °C (hold 4 min) to 240 °C at 3 °C/min (hold 10 min)
Carrier Gas H₂, constant flow
Flow Rate: 1.2 mL/min
Detector FID @ 250 °C

Peaks

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 linolelaidate (*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)

Rtx®-Wax Structure



similar phases

DB-Wax, CP Wax 52 CB, ZB-Wax

Rtx®-Wax Columns (fused silica)

(polar phase; Crossbond® polyethylene glycol)

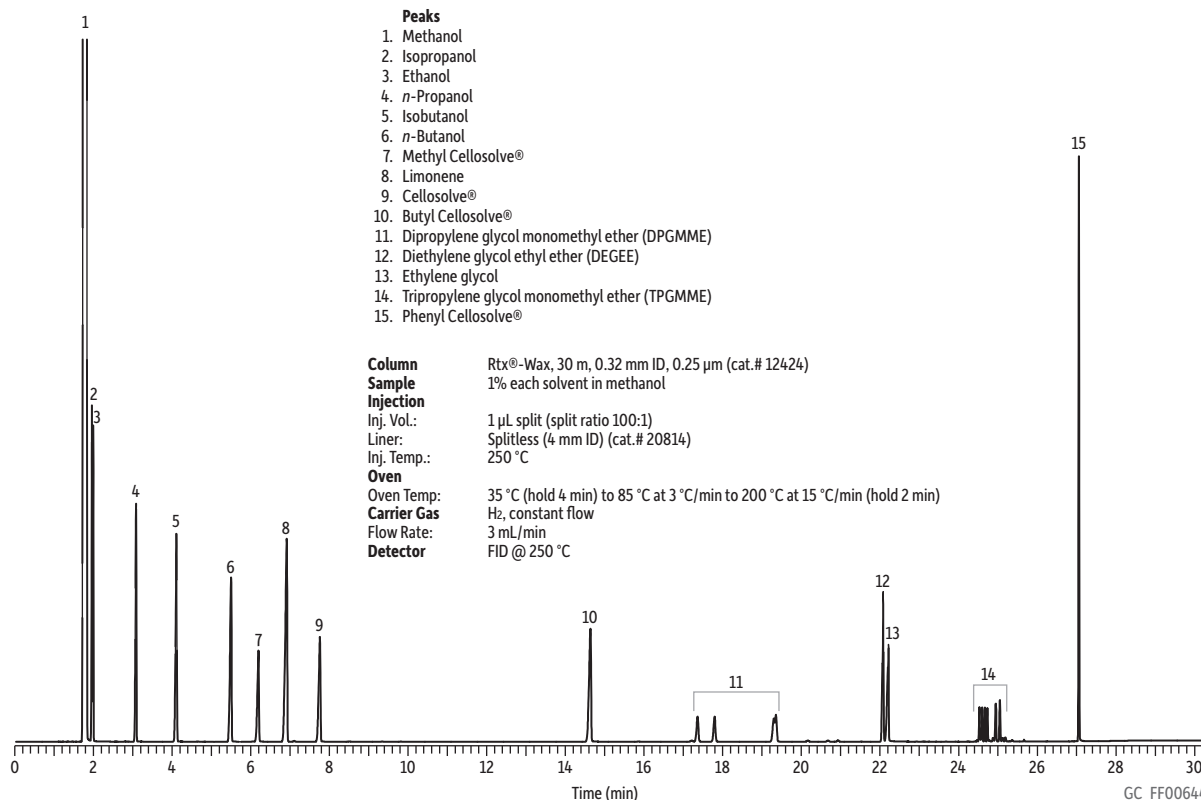
- Best polyethylene glycol (PEG) phase for alkenols, glycols, and aldehydes.
- Temperature range: 20 °C to 250 °C.
- Equivalent to USP G14, G15, G16, G20, G39 phases.

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.

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

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

Cleaning Solvents on Rtx®-Wax



Stabilwax® Columns (fused silica)

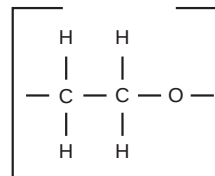
(polar phase; Crossbond® polyethylene glycol)

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

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

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

ID	df	temp. limits	10-Meter	20-Meter
0.15 mm	0.15 µm	40 to 250/260 °C	43830	43831
0.18 mm	0.18 µm	40 to 250 °C		40602

Stabilwax® Structure**similar phases**

HP-INNOWax, CP Wax 52 CB, VF-WAX MS, ZB-WAXplus

Six columns for the price of five!

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

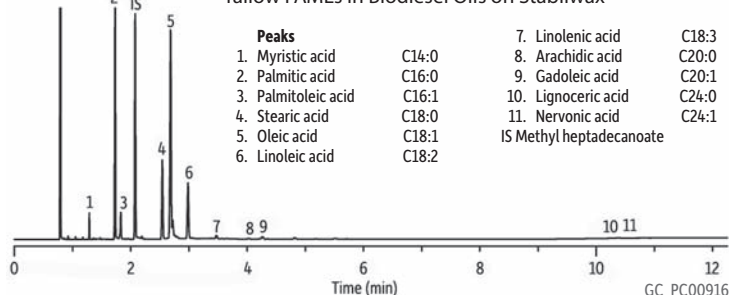
also available**Metal MXT® Columns**

Rugged, flexible, Siltek®-treated stainless steel tubing; inertness comparable to fused silica tubing.

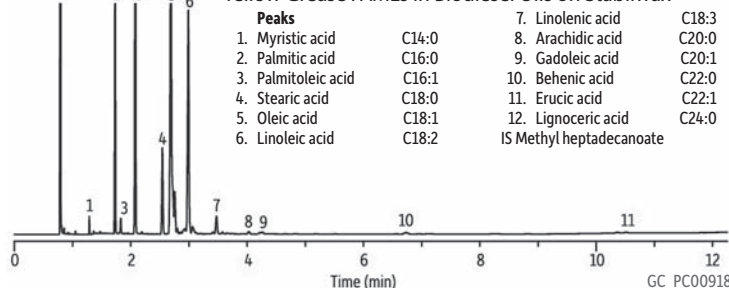
MXT®-WAX columnspage 96

FAMES in Biodiesel Oils on Stabilwax®

Tallow FAMES in Biodiesel Oils on Stabilwax®



Yellow Grease FAMES in Biodiesel Oils on Stabilwax®

**Column Sample**

Stabilwax®, 30 m, 0.32 mm ID, 0.25 µm (cat.# 10624)
Various sources of biodiesel (B100), prepared according to European Method EN 14103

Injection

Inj. Vol.: 1.0 µL split (split ratio 100:1)
Liner: Cyclosplitter® (cat.# 20706)
Inj. Temp.: 250 °C

Oven

Oven Temp: 210 °C (hold 5 min) to 230 °C at 20 °C/min (hold 5 min)

Carrier Gas

H₂, constant flow

Flow Rate:

3 mL/min

Linear Velocity:

60 cm/sec

Detector

FID @ 250 °C

See page 656 for Soy FAMES and Rapeseed FAMES analysis.

Restek GCxGC Columns: Your One Source for 2D Gas Chromatography

Why Use GCxGC?

GCxGC is a powerful multidimensional GC technique that combines two independent separations to accurately analyze highly complex samples. GCxGC involves two columns with differing stationary phase selectivity (orthogonal) that are press-fitted together in series and separated by a modulator. The first (primary) column performs an initial separation, and its effluent is continually focused and “injected” in defined cycles by the modulator onto the second (secondary) column, where another separation occurs. By choosing a secondary column that is orthogonal (has different selectivity) to the primary column, it is possible to separate and identify analytes that cannot be separated by the primary column. And, by keeping the secondary column very short, it is possible to maintain the separation produced by the primary column. Results generated through a series of high-speed chromatograms are plotted as a contour plot, sometimes known as a retention plane (Figure 1).

So, why use GCxGC? Because comprehensive two-dimensional gas chromatography allows you to perform separations that are simply not possible using standard one-dimensional chromatography!

Why Use Restek GCxGC Columns?

- Wide range of stationary phases offers orthogonal separations.
- High thermal stability increases system ruggedness.
- Unrivalled column inertness for accurate analysis of active compounds.
- 0.15, 0.18, and 0.25 mm ID formats accommodate varying sample capacities, speeds, and detectors.
- Secondary columns come in convenient 2 m lengths for economical methods development.

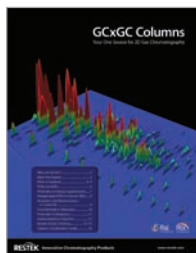
Restek has been performing comprehensive two-dimensional gas chromatography since its commercial inception. Our Innovations lab boasts multiple instruments dedicated to GCxGC applications, and we are continually exploring new application areas—including environmental, food safety, petroleum, forensics, fragrance, natural products, tobacco, metabolomics, and dietary supplements.

Restek's GCxGC secondary columns can be matched with any Restek Rtx® or Rxi® primary column to create the perfect orthogonal separation for your application. See our combination guide below for help choosing your GCxGC columns. We also offer a range of complementary GC accessories—including Sky® inlet liners, the Restek Electronic Leak Detector, and Press-Tight® connectors—to boost your success with GCxGC.

Restek GCxGC Column Combination Guide

To achieve ideal results in a GCxGC analysis, it is imperative that your primary and secondary columns feature orthogonal phases capable of producing differing separations. Use the chart below to find the perfect combination of Restek columns to maximize the effectiveness of your GCxGC system.

Application Area	Primary Column		Secondary Column	
	Phase	Selectivity	Phase	Selectivity
Petrochemical	Rxi®-1ms	Nonpolar	Rxi®-17Sil MS	Midpolar, aromatic selective
Petrochemical	Rxi®-5Sil MS	Nonpolar	Rxi®-17Sil MS	Midpolar, aromatic selective
PAHs, environmental	Rxi®-17Sil MS	Midpolar, aromatic selective	Rxi®-1ms	Nonpolar
PAHs, environmental	Rxi®-17Sil MS	Midpolar, aromatic selective	Rxi®-5Sil MS	Nonpolar
PCBs, PBDEs, PAHs, environmental	Rxi®-XLB	Nonpolar	Rxi®-17Sil MS	Midpolar, aromatic selective
Mono-ortho, coplanar PCBs	Rxi®-1ms	Nonpolar	Rxi®-XLB	Planar selective
Mono-ortho, coplanar PCBs	Rxi®-5Sil MS	Nonpolar	Rxi®-XLB	Planar selective
Pesticides, nitroaromatics, halogenated compounds	Rxi®-1ms	Nonpolar	Rtx®-200	Midpolar, electronegative selectivity
Pesticides, nitroaromatics, halogenated compounds	Rxi®-5Sil MS	Nonpolar	Rtx®-200	Midpolar, electronegative selectivity
Pesticides, nitroaromatics, halogenated compounds	Rxi®-XLB	Nonpolar	Rtx®-200	Midpolar, electronegative selectivity
Flavors, fragrances	Rxi®-1ms	Nonpolar	Stabilwax®	Polar
Flavors, fragrances	Rxi®-5Sil MS	Nonpolar	Stabilwax®	Polar
Flavors, fragrances	Stabilwax®	Polar	Rxi®-1ms	Nonpolar
Flavors, fragrances	Stabilwax®	Polar	Rxi®-5Sil MS	Nonpolar



free literature

GCxGC Columns: Your One Source for 2D Gas Chromatography

Download your free copy from www.restek.com

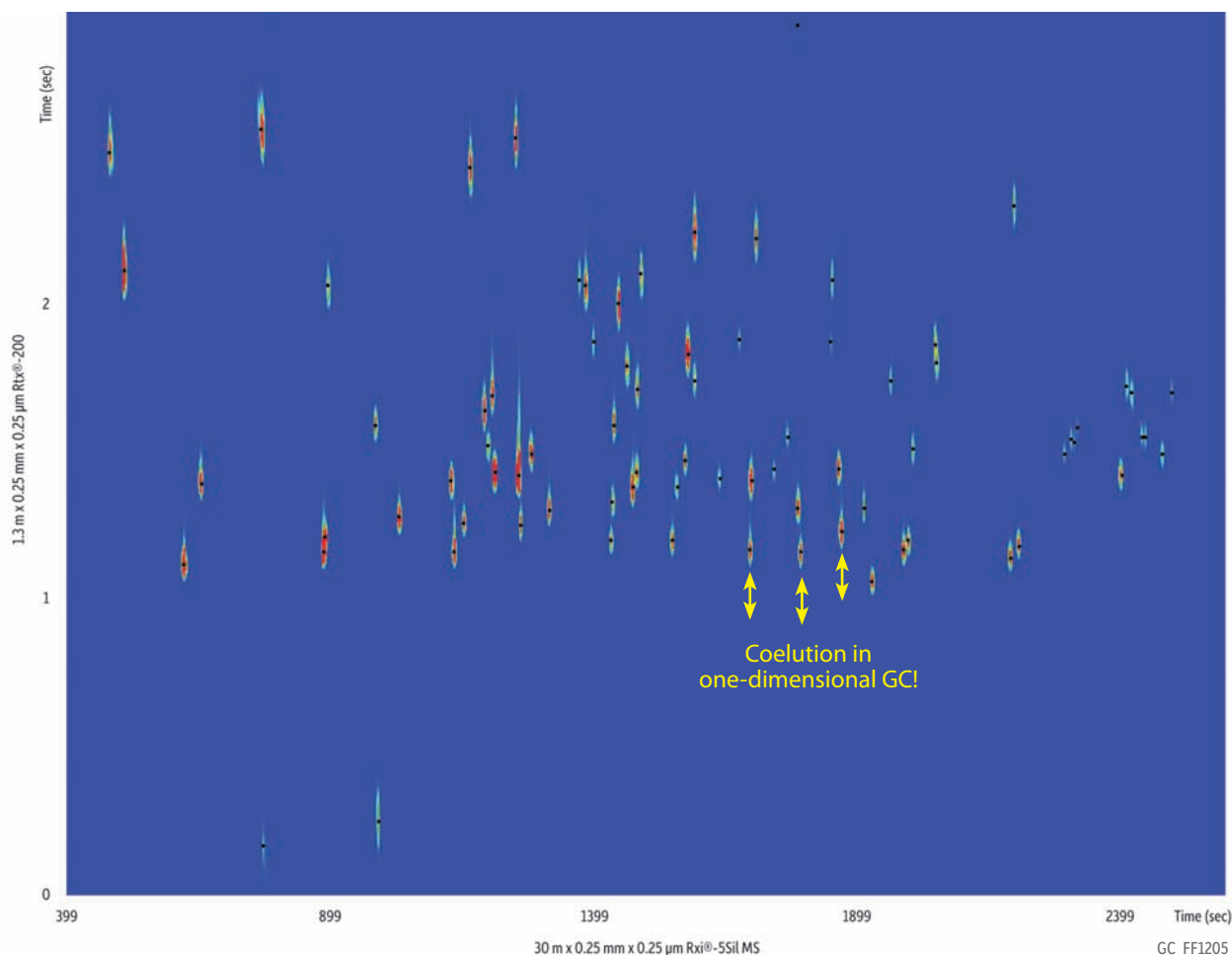
lit. cat.#
GNBR1585-UNV



To order Restek GCxGC columns and accessories, see **page 52**.

To get additional assistance in choosing a column pair, visit www.restek.com/gcxcg

Figure 1: In a contour plot like this one showing clear determination of over 80 pesticides in marijuana, the x-axis represents the primary column retention time and the y-axis represents the secondary column retention time. Peaks aligned along the y-axis would coelute in one-dimensional GC, which is especially problematic if they cannot then be separated by MS.



Column: Rxi®-5Sil MS 30 m, 0.25 mm ID, 0.25 µm (cat.# 13623); Rtx®-200 1.3 m, 0.25 mm ID, 0.25 µm (cat.# 15020); **Sample:** Diluent: Toluene; **Injection:** Inj. Vol.: 1 µL splitless (hold 1 min); **Liner:** Sky® 4 mm single taper w/wool (cat.# 23303.1); **Inj. Temp.:** 250 °C; **Purge Flow:** 40 mL/min; **Oven:** Oven Temp: Rxi®-5Sil MS: 80 °C (hold 1 min) to 310 °C at 5 °C/min; Rtx®-200: 85 °C (hold 1 min) to 315 °C at 5 °C/min; **Carrier Gas:** He, corrected constant flow (2 mL/min); **Modulation:** Modulator Temp. Offset: 20 °C; Second Dimension Separation Time: 3 sec; Hot Pulse Time: 0.9 sec; Cool Time between Stages: 0.6 sec; **Detector:** TOFMS; Transfer Line Temp.: 290 °C; **Analyzer Type:** TOF; **Source Temp.:** 225 °C; **Electron Energy:** 70 eV; **Mass Defect:** -20 mu/100 u; **Solvent Delay Time:** 5 min; **Tune Type:** PFTBA; **Ionization Mode:** EI; **Acquisition Range:** 45-550 amu; **Spectral Acquisition Rate:** 100 spectra/sec; **Instrument:** LECO Pegasus 4D GCxGC-TOFMS; **Notes:** Rtx®-200 (cat.# 15020) is a 15 m column. A 1.3 m section was used as the second dimension column.

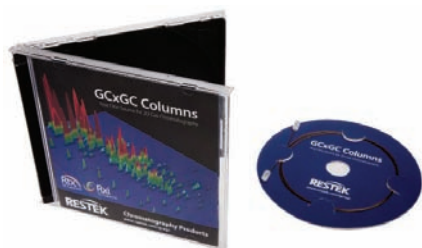
For a peak list, visit www.restek.com and enter chromatogram GC_FF1205 in the search function.

ChromaBLOGraphy

Check out the Restek blog for the most current topics in GCxGC.

blog.restek.com

To choose the perfect primary/secondary column combination for your application, use our guide on page 50!



To choose the perfect primary/secondary column combination for your application, use our guide on page 50!

Primary GCxGC Columns (In order of increasing polarity)

Phase	Length	ID	df	temp. limits	cat.#
Rxi-1ms	30 m	0.25 mm	0.25 μ m	-60 to 330/350 °C	13323
Rxi-5Sil MS	30 m	0.25 mm	0.25 μ m	-60 to 320/350 °C	13623
Rxi-XLB	30 m	0.25 mm	0.25 μ m	30 to 340/360 °C	13723
Rxi-17Sil MS	30 m	0.25 mm	0.25 μ m	40 to 340/360 °C	14123
Rtx-200	30 m	0.25 mm	0.25 μ m	-20 to 320/340 °C	15023
Stabilwax	30 m	0.25 mm	0.25 μ m	40 to 250/260 °C	10623

Secondary GCxGC Columns (In order of increasing polarity)

Phase	Length	ID	df	temp. limits	cat.#
Rxi-1ms	2 m	0.15 mm	0.15 μ m	-60 to 330/350 °C	15114
	2 m	0.18 mm	0.18 μ m	-60 to 330/350 °C	15120
	2 m	0.25 mm	0.25 μ m	-60 to 330/350 °C	15127
Rxi-5Sil MS	2 m	0.15 mm	0.15 μ m	-60 to 330/350 °C	15113
	2 m	0.18 mm	0.18 μ m	-60 to 330/350 °C	15119
	2 m	0.25 mm	0.25 μ m	-60 to 330/350 °C	15126
Rxi-XLB	2 m	0.15 mm	0.15 μ m	30 to 340/360 °C	15115
	2 m	0.18 mm	0.18 μ m	30 to 340/360 °C	15121
	2 m	0.25 mm	0.25 μ m	30 to 340/360 °C	15128
Rxi-17Sil MS	2 m	0.15 mm	0.15 μ m	40 to 340/360 °C	15110
	2 m	0.18 mm	0.18 μ m	40 to 340/360 °C	15116
	2 m	0.25 mm	0.25 μ m	40 to 340/360 °C	15123
Rtx-200	2 m	0.15 mm	0.15 μ m	-20 to 320/340 °C	15111
	2 m	0.18 mm	0.18 μ m	-20 to 320/340 °C	15117
	2 m	0.25 mm	0.25 μ m	-20 to 320/340 °C	15124
Stabilwax	2 m	0.15 mm	0.15 μ m	40 to 250/260 °C	15112
	2 m	0.18 mm	0.18 μ m	40 to 250/260 °C	15118
	2 m	0.25 mm	0.25 μ m	40 to 250/260 °C	15125

GCxGC Secondary Column Selectivity Kits

Description	qty.	cat.#
GCxGC (0.15 mm) Selectivity Kit	kit	15129

Includes (each product also available separately)

Rxi-1ms	2 m x 0.15 mm x 0.15 μ m	ea.	15114
Rxi-5Sil MS	2 m x 0.15 mm x 0.15 μ m	ea.	15113
Rxi-XLB	2 m x 0.15 mm x 0.15 μ m	ea.	15115
Rxi-17Sil MS	2 m x 0.15 mm x 0.15 μ m	ea.	15110
Rtx-200	2 m x 0.15 mm x 0.15 μ m	ea.	15111
Stabilwax	2 m x 0.15 mm x 0.15 μ m	ea.	15112
Universal Press-Tight Connectors	Deactivated	5-pk.	20429

Description	qty.	cat.#
GCxGC (0.18 mm) Selectivity Kit	kit	15130

Includes (each product also available separately)

Rxi-1ms	2 m x 0.18 mm x 0.18 μ m	ea.	15120
Rxi-5Sil MS	2 m x 0.18 mm x 0.18 μ m	ea.	15119
Rxi-XLB	2 m x 0.18 mm x 0.18 μ m	ea.	15121
Rxi-17Sil MS	2 m x 0.18 mm x 0.18 μ m	ea.	15116
Rtx-200	2 m x 0.18 mm x 0.18 μ m	ea.	15117
Stabilwax	2 m x 0.18 mm x 0.18 μ m	ea.	15118
Universal Press-Tight Connectors	Deactivated	5-pk.	20429

Description	qty.	cat.#
GCxGC (0.25 mm) Selectivity Kit	kit	15131

Includes (each product also available separately)

Rxi-1ms	2 m x 0.25 mm x 0.25 μ m	ea.	15127
Rxi-5Sil MS	2 m x 0.25 mm x 0.25 μ m	ea.	15126
Rxi-XLB	2 m x 0.25 mm x 0.25 μ m	ea.	15128
Rxi-17Sil MS	2 m x 0.25 mm x 0.25 μ m	ea.	15123
Rtx-200	2 m x 0.25 mm x 0.25 μ m	ea.	15124
Stabilwax	2 m x 0.25 mm x 0.25 μ m	ea.	15125
Universal Press-Tight Connectors	Deactivated	5-pk.	20429

- Each kit includes one Rxi®-1ms, Rxi®-5Sil MS, Rxi®-17Sil MS, Rtx®-200, Rxi®-XLB, and Stabilwax® column.
- Comprehensive kit simplifies column selection for method developers and frequent GCxGC users alike.
- Included Press-Tight® connectors offer a reliable, hassle-free installation.

Shorten Analysis Time and Boost Productivity With Restek Fast GC Columns

The math is simple: The less time it takes to perform each analysis, the more samples your laboratory can process. The easiest way to reduce analysis time while still maintaining resolution of critical compounds is to use hydrogen as your carrier gas. If hydrogen is not an option, or if you already use it and want to go even faster, turn to the higher resolving power of smaller-bore capillary columns from Restek.

As column ID decreases, column efficiency (i.e., plates/meter) increases, allowing you to achieve the same, or even better, resolution using a shorter length—and significantly less time. Whether you are currently using 0.25 or 0.53 mm ID columns, you can shorten analysis times as much as twofold by switching to Restek 0.15 mm ID fast GC columns. These high-efficiency columns speed up separations on your existing GC or GC-MS instrumentation—while maintaining resolution and meeting method criteria—so you can make more runs per shift with the same exceptional accuracy you've come to expect from Restek.

Fast GC 0.15 mm ID Columns

- Increase productivity up to 2x without sacrificing resolution.
- Compatible with your existing GC setup.
- Low bleed for maximum sensitivity and accurate GC-MS analyses.
- Thick films (up to 2 μm) eliminate loadability issues.
- OD similar to 0.25 mm columns for easy installation.
- Excellent as secondary columns for GCxGC.
- Available in a variety of stationary phases.

Rxi®-1ms Columns for Fast GC (fused silica) (nonpolar phase; Crossbond® dimethyl polysiloxane)

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

Rxi®-5Sil MS Columns for Fast GC (fused silica) (low polarity phase; Crossbond® 1,4-bis(dimethylsiloxy)phenylene dimethyl polysiloxane)

ID	df	temp. limits	10-Meter	20-Meter
0.15 mm	0.15 μm	-60 to 320/350 °C	43815	43816
	2.0 μm	-60 to 320/350 °C		43817

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

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

Stabilwax® Columns for Fast GC (fused silica) (polar phase; Crossbond® polyethylene glycol)

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

tech tip

Use a 20 m fast GC column in place of a standard 30 m column; a 10 m in place of a 15 m; and a 40 m in place of a 60 m.

How to Get the Same Chromatogram With a Fast GC Column

For over 20 years, 0.15 mm ID columns have been proven to work in virtually any application field. When switching to a smaller-ID and shorter-length column, there are several things you must do in order for your new, faster method to give you the same chromatogram (i.e., separations) as your old method:

- 1) Choose a column with the same phase ratio.
- 2) Adapt the temperature program so that the analyte elution temperatures are the same.
- 3) Adjust the linear velocity. (For a good starting point, see your column's certificate of analysis.)

Following these guidelines will help ensure that you achieve similar chromatography (i.e., identical elution order and resolution)—in a fraction of the time.

Application-Specific Columns

Clinical, Forensic & Toxicology.....	55
Environmental	56–70
Foods, Flavors & Fragrances	71–74
Petroleum & Petrochemical	75–79
Pharmaceutical.....	80–83
Specially Deactivated.....	84–89



Unique Column Chemistries for Application-Specific and Specially Deactivated Columns

Designed to help solve chromatographic challenges, these stationary phases are optimized for the best separations, accurate quantification, and shorter analysis times.

Application-Specific Columns

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

Specially Deactivated Columns

Designed for specific classes of compounds.

- Acidic compound analysis.
- Basic compound analysis.
- Chiral analysis.

Blood Alcohol Analysis

Rtx®-BAC Plus 1/Rtx®-BAC Plus 2 Columns

- Optimized column selectivities guarantee resolution of ethanol, internal standards, and frequently encountered interferences.
- Robust and reproducible column chemistry ensures longer column lifetime and consistent results.
- 2 minute analysis time increases lab productivity.
- Stable to 260 °C

These application-specific columns for blood alcohol analysis baseline separate all critical compounds—including ethanol, methanol, acetone, *tert*-butanol, acetaldehyde, isopropanol, and *n*-propanol—in less than 2 minutes. Every Rtx®-BAC Plus 1 and Rtx®-BAC Plus 2 column is qualified with a test mix containing these important BAC target compounds to ensure reproducibility.

These columns baseline separate all blood alcohol compounds in blood, breath, or urine, in less than 2 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 two elution order changes between the columns.

Rtx®-BAC Plus 1 Columns (fused silica)

ID	df	temp. limits	30-Meter
0.32 mm	1.80 µm	-20 to 240/260 °C	18004
0.53 mm	3.00 µm	-20 to 240/260 °C	18005

Rtx®-BAC Plus 2 Columns (fused silica)

ID	df	temp. limits	30-Meter
0.32 mm	0.6 µm	-20 to 240/260 °C	18006
0.53 mm	1.0 µm	-20 to 240/260 °C	18007



free literature

Rtx®-BAC Plus 1 and
Rtx®-BAC Plus 2 Columns
Advanced Technology for Fast,
Reliable Measurement
of Alcohol in Blood

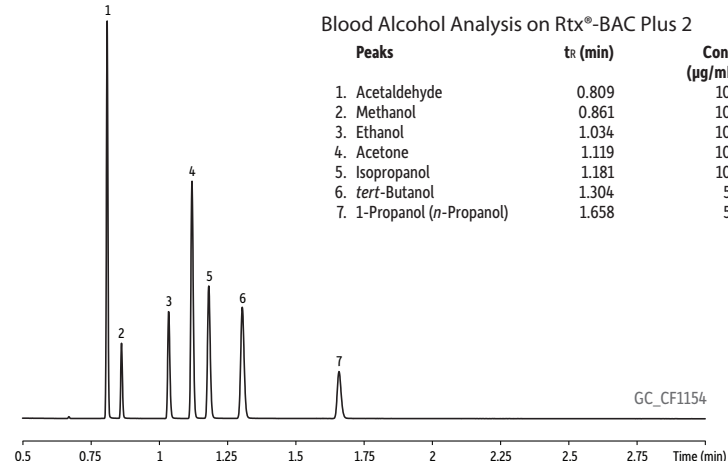
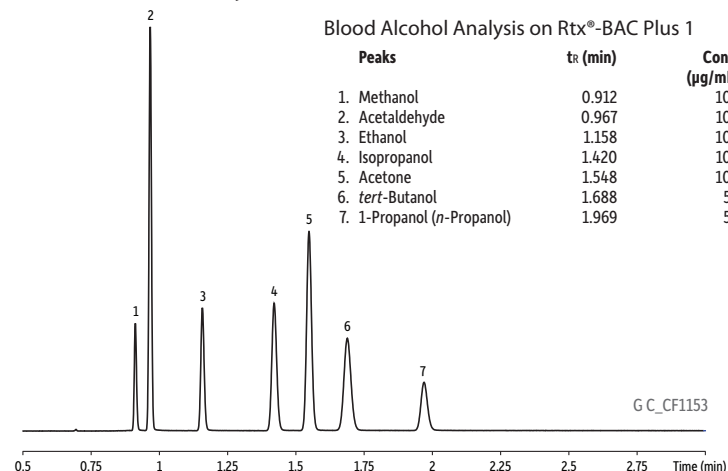
Download your
free copy from

www.restek.com

lit. cat.#
CFBR1538-UNV



Blood Alcohol Analysis on Rtx®-BAC Plus 1 and Rtx®-BAC Plus 2

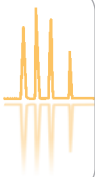


Columns	Rtx®-BAC Plus 1, 30 m, 0.32 mm ID, 1.8 µm (cat.# 18004) Rtx®-BAC Plus 2, 30 m, 0.32 mm ID, 0.6 µm (cat.# 18006)
Sample	BAC resolution control standard n-P (cat.# 36010) BAC resolution control standard t-B (cat.# 36011)
Diluent:	Water
Conc.:	50 µL of each standard were diluted in 900 µL water in a 20 mL headspace vial.
Injection	headspace-loop split (split ratio 50:1)
Liner:	1 mm ID straight inlet liner (cat.# 20972)
Headspace-Loop	
Inj. Port Temp.:	200 °C
Instrument:	Tekmar HT3
Inj. Time:	3 min
Transfer Line	
Temp.:	125 °C
Valve Oven Temp.:	125 °C
Standby flow	
rate:	50 mL/min
Sample Temp.:	60 °C
Sample Equil.	
Time:	5 min
Vial Pressure:	30 psi
Pressurize Time:	1 min
Loop Pressure:	20 psi
Loop Fill Time:	1 min
Oven	
Oven Temp:	40 °C (hold 3 min)
Carrier Gas	He, constant flow
Linear Velocity:	80 cm/sec @ 40 °C
Detector	FID @ 240 °C
Make-up Gas	
Flow Rate:	30 mL/min
Make-up Gas	
Type:	N ₂
Instrument	Agilent/HP6890 GC
Notes	Headspace concentrator courtesy of Teledyne Tekmar, Mason, OH.

Brominated Flame Retardants Analysis

Table of Contents for
GC Chromatograms

See **page 570**.



Rtx®-1614 Columns (fused silica)

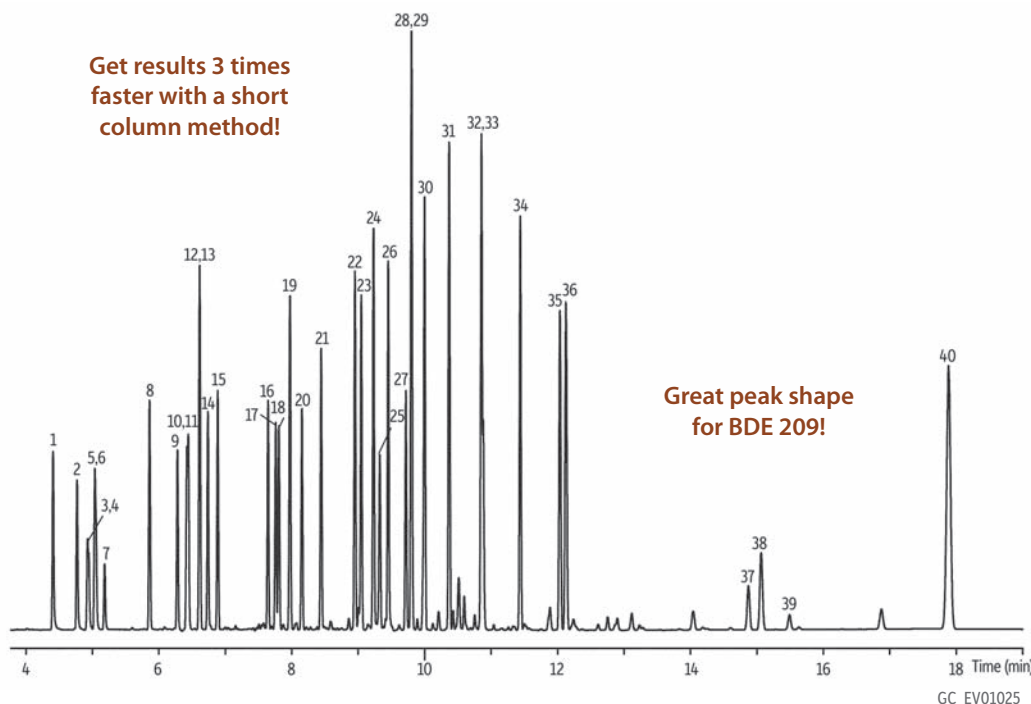
(5% phenyl methyl)

- 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.

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

Brominated Flame Retardants on Rtx®-1614

Get results 3 times
faster with a short
column method!



Peaks

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

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

Dioxin & Furan Analysis

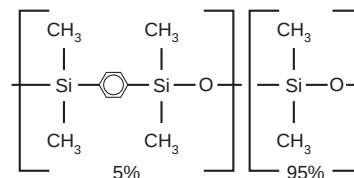
Rxi®-5Sil MS Columns (fused silica)

(low polarity phase; Crossbond® 1,4-bis(dimethylsiloxy)phenylene dimethyl polysiloxane)

- Engineered to be a low bleed GC-MS column.
- Excellent inertness for active compounds.
- Ideal for use in dual column confirmation of dioxin and furan.
- 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



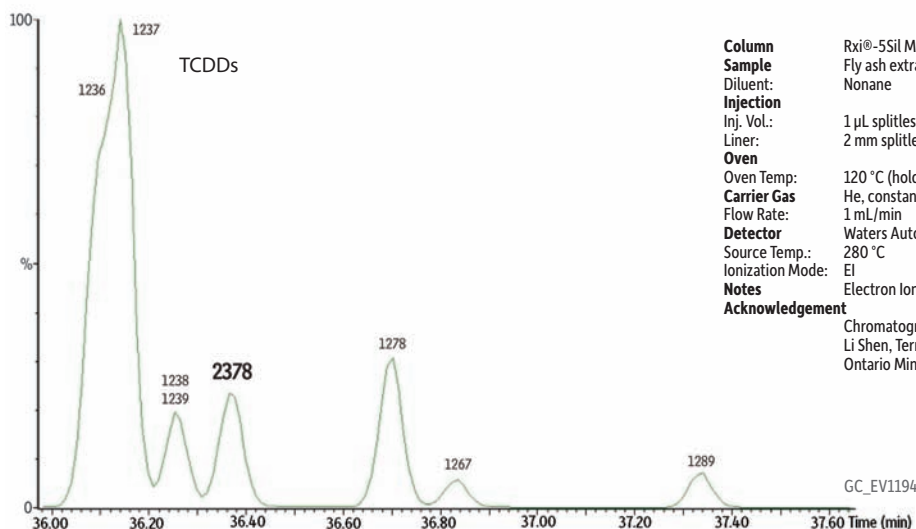
Similar to: (5%-phenyl)-methylpolysiloxane

similar phases

DB-5ms, DB-5msUI, VF-5ms, CP-Sil 8 CB, ZB-5msi, Rtx-5Sil MS

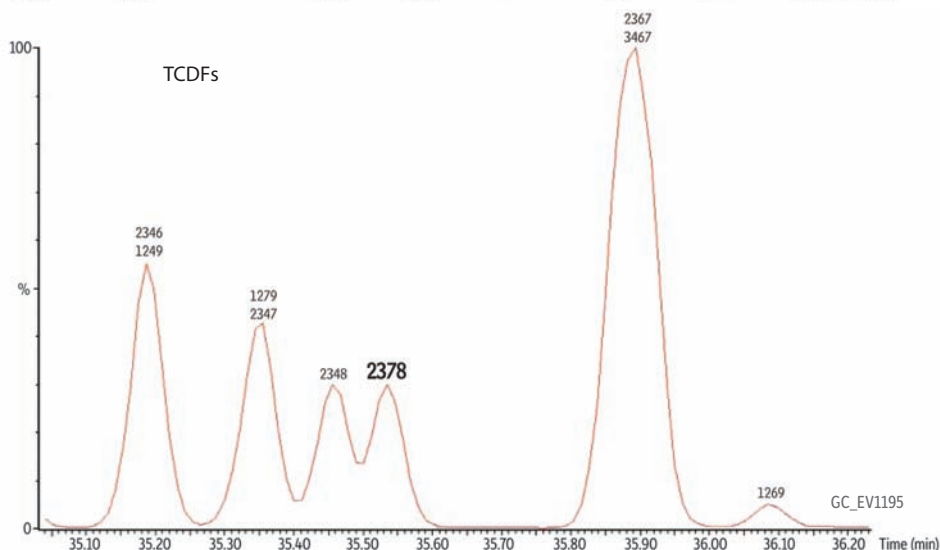
ID	df	temp. limits	30-Meter	60-Meter
0.18 mm	0.10 µm	-60 to 320/350 °C		43607
0.25 mm	0.25 µm	-60 to 320/350 °C	13623	

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: 2 mm 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.

"Using the Rtx®-Dioxin2 column allowed us to combine EPA 1613 TCDD-only and TCDF confirmation analyses onto one column and one instrument. This resulted in multiple benefits—we shortened run times, reduced instrument downtime and column changes, and increased instrument capacity for our full list samples."

Owen Cosby

Supervisor, HRMS Services
Maxxam Analytics

Dioxin & Furan Analysis

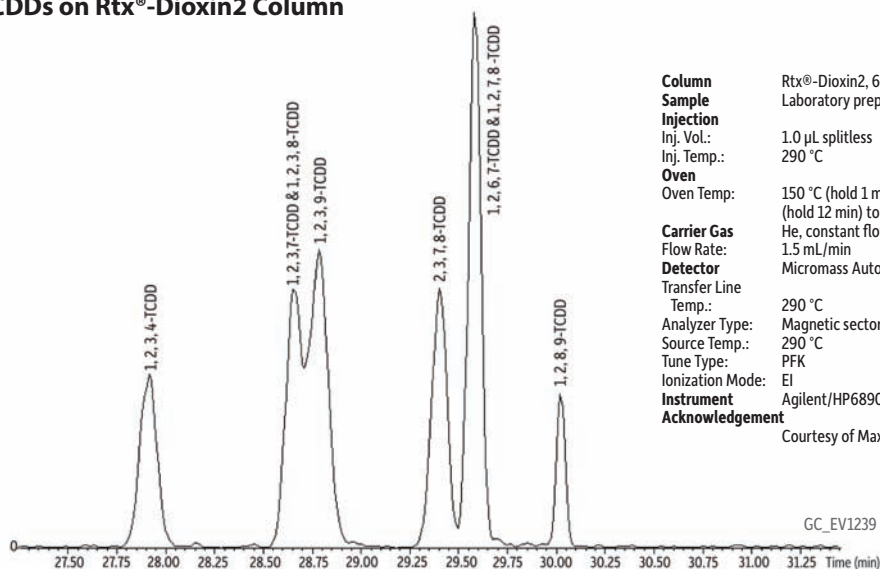
Rtx®-Dioxin2 Columns (fused silica)

(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 allows use as a confirmation GC column.

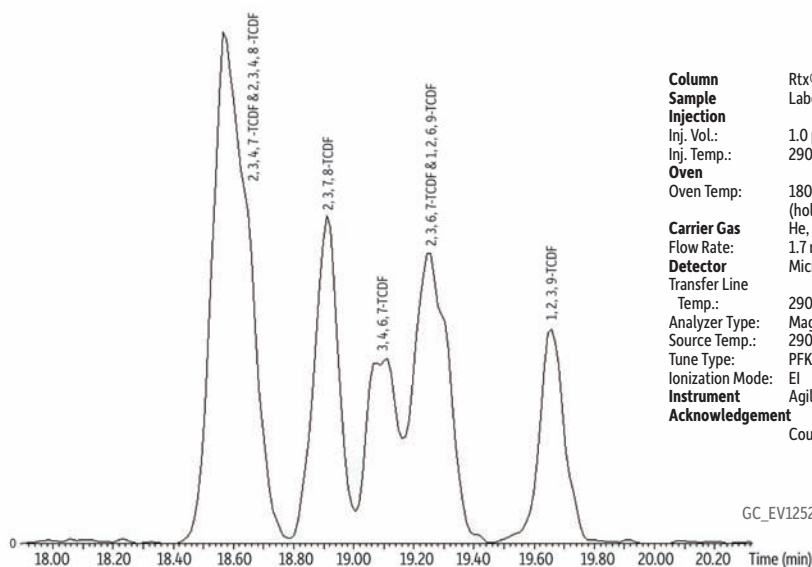
ID	df	temp. limits	40-Meter	60-Meter
0.18 mm	0.18 µm	20°C to 320/340 °C	10759	
0.25 mm	0.25 µm	20°C to 320/340 °C		10758

TCDDs on Rtx®-Dioxin2 Column



Column Rtx®-Dioxin2, 60 m, 0.25 mm ID, 0.25 µm (cat.# 10758)
Sample Laboratory prepared test mix
Injection
 Inj. Vol.: 1.0 µL splitless
 Inj. Temp.: 290 °C
Oven
 Oven Temp: 150 °C (hold 1 min) to 210 °C at 30 °C/min (hold 1 min) to 250 °C at 3 °C/min (hold 12 min) to 330 °C at 70 °C/min (hold 6 min)
Carrier Gas
 Flow Rate: He, constant flow
 1.5 mL/min
Detector
 Transfer Line Micromass Autospec Ultima
 Temp.: 290 °C
 Analyzer Type: Magnetic sector
 Source Temp.: 290 °C
 Tune Type: PFK
 Ionization Mode: EI
Instrument Agilent/HP6890 GC
Acknowledgement Courtesy of Maxxam Analytics (Ontario, Canada).

TCDFs on Rtx®-Dioxin2 Column



Column Rtx®-Dioxin2, 60 m, 0.25 mm ID, 0.25 µm (cat.# 10758)
Sample Laboratory prepared test mix
Injection
 Inj. Vol.: 1.0 µL splitless
 Inj. Temp.: 290 °C
Oven
 Oven Temp: 180 °C (hold 1 min) to 235 °C at 45 °C/min (hold 1 min) to 250 °C at 3 °C/min (hold 15 min) to 300 °C at 50 °C/min (hold 1 min)
Carrier Gas
 Flow Rate: He, constant flow
 1.7 mL/min
Detector
 Transfer Line Micromass Autospec Ultima
 Temp.: 290 °C
 Analyzer Type: Magnetic sector
 Source Temp.: 290 °C
 Tune Type: PFK
 Ionization Mode: EI
Instrument Agilent/HP6890 GC
Acknowledgement Courtesy of Maxxam Analytics (Ontario, Canada).

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.

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

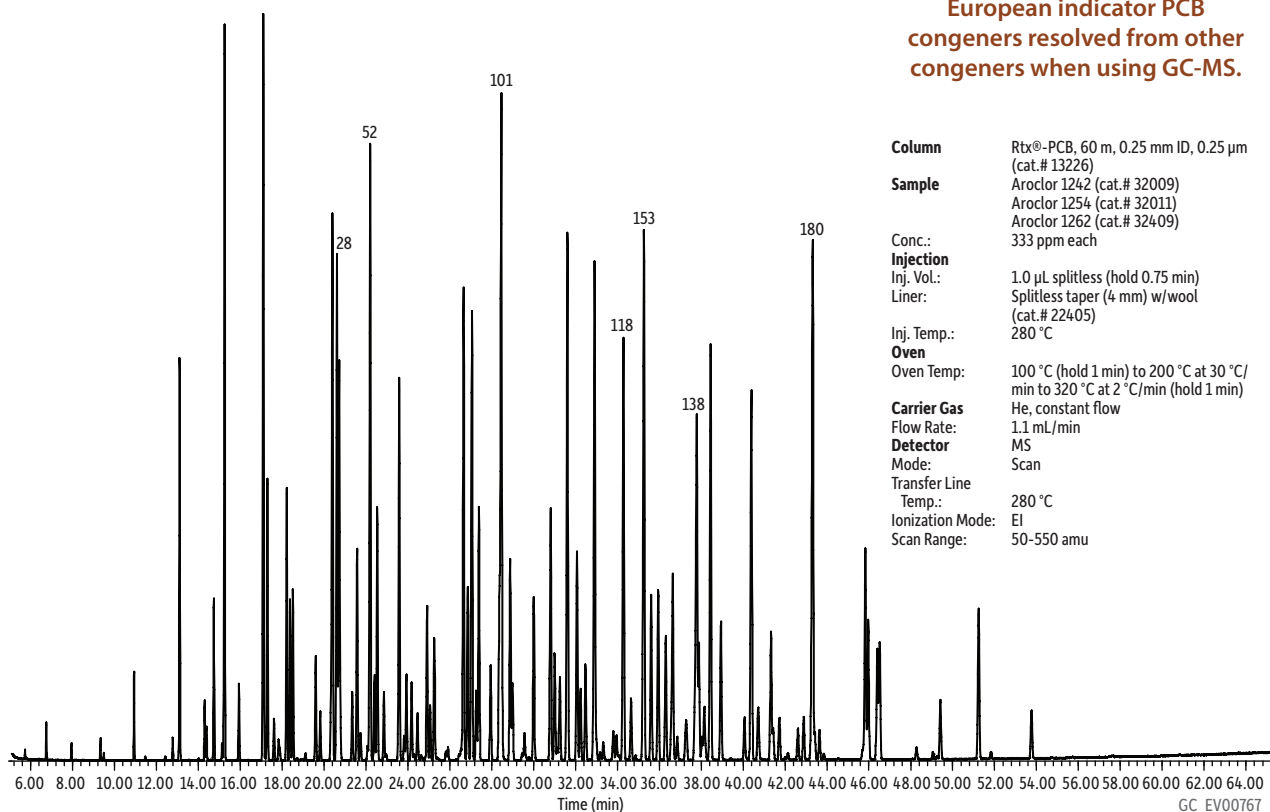
*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

restek innovation!

Aroclor PCBs on Rtx®-PCB

European indicator PCB congeners resolved from other congeners when using GC-MS.

Column Rtx®-PCB, 60 m, 0.25 mm ID, 0.25 µm (cat.# 13226)
Sample Aroclor 1242 (cat.# 32009)
 Aroclor 1254 (cat.# 32011)
 Aroclor 1262 (cat.# 32409)
 Conc.: 333 ppm each
Injection Inj. Vol.: 1.0 µL splitless (hold 0.75 min)
 Liner: Splitless taper (4 mm) w/wool (cat.# 22405)
 Inj. Temp.: 280 °C
Oven Oven Temp: 100 °C (hold 1 min) to 200 °C at 30 °C/min to 320 °C at 2 °C/min (hold 1 min)
Carrier Gas He, constant flow
 Flow Rate: 1.1 mL/min
Detector MS
 Mode: Scan
 Transfer Line Temp.: 280 °C
 Ionization Mode: EI
 Scan Range: 50-550 amu



similar phases

DB-XLB, VF-Xms, MR1, ZB-XLB

PCB Congeners Analysis

Rxi®-XLB Columns (fused silica)

(low polarity proprietary phase)

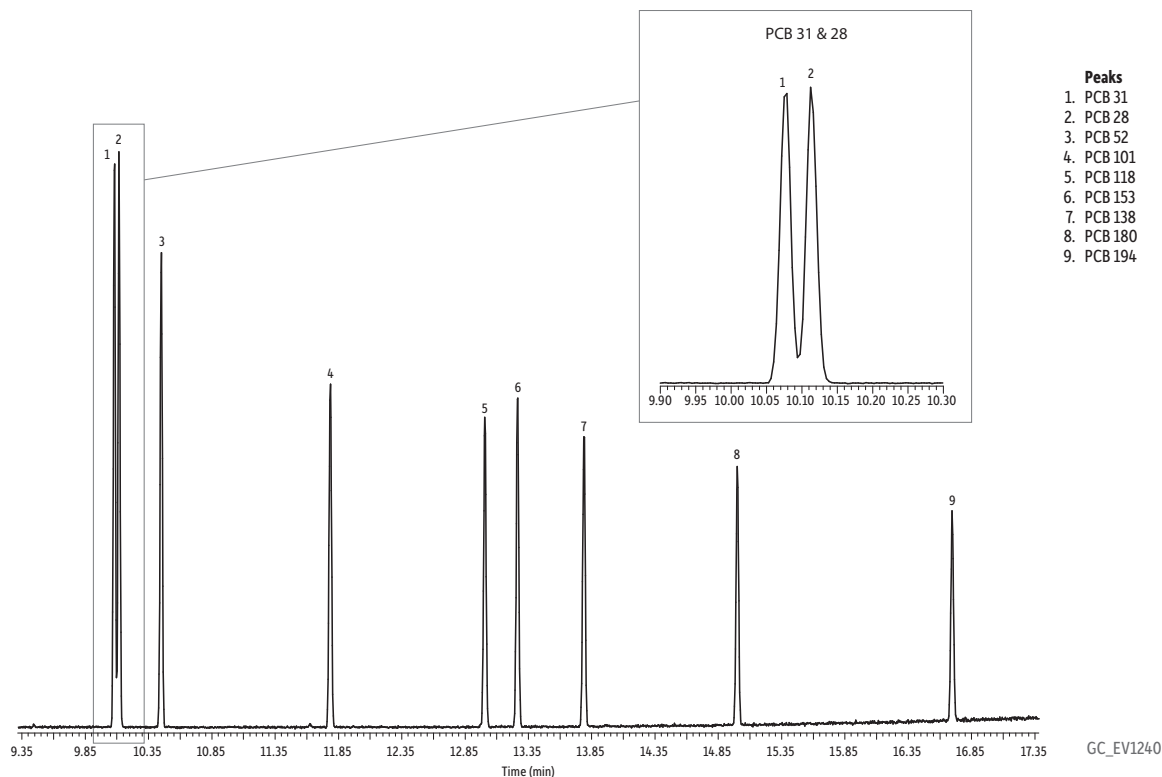
- General-purpose columns exhibiting extremely low bleed. Ideal for many GC-MS applications, including pesticides, PCB congeners (e.g., Aroclor mixes), PAHs.
- Unique selectivity.
- Temperature range: 30 °C to 360 °C.

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

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

*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

EU PCB Congeners on Rxi®-XLB



Column Rxi®-XLB, 30 m, 0.25 mm ID, 0.25 µm (cat.# 13723)
Sample PCB congener standard #2 (cat.# 32294)
 PCB 31 (cat.# custom)
Diluent: Dichloromethane
Conc.: 3.5 ppm

Injection
Inj. Vol.: 0.5 µL splitless (hold 1.75 min)
Liner: 2.0 mm ID straight inlet liner w/wool (cat.# 21718)
Inj. Temp.: 300 °C
Purge Flow: 50 mL/min
Oven
Oven Temp: 40 °C (hold 2 min) to 240 °C at 30 °C/min (hold 2 min) to 340 °C at 10 °C/min (hold 5 min)

Carrier Gas He, constant flow
Flow Rate: 1 mL/min
Detector MS
Mode: Scan
Transfer Line
Temp.: 300 °C
Analyzer Type: Quadrupole
Source Temp.: 280 °C
Electron Energy: 70 eV
Ionization Mode: EI
Scan Range: 45-550 amu
Scan Rate: 5 scans/sec
Instrument PE Clarus 500 GC & Clarus 500 MS

GC_EV1240

Pesticides Analysis (Organophosphorus)

Rtx®-OPPesticides/Rtx®-OPPesticides2

- Application-specific columns for organophosphorus pesticides; best column combination for U.S. 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.

Rtx®-OPPesticides Columns (fused silica)

(proprietary Crossbond® phases)

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

Rtx®-OPPesticides2 Columns (fused silica)

(proprietary Crossbond® phases)

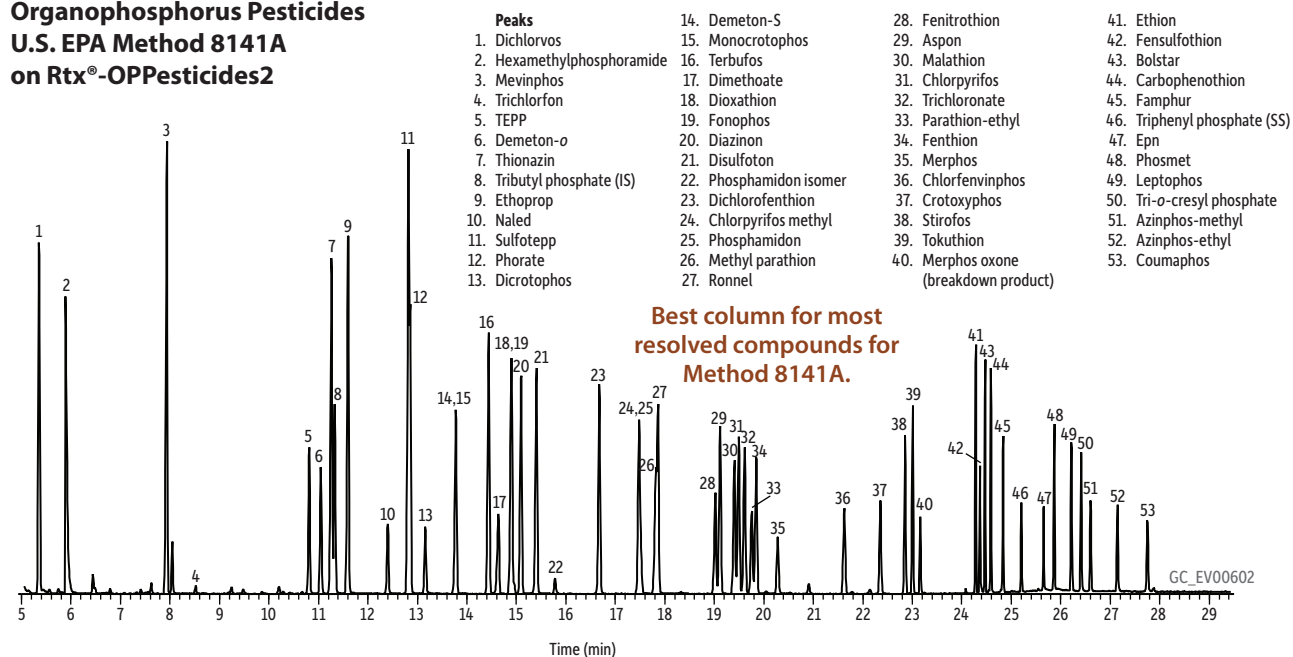
ID	df	temp. limits	20-Meter	30-Meter
0.18 mm	0.20 µm	-20 to 310/330 °C	11244	
0.25 mm	0.25 µm	-20 to 310/330 °C		11243
0.32 mm	0.32 µm	-20 to 310/330 °C		11241
0.53 mm	0.50 µm	-20 to 300/330 °C		11242



restek innovation!

- Better separations
- Faster analyses

Organophosphorus Pesticides U.S. EPA Method 8141A on Rtx®-OPPesticides2



Column Rtx®-OPPesticides2, 30 m, 0.25 mm ID, 0.25 µm (cat.# 11243)
Sample Triphenylphosphate (cat.# 32281)
 Tributylphosphate (cat.# 32280)
 8140/8141 OP pesticide calibration mix A (cat.# 32277)
 8141 OP pesticide calibration mix B (cat.# 32278)
Conc.: 100 ppm (100 ng on-column)
Injection
 Inj. Vol.: 1.0 µL splitless (hold 0.4 min)
 Liner: Double taper splitless (4 mm) (cat.# 20785)
 Inj. Temp.: 250 °C
Oven
 Oven Temp.: 80 °C (hold 0.5 min) to 140 °C at 20 °C/min to 210 °C at 4 °C/min (hold 1 min) to 280 °C at 30 °C/min (hold 5 min)

Carrier Gas He, constant flow
Flow Rate: 1.0 mL/min
Detector MS
Mode: Scan
Transfer Line
Temp.: 280 °C
Analyzer Type: Quadrupole
Ionization Mode: EI
Scan Range: 35-400 amu
Notes U.S. EPA Method 8141A custom standard mix. Additional mixes not shown. Contact Restek for more information.

restek innovation!

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



free literature

Analyze Chlorinated
Pesticides, PCBs and
Chlorinated Herbicides

Download your
free copy from

www.restek.com

lit. cat.# EVFL1013



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



Pesticides Analysis (Chlorinated)

Rtx®-CLPesticides/Rtx®-CLPesticides2

- 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.
- Analyze EPA Method 8081B, 8082A, 8151A, 504.1, 515, 508.1, and 552.2 compounds without time-consuming column change.

Rtx®-CLPesticides Columns (fused silica) (proprietary Crossbond® phases)

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

Rtx®-CLPesticides2 Columns (fused silica) (proprietary Crossbond® phases)

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

Rtx®-CLPesticides Column Kit (0.25 mm ID)

(Note: Columns are not preconnected in this kit.)

Rtx-CLPesticides Kit (0.25 mm ID) cat.# 11199 (kit)

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



Rtx®-CLPesticides Column Kit (0.32 mm ID)

(Note: Columns are not preconnected in this kit.)

Rtx-CLPesticides Kit (0.32 mm ID) cat.# 11196 (kit)

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



Rtx®-CLPesticides Column Kit (0.53 mm ID)

(Note: Columns are not preconnected in this kit.)

Rtx-CLPesticides Kit (0.53 mm ID) cat.# 11197 (kit)

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

also available

Column connectors

See **pages 208–214**
for a wide selection.



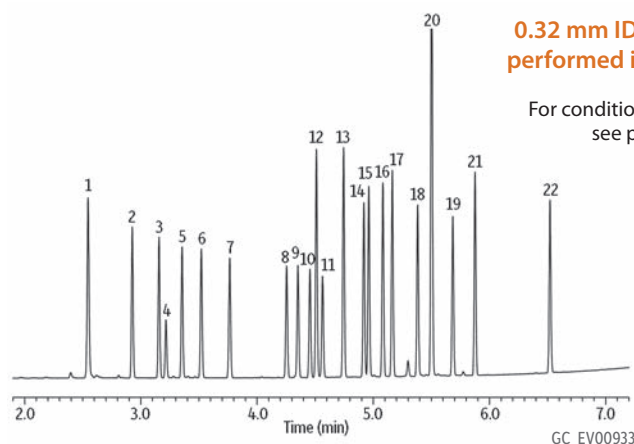
Organochlorine Pesticide Mix AB #2 on Rtx®-CLPesticides and Rtx®-CLPesticides2 (0.32 mm ID column set)

Rtx®-CLPesticides

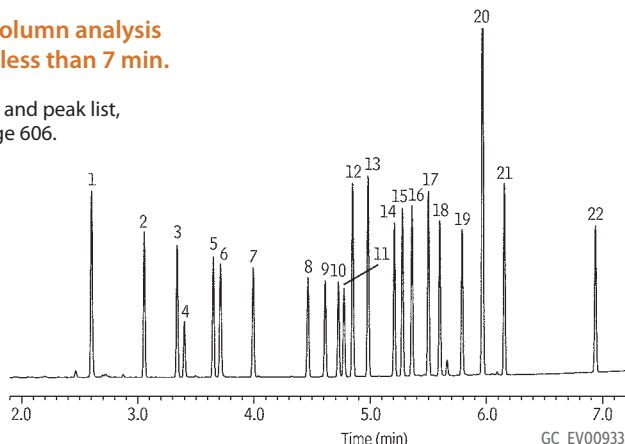
Rtx®-CLPesticides2

0.32 mm ID column analysis
performed in less than 7 min.

For conditions and peak list,
see page 606.



GC_EV00933



GC_EV00933A

EPA Method	Column Pair	Analysis Time (min)	Coelutions	Restek Advantage
8081B (Organochlorine pesticides)	Rtx-CLPesticides / Rtx-CLPesticides2	7 / 7	0 / 0	• Increase sample throughput with 7 min analyses and baseline resolution.
	DB-35ms / DB-XLB	7 / 8	0 / 1	
	ZB-MR1 / ZB-MR2	10 / 9	0 / 0	
8081B (extended) (Organochlorine pesticides)	Rtx-CLPesticides / Rtx-CLPesticides2	24 / 23	1 / 2	• Best balance of speed and selectivity. • All compounds are resolved between both columns.
	DB-35ms / DB-XLB	27 / 28	2 / 3	
	ZB-MR1 / ZB-MR2	NDP / 16	NDP / 3	
8082A (Polychlorinated biphenyls (PCBs), Aroclors)	Rtx-CLPesticides / Rtx-CLPesticides2	7 / 7	0 / 0	• Fast PCB analysis times.
	DB-35ms / DB-XLB	6 / 7	0 / 0	
	ZB-MR1 / ZB-MR2	24 / 21	0 / 0	
8151A (Chlorinated herbicides)	Rtx-CLPesticides / Rtx-CLPesticides2	13 / 13	1 / 0	• More elution order changes improve confidence in confirmational results.
	DB-35ms / DB-XLB	12 / 13	0 / 0	
	ZB-MR1 / ZB-MR2	16 / 15	1 / 1	
504.1 (EDB, DBCP, TCP)	Rtx-CLPesticides / Rtx-CLPesticides2	6 / 6	0 / 0	• Reliably separate analytes from trihalomethane interferences.
	DB-35ms / DB-XLB	6 / 6	0 / 0	
	ZB-MR1 / ZB-MR2	NDP	NDP	
505 (Organohalide pesticides)	Rtx-CLPesticides / Rtx-CLPesticides2	18 / 18	1 / 1	• All compounds resolved between both columns.
	DB-35ms / DB-XLB	14 / 14	0 / 1	
	ZB-MR1 / ZB-MR2	35 / 36	1 / 2	
508.1 (Chlorinated pesticides, herbicides, organohalides)	Rtx-CLPesticides / Rtx-CLPesticides2	23 / 24	2 / 2	• Best overall balance of speed and resolution.
	DB-35ms / DB-XLB	22 / 24	2 / 4	
	ZB-MR1 / ZB-MR2	18 / 17	2 / 4	
552.2 (Haloacetic acids, dalapon)	Rtx-CLPesticides / Rtx-CLPesticides2	12 / 12	0 / 0	• No coelutions—get accurate results for compounds that coelute on other columns.
	DB-35ms / DB-XLB	8 / 9	2 / 1	
	ZB-MR1 / ZB-MR2	NDP/10	NDP/1	

Comparison based on published competitor data. All columns tested were 0.32 mm ID. NDP = no data published

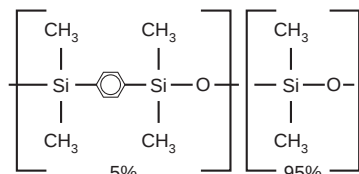
How much time do column changes cost you?

Switch to Rtx®-CLPesticides columns and analyze pesticides, herbicides, PCBs and more on a single column set.

did you know?

Analyzing dirty or derivatized samples can contaminate your column. Restek does not recommend analyzing trace-level pesticide samples following derivatized samples.

Rxi®-5Sil MS Structure

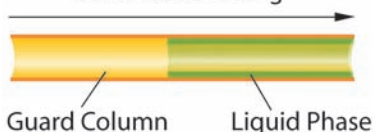


similar phases

DB-5ms, DB-5msUI, VF-5ms, CP-Sil 8 CB, ZB-5msi, Rtx-5Sil MS

Integra-Guard® Built-In Guard Column

Continuous Tubing



Get the protection without the connection!
See **page 25** for Rxi®-5Sil MS columns with built-in Integra-Guard® guard columns.

Polycyclic Aromatic Hydrocarbons (PAHs) Analysis

Rxi®-5Sil MS Columns (fused silica)

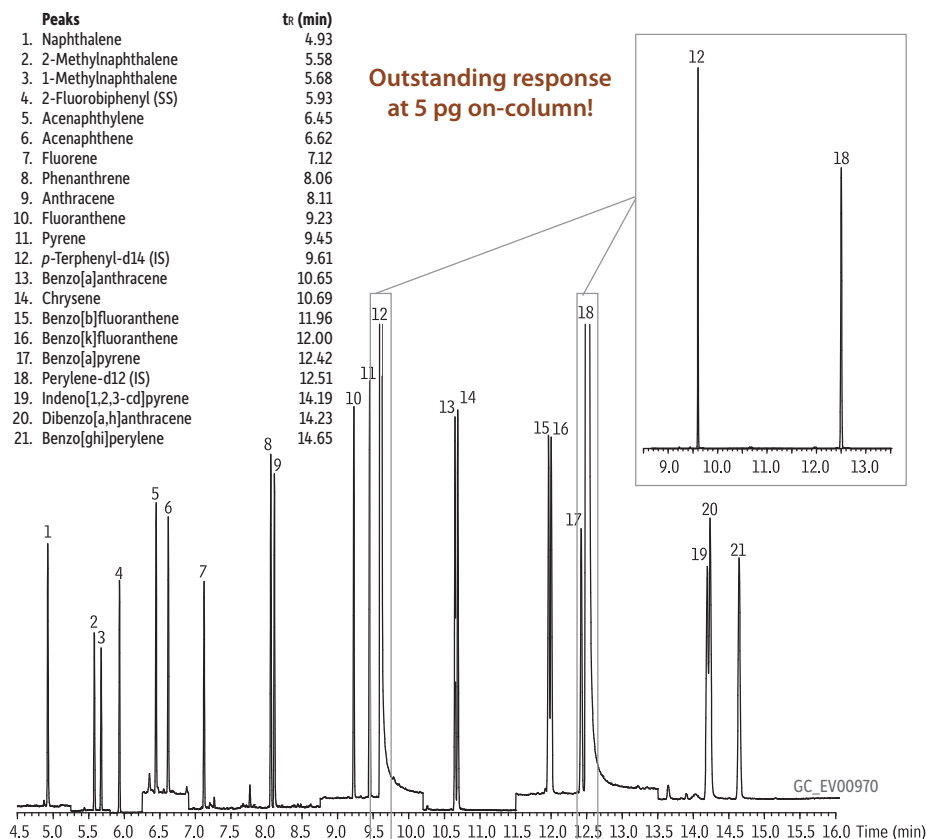
(low polarity phase; Crossbond® 1,4-bis(dimethylsiloxy)phenylene dimethyl polysiloxane)

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

ID	df	temp. limits	15-Meter	30-Meter	60-Meter
0.25 mm	0.10 µm	-60 to 320/350 °C	13605	13608	
	0.25 µm	-60 to 320/350 °C	13620	13623	13626
	0.50 µm	-60 to 320/350 °C	13635	13638	
	1.00 µm	-60 to 320/350 °C	13650	13653	13697
0.32 mm	0.25 µm	-60 to 320/350 °C	13621	13624	
	0.50 µm	-60 to 320/350 °C		13639	
	1.00 µm	-60 to 320/350 °C		13654	
0.53 mm	1.50 µm	-60 to 320/330 °C		13670	

ID	df	temp. limits	10-Meter	20-Meter	40-Meter	60-Meter
0.15 mm	0.15 µm	-60 to 320/350 °C	43815	43816		
	2.0 µm	-60 to 320/350 °C		43817		
0.18 mm	0.10 µm	-60 to 320/350 °C				43607
	0.18 µm	-60 to 320/350 °C		43602	43605	
	0.36 µm	-60 to 320/350 °C		43604		

Polycyclic Aromatic Hydrocarbons on Rxi®-5Sil MS



Column Rxi®-5Sil MS, 30 m, 0.25 mm ID, 0.25 µm (cat. # 13623)
Sample PAH mix, 1 µL of 0.005 µg/mL (IS 2 µg/mL)
 SV Calibration mix #5 / 610 PAH Mix (cat. # 31011)
 1-Methylnaphthalene (cat. # 31283)
 2-Methylnaphthalene (cat. # 31285)
 2-Fluorobiphenyl (cat. # 31091)
 5 pg on-column

Conc.:
Injection 1.0 µL pulsed splitless (hold 0.15 min)
Inj. Vol.: Drilled Uniliner® (hole near top) w/wool (cat. # 21055-200.5)
Liner:
Inj. Temp.: 300 °C
Pulse Pressure: 20 psi (137.9 kPa)
Pulse Time: 0.2 min
Purge Flow: 60 mL/min
Oven
Oven Temp: 50 °C (hold 0.5 min) to 290 °C at 25 °C/min to 320 °C at 5 °C/min

Carrier Gas He, constant flow
Flow Rate: 1.4 mL/min
Detector MS
Mode: SIM
SIM Program:

Start Time Group (min)	Ion(s)	Dwell (ms)
1	128 m/z	100
2	142 m/z	100
3	172 m/z	100
4	152 m/z	100
5	166 m/z	100
6	178 m/z	100
7	202,244 m/z	100
8	228 m/z	100
9	252,264 m/z	100
10	276,278 m/z	100

Transfer Line
Temp.: 290 °C
Ionization Mode: EI

Polycyclic Aromatic Hydrocarbons (PAHs) Analysis

Rxi®-17Sil MS Columns (fused silica)

(midpolarity Crossbond® phase)

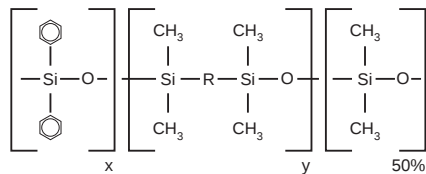
- 340/360 °C upper temperature limits.
- Excellent inertness and selectivity for active environmental compounds, such as PAHs.
- Equivalent to USP phase G3.
- Low bleed for use with sensitive detectors, such as MS.
- Excellent separation of EU-PAHs, including fluoranthenes.

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

ID	df	temp. limits	10-Meter	20-Meter
0.15 mm	0.15 µm	40 to 340/360 °C	43820	43821
0.18 mm	0.18 µm	40 to 340/360 °C		14102
	0.36 µm	40 to 340/360 °C		14111

*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

Rxi®-17Sil MS Structure



Similar to: (50%-phenyl)-methylpolysiloxane

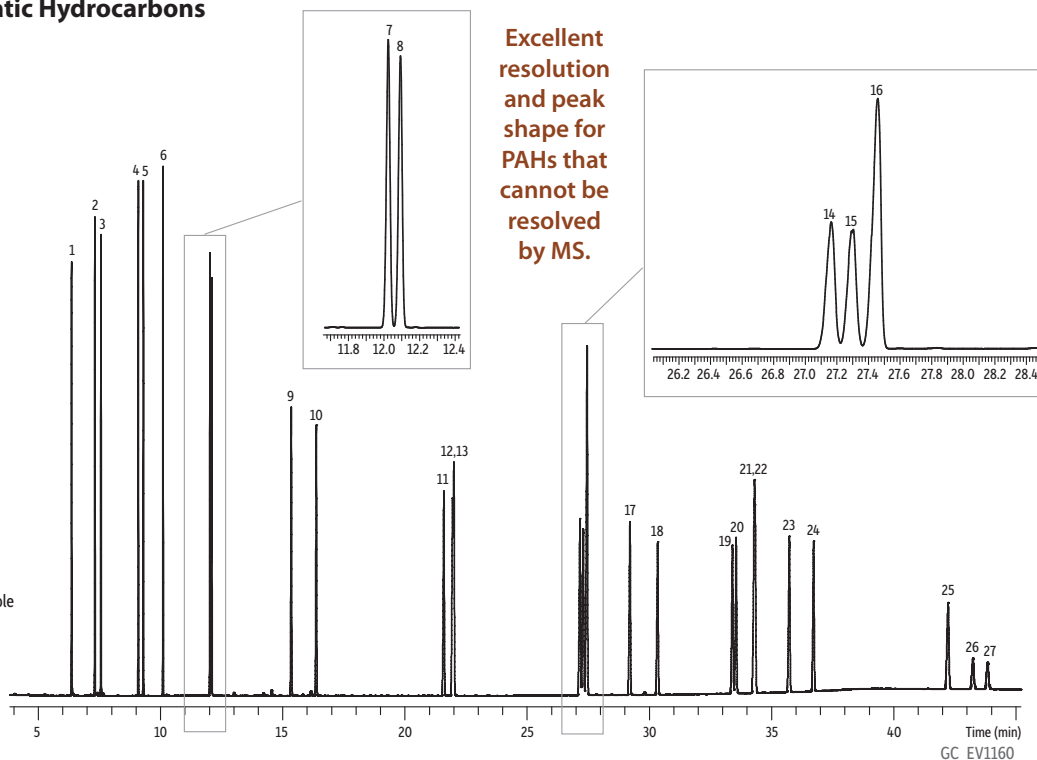
similarp hases

DB-17ms, VF-17ms, CP-Sil 24 CB, ZB-50

Polycyclic Aromatic Hydrocarbons on Rxi®-17Sil MS

Peaks

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)

PAH supplement mix for method 8100 (cat.# 31857)

EPA Method 8310 PAH mixture (cat.# 31841)

Triphenylene (custom)

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

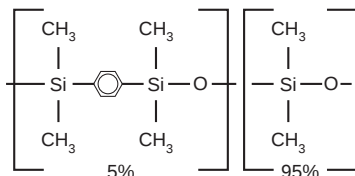
2.0 mL/min

FID @ 320 °C

PE Clarus 600 GC

Instrument provided by PerkinElmer

Rxi®-5Sil MS Structure



Similar to: (5%-phenyl)-methylpolysiloxane

similarp hases

DB-5ms, DB-5msUI, VF-5ms, CP-Sil 8 CB, ZB-5msi, Rtx-5Sil MS

ordering note

Get the protection without the connection!

For Rxi®-5Sil MS columns with built-in Integra-Guard® guard columns, see **page 25**.

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



Semivolatiles Analysis

Rxi®-5Sil MS Columns (fused silica)

(low polarity phase; Crossbond® 1,4-bis(dimethylsiloxy)phenylene dimethyl polysiloxane)

- Engineered to be a low-bleed GC-MS column.
- Excellent inertness for active compounds.
- General-purpose columns—ideal for GC-MS analysis of semivolatiles, 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.

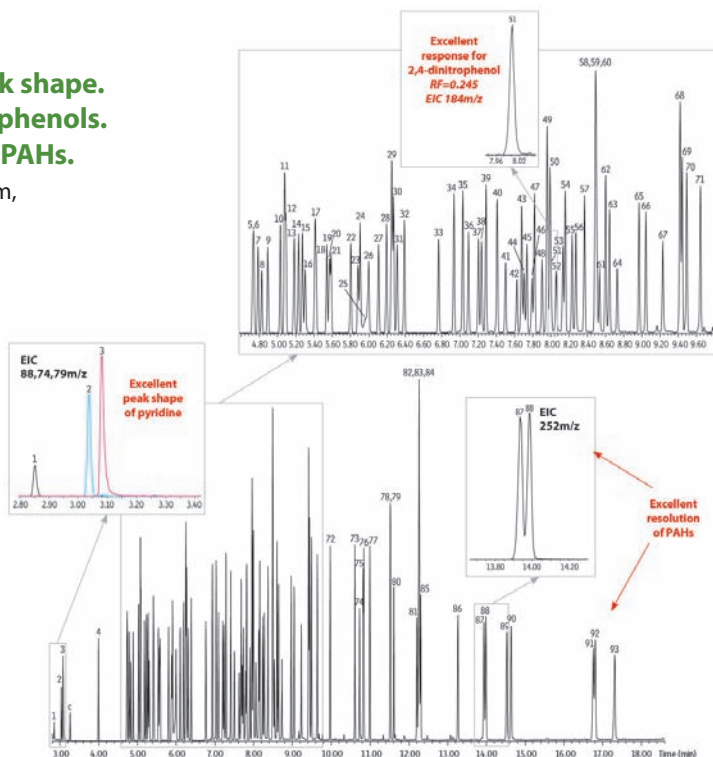
ID	df	temp. limits	15-Meter	30-Meter	60-Meter
0.25 mm	0.10 µm	-60 to 320/350 °C	13605	13608	
	0.25 µm	-60 to 320/350 °C	13620	13623	13626
	0.50 µm	-60 to 320/350 °C	13635	13638	
	1.00 µm	-60 to 320/350 °C	13650	13653	13697
0.32 mm	0.25 µm	-60 to 320/350 °C	13621	13624	
	0.50 µm	-60 to 320/350 °C		13639	
	1.00 µm	-60 to 320/350 °C		13654	
0.53 mm	1.50 µm	-60 to 320/330 °C		13670	

ID	df	temp. limits	10-Meter	20-Meter	40-Meter	60-Meter
0.15 mm	0.15 µm	-60 to 320/350 °C	43815	43816		
	2.0 µm	-60 to 320/350 °C		43817		
0.18 mm	0.10 µm	-60 to 320/350 °C				43607
	0.18 µm	-60 to 320/350 °C		43602	43605	
	0.36 µm	-60 to 320/350 °C		43604		

Semivolatiles by EPA Method 8270 on Rxi®-5Sil MS (30 m, 0.25 mm ID, 0.25 µm) w/Drilled Uniliner® Inlet Liner.

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

For complete chromatogram, see page 33.



GC_EV00943

Volatile Organics Analysis

Rtx®-VMS Columns (fused silica)

(proprietary Crossbond® phase)

- Application-specific columns for volatile organic pollutants by GC-MS.
- Complete separation of U.S. 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 U.S. 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-and-trap transfer line in a system equipped with a jet separator.

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

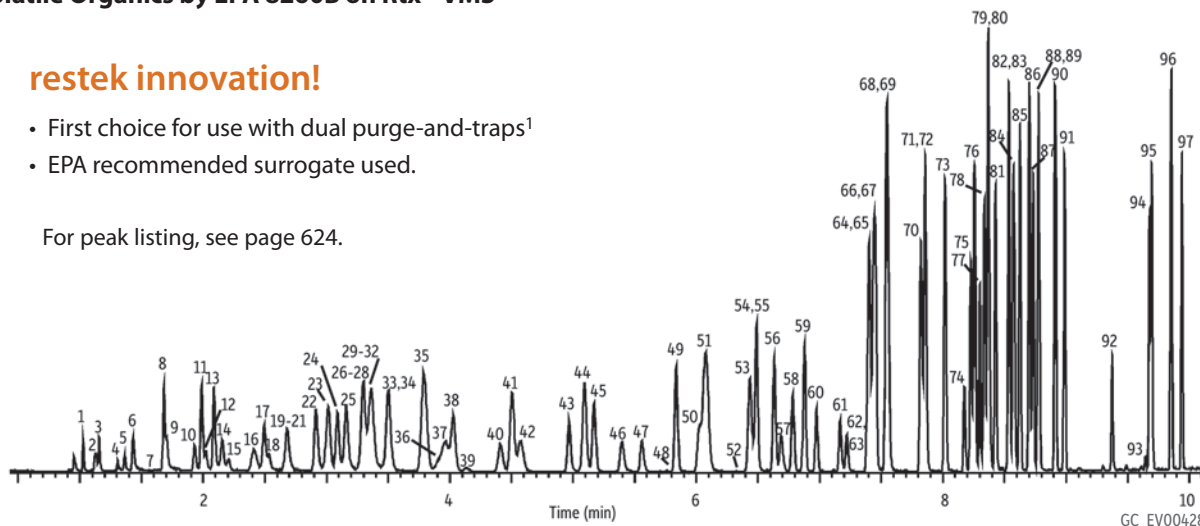
ID	df	temp. limits	20-Meter	40-Meter
0.18 mm	1.00 µm	-40 to 240/260 °C	49914	49915

Volatile Organics by EPA 8260B on Rtx®-VMS

restek innovation!

- First choice for use with dual purge-and-traps¹
- EPA recommended surrogate used.

For peak listing, see page 624.



Column Rtx®-VMS, 20 m, 0.18 mm ID, 1.00 µm (cat.# 49914)
Sample Water
Diluent: 10 ppb in 5 mL RO water (unless noted); ketones 2.5X
Injection Purge and trap split (split ratio 40:1)
Liner: 1 mm split (cat.# 20973)
Inj. Temp.: 220 °C
Purge and Trap
Instrument: Tekmar LCS 3100
Trap Type: Vocab® 3000
Purge: 11 min @ ambient, flow 40 mL/min
Dry Purge: 1 min, flow 40 mL/min
Desorb Preheat
Temp.: 245 °C
Desorb: 2 min @ 250 °C, flow 40 mL/min
Bake: 8 min @ 260 °C
Interface
Connection: Injection port
Transfer Line
Tubing: Silcosteel® treated 0.53 mm ID tubing (cat.# 20595)
Transfer Line
Temp.: 120 °C

Oven
Oven Temp: 50 °C (hold 4 min) to 100 °C at 18 °C/min (hold 0 min) to 230 °C at 40 °C/min (hold 3 min)
Carrier Gas He, constant flow
Flow Rate: 1.0 mL/min
Detector MS
Mode: Scan
Transfer Line
Temp.: 280 °C
Analyzer Type: Quadrupole
Tune Type: BFB
Ionization Mode: EI
Scan Range: 35-300 amu
Instrument HP6890 GC & 5973 MSD
Notes For proper flows, adjust retention time of dichlorodifluoromethane to a retention time of 1.03 min @ 50 °C

¹A.L. Hilling and G. Smith, Environmental Testing & Analysis, 10(3), 15-19, 2001.

similarp hase

DB-VRX

Volatile Organics Analysis

Rtx®-VRX Columns (fused silica)

(proprietary Crossbond® phase)

- Application-specific columns for volatile organic pollutants.
- Excellent for U.S. 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.

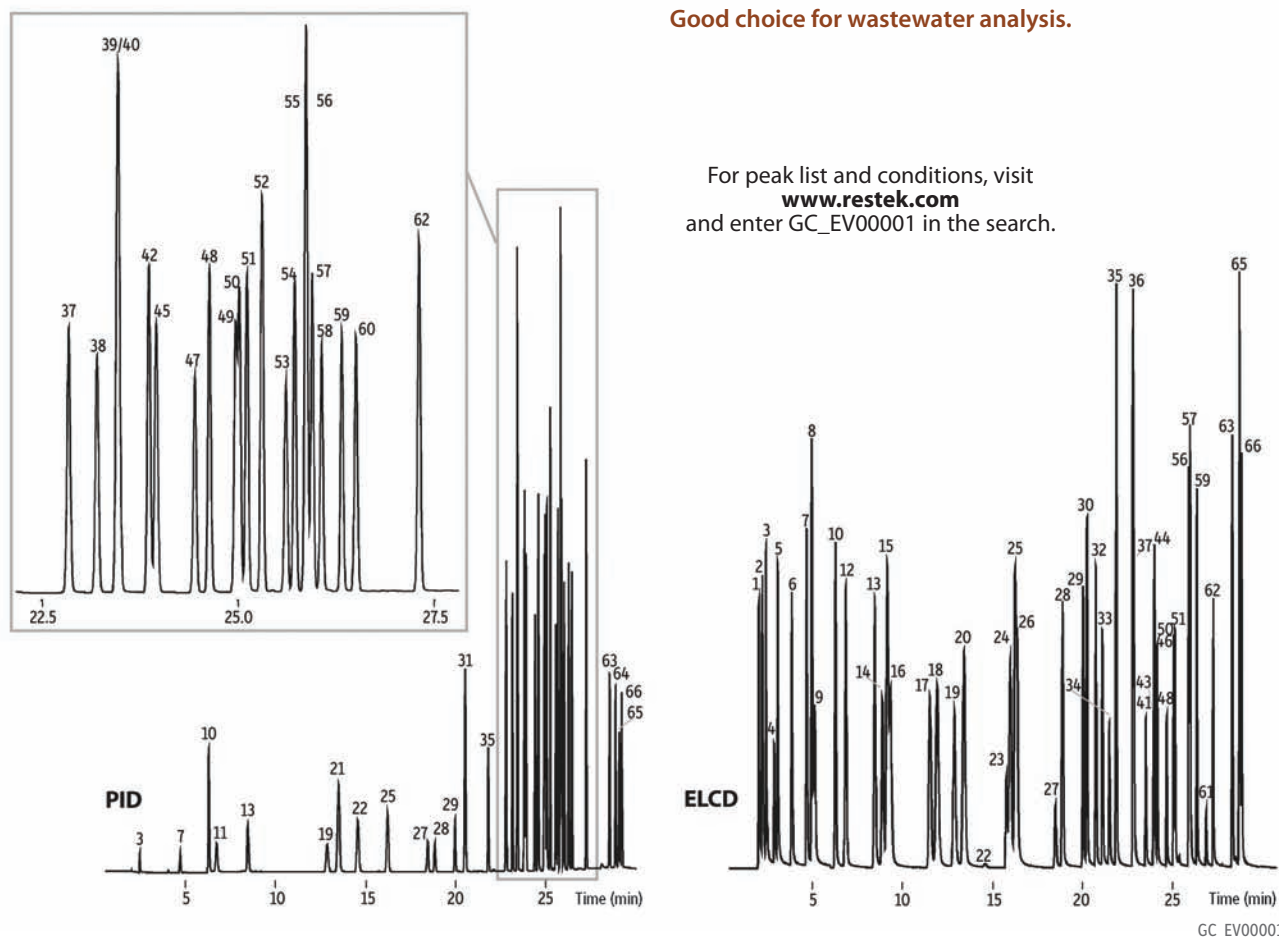
ID	df	temp. limits	30-Meter	60-Meter	75-Meter
0.25 mm	1.40 µm	-40 to 240/260 °C	19315	19316	
0.32 mm	1.80 µm	-40 to 240/260 °C	19319	19320	
0.45 mm	2.55 µm	-40 to 240/260 °C	19308		19309
0.53 mm	3.00 µm	-40 to 240/260 °C	19385	19388	

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

Volatile Organics by EPA 8021 on Rtx®-VRX

Good choice for wastewater analysis.

For peak list and conditions, visit
www.restek.com
and enter GC_EV00001 in the search.



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 U.S. 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 U.S. 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
0.25 mm	1.40 µm	-20 to 250/270 °C	10915	10916		
0.32 mm	1.80 µm	-20 to 250/270 °C	10919	10920		10921
0.45 mm	2.55 µm	-20 to 250/270 °C			10986	
0.53 mm	3.00 µm	-20 to 250/270 °C	10908	10909		10910

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

*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

similar phases

DB-502.2

also available



Metal MXT® Columns

Rugged, flexible, Siltek®-treated stainless steel tubing; inertness comparable to fused silica tubing.

MXT®-502.2 columnspage 97

MXT®-Volatilespage 97

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 U.S. 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
0.25 mm	1.00 µm	-20 to 270/280 °C	10900	10903	
0.32 mm	1.50 µm	-20 to 270/280 °C	10901	10904	
0.53 mm	2.00 µm	-20 to 270/280 °C	10902	10905	10906

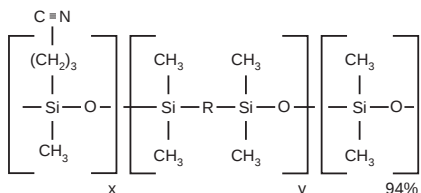
*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

similar phases

VOCOL

Volatile Organics Analysis

Rxi®-624Sil MS Structure



Similar to: (6%-cyanopropylphenyl)-methylpolysiloxane

similarp hases

DB-624, VF-624ms, CP-Select 624 CB,
ZB-624

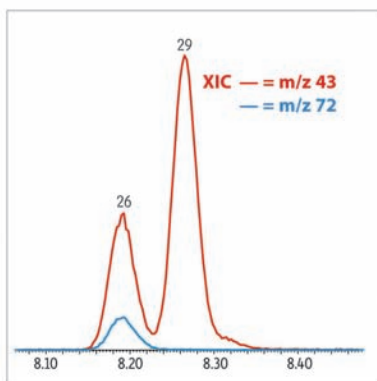
Rxi®-624Sil MS Columns (fused silica)

(midpolarity Crossbond® phase)

- Low-bleed, high-thermal stability column—maximum temperatures up to 320 °C.
- Inert—excellent peak shape for a wide range of compounds.
- Selective—highly selective for volatile organics and 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	75-Meter	105-Meter
0.18 mm	1.00 µm	-20 to 300/320 °C	13865				
0.25 mm	1.40 µm	-20 to 300/320 °C		13868	13869		
0.32 mm	1.80 µm	-20 to 300/320 °C		13870	13872		
0.53 mm	3.00 µm	-20 to 280/300 °C		13871	13873	13874	13875

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



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

Column
Sample

Rxi®-624Sil MS, 30 m, 0.25 mm ID, 1.40 µm (cat.# 13868)
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.:

Injection

Inj. Temp.:

Purge and Trap

Instrument:

Trap Type:

Purge:

Desorb Preheat Temp.:

Desorb:

Bake:

Interface Connection:

Oven

Oven Temp.:

Carrier Gas

Flow Rate:

Detector

Mode:

Transfer Line Temp.:

Analyzer Type:

Source Temp.:

Quad Temp.:

Electron Energy:

Solvent Delay Time:

Tune Type:

Ionization Mode:

Scan Range:

Instrument

25 ppb in RO water
purge and trap split (split ratio 30:1)
225 °C

OI Analytical 4660

10 Trap

11 min @ 20 °C

180 °C

0.5 min @ 190 °C

5 min @ 210 °C

injection port

35 °C (hold 5 min) to 60 °C at 11 °C/min to 220 °C
at 20 °C/min (hold 2 min)

He, constant flow

1.0 mL/min

MS

Scan

230 °C

Quadrupole

230 °C

150 °C

70 eV

1.5 min

BFB

EI

36–260 amu

Agilent 7890A GC

& 5975C MSD

Notes

Other Purge and Trap Conditions:

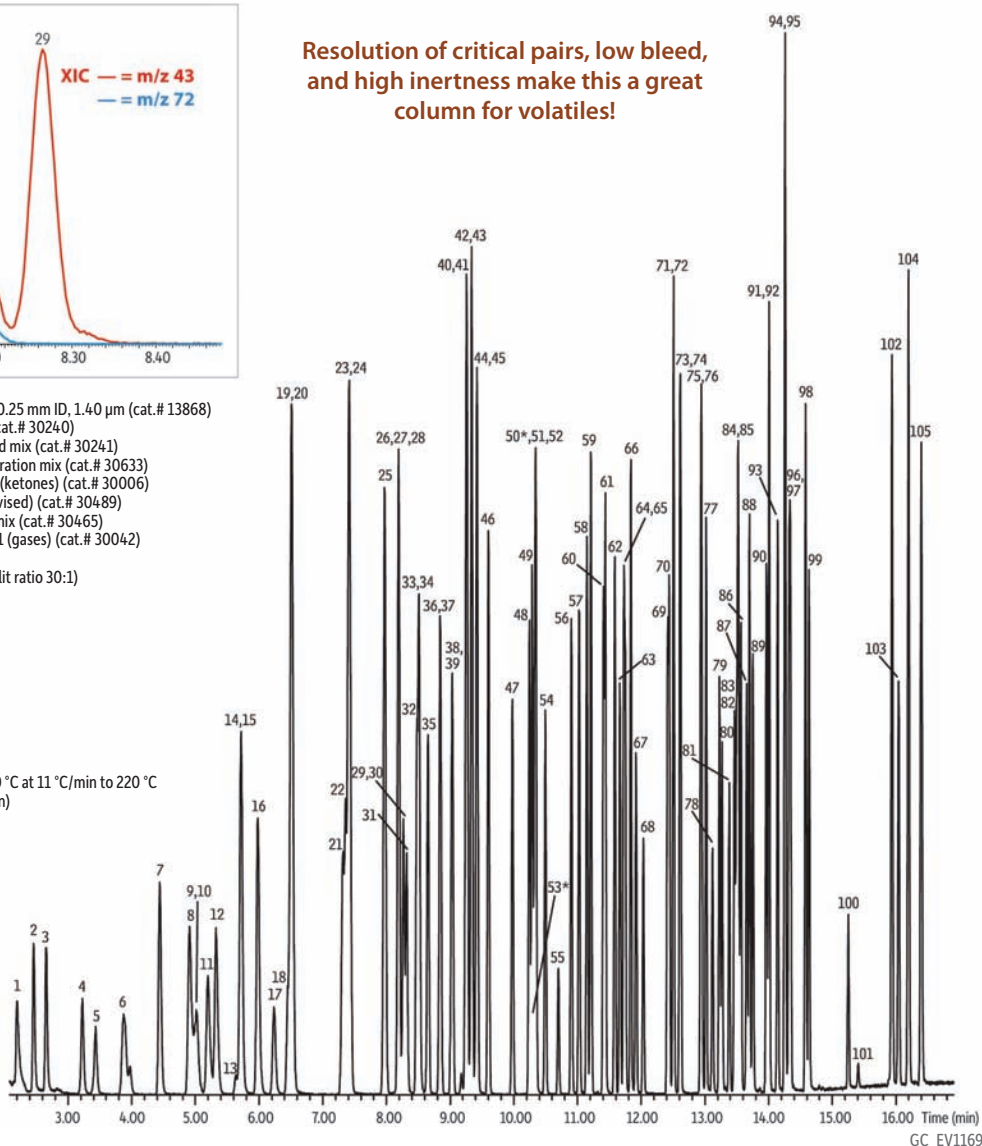
Sample Inlet: 40 °C

Sample: 40 °C

Water Management: Purge 110 °C, Desorb 0 °C, Bake, 240 °C

Eclipse 4660 purge and trap courtesy of O.I. Analytical, College Station, TX.

Acknowledgement



For peak listing, see page 622.

GC_EV1169

FAME Analysis (*cis/trans*)**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
0.25 mm	0.20 µm	20 to 250 °C	13199

similarp hases

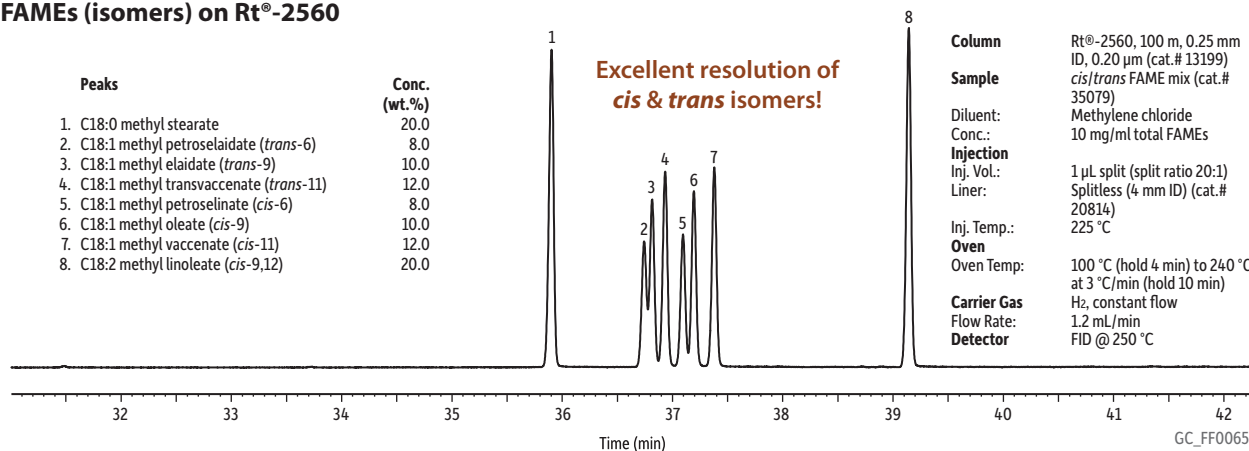
HP-88, CP Sil 88, SPB-2560

FAMEs (isomers) on Rt®-2560**Peaks**

1. C18:0 methyl stearate
2. C18:1 methyl petroselinic acid (*trans*-6)
3. C18:1 methyl elaidic acid (*trans*-9)
4. C18:1 methyl transvaccenic acid (*trans*-11)
5. C18:1 methyl petroselinic acid (*cis*-6)
6. C18:1 methyl oleic acid (*cis*-9)
7. C18:1 methyl vaccenic acid (*cis*-11)
8. C18:2 methyl linoleic acid (*cis*-9,12)

**Conc.
(wt.%)**

- 20.0
- 8.0
- 10.0
- 12.0
- 8.0
- 10.0
- 12.0
- 20.0

**Excellent resolution of
cis & *trans* isomers!**

Column Rt®-2560, 100 m, 0.25 mm ID, 0.20 µm (cat.# 13199)

Sample *cis/trans* FAME mix (cat.# 35079)

Diluent: Methylene chloride

Conc.: 10 mg/ml total FAMES

Injection

Inj. Vol.: 1 µL split (split ratio 20:1)

Liner: Splitless (4 mm ID) (cat.# 20814)

Inj. Temp.: 225 °C

Oven

Oven Temp: 100 °C (hold 4 min) to 240 °C at 3 °C/min (hold 10 min)

Carrier Gas H₂, constant flow

Flow Rate: 1.2 mL/min

Detector FID @ 250 °C

FAME Analysis (Polyunsaturated)

FAMEWAX Columns (USP G16) (fused silica)

(polar phase; Crossbond® polyethylene glycol)

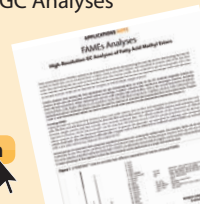
- Application-specific columns for FAMES, specially tested with a FAME mixture.
- Temperature range: 20 °C to 250 °C.

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.

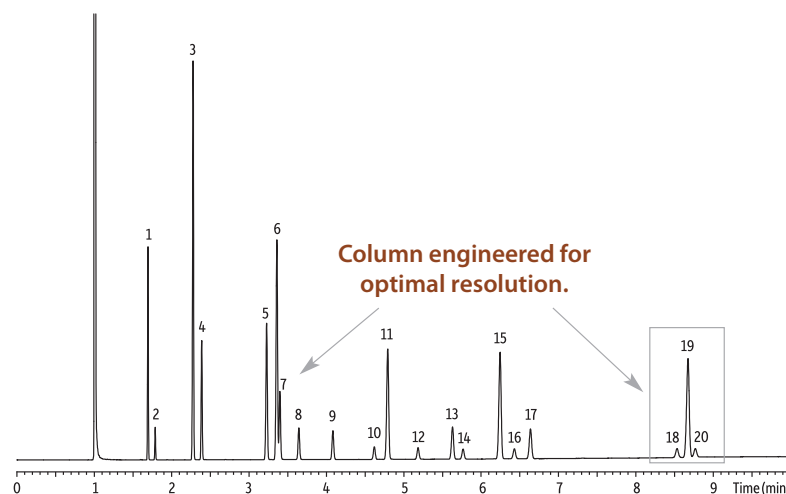
ID	df	temp. limits	30-Meter
0.25 mm	0.25 µm	20 to 240/250 °C	12497
0.32 mm	0.25 µm	20 to 240/250 °C	12498
0.53 mm	0.50 µm	20 to 250 °C	12499

FAMES AnalysesHigh-Resolution GC Analyses
of Fatty Acid
Methyl EstersDownload your
free copy fromwww.restek.com

lit. cat.# 59584B

**similarp hases**

Select FAME, Omegawax

FAMES (Marine Oil Standard) on FAMEWAX

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

Column FAMEWAX, 30 m, 0.32 mm ID, 0.25 µm (cat.# 12498)

Sample Marine oil FAME mix (cat.# 35066)

Diluent: Iooctane

Conc.: 10,000 µg/mL (total FAMES; see breakdown in peak list)

Injection

Inj. Vol.: 1 µL split (split ratio 100:1)

Inj. Temp.: 250 °C

Oven

Oven Temp: 195 °C to 240 °C at 5 °C/min (hold 1 min)

Carrier Gas H₂, constant flow

Flow Rate: 3 mL/min

Detector FID @ 275 °C

GC_FF00499



PAHs in Food Analysis

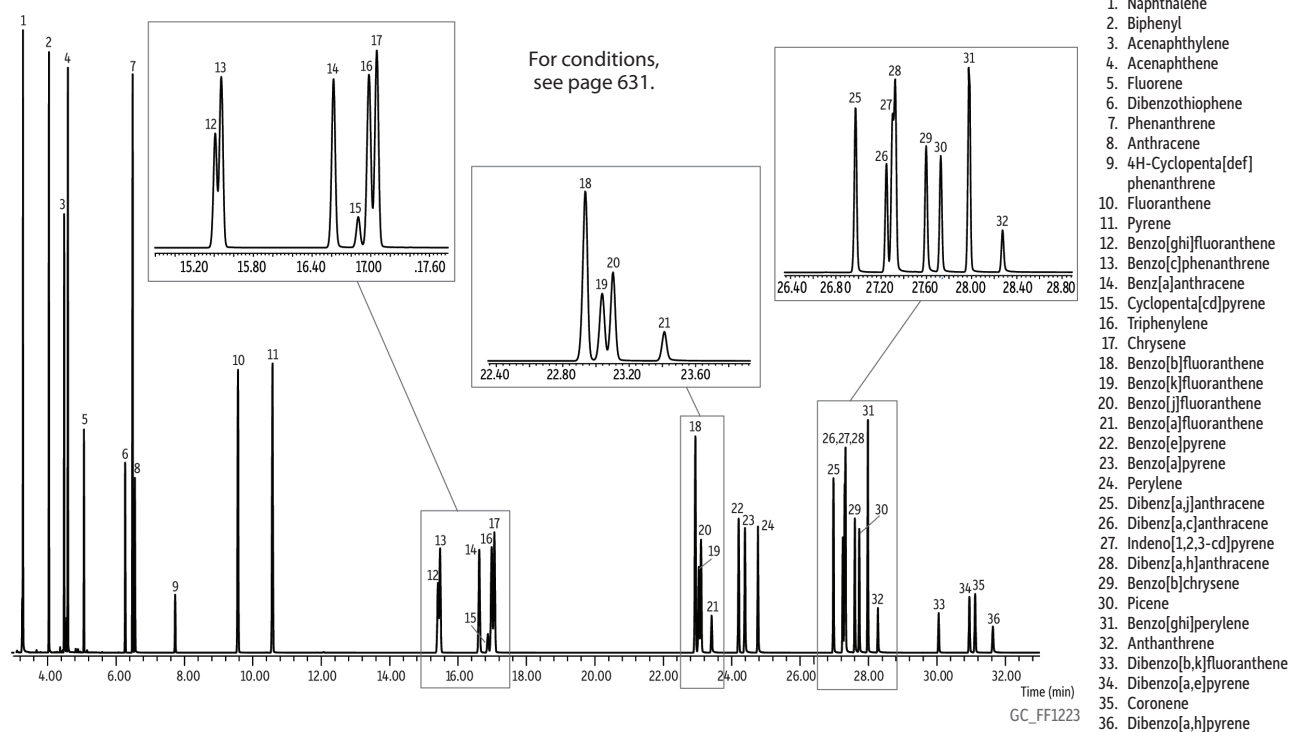
Rxi®-PAH Columns (fused silica)

- Ideal for EFSA PAH4 analysis—separates all priority compounds: benz[a]anthracene, chrysene, benzo[b]fluoranthene, and benzo[a]pyrene.
- Best resolution of chrysene from interfering PAHs, triphenylene and cyclopenta[cd]pyrene.
- Complete separation of benzo [b], [k], [j], and [a] fluoranthenes.
- 360 °C thermal stability allows analysis of low volatility dibenzo pyrenes.

The Rxi®-PAH GC columns were designed by Restek with a higher phenyl-content stationary phase that provides unique selectivity to separate important polycyclic aromatic hydrocarbons (PAH) for food safety that cannot be distinguished by mass spectrometry. Even difficult priority compounds, such as the European Food Safety Authority (EFSA) PAH4, are easily separated and accurately quantified, results that cannot be achieved on typical GC columns. Arylene modification and surface bonding of the stationary phase increase thermal stability and ruggedness so relatively non-volatile, higher molecular weight PAHs can be analyzed routinely without interference from column bleed. Excellent column efficiency means that the column can be trimmed for maintenance purposes many times without losing critical PAH separations, including those that are part of environmental methods, as well as food safety testing. The selectivity and efficiency of the Rxi®-PAH column make it ideal for EFSA PAH4 analysis; chrysene/triphenylene separation and resolution of all benzofluoranthenes are easily achieved.

ID	df	temp. limits	30-Meter	40-Meter	60-Meter
0.18 mm	0.07 µm	to 360 °C		49316	
0.25 mm	0.10 µm	to 360 °C	49318		49317

NIST SRM 2260a PAH Mix on Rxi®-PAH



Pesticides in Food Residues Analysis

Rxi®-5Sil MS Columns (fused silica)

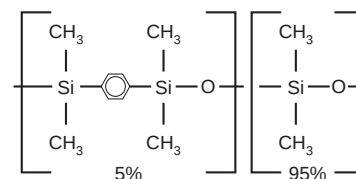
(low polarity phase; Crossbond® 1,4-bis(dimethylsiloxy)phenylene dimethyl polysiloxane)

- Engineered to be a low-bleed GC-MS column.
- Excellent inertness for active compounds.
- General-purpose columns—ideal for GC-MS analysis of semivolatiles, 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
0.25 mm	0.10 µm	-60 to 320/350 °C	13605	13608	
	0.25 µm	-60 to 320/350 °C	13620	13623	13626
	0.50 µm	-60 to 320/350 °C	13635	13638	
	1.00 µm	-60 to 320/350 °C	13650	13653	13697
0.32 mm	0.25 µm	-60 to 320/350 °C	13621	13624	
	0.50 µm	-60 to 320/350 °C		13639	
	1.00 µm	-60 to 320/350 °C		13654	
0.53 mm	1.50 µm	-60 to 320/330 °C		13670	

ID	df	temp. limits	10-Meter	20-Meter	40-Meter	60-Meter
0.15 mm	0.15 µm	-60 to 320/350 °C	43815	43816		
	2.0 µm	-60 to 320/350 °C		43817		
0.18 mm	0.10 µm	-60 to 320/350 °C				43607
	0.18 µm	-60 to 320/350 °C		43602	43605	
	0.36 µm	-60 to 320/350 °C		43604		

Rxi®-5Sil MS Structure

Similar to: (5%-phenyl)-methylpolysiloxane

similar phases

DB-5ms, DB-5msUI, VF-5ms, CP-Sil 8 CB, ZB-5msi, Rtx-5Sil MS

Chlorinated Pesticide Residues in Olive Oil on Rxi®-5Sil MS

Column Rxi®-5Sil MS 30 m, 0.25 mm ID, 0.25 µm (cat.# 13623)
Sample Olive oil spiked with organochlorine pesticide mix AB # 3 (cat.# 324-15)
Conc.: 10 µg/mL

Injection
Inj. Vol.: 1 µL splitless (hold 0.5 min)
Liner: Single taper w/wool (cat.# 22286-200.1)
Inj. Temp.: 225 °C

Oven
Oven Temp.: 130 °C (hold 0.5 min) to 330 °C at 5 °C/min

Carrier Gas
Flow Rate: He, constant flow
 1 mL/min

Detector
Mode: MS
Transfer Line

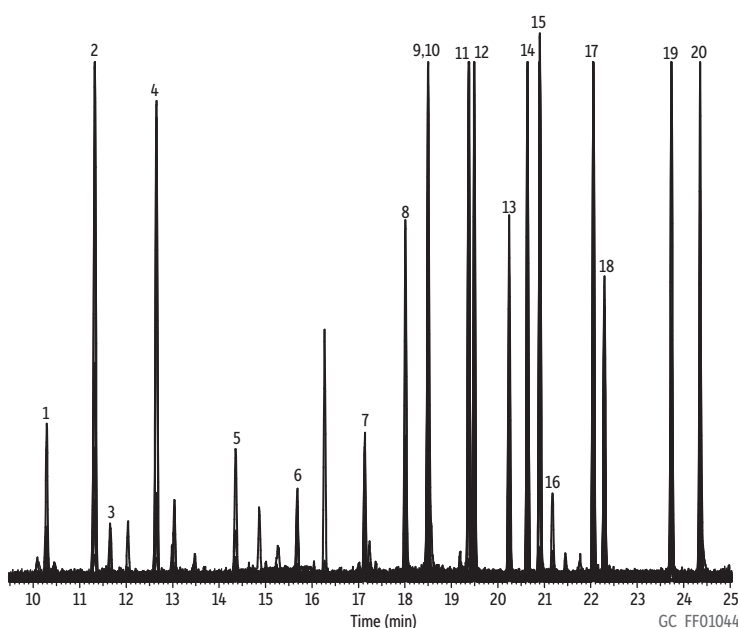
Temp.: 320 °C

Ionization Mode: EI

Notes *Extraction and dSPE Cleanup for Pesticide Residues in Olive Oil*

Test sample: A 1.5 mL sample of commercially obtained virgin olive oil was spiked with a standard organochlorine pesticide mix. The spiked sample was processed as follows.

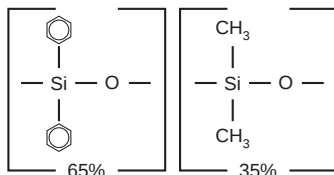
- Dilute with 1.5 mL hexane.
- Add 6 mL of acetonitrile (ACN).
- Mix for 30 minutes on a shaker.
- Allow layers to separate (approximately 20 minutes), then collect the top (ACN) layer.
- Repeat the liquid-liquid extraction (steps 2-4) and combine both ACN extract layers.
- Place 1 mL of the combined ACN extract in a 1.5 mL tube containing 150 mg magnesium sulfate and 50 mg PSA.
- Shake the tube for 2 minutes.
- Centrifuge at 3,000 U/min for approximately 5 minutes.
- Remove the top layer and inject directly into the gas chromatograph system.



For peak list, visit www.restek.com and enter GC_FF01044 in the search

Triglycerides in Foods Analysis

Rtx®-65TG Structure



Similar to: (65%-phenyl)-methylpolysiloxane

Rtx®-65TG Columns (fused silica)

(high polarity phase; Crossbond® diphenyl 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
0.25 mm	0.10 µm	40 to 370 °C	17005	17008
0.32 mm	0.10 µm	40 to 370 °C	17006	17009
0.53 mm	0.10 µm	40 to 370 °C	17007	17010

crossbond® technology

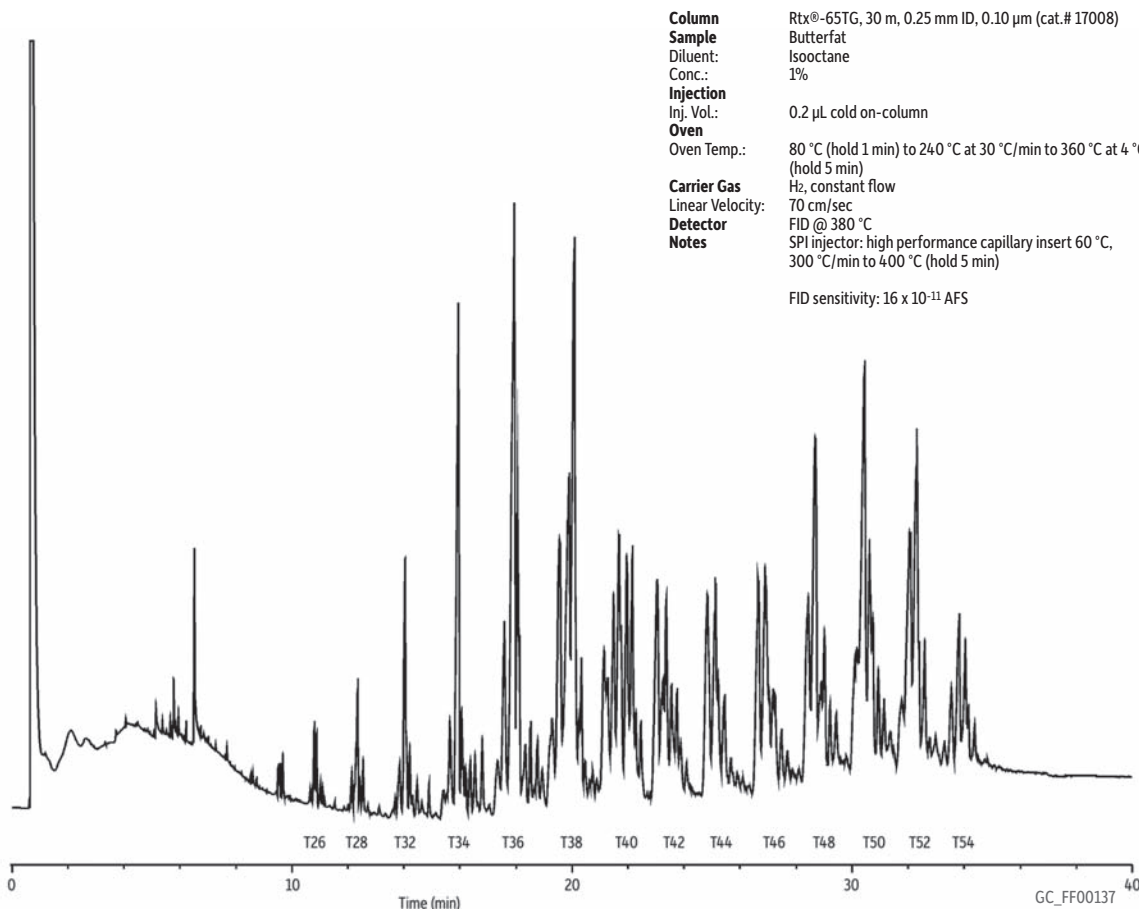
Reduces bleed, prolongs column lifetime, and allows rejuvenation through solvent rinsing.

please note

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

- Vu2 Union® connectors (see page 210)
- MXT®-Union connector kits for fused silica (see page 212)

Butter Triglycerides on Rtx®-65TG



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 1,100 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.

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

similar phases

SPB-TCEP, CP-TCEP

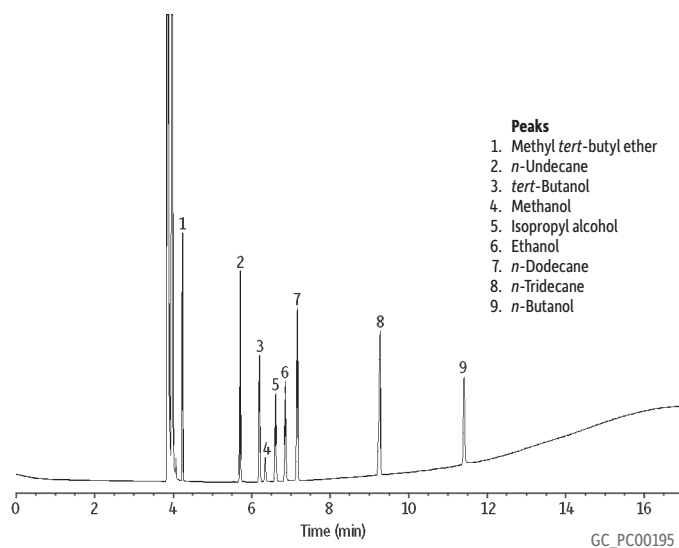
free literature

Analyzing Oxygenates in Gasoline Using TCEP and Rt®-1/MXT®-1 Columns

Download your free copy from

www.restek.com

lit. cat.# 59587A

**Petroleum Oxygenates on Rt®-TCEP**

Column Rt®-TCEP, 60 m, 0.25 mm ID, 0.40 µm (cat.# 10999)
Sample
Conc.: 500 ppm
Injection
Inj. Vol.: 1.0 µL split
Inj. Temp.: 200 °C
Split Vent
Flow Rate: 46 mL/min
Oven
Oven Temp: 60 °C (hold 5 min) to 100 °C at 5 °C/min (hold 10 min)
Carrier Gas He, constant pressure
Linear Velocity: 30 cm/sec @ 80 °C
Detector FID @ 200 °C
Notes FID sensitivity: 6.4 x 10⁻¹¹ AFS

save money!

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

Biodiesel Fuels Analysis

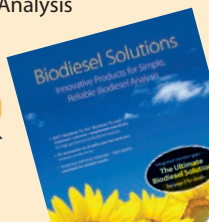
free literature

Biodiesel Solutions
Innovative Products for Simple,
Reliable Biodiesel Analysis

Download your
free copy from

www.restek.com

lit. cat.#
PCFL1409-UNV

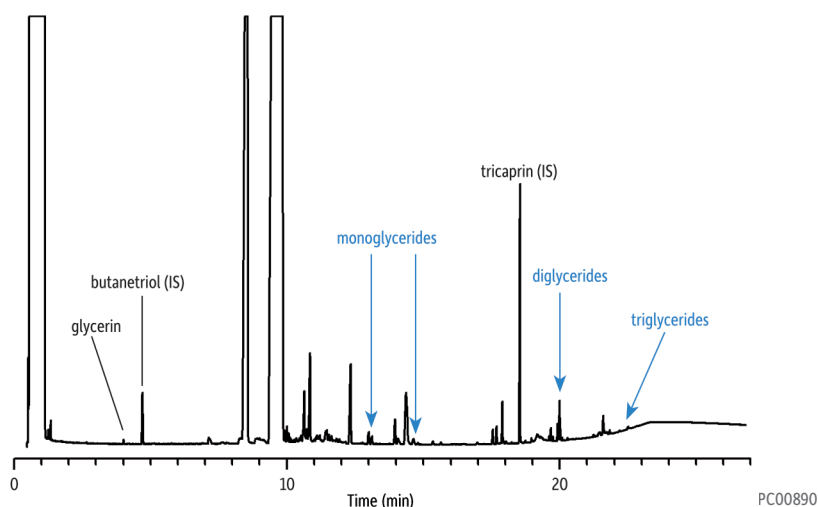


Rtx®-Biodiesel TG Columns (fused silica)

- Linearity for all reference compounds exceeds method requirements.
- Columns with retention gaps feature Alumaseal® connectors to prevent leaks and extend column life.
- Low column bleed at high temperatures.
- For glycerin and glycerides analysis, according to ASTM D6584 and EN 14105 methods.

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

Glycerin in Biodiesel on Rtx®-Biodiesel TG



Column Rtx®-Biodiesel TG, 10 m, 0.32 mm ID, 0.10 µm
using Hydroguard® tubing 2 m, 0.53 mm ID,
with Alumaseal® connector (cat.# 10291)

Sample Injection Biodiesel (B100) plus monoolein, diolein, triolein, glycerin, butanetriol, tricaprin

Inj. Vol.: 1.0 µL cold on-column

Temp. Program: oven track

Oven

Oven Temp.: 50 °C (hold 1 min) to 180 °C at 15 °C/min (hold 7 min) to 230 °C at 30 °C/min to 380 °C at 30 °C/min (hold 5 min)

Carrier Gas H₂, constant flow

Flow Rate: 4 mL/min

Detector FID @ 380 °C

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
0.20 mm	0.50 µm	-60 to 300/340 °C	10147		
0.25 mm	0.50 µm	-60 to 300/340 °C		10148	
	1.00 µm	-60 to 280/340 °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
0.25 mm	1.00 µm	-60 to 325/350 °C	10165

similar phases

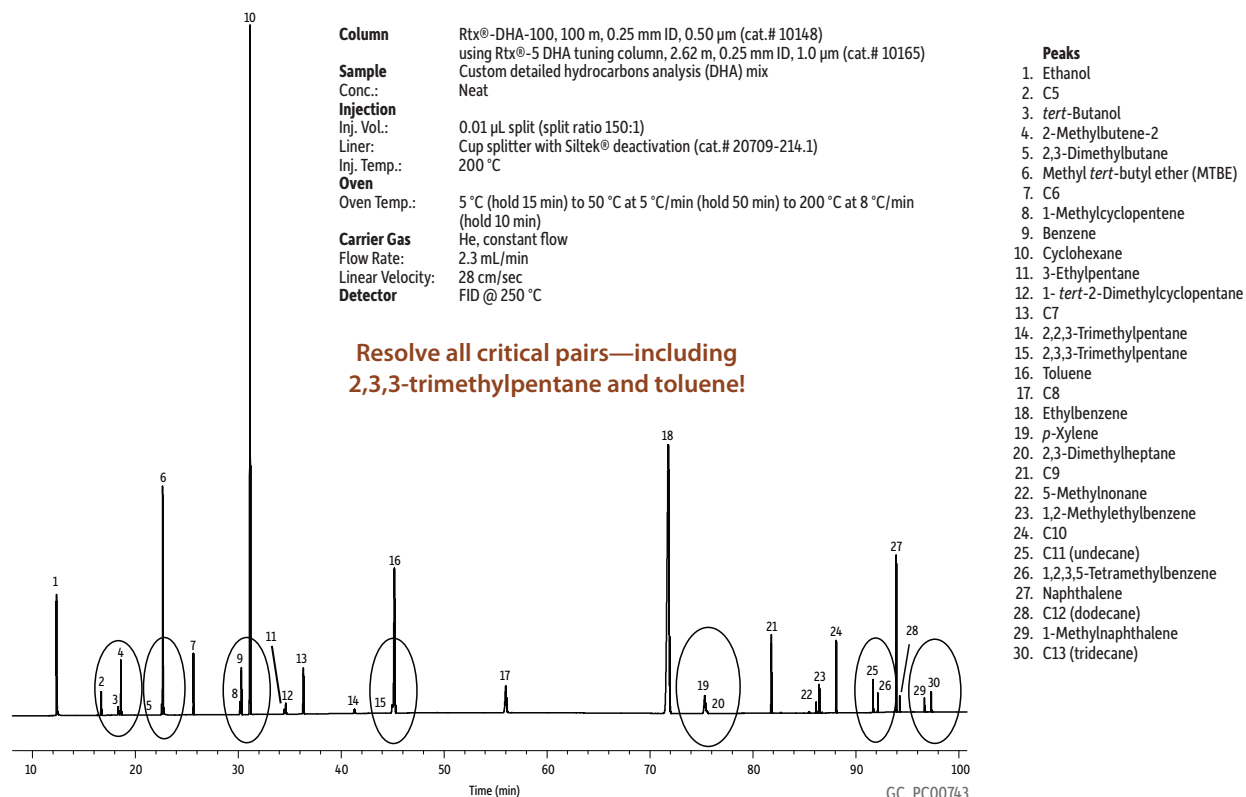
HP-PONA, DB-Petro, CP-Sil PONA C8, Petrocol DH

Method Recommended

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

did you know?

Using hydrogen instead of helium can cut analysis time in half! Visit www.restek.com to learn more.

Detailed Hydrocarbons Analysis on Rtx®-DHA-100

similarp hases

Select Mineral Oil

Fused Silica, PLOT, & MXT® Capillary GC Column Ferrule Guide

GC Column ID	Ferrule ID
0.10 mm	0.4
0.15 mm	0.4
0.18 mm	0.4
0.25 mm	0.4
0.28 mm	0.4
0.32 mm	0.5
0.45 mm	0.8
0.53 mm	0.8

Mineral Oils/Extractable Petroleum Hydrocarbon Analysis

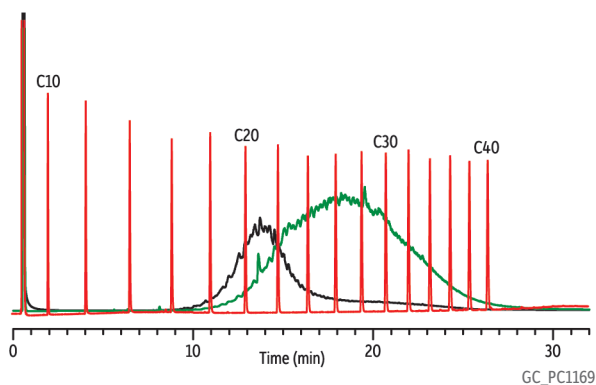
Rtx®-Mineral Oil Columns (fused silica)

- 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 volumes are used. Compared with common industry solutions, the unique surface bonding of the Rtx®-Mineral Oil column ensures long column lifetime, even at higher temperatures. These unique columns can be used at temperatures ranging from 380 °C (isothermal) to 400 °C (programmable), and each column is tested individually for bleed to ensure exceptional performance at these extreme conditions.

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

Mineral Oil and Motor Oil on Rtx®-Mineral Oil



Column Rtx®-Mineral Oil, 15 m, 0.32 mm ID, 0.15 µm (cat.# 18074)
using IP deactivated guard column 2 m, 0.53 mm ID (cat.# 10047)

Sample Custom mineral oil/motor oil mix

Diluent: Hexane

Conc.: 500 µg/mL

Injection

Inj. Vol.: 0.5 µL cold on-column

Temp. Program: 53 °C to 300 °C at 10 °C/min (hold 20 min)

Oven

Oven Temp: 50 °C to 300 °C at 10 °C/min (hold 20 min)

Carrier Gas H₂, constant flow

Linear Velocity: 40 cm/sec @ 50 °C

Dead Time: 0.625 min @ 50 °C

Detector FID @ 330 °C

Make-up Gas

Flow Rate: 30 mL/min

Make-up Gas Type: N₂

Data Rate: 20 Hz

Instrument Agilent/HP6890 GC

Notes Black trace = mineral oil
Green trace = motor oil
Red trace = C10-C40 standard

Simulated Distillation Analysis (C5-C44)

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 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
0.53 mm	2.65 µm	-60 to 360 °C	10199

similar phases

DB-2887, Petrocol 2887, Petrocol EX2887

also available**Rtx®-1 SimDist 2887**

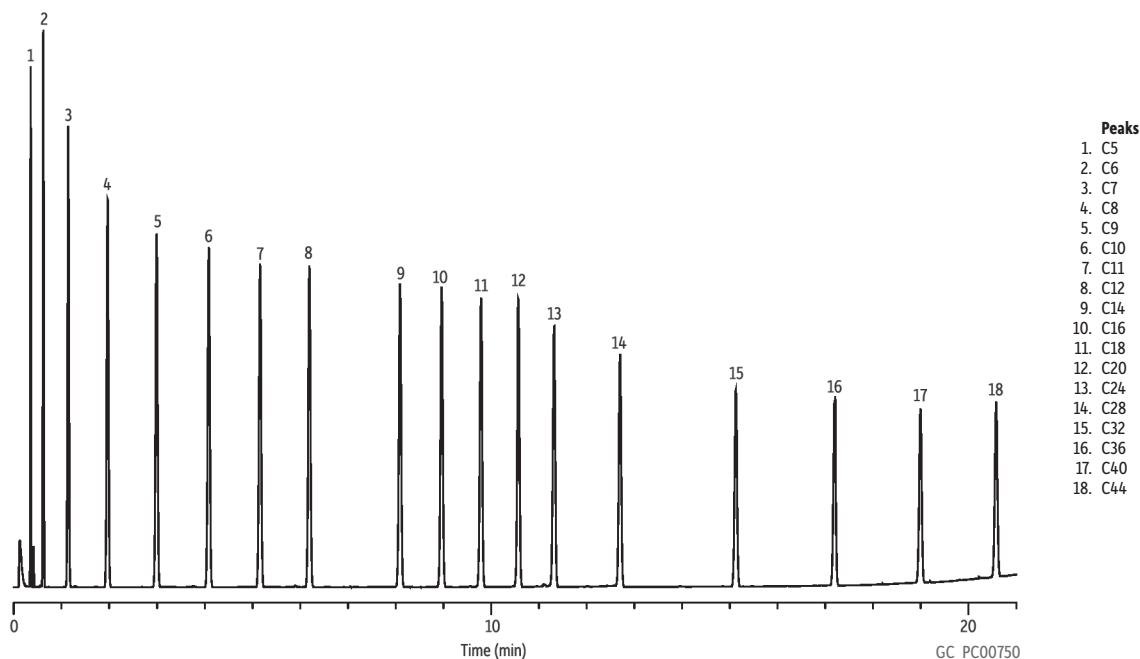
A packed column for process instrumentation.

See **page 118**.**free literature****Rtx®-2887/MXT®-2887**

Restek's Capillary GC Columns for Simulated Distillation of Petroleum Fractions

Download your free copy from www.restek.com

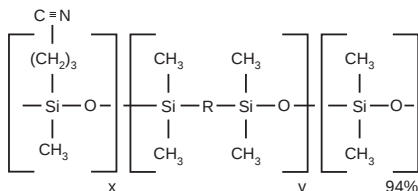
lit. cat.# 59567B

**also available**For more simulated distillation products, see **pages 100–101**.**Simulated Distillation (C5-C44) on Rtx®-2887**

Column Rtx®-2887, 10 m, 0.53 mm ID, 2.65 µm (cat.# 10199)
Sample C5 to C44 hydrocarbon standard
Diluent: Carbon disulfide
Conc.: 0.01–0.1 wt. %
Injection
Inj. Vol.: 1 µL direct
Inj. Temp.: 360 °C
Oven
Oven Temp: 35 °C to 360 °C at 15 °C/min (hold 5 min)
Carrier Gas He, constant flow
Flow Rate: 15 mL/min
Linear Velocity: 112 cm/sec
Detector FID @ 360 °C

Organic Volatile Impurities (OVI) Analysis

Rxi®-624Sil MS Structure



similarp hases

DB-624, VF-624ms, CP-Select 624 CB, ZB-624

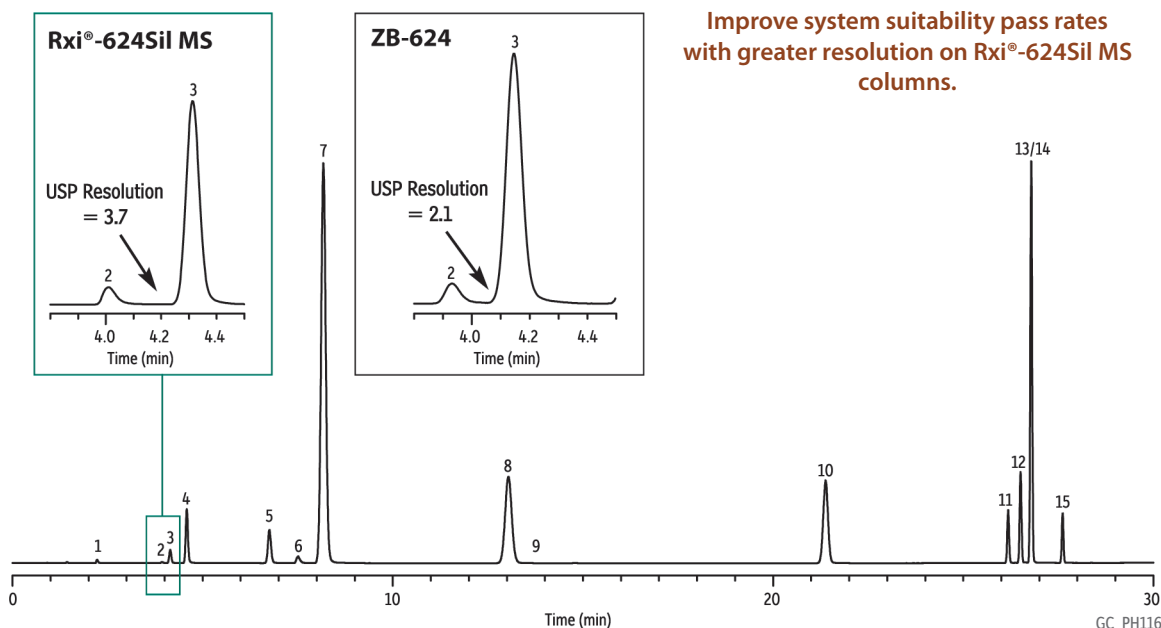
Rxi®-624Sil MS Columns (fused silica)

(midpolarity Crossbond® phase)

- Low-bleed, high-thermal stability column—maximum temperatures up to 320 °C.
- Inert—excellent peak shape for a wide range of compounds.
- Selective—highly selective for volatile organics and 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	75-Meter	105-Meter
0.18 mm	1.00 µm	-20 to 300/320 °C	13865				
0.25 mm	1.40 µm	-20 to 300/320 °C		13868	13869		
0.32 mm	1.80 µm	-20 to 300/320 °C		13870	13872		
0.53 mm	3.00 µm	-20 to 280/300 °C		13871	13873	13874	13875

Competitor Comparison: Class 2 - Mix A Residual Solvents for USP <467> Water-Soluble Articles



Column Rxi®-624Sil MS, 30 m, 0.32 mm ID, 1.80 µm (cat.# 13870)
Sample Residual solvents class 2 - mix A (cat.# 36271)
Diluent: Water
Injection Headspace-loop split (split ratio 5:1)
Liner: 1 mm split (cat.# 20972)
Headspace-Loop
Inj. Port Temp.: 140 °C
Instrument: Tekmar HT3
Inj. Time: 1 min
Transfer Line Temp.: 110 °C
Valve Oven Temp.: 110 °C
Sample Temp.: 80 °C
Sample Equil. Time: 60 min
Vial Pressure: 10 psi
Pressurize Time: 0.5 min
Pressure
Equilibration Time: 0.05 min
Loop Pressure: 5 psi
Loop Fill Time: 0.1 min
Oven
Oven Temp.: 40 °C (hold 20 min) to 240 °C at 10 °C/min (hold 20 min)
Carrier Gas He, constant flow
Linear Velocity: 35 cm/sec
Dead Time: 1.45 min @ 40 °C
Detector FID @ 250 °C
Data Rate: 5 Hz
Instrument Agilent/HP6890 GC
Acknowledgement Teledyne Tekmar

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

Organic Volatile Impurities (OVI) Analysis

Stabilwax® Columns (fused silica)

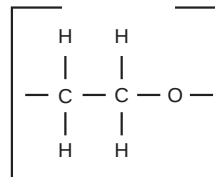
(polar phase; Crossbond® polyethylene glycol)

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

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

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

ID	df	temp. limits	10-Meter	20-Meter
0.15 mm	0.15 µm	40 to 250/260 °C	43830	43831
0.18 mm	0.18 µm	40 to 250 °C		40602

G16 phase**Stabilwax® Structure****similar phases**

HP-INNOWax, CP Wax 52 CB, VF-WAX MS, ZB-WAXplus

ordering note

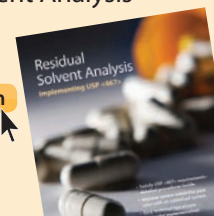
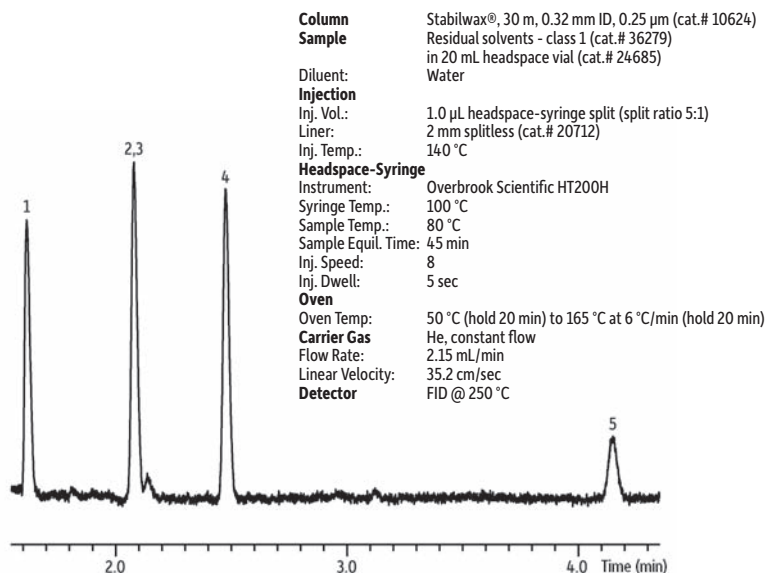
Get the protection without the connection!
For Stabilwax® columns with built-in Integra-Guard® guard columns, see **page 25**.

free literature**Residual Solvent Analysis**

Download your
free copy from

www.restek.com

lit. cat.#
PHFL1018A

**Residual Solvents Class 1 on Stabilwax® (G16)****Peaks**

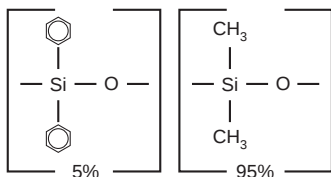
1. 1,1-Dichloroethene
2. 1,1,1-Trichloroethane
3. Carbon tetrachloride
4. Benzene
5. 1,2-Dichloroethane

**SYSTEM
SUITABILITY
CRITERIA
MET**

GC_PH00951

G27 phase

Rtx®-5 Structure



Similar to: (5%-phenyl)-methylpolysiloxane

similar phases

HP-5, DB-5, CP-Sil 8 CB, ZB-5

Organic Volatile Impurities (OVI) Analysis

Rtx®-5 Columns (fused silica)

(low polarity phase; Crossbond® diphenyl 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.

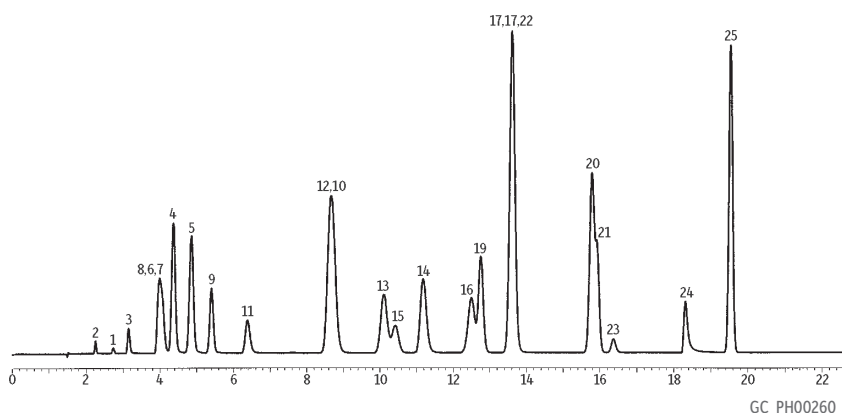
The diphenyl dimethyl polysiloxane stationary phase is the most popular GC stationary phase and is used in a wide variety of applications. All residual catalysts and low molecular weight fragments are removed from the Rtx®-5 polymer, providing a tight mono-modal distribution and extremely low bleed.

ID	df	temp. limits*	15-Meter	30-Meter	60-Meter	105-Meter
0.25 mm	0.10 µm	-60 to 330/350 °C	10205	10208	10211	
	0.25 µm	-60 to 330/350 °C	10220	10223	10226	10229
	0.50 µm	-60 to 330/350 °C	10235	10238	10241	10244
	1.00 µm	-60 to 325/340 °C	10250	10253	10256	10259
0.32 mm	0.10 µm	-60 to 330/350 °C	10206	10209	10212	
	0.25 µm	-60 to 330/350 °C	10221	10224	10227	
	0.50 µm	-60 to 330/350 °C	10236	10239	10242	
	1.00 µm	-60 to 325/340 °C	10251	10254	10257	10260
	1.50 µm	-60 to 310/330 °C	10266	10269	10272	10275
	3.00 µm	-60 to 280/300 °C	10281	10284	10287	10290
0.53 mm	0.10 µm	-60 to 320/340 °C	10207	10210		
	0.25 µm	-60 to 320/340 °C	10222	10225	10228	
	0.50 µm	-60 to 320/330 °C	10237	10240	10243	
	1.00 µm	-60 to 320/330 °C	10252	10255	10258	
	1.50 µm	-60 to 310/330 °C	10267	10270	10273	
	3.00 µm	-60 to 270/290 °C	10282	10285	10288	
	5.00 µm	-60 to 270/290 °C	10277	10279	10283	

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

*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

Organic Volatile Impurities on Rtx®-5 (Rtx®-G27)



Peaks

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

Column Rtx®-5 w/5m Integra-Guard® Column (Rtx®-G27), 30 m, 0.53 mm ID, 5.00 µm (cat.# 10279-126)
Sample Headspace injection of common solvents for pharmaceutical processing. Prepared to equal about 500 ppm in the bulk pharmaceutical. Samples shaken and heated at 90 °C for 15 minutes, 1 mL headspace injection.

Injection
 Inj. Vol.: 1.000 µL headspace-syringe split (split ratio 2:1)
 Inj. Temp.: 220 °C

Oven
 Oven Temp: 35 °C (hold 10 min) to 100 °C at 5 °C/min to 240 °C at 25 °C/min (hold 5 min)

Carrier Gas
 He, constant pressure

Linear Velocity: 35 cm/sec @ 35 °C

Detector
 FID @ 240 °C

Notes
 FID sensitivity: 1.05 x 10⁻¹¹ AFS

Organic Volatile Impurities (OVI) Analysis

Rtx®-G27 Column (fused silica with 5-meter Integra-Guard® guard column)
(Crossbond® diphenyl 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
0.53 mm	5.00 µm	-60 to 270/290 °C	10279-126

Rtx®-G43 Column (fused silica with 5-meter Integra-Guard® guard column)
(Crossbond® cyanopropylphenyl 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
0.53 mm	3.00 µm	-20 to 240 °C	16085-126

USP

Pharmaceutical
Standards

See pages 551–552.



free literature

A Technical Guide for
Static Headspace
Analysis
Using GC

lit. cat.#
59895A



Custom Residual
Solvents
Mixes

lit. cat.#
PHTS1212



Download your free copies from

www.restek.com

Get More Choices
in Headspace Vials

- Diverse closures
- Quality septa materials
- Wide range of vial sizes and styles

www.restek.com/vials



similar phases

HP-FFAP, DB-FFAP, VF-DA, CP WAX58,
NUKOL, ZB-FFAP

crossbond® technology

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

please note

Stabilwax®-DA columns should not be rinsed
with water.

Acidic Compounds Analysis

Stabilwax®-DA Columns (fused silica)

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

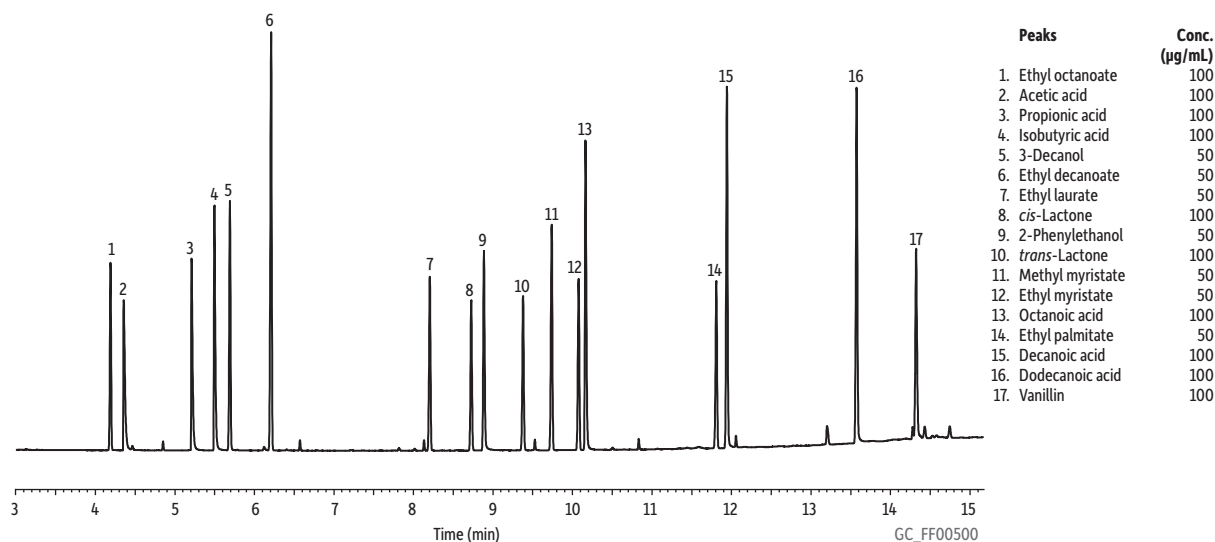
- Application-specific columns for free (underivatized) acids, some inorganic acids.
- Resistant to oxidative damage.
- Temperature range: 40 °C to 260 °C.
- Equivalent to USP G25, G35 phases.

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.

ID	df	temp. limits	15-Meter	30-Meter	60-Meter
0.25 mm	0.10 µm	40 to 250/260 °C	11005	11008	
	0.25 µm	40 to 250/260 °C	11020	11023	11026
	0.50 µm	40 to 250/260 °C	11035	11038	11041
0.32 mm	0.10 µm	40 to 250/260 °C		11009	
	0.25 µm	40 to 250/260 °C	11021	11024	11027
	0.50 µm	40 to 250/260 °C	11036	11039	11042
	1.00 µm	40 to 240/250 °C	11051	11054	11057
0.53 mm	0.10 µm	40 to 250/260 °C	11007		
	0.25 µm	40 to 250/260 °C	11022	11025	11028
	0.50 µm	40 to 250/260 °C	11037	11040	11043
	1.00 µm	40 to 240/250 °C	11052	11055	11058
	1.50 µm	40 to 230/240 °C	11062	11065	11068

Underivatized Alcoholic Beverage Acids and Methyl Esters on Stabilwax®-DA



Column Stabilwax®-DA, 30 m, 0.18 mm ID, 0.18 µm (cat.# 550752)
Sample Ethyl acetate
Diluent:
Injection 1 µL splitless (hold 0.5 min)
Inj. Vol.: Splitless (4 mm ID) w/glass wool (cat.# 20814-202.1)
Liner: 240 °C
Inj. Temp.:
Oven 70 °C to 240 °C at 12 °C/min (hold 3 min)
Oven Temp: H₂, constant linear velocity
Carrier Gas: 28 psi, 193.1 kPa @ 240 °C
Linear Velocity:
Detector FID
Make-up Gas
Type: N₂

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 symmetrical peaks that allow low detection limits. The stable bonded phase yields a column that is not only retentive and highly selective for these compounds, but it 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.

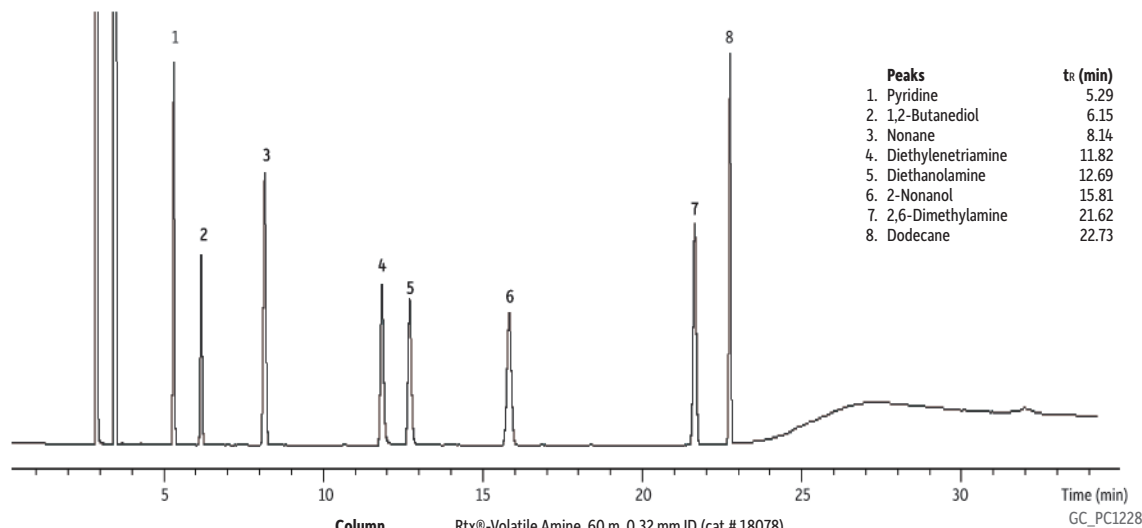
similar phase

CP-Volatile

please note

We recommend using base-deactivated fused silica guard columns (**page 24**) and base-deactivated liners (**page 185**) with Rtx®-Volatile Amine columns.

ID	temp. limits	15-Meter	30-Meter	60-Meter
0.32 mm	-60 to 270/290 °C	18076	18077	18078

Volatile Amine Test Mix on Rtx®-Volatile Amine (60 m x 0.32 mm ID)

Column Rtx®-Volatile Amine, 60 m, 0.32 mm ID (cat.# 18078)
Sample Volatile amine column test mix (cat.# 35008)
Diluent: Methanol:dichloromethane (50:50)
Conc.: 900-1,800 µg/mL snap and shoot
Injection
Inj. Vol.: 1 µL split (split ratio 17.8:1)
Liner: Sky® 4 mm single taper w/wool (cat.# 23303.1)
Inj. Temp.: 250 °C
Split Vent
Flow Rate: 60 mL/min
Oven
Oven Temp.: 160 °C (hold 21 min) to 290 °C at 40 °C/min (hold 10 min)
Carrier Gas He, constant flow
Flow Rate: 3.4 mL/min
Detector FID @ 300 °C
Make-up Gas
Flow Rate: 30 mL/min
Make-up Gas Type: N₂
Data Rate: 50 Hz
Instrument Agilent/HP6890 GC

restek
innovation!

similarp hases

PTA-5, CP-Sil CB

Basic Compounds Analysis

Rtx®-5 Amine Columns (fused silica)

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

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

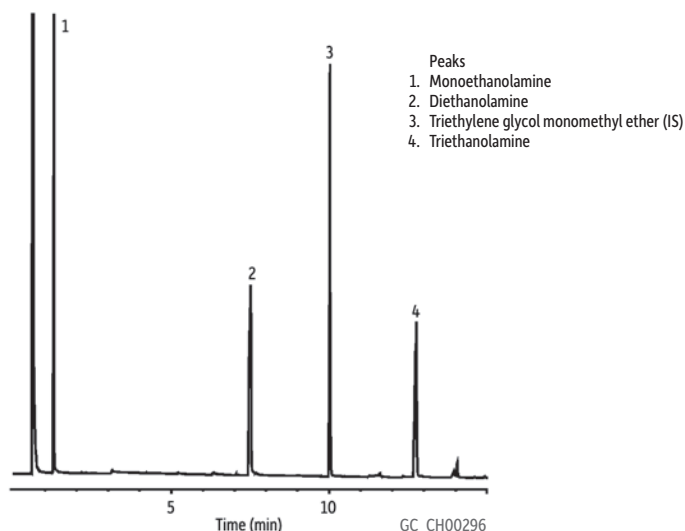
Active basic compounds that otherwise require derivatization, or an alternative analytical technique, can be analyzed on an Rtx®-5 Amine column. The tubing surface is chemically altered to reduce tailing of basic compounds, eliminating the need for column priming. An Rtx®-5 Amine column is ideal for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

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

please note

We recommend using base-deactivated fused silica guard columns (**page 24**) and base-deactivated liners (**page 185**) with Rtx®-5 Amine columns.

Ethanolamines on Rtx®-5 Amine



Column Rtx®-5 Amine, 15 m, 0.25 mm ID, 0.50 µm (cat.# 12335)
Sample Ethanolamine mix
Diluent: Methanol
Conc.: 34 ng on column
Injection
Inj. Vol.: 1.0 µL split (split ratio 58:1)
Inj. Temp.: 280 °C
Oven
Oven Temp: 50 °C (hold 2 min) to 180 °C at 10 °C/min (hold 2 min)
Carrier Gas H₂, constant pressure
Linear Velocity: 43 cm/sec @ 50 °C
Detector FID @ 300 °C
Notes FID sensitivity: 6.4 x 10⁻¹¹ AFS

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 and 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
0.25 mm	0.50 µm	0 to 220 °C	11335	11338
	1.00 µm	0 to 220 °C	11350	11353
0.32 mm	1.00 µm	0 to 220 °C	11351	11354
	1.50 µm	0 to 220 °C	11366	11369
0.53 mm	1.00 µm	0 to 220 °C	11352	11355
	3.00 µm	0 to 220 °C		11385

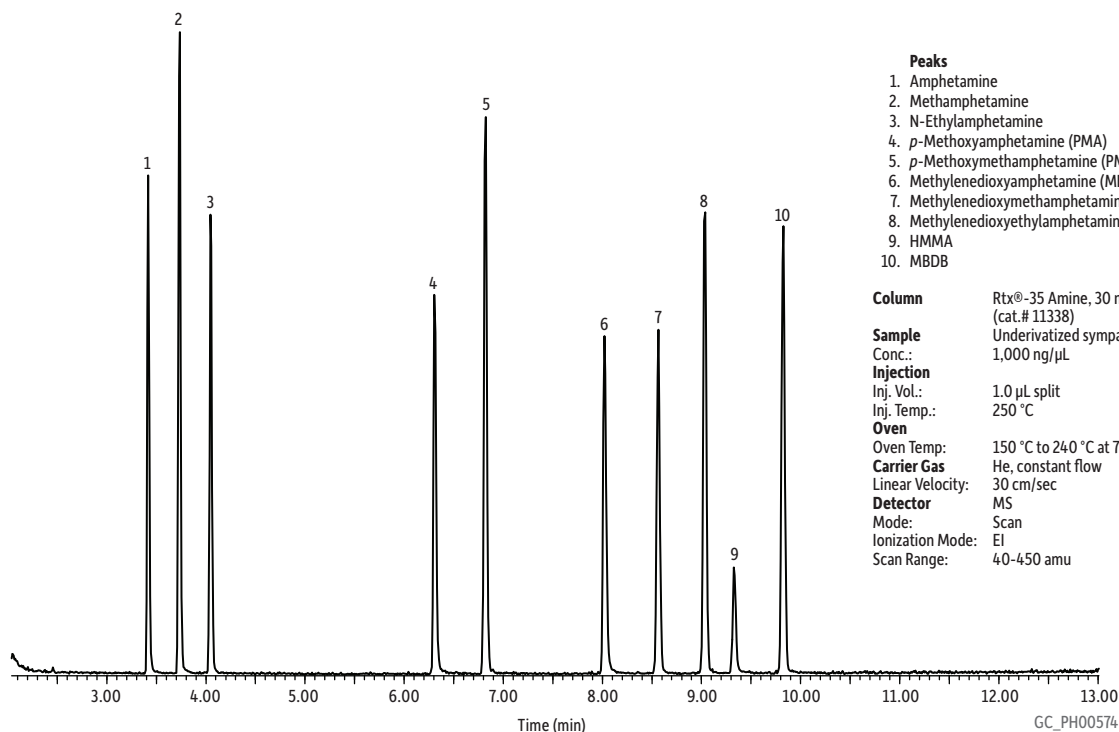
restek
innovation!

please note

We recommend using base-deactivated fused silica guard columns (**page 24**) and base-deactivated liners (**page 185**) with Rtx®-35 Amine columns.

Table of Contents for
GC ChromatogramsSee **page 570**.

Underivatized Sympathomimetic Amines (Basic Drugs) on Rtx®-35 Amine



Peaks

1. Amphetamine
2. Methamphetamine
3. N-Ethylamphetamine
4. *p*-Methoxyamphetamine (PMA)
5. *p*-Methoxymethamphetamine (PMMA)
6. Methylenedioxyamphetamine (MDA)
7. Methylenedioxymethamphetamine (MDMA)
8. Methylenedioxyethylamphetamine (MDEA)
9. HMMA
10. MBDB

Column Rtx®-35 Amine, 30 m, 0.25 mm ID, 0.50 µm (cat.# 11338)
Sample Underivatized sympathomimetic amines
Conc.: 1,000 ng/µL
Injection
 Inj. Vol.: 1.0 µL split
 Inj. Temp.: 250 °C
Oven
 Oven Temp: 150 °C to 240 °C at 7 °C/min
Carrier Gas He, constant flow
 Linear Velocity: 30 cm/sec
Detector MS
 Mode: Scan
 Ionization Mode: EI
 Scan Range: 40-450 amu

similar phases

CAM, CP WAX 51, Carbowax® Amine

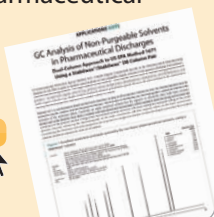
free literature

GC Analysis of Non-Purgeable Solvents in Pharmaceutical Discharges

Download your free copy from

www.restek.com

lit. cat.# 580027



Basic Compounds Analysis

Stabilwax®-DB Columns (fused silica)

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

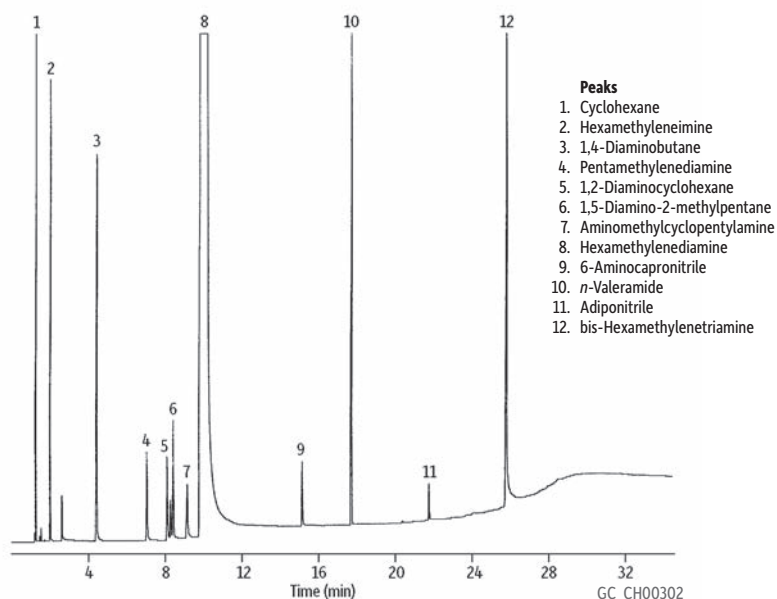
- Application-specific columns for underivatized amines and other basic compounds, including alkylamines, diamines, triamines, nitrogen-containing heterocyclics. No need for column priming.
- Temperature range: 40 °C to 220 °C.

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
0.25 mm	0.25 µm	40 to 210/220 °C	10820	10823	
	0.50 µm	40 to 210/220 °C		10838	
0.32 mm	0.25 µm	40 to 210/220 °C	10821	10824	
	0.50 µm	40 to 210/220 °C		10839	
0.53 mm	1.00 µm	40 to 210/220 °C	10851	10854	10857
	0.50 µm	40 to 210/220 °C		10840	
	1.00 µm	40 to 210/220 °C	10852	10855	10858
	1.50 µm	40 to 210/220 °C		10869	

Hexamethylenediamine on Stabilwax®-DB



Column Stabilwax®-DB, 30 m, 0.32 mm ID, 0.25 µm (cat.# 10824)
Sample Neat hexamethylenediamine (HMD)
Conc.: 10 to 1,000 ng/component on-column
Injection
 Inj. Vol.: 0.4 µL direct
 Inj. Temp.: 250 °C
Oven
 Oven Temp: 95 °C (hold 6 min) to 235 °C at 7 °C/min (hold 4 min)
Carrier Gas Hz, constant pressure
 Linear Velocity: 40 cm/sec
Detector FID @ 250 °C
Notes FID sensitivity: 2 x 10⁻¹¹ AFS

Chiral Analysis

Cyclodextrin Columns for Analyzing Many Chiral Compounds

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

Rt[®]- γ DEXsa Columns (fused silica)

(2,3-di-acetoxy-6-O-*tert*-butyl dimethylsilyl gamma cyclodextrin added into 14% cyanopropylphenyl/86% dimethyl polysiloxane)

Uses: Larger organic molecules. Also useful for flavor compounds in fruit juices.

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

Rt[®]- β DEXm Columns (fused silica)

(permethylated beta cyclodextrin added into 14% cyanopropylphenyl/86% dimethyl polysiloxane)

Uses: General-purpose chiral phase with many published applications.

ID	df	temp. limits	30-Meter
0.25 mm	0.25 μ m	40 to 230 °C	13100
0.32 mm	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 added into 14% cyanopropylphenyl/86% dimethyl polysiloxane)

Uses: Excellent column for most chiral compounds in essential oils.

ID	df	temp. limits	30-Meter
0.25 mm	0.25 μ m	40 to 230 °C	13105
0.32 mm	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 added 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
0.25 mm	0.25 μ m	40 to 230 °C	13107
0.32 mm	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 added 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
0.25 mm	0.25 μ m	40 to 230 °C	13111
0.32 mm	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 added into 14% cyanopropylphenyl/86% dimethyl polysiloxane)

Uses: Unique selectivity for esters, lactones, and other fruit flavor components.

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

Rt[®]- β DEXcst Columns (fused silica)

(Proprietary cyclodextrin material added 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
0.25 mm	0.25 μ m	40 to 230 °C	13103
0.32 mm	0.25 μ m	40 to 230 °C	13102

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



Download your free copies from

www.restek.com



GC Columns

Metal MXT® Capillary Columns

MXT® Columns Overview	91
Guard/Retention Gap Columns	92
Tubing Scorer	92
General-Purpose Columns	93–96
Application-Specific Columns	97–101
<i>Environmental</i>	97
<i>Foods, Flavors & Fragrances</i>	98
<i>Petroleum & Petrochemical</i>	99–101



What is an MXT® column?

MXT® columns are wall coated open tubular (WCOT) columns 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, 0.28 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.



4.5" coil,
standard diameter

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:

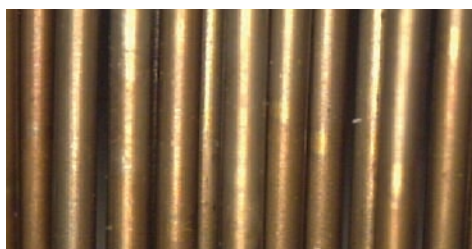
- | | | | |
|-----------|-------------|---------------------|--------------------|
| • MXT®-1 | • MXT®-65 | • MXT®-65TG | • MXT®-500 SimDist |
| • MXT®-5 | • MXT®-1301 | • MXT®-Biodiesel TG | • MXT®-502.2 |
| • MXT®-20 | • MXT®-1701 | • MXT®-2887 | • MXT®-Volatiles |
| • MXT®-35 | • MXT®-200 | • MXT®-1HT 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.

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, contact Customer Service and we will be happy to help.

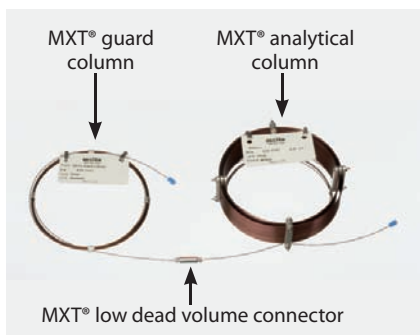


Guard/Retention Gap Columns, Tubing Scorer

MXT® guard columns are tested for inertness and bleed.



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



also available

Column connector kits & ferrules

See **page 213**.



Make a perfect column cut every time!

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: 325 °C

Nominal ID	Nominal OD	5-Meter	5-Meter/6-pk.	10-Meter
0.28 mm	0.56 ± 0.025 mm	70044	70044-600	70046
0.53 mm	0.74 ± 0.025 mm	70045	70045-600	70047

Hydroguard®-Treated MXT® Guard/Retention Gap Columns/Transfer Lines (passivated stainless steel)

- Extend analytical column lifetime by preventing degradation from harsh “steam-cleaning” water injections.
- Maximum temperature: 325 °C.

When transfer lines from purge-and-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—Hydroguard® deactivated tubing. 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 surface beneath. Use Hydroguard® tubing for connecting GCs to:

- Headspace analyzers.
- Air analysis equipment and concentrator units.
- Purge-and-trap systems.

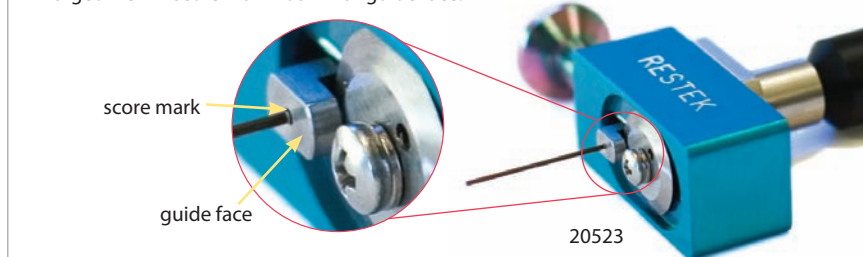
Nominal ID	Nominal OD	5-Meter	10-Meter	30-Meter*	60-Meter*†
0.28 mm	0.56 ± 0.025 mm	70080	70083	70086	70089
0.53 mm	0.74 ± 0.025 mm	70081	70084	70087	70090

*30- and 60-meter lengths are banded in 5-meter sections.

†Recommendation: Cut 60 m guard columns into shorter lengths. Using full length may cause peak distortion.

Diameters greater than 0.10 mm are tested with the Grob test mix to ensure high inertness.

Enlarged view—score mark flush with guide face.



Restek Tubing Scorer for MXT® Columns

- Makes a perfect cut every time.
- Easy to use.
- Leaves column entrance perfectly round.
- Ideal for creating a leak-free seal with connectors and valves.

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.

Description	qty.	cat.#
Restek Tubing Scorer for MXT Columns (0.25-0.53 mm ID & 0.5-0.8 mm OD)	ea.	20523
Replacement Scoring Wheel	ea.	20522

MXT®-1 Columns (Silex®-treated stainless steel)

(nonpolar phase; Crossbond® dimethyl polysiloxane)

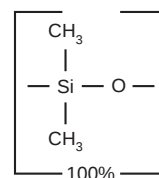
- General-purpose columns for solvent impurities, PCB congeners (e.g., Aroclor mixes), gases, natural gas odorants, sulfur compounds, essential oils, hydrocarbons, semivolatiles, pesticides, and oxygenates.
- Temperature range: -60 °C to 430 °C.
- Equivalent to USP G1, G2, G38 phases.

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
0.25 mm	0.10 µm	-60 to 360/430 °C		70105	70116	70117	70114
	0.25 µm	-60 to 360/430 °C		70120	70123	70126	70129
	0.50 µm	-60 to 330/400 °C		70135	70138	70141	70144
	1.00 µm	-60 to 320/360 °C		70150	70153	70156	70159
0.28 mm	0.10 µm	-60 to 360/430 °C	70102	70106	70109		
	0.25 µm	-60 to 360/430 °C		70121	70124	70127	
	0.50 µm	-60 to 330/400 °C		70136	70139	70142	
	1.00 µm	-60 to 320/360 °C		70151	70154	70157	
	3.00 µm	-60 to 285/360 °C		70181	70184	70187	
0.53 mm	0.15 µm	-60 to 360/430 °C	70101	70107			
	0.25 µm	-60 to 360/430 °C		70122	70125	70128	
	0.50 µm	-60 to 330/400 °C		70137	70140	70143	
	1.00 µm	-60 to 320/360 °C		70152	70155	70158	
	1.50 µm	-60 to 310/360 °C		70167	70170	70173	
	3.00 µm	-60 to 285/360 °C		70182	70185	70188	70189
	5.00 µm	-60 to 270/360 °C		70177	70179	70183	
	7.00 µm	-60 to 240/360 °C		70191	70192	70193	

ID	df	temp. limits	10-Meter	20-Meter	40-Meter
0.18 mm	0.20 µm	-60 to 330/430 °C	71811	71812	71813
	0.40 µm	-60 to 320/400 °C	71814	71815	71816

*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

MXT®-1 Structure

Similar to: (100%-methyl)-polysiloxane

similar columns

DB-PS1, UAC-1, UAC-1MS

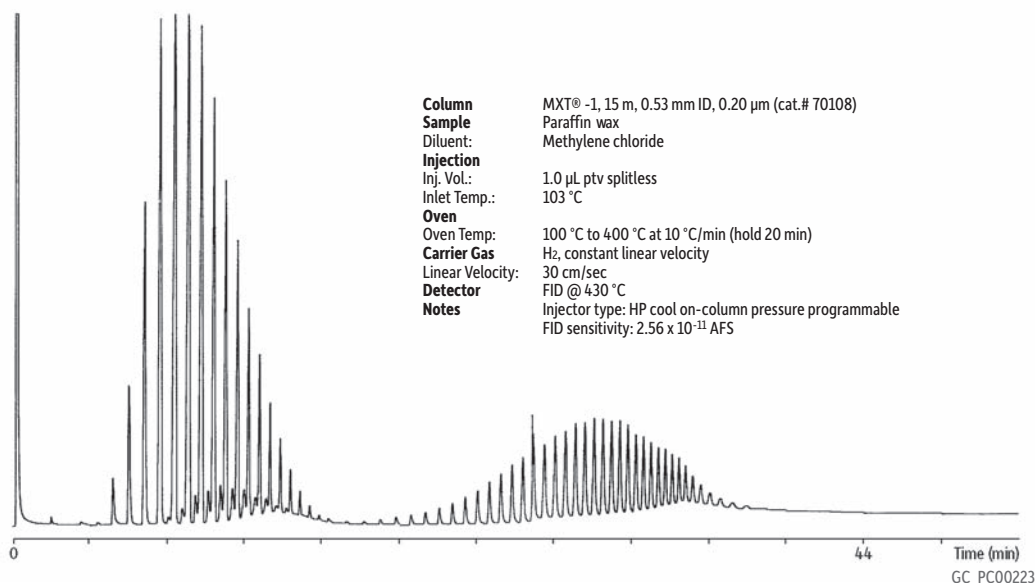
free literature

Analyzing Oxygenates in Gasoline Using TCEP and Rtx®-1/MXT®-1 Columns

Download your free copy from

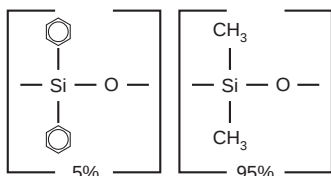
www.restek.com

lit. cat.# 59587A

**Hydrocarbons (High Temp. Petroleum Wax) on MXT®-1**

Column MXT® -1, 15 m, 0.53 mm ID, 0.20 µm (cat.# 70108)
Sample Paraffin wax
Diluent: Methylene chloride
Injection
 Inj. Vol.: 1.0 µL pvt splitless
 Inlet Temp.: 103 °C
Oven
 Oven Temp: 100 °C to 400 °C at 10 °C/min (hold 20 min)
Carrier Gas H₂, constant linear velocity
 Linear Velocity: 30 cm/sec
Detector FID @ 430 °C
Notes Injector type: HP cool on-column pressure programmable
 FID sensitivity: 2.56 x 10⁻¹¹ AFS

MXT®-5 Structure



Similar to: (5%-phenyl)-methylpolysiloxane

similar columns

DB-PS5, VF-5ht UltiMetal, UAC-5, UAC-5MS

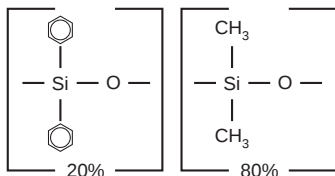
also
available

Metal MXT®
PLOT Columns

See page 113.



MXT®-20 Structure



Similar to: (20%-phenyl)-methylpolysiloxane

MXT®-5 Columns (Siltek®-treated stainless steel)

(low polarity phase; Crossbond® diphenyl 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 diphenyl 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
0.25 mm	0.10 µm	-60 to 330/430 °C	70205	70208	70211
	0.25 µm	-60 to 360/430 °C	70220	70223	70226
	0.50 µm	-60 to 330/360 °C	70235	70238	70241
	1.00 µm	-60 to 310/340 °C	70250	70253	70256
0.28 mm	0.25 µm	-60 to 340/430 °C	70221	70224	70227
	0.50 µm	-60 to 315/400 °C	70236	70239	70242
	1.00 µm	-60 to 310/360 °C	70251	70254	70257
	3.00 µm	-60 to 290/360 °C	70281	70284	70287
0.53 mm	0.25 µm	-60 to 340/430 °C	70222	70225	70228
	0.50 µm	-60 to 330/400 °C	70237	70240	70243
	1.00 µm	-60 to 310/360 °C	70252	70255	70258
	1.50 µm	-60 to 300/360 °C	70267	70270	70273
	3.00 µm	-60 to 290/360 °C	70282	70285	70288
	5.00 µm	-60 to 270/360 °C	70277	70279	70283

ID	df	temp. limits	10-Meter	20-Meter	40-Meter
0.18 mm	0.20 µm	-60 to 325/430 °C	71821	71822	71823
	0.40 µm	-60 to 315/400 °C	71824	71825	71826

*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

MXT®-20 Columns (Siltek®-treated stainless steel)

(low to midpolarity phase; Crossbond® diphenyl 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
0.25 mm	0.25 µm	-20 to 300/340 °C	70320	70323	70326
	1.00 µm	-20 to 300/340 °C	70350	70353	70356
0.28 mm	0.25 µm	-20 to 310/340 °C	70321	70324	70327
	1.00 µm	-20 to 295/340 °C	70351	70354	70357
	3.00 µm	-20 to 260/340 °C	70381	70384	70387
0.53 mm	0.25 µm	-20 to 300/340 °C	70322	70325	70328
	1.00 µm	-20 to 260/340 °C	70352	70355	70358
	3.00 µm	-20 to 260/340 °C	70382	70385	70388

*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

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

(midpolarity phase; Crossbond® diphenyl 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
0.25 mm	0.50 µm	0 to 290/340 °C	70435	70438	
	1.00 µm	0 to 290/340 °C	70450	70453	
0.53 mm	1.00 µm	0 to 260/340 °C	70452	70455	70458
	1.50 µm	0 to 250/340 °C	70467	70470	70473
	3.00 µm	0 to 240/340 °C	70482	70485	70488

*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

MXT®-50 Columns (Siltek®-treated stainless steel)

(midpolarity phase; Crossbond® phenyl methyl polysiloxane)

- General-purpose columns for pesticides, herbicides, rosin acids, phthalate esters, and sterols.
- Temperature range: 0 °C to 300 °C.
- Equivalent to USP G3 phase.

ID	df	temp. limits*	15-Meter	30-Meter	60-Meter
0.53 mm	0.83 µm	0 to 280/300 °C		70569	
	1.00 µm	0 to 260/280 °C	70552	70555	70558
	1.50 µm	0 to 250/280 °C	70567	70570	70573

*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

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

(mid to high polarity phase; Crossbond® diphenyl dimethyl polysiloxane)

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

ID	df	temp. limits	15-Meter	30-Meter
0.25 mm	0.25 µm	50 to 300 °C	77020	77023
	0.50 µm	50 to 280/300 °C	77035	77038
	1.00 µm	50 to 280/300 °C	77050	77053

*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

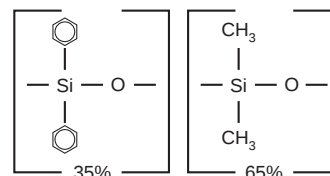
MXT®-1301 Columns (Siltek®-treated stainless steel)

(low to midpolarity phase; Crossbond® cyanopropylphenyl 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
0.25 mm	0.25 µm	-20 to 280 °C	76020	76023	76026
	1.00 µm	-20 to 260/280 °C	76050	76053	76056
0.28 mm	0.25 µm	-20 to 280 °C	76021	76024	76027
	1.00 µm	-20 to 260/280 °C	76051	76054	76057
	1.50 µm	-20 to 250/280 °C	76066	76069	76072
0.53 mm	0.25 µm	-20 to 280 °C	76022	76025	76028
	1.00 µm	-20 to 260/280 °C	76052	76055	76058
	1.50 µm	-20 to 250/280 °C	76067	76070	76073
	3.00 µm	-20 to 240/280 °C	76082	76085	76088

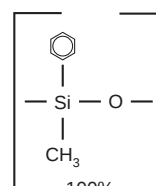
*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

MXT®-35 Structure

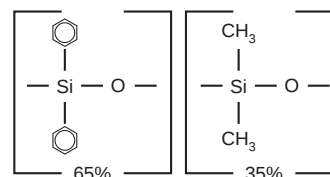
Similar to: (35%-phenyl)-methylpolysiloxane

similar column

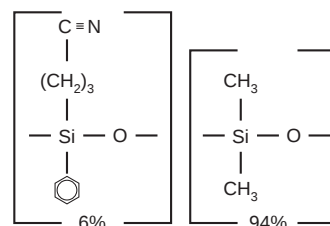
DB-PS35

MXT®-50 Structure

Similar to: (50%-phenyl)-methylpolysiloxane

MXT®-65 Structure

Similar to: (65%-phenyl)-methylpolysiloxane

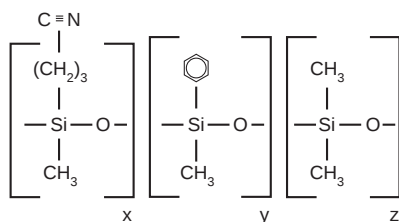
MXT®-1301 Structure

Similar to: (6%-cyanopropylphenyl)-methylpolysiloxane

similar column

DB-PS1301

MXT®-1701 Structure



Similar to: (14%-cyanopropylphenyl)-methylpolysiloxane

similar column

DB-PS1701

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

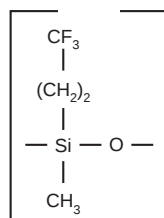
(midpolarity Crossbond® phase)

- 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
0.25 mm	0.25 µm	-20 to 280 °C	T2020	T2023	T2026
	1.00 µm	-20 to 260 °C	T2050	T2053	T2056
0.28 mm	0.25 µm	-20 to 280 °C	T2021	T2024	T2027
	1.00 µm	-20 to 260 °C	T2051	T2054	T2057
0.53 mm	1.50 µm	-20 to 250 °C	T2066	T2069	T2072
	0.25 µm	-20 to 280 °C	T2022	T2025	T2028
	0.50 µm	-20 to 260/280 °C	T2037	T2040	T2043
	1.00 µm	-20 to 260 °C	T2052	T2055	T2058
	1.50 µm	-20 to 250 °C	T2067	T2070	T2073
	3.00 µm	-20 to 240 °C	T2082	T2085	T2088

*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

MXT®-200 Structure



Similar to: (trifluoropropyl)-methylpolysiloxane

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

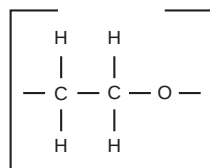
(midpolarity phase; Crossbond® trifluoropropylmethyl polysiloxane)

- 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
0.25 mm	0.50 µm	-20 to 310/400 °C	T5035	T5038	
	1.00 µm	-20 to 290/360 °C	T5050	T5053	
0.53 mm	1.00 µm	-20 to 290/360 °C	T5052	T5055	T5058
	1.50 µm	-20 to 280/360 °C	T5067	T5070	T5073
	3.00 µm	-20 to 260/360 °C	T5082	T5085	T5088

*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

MXT®-WAX Structure



similar columns

DB-PSWAX, UAC-CW

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 U.S. EPA Method 603 (acrolein/acrylonitrile).
- 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
0.25 mm	0.10 µm	40 to 250/260 °C	T0605	T0608	T0611
	0.25 µm	40 to 250/260 °C	T0620	T0623	T0626
	0.50 µm	40 to 250/260 °C	T0635	T0638	T0641
0.28 mm	0.25 µm	40 to 250/260 °C	T0621	T0624	T0627
	0.50 µm	40 to 250/260 °C	T0636	T0639	T0642
	1.00 µm	40 to 240/250 °C	T0651	T0654	T0657
0.53 mm	0.25 µm	40 to 250/260 °C	T0622	T0625	T0628
	0.50 µm	40 to 250/260 °C	T0637	T0640	T0643
	1.00 µm	40 to 240/250 °C	T0652	T0655	T0658
	1.50 µm	40 to 230/250 °C	T0666	T0669	T0672
	2.00 µm	40 to 220/250 °C	T0667	T0670	

*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

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 U.S. 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 U.S. 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
0.25 mm	1.40 µm	-20 to 250/320 °C	70915	70916	
0.28 mm	1.60 µm	-20 to 250/320 °C	70919	70920	70921
0.53 mm	3.00 µm	-20 to 250/320 °C	70908	70909	70910

ID	df	temp. limits	its	lim	10-Meter	20-Meter
0.18 mm	1.00 µm	-20 to 250/320 °C			71891	71892

*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

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 U.S. 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
0.25 mm	1.00 µm	-20 to 280/320 °C	70900	70903	
0.28 mm	1.25 µm	-20 to 280/320 °C	70924	70926	70928
0.53 mm	2.00 µm	-20 to 280/320 °C	70925	70927	70929
	3.00 µm	-20 to 250/320 °C	70922	70923	

*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

MXT®-624 Columns (Siltek®-treated stainless steel)

(low to midpolarity phase; Crossbond® cyanopropylphenyl dimethyl polysiloxane)

- Application-specific columns for volatile organic pollutants. Recommended in U.S. 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
0.25 mm	1.40 µm	-20 to 240/280 °C	70968	70969
0.53 mm	3.00 µm	-20 to 240/280 °C	70971	70973

ID	df	temp. limits	its	lim	10-Meter	20-Meter
0.18 mm	1.00 µm	-20 to 240/280 °C			71893	71894

similar column

DB-PS502.2

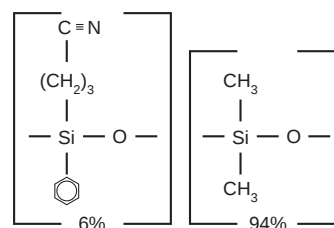
also
available

Metal MXT®
PLOT Columns

See page 113.



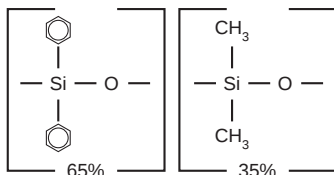
MXT®-624 Structure



Similar to: (6%-cyanopropylphenyl)-methylpolysiloxane

similar columns

DB-PS624, UAC-624

MXT®-65TG Structure

Similar to: (65%-phenyl)-methylpolysiloxane

similar column

UAC-65HT

free literature

MXT® Capillary Columns:
Ideal for High Temperature
GC Analysis

Download your
free copy from

www.restek.com

lit. cat.# GNTS1368A

**Triglycerides in Foods Analysis****MXT®-65TG Columns** (Siltek®-treated stainless steel)

(high polarity phase; Crossbond® diphenyl 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
0.25 mm	0.10 µm	20 to 370 °C	77005	77008
0.53 mm	0.10 µm	20 to 370 °C	77007	77010

MXT® Columns Are Sized to Order!

For your convenience, not only are MXT® columns available in the standard 4.5" coil diameter, but they also are available in 3.5" and 6" coil diameters. Whether you're using them in a process GC or a benchtop GC, our MXT® columns will be a perfect fit. Just add one of the suffix numbers below to the column part number when you order! Additional sizes and configurations may be available; call for details.

Coil Diameter	Suffix Number	Configuration*
3.5"	-273	Bundled
4.5"	None	Standard Banded
6.0"	-276	Bundled

*Standard configuration may vary for PLOT columns.

**Connect transfer lines or guard columns directly to your MXT® columns without compromising your data.**

Rugged MXT® low dead volume connectors are Siltek® treated to make them inert to active compounds, just like our MXT® columns! They can be used at temperatures up to 430 °C without degrading the deactivated layer, and their low thermal mass tracks rapid oven temperature programming. Kits are available for 0.28 mm, 0.32 mm, and 0.53 mm ID columns in a standard configuration for column-to-column connections and a "Y" configuration for connecting two columns to one inlet or one column to two detectors. In addition to the MXT® union, each kit also contains stainless steel 1/32-inch ferrules and nuts.

▶ See **page 213** for product listing.

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.

Description	temp. limits	3.5" Coil	7" diameter 11-pin cage
		cat.#	cat.#
14 m, 0.53 mm ID, 0.16 µm with 2 m Integra-Gap*	-60 to 380/430 °C	70289-273	70289
10 m, 0.32 mm ID, 0.10 µm	-60 to 380/430 °C		70292
10 m, 0.32 mm ID, 0.10 µm with 2 m x 0.53 mm Retention Gap**	-60 to 380/430 °C	70290-273	70290
15 m, 0.32 mm ID, 0.10 µm	-60 to 380/430 °C		70293
15 m, 0.32 mm ID, 0.10 µm with 2 m x 0.53 mm Retention Gap**	-60 to 380/430 °C	70291-273	70291
2 m x 0.53 mm MXT Biodiesel TG Retention Gap			70294

*Total column length = 16 meters.

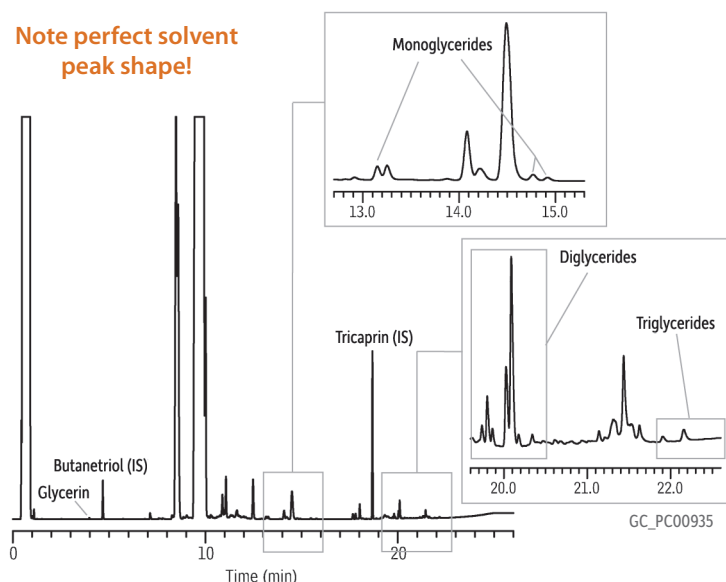
**Connected with low dead volume MXT connector.

similar column

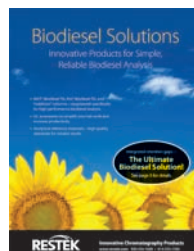
MET-Biodiesel

ASTM D6584 Derivatized B100 and Internal Standards on MXT®-Biodiesel TG

Note perfect solvent peak shape!



Column	MXT®-Biodiesel TG w/2 m x 0.53 mm retention gap, 10 m, 0.32 mm ID, 0.10 µm (cat.# 70290)
Sample	B100 + IS butanetriol & tricaprin derivatized with MSTFA as per ASTM D6584
Injection	1.0 µL cold on-column
Inj. Vol.:	oven track
Temp. Program:	
Oven	
Oven Temp:	50 °C (hold 1 min) to 180 °C at 15 °C/min to 230 °C at 7 °C/min to 430 °C at 30 °C/min (hold 5 min)
Carrier Gas	H ₂ , constant flow
Flow Rate:	4 mL/min
Detector	FID @ 430 °C



free literature

Biodiesel Solutions:
Innovative Products
for Simple, Reliable
Biodiesel Analysis

Download your
free copy from

www.restek.com

lit. cat.# PCFL1409-UNV

Simulated Distillation Analysis (C5-C44)

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 thicknesses have been optimized to exceed the resolution and skewing factor requirements 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
0.53 mm	2.65 µm	-60 to 360/400 °C	70199

similar column

DB-PS2887

free literature

Rtx®-2887/ MXT®-2887
Restek's Capillary GC Columns
for Simulated Distillation of
Petroleum Fractions

Download your
free copy from

www.restek.com

lit. cat.# 59567B



similar columns

DB-HT SimDis ProSteel, CP-SimDist
UltiMetal, ZB-1X SimDist

Method Recommended Columns

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

Simulated Distillation Analysis (C5-C110)

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
0.53 mm	0.10 µm	-60 to 400/450 °C	70112	
	0.20 µm	-60 to 400/430 °C	70115	
	0.21 µm	-60 to 400/430 °C		70118
	0.88 µm	-60 to 380/430 °C	70131	70134
	1.00 µm	-60 to 380/400 °C		70130
	1.20 µm	-60 to 380/380 °C		70119
	2.65 µm	-60 to 360/400 °C		70132
	5.00 µm	-60 to 360/400 °C		70133

Low Bleed, High Efficiency MXT®-1HT SimDist Columns Outperform Competitors for Simulated Distillation (ASTM D6352)

Lower bleed means:

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

RESTEK ADVANTAGE:

Longer column lifetime and
more accurate data!

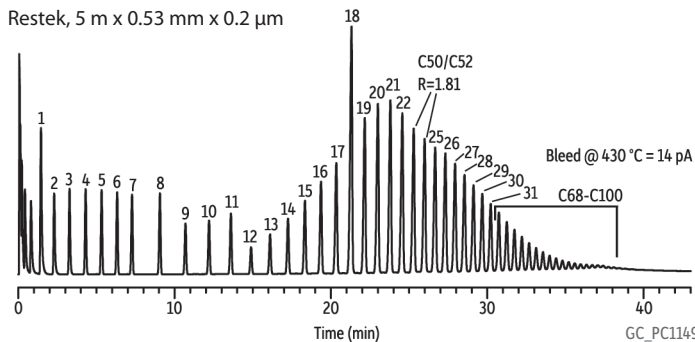
Higher efficiency means:

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

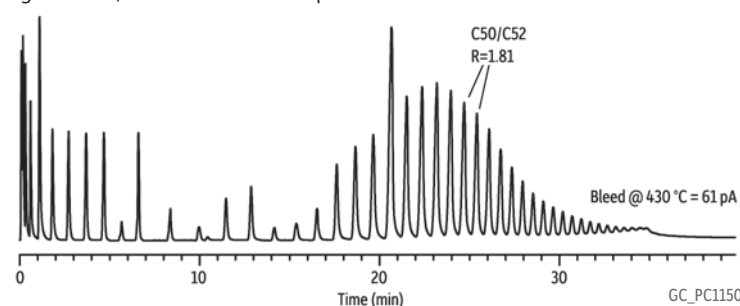
RESTEK ADVANTAGE:

Run more samples within method
specifications!

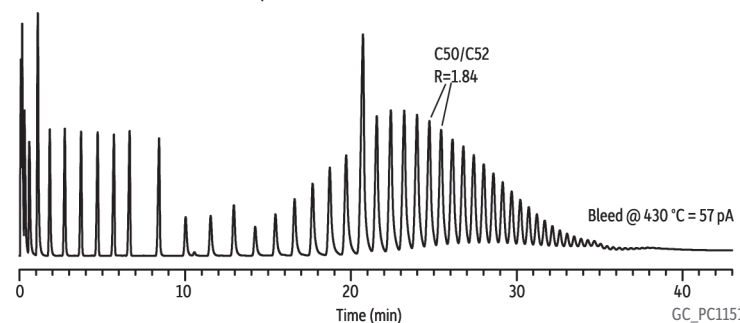
Restek, 5 m x 0.53 mm x 0.2 µm



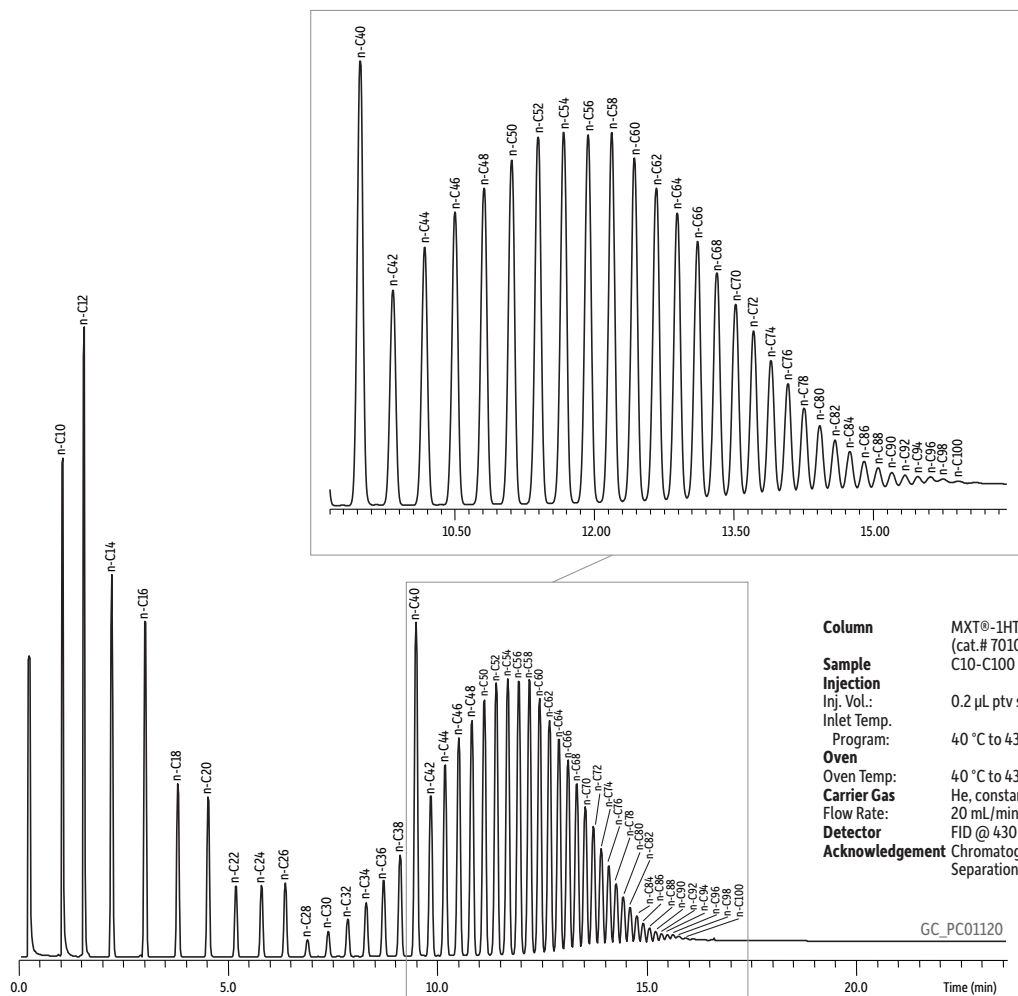
Agilent/J&W, 5 m x 0.53 mm x 0.15 µm



Varian, 5 m x 0.53 mm x 0.17 µm



Hydrocarbons (C10-C100) on MXT®-1HT Sim Dist



Column MXT®-1HT SimDist, 5 m, 0.53 mm ID, 0.20 µm (cat.# 70103)
Sample C10-C100 1% in carbon disulfide
Injection Inj. Vol.: 0.2 µL pvt splitless
 Inlet Temp. Program: 40 °C to 430 °C at 100 °C/min
Oven Oven Temp: 40 °C to 430 °C at 25 °C/min
Carrier Gas He, constant flow
Flow Rate: 20 mL/min
Detector FID @ 430 °C
Acknowledgement Chromatograms courtesy of Joaquin Lubkowitz, Separation Systems, Gulf Breeze, FL.

MXT®-1 SimDist/MXT®-500 SimDist

- Application-specific columns in unbreakable Siltek®-treated stainless steel tubing meet all resolution criteria for high temperature simulated distillation (e.g., ASTM Method D2887 Extended).
- MXT®-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
0.53 mm	0.15 µm	-60 to 400/430 °C	70101

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

ID	df	temp. limits	6-Meter
0.53 mm	0.15 µm	-60 to 420/430 °C	70104

Polywax® Calibration Materials

Description	qty.	cat.#
Polywax 655 calibration material	1 g	36225
Polywax 1,000 calibration material	1 g	36227

free literature

GC Analysis of Petroleum Products
by Simulated Distillation, Using
MXT® SimDist Columns

Download your
free copy from

www.restek.com

lit. cat.# 59551A



similarc olumns

DB-HT SimDis ProSteel, CP-SimDist
UltiMetal, ZB-1X SimDist

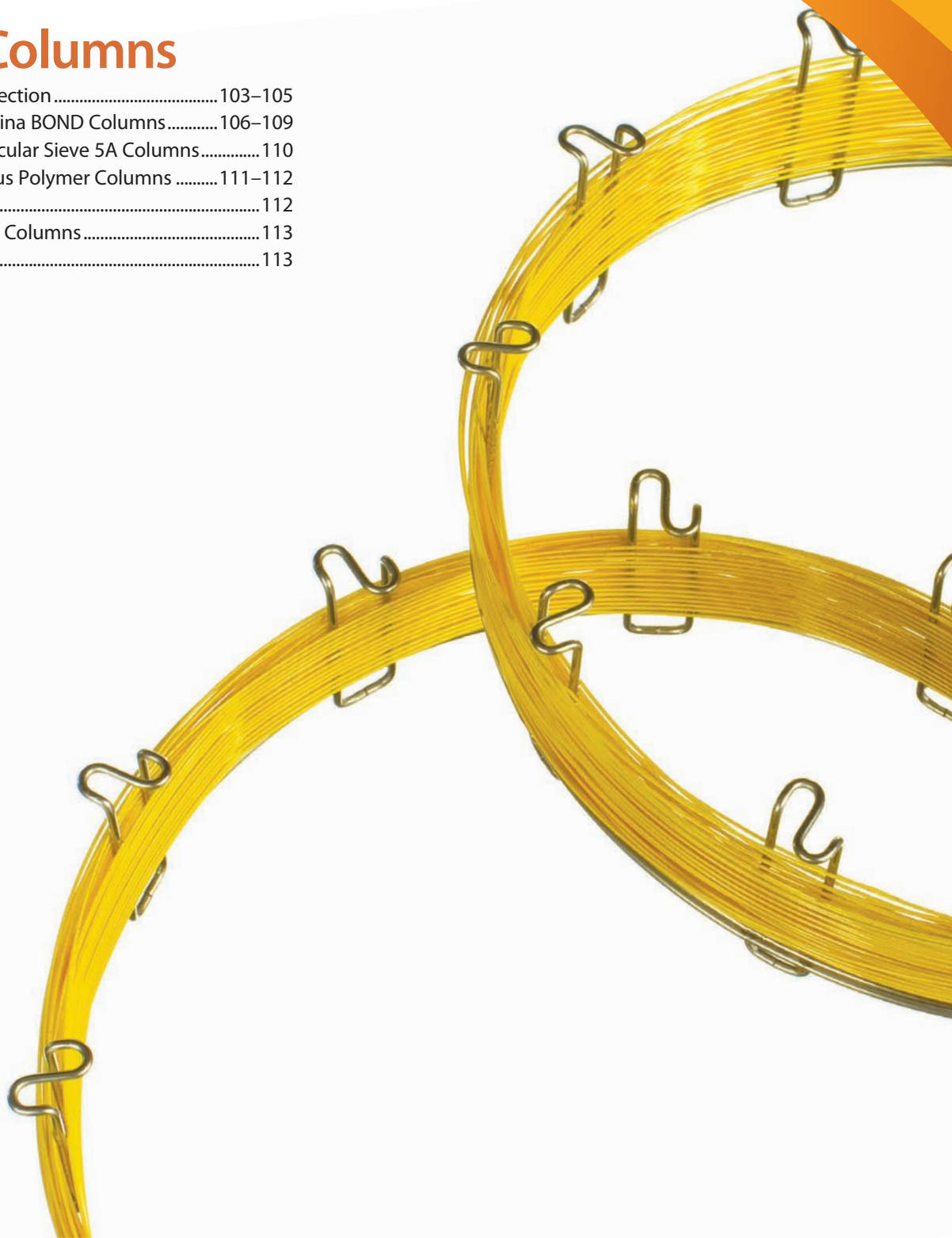
similarc olumn

UAC-DX30

GC Columns

PLOT Columns

PLOT Column Selection	103–105
Fused Silica Alumina BOND Columns	106–109
Fused Silica Molecular Sieve 5A Columns	110
Fused Silica Porous Polymer Columns	111–112
Particle Trap	112
Metal MXT® PLOT Columns	113
Tubing Scorer	113

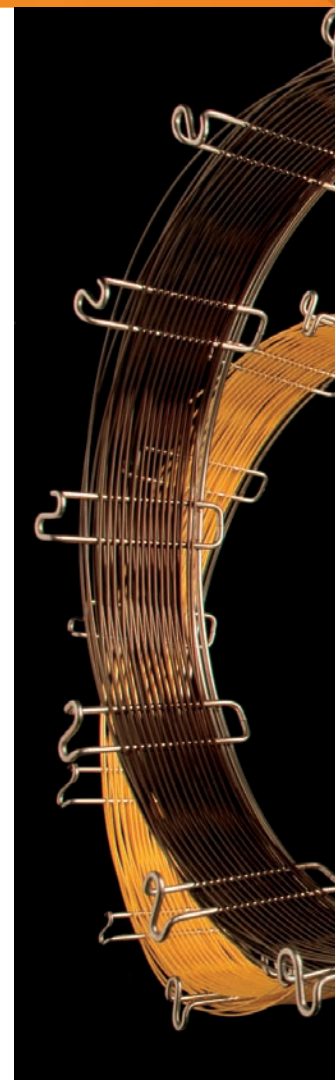


Next Generation GC PLOT Columns

- Innovative 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
Rt-Alumina BOND/Na ₂ SO ₄ (p. 106) MXT-Alumina BOND/Na ₂ SO ₄ (p. 113)	C1–C5 hydrocarbons Purity analysis of ethylene, propylene, butenes, butadiene
Rt-Alumina BOND/KCl (p. 107)	C1–C10 hydrocarbons, C1–C5 isomers Purity analysis of ethylene, propylene, butene, butadiene.
Rt-Alumina BOND/CFC (p. 108)	Multi-halogenated alkanes, C1–C-5 range CFCs (chlorofluorocarbons)
Rt-Alumina BOND/MAPD (p. 109) MXT-Alumina BOND MAPD (p. 113)	Trace analysis of methylacetylene, propadiene, acetylene
Rt-Msieve 5A (p. 110) MXT-Msieve 5A (p. 113)	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 ₆ , CO
Rt-Q-BOND (p. 111) MXT-Q-BOND (p. 113)	Nonpolar porous polymer High retention for solvents, alcohols, polar volatiles, CO ₂ , sulfur, and ppm water in solvents
Rt-QS-BOND (p. 112)	Intermediate polarity porous polymer Neutral solvents, ketones, esters, hydrocarbons, and baseline separation of ethane, ethene, acetylene
Rt-S-BOND (p. 112) MXT-S-BOND (p. 113)	Intermediate polarity porous polymer Light gases in ethylene and propylene, ketones, esters, hydrocarbons
Rt-U-BOND (p. 112)	Polar porous polymer More retention for polar compounds



PLOT Column Phase Cross-Reference: Similar Selectivity

Restek	Porous Layer	Agilent	Supelco
Rt-Alumina BOND/Na ₂ SO ₄ (p. 106) MXT-Alumina BOND/Na ₂ SO ₄ (p. 113)	Aluminum oxide	GS-Alumina, CP-Al ₂ O ₃ /Na ₂ SO ₄	Alumina-Sulfate
Rt-Alumina BOND/KCl (p. 107)	Aluminum oxide	GS-Alumina/KCl, HP-PLOT Al ₂ O ₃ /KCl, CP-Al ₂ O ₃ /KCl	Alumina-Chloride
Rt-Alumina BOND/CFC (p. 108)	Aluminum oxide	Restek innovation	
Rt-Alumina BOND/MAPD (p. 109) MXT-Alumina BOND MAPD (p. 113)	Aluminum oxide	Select Al ₂ O ₃ MAPD	
Rt-Msieve 5A (p. 110), MXT-Msieve 5A (p. 113)	Molecular sieve 5A	HP PLOT Molsieve, CP-Molsieve 5A	Molsieve 5A
Rt-Q-BOND (p. 111), MXT-Q-BOND (p. 113)	100% Divinylbenzene	HP PLOT Q, CP-PoraPLOT Q, CP-PoraBond Q	Supel-Q-PLOT
Rt-QS-BOND (p. 112)	Intermediate polarity porous polymer	GS-Q	
Rt-S-BOND (p. 112), MXT-S-BOND (p. 113)	DVB vinylpyridine polymer	CP-PoraPLOT S	
Rt-U-BOND (p. 112)	DVB ethylene glycol - dimethylacrylate polymer	HP-PLOT U, CP-PoraPLOT U, CP-PoraBond U	

Next Generation of Porous Layer Open Tubular (PLOT) Columns

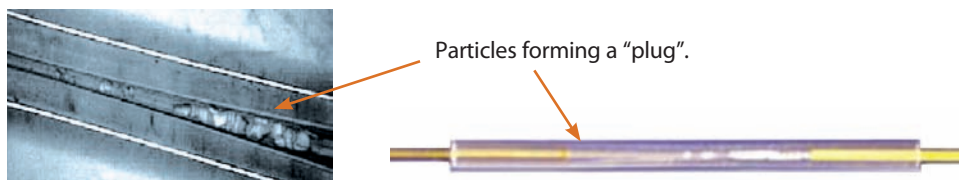
- Stabilized particle layers improve robustness and reproducibility of retention and flow.
- Fully compatible with valve switching and Deans switching systems.
- Highly efficient, reproducible analyses; ideal for permanent gases, solvents, and hydrocarbons.
- Innovative manufacturing procedure reduces particle generation and improves performance of porous polymer and molecular sieve PLOT columns.
- Wound on a 7"-diameter, 11-pin cage, unless otherwise noted.
- Available in fused silica and metal MXT® tubing.

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 μm 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. Traditional PLOT columns also must generally be used in conjunction with particle traps to prevent the contamination of valves, injectors, and GC detectors. Detectors contaminated with particles typically generate electronic noise, which shows up chromatographically as a spike in the baseline. In extreme cases, detector flow can be obstructed by particle buildup. Particles can also affect valves by becoming lodged in the valve and causing leaks or restricting flow. Figure 1 shows an example of blockage caused by particle accumulation inside a Press-Tight® connector.

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



Restek PLOT Columns Offer Improved Stability to Minimize Particle Release

Restek has developed technology and procedures to manufacture PLOT columns with concentric stabilized adsorption layers. These next 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 Restek stabilization chemistry is currently applied to all fused silica and metal PLOT columns featured in this catalog.

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 to 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.

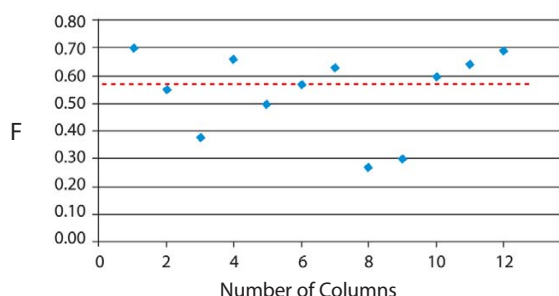
Figure 2: Inconsistent coating thicknesses result in restrictions that cause significant variation in flow.



In order to measure flow restriction reproducibility, Restek has introduced 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 molecular sieve 5A columns.

Flow restriction factor determination can be used to assess both the degree of column restriction and the reproducibility of the column coating process. 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 our Rt®-QS-BOND (bonded porous polymer) PLOT column process. Clearly, our manufacturing process results in greater consistency in both column coating thickness and flow restriction, which results in more stable retention times and better performance in Deans and related flow switching techniques.

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



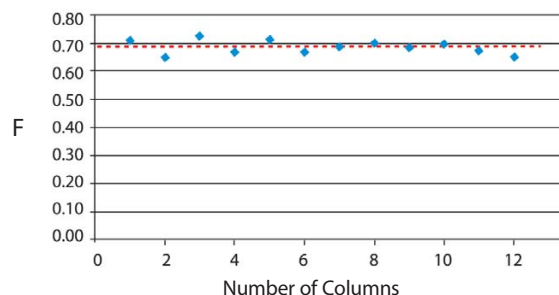
Equation 1: Flow restriction factor (F) is used to demonstrate coating consistency.

$$F = \frac{\text{tr}_1 \text{ of unretained component (uncoated tubing)}}{\text{tr}_2 \text{ of unretained component (coated column)}}$$

tr = retention time

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

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



Equation 2: Percent flow restriction of coated column.

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

Restek's PLOT columns are exceptionally robust, featuring concentric stabilized coating layers. They allow for more consistent gas flows and are recommended for applications sensitive to variation in retention time or flow. These PLOT columns are a significant advance in technology and are ideal for efficient, reproducible analyses of permanent gases, solvents, and hydrocarbons.

Fused Silica, PLOT, & MXT® Capillary GC Column Ferrule Guide

GC Column ID	Ferrule ID
0.10 mm	0.4
0.15 mm	0.4
0.18 mm	0.4
0.25 mm	0.4
0.28 mm	0.4
0.32 mm	0.5
0.45 mm	0.8
0.53 mm	0.8

free literature

Restek's PLOT Column Family
The New Benchmark For
Performance!

Download your
free copy from

www.restek.com

lit. cat.#
PCBR1163B-UNV



similar phases

GS-Alumina, CP-Al₂O₃/Na₂SO₄,
Alumina-Sulfate

i tech tip**Trace Water in the Carrier Gas**

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

Restek Rt®-Alumina BOND columns are highly selective for C1–C5 hydrocarbons and separate all unsaturated hydrocarbon isomers above ambient temperatures. The reactivity of the aluminum oxide stationary phase is minimized to improve column response for polar unsaturates, such as dienes, and the column's sensitivity (or response) ensures linear and quantitative chromatographic analysis for these compounds. Strong bonding prevents particle generation and release, which allows valve switching without harming the injection or detection systems. And because they are stable up to at least 200 °C, Rt®-Alumina BOND columns can be regenerated to restore full efficiency and selectivity by conditioning at their maximum temperature if water is adsorbed. High capacity and loadability give you exceptionally symmetrical peaks, making these columns ideal for volatile hydrocarbon separations at percent levels, as well as impurity analyses at ppm concentrations. Restek Rt®-Alumina BOND PLOT columns are manufactured on fused silica tubing; select phases are also available on metal MXT® tubing.

Guaranteed Reproducibility

To ensure reproducible retention times and predictable flow behavior column-to-column, each Rt®-Alumina BOND column is extensively tested. A hydrocarbon test mix confirms proper phase retention and selectivity. To calculate *k* (retention or capacity factor), which is a measure of phase retention, 1,3-butadiene is used, while selectivity is measured using retention indices for propadiene and methyl acetylene. The resolution of *trans*-2-butene and 1-butene is also verified, and to measure efficiency, plates per meter are checked using 1,3-butadiene.

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

(Na₂SO₄ deactivation)

- Acetylene and propadiene elute after butanes.
- 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
0.25 mm	4 µm	to 200 °C	19775	
0.32 mm	5 µm	to 200 °C	19757	19758
0.53 mm	10 µm	to 200 °C	19755	19756

**also
available**

Metal MXT®
PLOT Columns

See **page 113**.



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

(KCl deactivation)

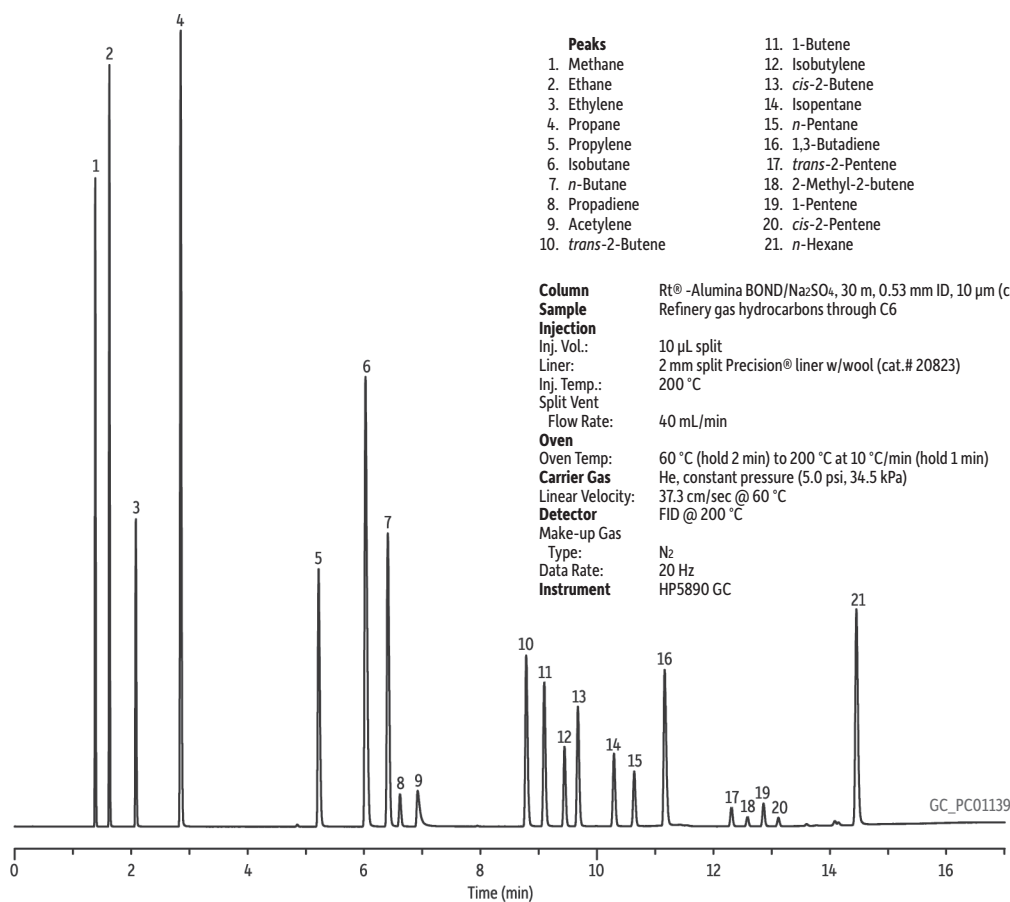
- Restek's lowest polarity alumina column.
- Low moisture sensitivity reduces the need for frequent regeneration.
- Acetylene elutes before *n*-butane.
- Methyl acetylene (impurity in 1,3-butadiene) elutes before 1,3-butadiene.

similar phases

GC-Alumina KCl, HP-PLOT Al₂O₃/KCl,
CP-Al₂O₃/KCl, Alumina-Chloride

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

Refinery Gas Hydrocarbons on Rt®-Alumina BOND/Na₂SO₄



did you know?

All Restek PLOT columns come standard on a 7"-diameter, 11-pin cage. Metal MXT columns are also available coiled to 3.5" diameter by adding the suffix -273 to the part number. If you need more information, please call Restek Customer Service at 1-814-353-1300, ext. 3, or your Restek Representative.

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

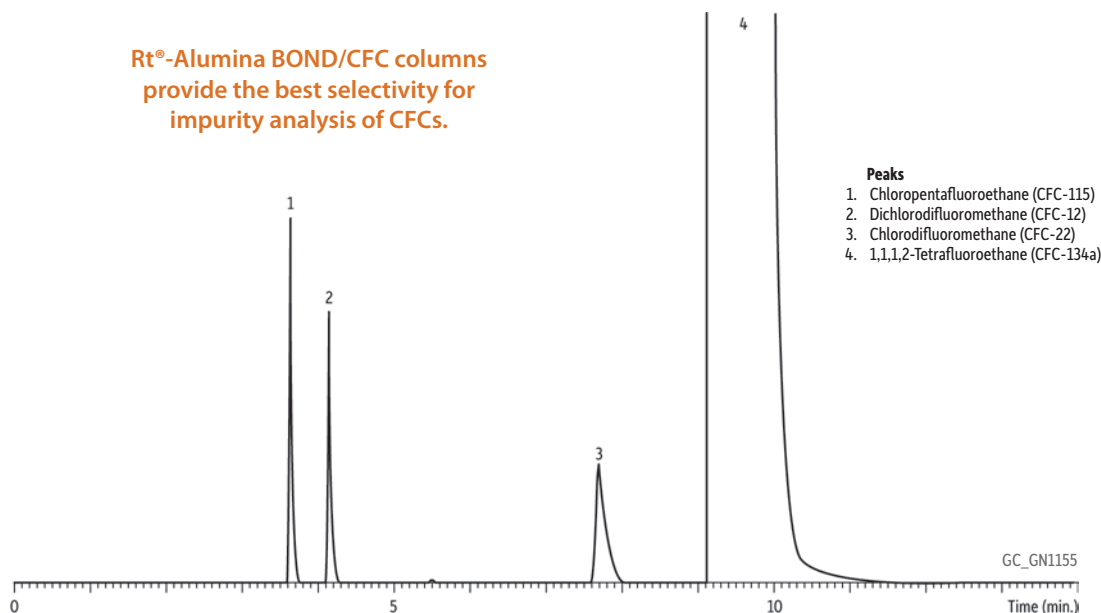
- Improved inertness for chlorofluorocarbon (CFC) compounds.
- Highly selective alumina-based column, separates most CFCs.
- High retention and capacity for CFCs.

The alumina adsorbent is ideal for retaining halogenated compounds, especially CFCs (chlorinated fluorocarbons) like Freon® products. 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 CFCs, the majority of these compounds can be accurately quantified from main stream processes or in impurity analyses.

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

Impurity Analysis of 1,1,1,2-Tetrafluoroethane (CFC-134a) on Rt®-Alumina BOND/CFC

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



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

Note that tailing peaks are common in CFC analyses due to overloading normally employed for this type of work.

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

- Optimized deactivation produces maximum response when analyzing trace levels of acetylene, methyl acetylene, and propadiene.
- Stable response factors make this column ideal for process-type applications where recalibration must be minimized.
- High loadability reduces peak tailing and improves separations.
- Extended temperature range up to 250 °C for fast elution of high molecular weight (HMW) hydrocarbons and accelerated column regeneration following exposure to water.

Restek's R&D chemists have optimized the deactivation technology applied to our Rt®-Alumina BOND/MAPD column for improved analysis of trace concentrations of polar hydrocarbons like acetylene, methyl acetylene, and propadiene in hydrocarbon streams containing higher levels of C1-C5 hydrocarbons. Our alumina PLOT deactivation produces an incredibly inert column that offers superior reproducibility and stable response factors to maximize the number of analyses before recalibration is required. Its high sample capacity reduces peak tailing, thereby improving the separation of target compounds. In addition, a 250 °C maximum operating temperature lets you more quickly elute hydrocarbons up to dodecane and reduces regeneration time when the column is exposed to water from samples or carrier gases.

ID	df	temp. limits	30-Meter	50-Meter
0.32 mm	5 µm	to 250 °C	19779	19780
0.53 mm	10 µm	to 250 °C	19777	19778

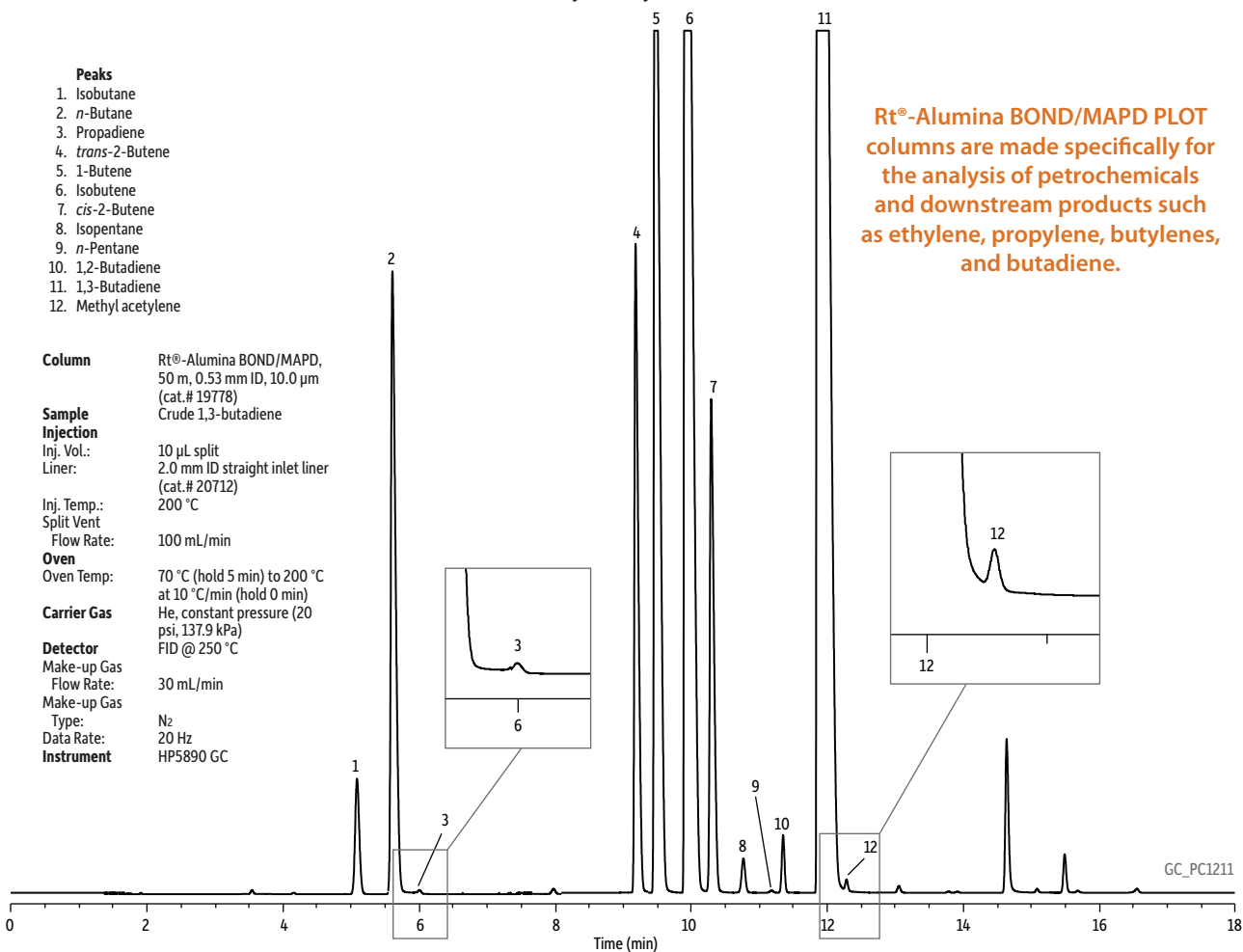
similar phasesSelect Al₂O₃ MAPD**free literature**

Analyze Trace Polar Hydrocarbons More Accurately and Reliably With New Alumina BOND/MAPD PLOT Columns

Download your free copy from

www.restek.com

lit. cat.#
PCFL1412-UNV

**1,3-Butadiene on Rt®-Alumina BOND/MAPD (Purity Analysis)**

did you know?

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

similar products

HP PLOT Molsieve, CP-Molsieve 5A, Molsieve 5A, AT-Molsieve, PLT-5A

tech tip

Molecular sieve materials are very hydrophilic

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®-M sieve 5A PLOT column by conditioning at 300 °C with dry carrier gas flow for 3 hours.

also available

Metal MXT® PLOT Columns

See page 113.



Molecular Sieve 5A PLOT Columns

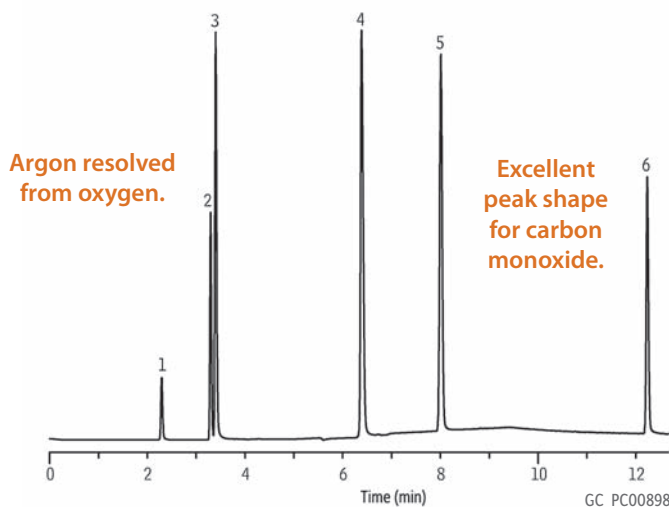
Restek's molecular sieve 5A PLOT columns are designed for efficient separation of Ar/O₂ and other permanent gases, including CO. Special coating and deactivation procedures ensure chromatographic efficiency and the integrity of the porous layer coating. Molecular sieves have very high retention, allowing separations of permanent gases at temperatures above ambient. Our deactivation technology also allows CO to elute as a sharp peak. 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 chromatogram). These columns also are an excellent choice for rapid separation of permanent gases in refinery or natural gas.

Rt®-M sieve 5A Columns (fused silica PLOT)

ID	df	temp. limits	15-Meter	30-Meter
0.25 mm	20 µm	to 300 °C	19773	
0.32 mm	30 µm	to 300 °C	19720	19722
0.53 mm	50 µm	to 300 °C	19721	19723

Separation of Argon/Oxygen and Other Permanent Gases on Rt®-M sieve 5A



Peaks	Conc. (µg/mL)	Column	Rt®-M sieve 5A, 30 m, 0.53 mm ID, 50 µm (cat.# 19723)
1. Hydrogen	40	Sample	Permanent gases
2. Argon	30	Injection	Sample valve
3. Oxygen	50	Sample Loop Vol.:	5 µL
4. Nitrogen	50	Valve Name:	6-port Valco® valve
5. Methane	40	Inj. Temp.:	200 °C
6. Carbon monoxide	50	Valve Temp.:	Ambient
		Oven	
		Oven Temp:	27 °C (hold 5 min) to 100 °C at 10 °C/min (hold 5 min)
		Carrier Gas	He, constant flow
		Flow Rate:	5.0 mL/min
		Detector	Valco® helium ionization detector @ 150 °C

Porous Polymer Columns

The process used to manufacture porous polymer PLOT columns causes the particles to adhere strongly to the walls of the tubing, so there is virtually no particle generation. You get reproducible performance from column to column, including selectivity and flow.

Rt®-Q-BOND Columns (fused silica PLOT)

100% divinylbenzene

- Nonpolar PLOT column incorporating 100% divinylbenzene.
- 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
0.25 mm	8 µm	to 280/300 °C	19764	19765
0.32 mm	10 µm	to 280/300 °C	19743	19744
0.53 mm	20 µm	to 280/300 °C	19741	19742

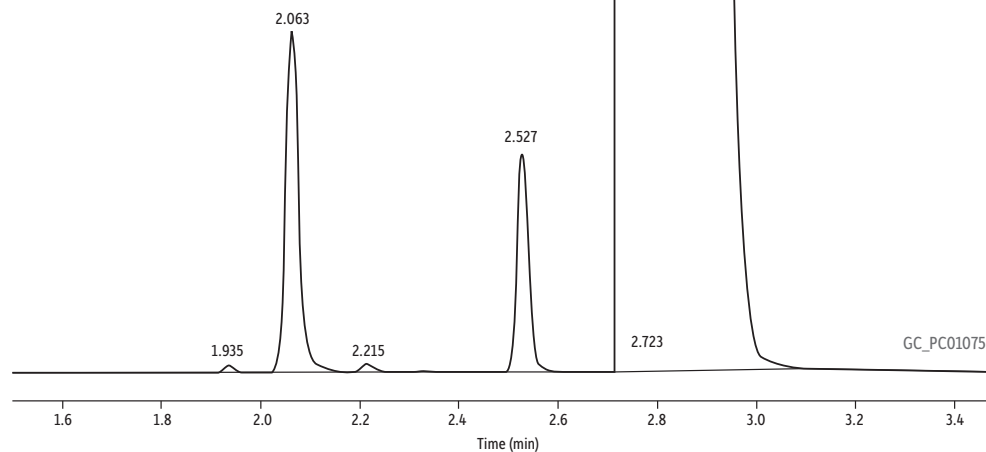
similarp hases

HP PLOT Q, CP-PoraPLOT Q, CP-PoraBond Q, Supel-Q-PLOT, AT-Q

Our porous polymer PLOT columns are not moisture sensitive, making them ideal for applications where moisture is of major concern.

Water and Ethanol in Acetone on Rt®-Q-BOND

Peaks	tR (min)
1. Methane	1.935
2. Water	2.063
3. Methanol	2.215
4. Ethanol	2.527
5. Acetone	2.723



Column Rt®-Q-BOND, 30 m, 0.53 mm ID, 20 µm (cat.# 19742)
Sample Acetone
Diluent: 0.5% Water and ethanol
Injection 3 µL split (split ratio 11:1)
Inj. Vol.: Splitless taper (4 mm) w/wool (cat.# 22405)
Liner: 250 °C
Oven 200 °C (hold 4 min)
Oven Temp: He, constant linear velocity
Carrier Gas: 28.7 cm/sec @ 200 °C
Linear Velocity: TCD @ 260 °C
Detector

Restek porous polymer PLOT columns cover a wide range of polarities

least polar

Q-BOND

QS-BOND

S-BOND

U-BOND

most polar

Fused Silica Porous Polymer Columns, Particle Trap

similarp hases

GS-Q

Rt®-QS-BOND Columns (fused silica PLOT)

porous divinylbenzene homopolymer

- Intermediate polarity PLOT column incorporating low 4-vinylpyridine.
- Separates ethane, ethylene, and acetylene to baseline.

ID	df	temp. limits	15-Meter	30-Meter
0.25 mm	8 µm	to 250 °C	19767	19768
0.32 mm	10 µm	to 250 °C	19739	19740
0.53 mm	20 µm	to 250 °C	19737	19738

similarp hases

CP-PoraPlot S

Rt®-S-BOND Columns (fused silica PLOT)

porous divinylbenzene homopolymer

- Midpolarity PLOT column, incorporating high 4-vinylpyridine.
- Use for the analysis of nonpolar and polar compounds.

ID	df	temp. limits	15-Meter	30-Meter
0.25 mm	8 µm	to 250 °C	19769	19770
0.32 mm	10 µm	to 250 °C	19747	19748
0.53 mm	20 µm	to 250 °C	19745	19746

similarp hases

HP-PLOT U, CP-PoraPLOT U,
CP-PoraBond U**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
0.25 mm	8 µm	to 190 °C	19771	19772
0.25 mm	12 µm	to 190 °C	19782	
0.32 mm	10 µm	to 190 °C	19751	19752
0.53 mm	20 µm	to 190 °C	19749	19750

NEW!



19754

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 switching or backflush is used. In those cases, using particle traps is recommended.

Description	qty.	cat.#
PLOT Column Particle Trap, 2.5 m, 0.32 mm ID with 2 Press-Tight Connectors	ea.	19753
PLOT Column Particle Trap, 2.5 m, 0.53 mm ID with 2 Press-Tight Connectors	ea.	19754

Metal MXT® PLOT Columns

Advantages of metal MXT® PLOT columns include:

- Can be made in small coil diameters—perfect for tight spaces.
- Rugged material withstands rough handling and shock.
- Designed for robust performance in process GCs and field instruments.
- Available in 3.5"-coil diameter or 7"-diameter, 11-pin cage.

Restek chemists have developed technology that allows many of our popular PLOT columns to be made on Siltek®-treated stainless steel. These columns have the same characteristics and performance as fused silica PLOT columns, but offer several additional benefits for process GCs and field applications.

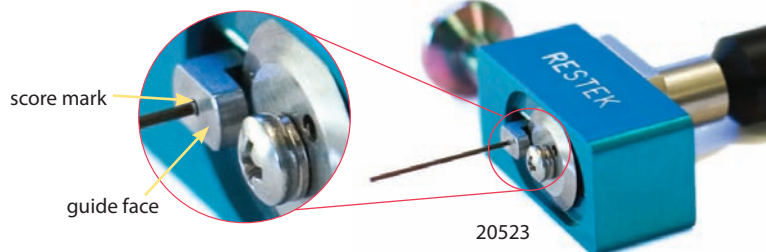
ID	df	temp. limits	3.5" coil 15-Meter	7" diameter 11-pin cage 15-Meter	3.5" coil 30-Meter	7" diameter 11-pin cage 30-Meter
MXT-Msieve 5A						
0.25 mm	20 µm	to 300 °C	79717-273	79717		
0.53 mm	50 µm	to 300 °C			79723-273	79723
MXT-Alumina BOND/Na₂SO₄						
0.53 mm	10 µm	to 200 °C			79714-273	79714
MXT-Alumina BOND/MAPD						
0.53 mm	10 µm	to 250 °C			79728-273	79728
MXT-Q-BOND						
0.25 mm	8 µm	to 300 °C	79718-273	79718		
0.53 mm	20 µm	to 280/300 °C			79716-273	79716
MXT-S-BOND						
0.53 mm	20 µm	to 250 °C			79712-273	79712



Fused Silica & MXT® Capillary GC Column Ferrule Guide

GC Column ID	Ferrule ID
0.10 mm	0.4
0.15 mm	0.4
0.18 mm	0.4
0.25 mm	0.4
0.28 mm	0.4
0.32 mm	0.5
0.45 mm	0.8
0.53 mm	0.8

Enlarged view—score mark flush with guide face.

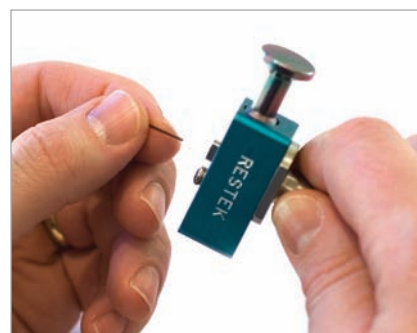


Restek Tubing Scorer for MXT® Columns

- Makes a perfect cut every time.
- Easy to use.
- Leaves column entrance perfectly round.
- Ideal for creating a leak-free seal with connectors and valves.

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.

Description	qty.	cat.#
Restek Tubing Scorer for MXT Columns (0.25-0.53 mm ID & 0.5-0.8 mm OD)	ea.	20523
Replacement Scoring Wheel	ea.	20522



Make a perfect column cut every time!

GC Columns

Packed/Micropacked Columns

Bonded Stationary Phases.....	115–116
Packed Column Tubing	117
Stock Packed Columns.....	118–119
Stock Micropacked Columns.....	120
Application-Specific	
Packed/Micropacked Columns.....	121–124
Packed/Micropacked Column Installation Kits	125
Packed Column Packing Materials	126–129
Liquid Phases for Custom Columns.....	130
USP Liquid Phase & Solid Support	
Cross-Reference	131
Custom Coated Packing Materials	132
Custom Packed/Micropacked Columns.....	133
Packed/Micropacked Column	
Custom Order Form.....	134
Column Configurations	135



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 columns) and bonded Carbowax® phase (Stabilwax® columns) are completely cross-linked on Silcoport® packing. We have evaluated Rtx®-1 and Rtx®-5 bonded packed column phases side by side with non-bonded phases of comparable polarity; the bonded phases last longer than the equivalent nonbonded packing materials. Table I shows that retention times on an Rtx®-1 bonded packed column are highly repeatable after only 30 minutes of conditioning.

Table I: Retention data shows the perfect reproducibility of the bonded phase packed columns with respect to retention times.

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

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.
- Reproducible bonded phase selectivity.
- Low bleed levels.
- 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!

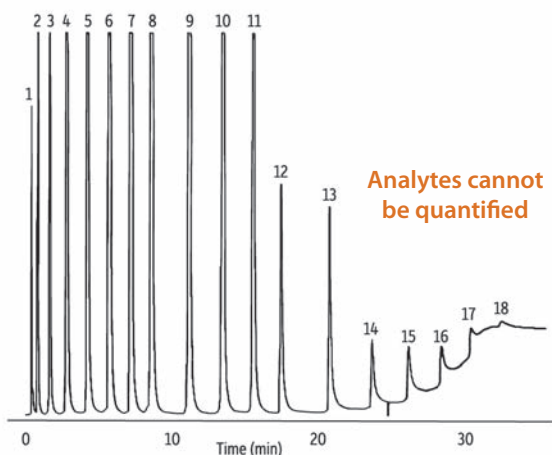
1. Bonded stationary phases mean short conditioning times, low bleed, and unsurpassed column lifetimes.
2. SilcoSmooth® tubing provides the inertness of glass and the durability of stainless steel.
3. Silcoport® diatomaceous earth provides unsurpassed inertness for trace analysis.

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

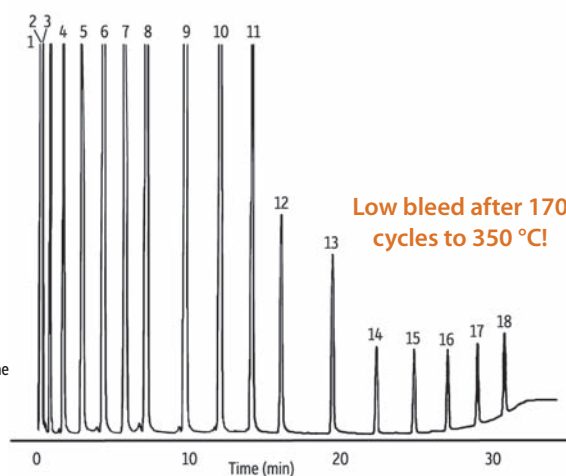
Figure 1: Bonded packed columns exhibit longer lifetime than nonbonded packed columns.

Nonbonded Methyl Silicone



Analytes cannot be quantified

Bonded Rtx®-1



Low bleed after 170 cycles to 350 °C!

GC_PC00369

Column Sample

Rtx®-1 Sim Dist 2887, SilcoSmooth® Tubing, 25 inches, 1/8 in. OD, 2 mm ID (cat.# 80000-800)
1-12% (w/w) each component
ASTM D2887-01 calibration mix (1% each listed analyte in CSs) (cat.# 31674)
ASTM D2887-01 calibration mix (5% each, neat) (cat.# 31675)

Injection

Inj. Vol.: 1.0 µL packed not on-column
Inj. Temp.: 350 °C

Oven

Oven Temp: 35 °C to 350 °C at 10 °C/min (hold 5 min)

Carrier Gas

He, constant flow

Flow Rate

25 mL/min

Detector

FID @ 350 °C

Notes

FID sensitivity: 256 x 10⁻¹¹ AFS

Packed Column Tubing

Restek offers a wide range of tubing choices for our packed columns, including SilcoSmooth® (Siltek®-treated stainless steel), stainless steel, PTFE, nickel, copper, and Hastelloy® tubing. SilcoSmooth® and stainless steel tubing are our two most popular column materials. SilcoSmooth® tubing is an excellent replacement for fragile glass columns. Stainless steel tubing works well with most applications for nonreactive compounds.

SilcoSmooth® Tubing

If your analysis involves reactive compounds, you can use fragile and inflexible glass columns, or you can step up to SilcoSmooth® tubing, which combines the inertness of glass with the strength and flexibility of stainless steel. Made from ultra-smooth, seamless 304 stainless steel and treated with the innovative Siltek® deactivation process, SilcoSmooth® tubing can replace glass columns for virtually any application.

Stainless Steel Tubing

If you are analyzing hydrocarbons or nonreactive compounds, you can use our rugged, flexible, and economical stainless steel columns. Restek stainless steel columns are made from high-quality weldrawn tubing.

Hastelloy® Tubing

Hastelloy® tubing is a nickel-chromium alloy with excellent inertness. It is normally used only for highly corrosive or oxidizing compounds or gases.

Nickel Tubing

Nickel tubing is often used for analyses of caustic or oxidizing compounds or gases.

Copper Tubing

Copper is a general-purpose tubing that is only recommended for nonactive compounds.

PTFE Tubing

PTFE 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 5.3 mm ID	³ / ₁₆ -inch OD x 3.2 mm ID ¹	¹ / ₈ -inch OD x 2.0 mm ID ²	¹ / ₈ -inch OD x 2.1 mm ID	¹ / ₁₆ -inch OD x 1.0 mm ID ³	0.95 mm OD x 0.75 mm ID ⁴	0.74 mm OD x 0.53 mm ID
SilcoSmooth	✓	✓	✓		✓	✓	✓
Stainless Steel	✓	✓		✓	✓	✓	
Hastelloy				✓			
Nickel				✓			
Copper	✓			✓			
PTFE				✓			

¹ ³/₁₆-inch OD x 3.2 mm ID replaces ¹/₄-inch OD x 4 mm ID glass columns.

² ¹/₈-inch OD x 2.0 mm ID replaces ¹/₄-inch OD x 2 mm ID glass columns.

³ ¹/₁₆-inch OD x 1.2 mm and 1.0 mm ID micropacked columns are designed for packed column injection systems.

⁴ 0.95 mm OD x 0.75 mm ID micropacked columns are designed for capillary injection systems.

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 and availability.



Welded Tubing Reducers



Welded VCR Fittings

please note

We do not offer glass packed columns. SilcoSmooth® columns offer the inertness of glass, without breakage problems.

Stock Packed Columns

Bonded Packed Column Stationary Phases

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

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.

Bonded Phase on 100/120 Silcoport W	Stainless Steel Tubing				SilcoSmooth Tubing**			
	L (ft)	OD (in)	ID (mm)	cat.#*	L (m)	OD (in)	ID (mm)	cat.#*
3% Rtx-1	6	1/8	2.1	80441-	2	1/8	2.0	80401-
10% Rtx-1	6	1/8	2.1	80442-	2	1/8	2.0	80405-
20% Rtx-1	6	1/8	2.1	80443-	2	1/8	2.0	80409-
3% Rtx-5	6	1/8	2.1	80444-	2	1/8	2.0	80477-
10% Rtx-5	6	1/8	2.1	80445-	2	1/8	2.0	80478-
20% Rtx-5	6	1/8	2.1	80446-	2	1/8	2.0	80479-
5% Rtx-Stabilwax	6	1/8	2.1	80447-	2	1/8	2.0	80415-
10% Rtx-Stabilwax	6	1/8	2.1	80448-	2	1/8	2.0	80416-
20% Rtx-Stabilwax	6	1/8	2.1	80449-	2	1/8	2.0	80417-
Rtx-1 SimDist 2887***	25"	1/8	2.1	80450-	25"	1/8	2.0	80000-

*Please add column instrument configuration suffix number to cat.# when ordering. See chart on the next page.

**Siltek-treated stainless steel.

***Application specific column.

Chromosorb® Diatomaceous Earth Supports

On 100/120 Silcoport W***	Stainless Steel Tubing				SilcoSmooth Tubing**			
	L (ft)	OD (in)	ID (mm)	cat.#*	L (m)	OD (in)	ID (mm)	cat.#*
3% Rt-101	6	1/8	2.1	80461-	2	1/8	2.0	80400-
3% Rt-2100	6	1/8	2.1	80462-	2	1/8	2.0	80420-
5% Rt-1200/1.75% Bentone 34	6	1/8	2.1	80463-	2	1/8	2.0	80125-
5% Rt-1200/5% Bentone 34	6	1/8	2.1	80464-	2	1/8	2.0	80129-

On Chromosorb PAW	Mesh	Stainless Steel Tubing				SilcoSmooth Tubing**			
		L (ft)	OD (in)	ID (mm)	cat.#*	L (m)	OD (in)	ID (mm)	cat.#*
10% TCEP	100/120	8	1/8	2.1	80465-	2.5	1/8	2.0	80126-
23% Rt-1700	80/100	30	1/8	2.1	80466-	9.2	1/8	2.0	80128-

*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 130**.

Porous Polymer Packed Columns

Restek offers a full range of porous polymers, including HayeSep®, Porapak, and Chromosorb® Century Series polymer packings 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.#*	L (m)	OD (in)	ID (mm)	cat.#*
HayeSep Q	6	1/8	2.1	80467-	2	1/8	2.0	80433-
Porapak Q	6	1/8	2.1	80468-	2	1/8	2.0	80427-
Porapak QS	6	1/8	2.1	80469-	2	1/8	2.0	80426-
Porapak R	6	1/8	2.1	80470-	2	1/8	2.0	80425-

*Please add column instrument configuration suffix number to cat.# when ordering. See chart on the next page.

**Siltek-treated stainless steel.

also available

Chromosorb®, Porapak, HayeSep®, and Tenax® packing materials. See **page 129**.

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 Carbowax™ and Carbowax graph supports.

On CarboBlack B	Mesh	Stainless Steel Tubing				SilcoSmooth Tubing**			
		L (ft)	OD (in)	ID (mm)	cat.#*	L (m)	OD (in)	ID (mm)	cat.#*
5% Carbowax 20M	80/120	—	—	—	—	2	1/8	2.0	80105-
5% Carbowax 20M	60/80	6	1/8	2.1	88012-	1.8	1/8	2.0	80106-
6.6% Carbowax 20M	80/120	6	1/8	2.1	80451-	2	1/8	2.0	80107-
4% Carbowax 20M/ 0.8% KOH	60/80	—	—	—	—	2	1/8	2.0	80116-
1% Rt-1000	60/80	8	1/8	2.1	88013-	2.4	1/8	2.0	80206-
1% Rt-1000	60/80	6	1/8	2.1	80452-	2	1/8	2.0	80207-
3% Rt-1500	80/120	10	1/8	2.1	80453-	3.05	1/8	2.0	80211-
1% Rt-1510	60/80	10	1/8	2.1	80454-	3.05	1/8	2.0	80216-
1.5% XE-60/1% H ₃ PO ₄	60/80	6	1/8	2.1	80455-	1.8	1/8	2.0	80305-

*Please add column instrument configuration suffix number to cat.# when ordering. See chart on this page.

**Siltek-treated stainless steel.

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

*Please add column instrument configuration suffix number to cat.# when ordering. See chart on this page.

On CarboBlack C	Mesh	Stainless Steel Tubing				SilcoSmooth Tubing**			
		L (ft)	OD (in)	ID (mm)	cat.#*	L (m)	OD (in)	ID (mm)	cat.#*
0.2% Carbowax 1500	60/80	6	1/8	2.1	80456-	2	1/8	2.0	80121-
0.2% Carbowax 1500	80/100	6	1/8	2.1	80457-	2	1/8	2.0	80122-
0.1% Rt-1000	80/100	6	1/8	2.1	80458-	1.8	1/8	2.0	80205-
0.19% picric acid	80/100	6	1/8	2.1	80459-	2	1/8	2.0	80311-

*Please add column instrument configuration suffix number to cat.# when ordering. See chart on this page.

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.#*	L (m)	OD (in)	ID (mm)	cat.#*
Molesieve 5A	60/80	6	1/8	2.1	80473-	2	1/8	2.0	80428-
Molesieve 5A	80/100	3	1/8	2.1	88015-	1	1/8	2.0	80440-
Molesieve 5A	80/100	6	1/8	2.1	80474-	2	1/8	2.0	80429-
Molesieve 5A	80/100	10	1/8	2.1	88014-	3.05	1/8	2.0	80430-
Molesieve 13X	60/80	6	1/8	2.1	80475-	2	1/8	2.0	80480-
Molesieve 13X	80/100	6	1/8	2.1	80476-	2	1/8	2.0	80439-

*Please add column instrument configuration suffix number to cat.# when ordering. See chart on this page.

**Siltek-treated stainless steel.

also available

CarboBlack packing materials. See **page 127**.

Column Instrument Configurations

General Configuration
Suffix -800



Agilent 5880, 5890, 5987,
6890, 7890:
Suffix -810*



Bruker 430, 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 135 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.

Custom
Packed/Micropacked
Column Request Form

See **page 134** or visit

www.restek.com/packed

Stock Micropacked Columns



All micropacked columns are made with inert SilcoSmooth® tubing, which is Siltek® treated for maximum inertness. See **page 117**.

Micropacked GC 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 (0.95 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.

Micropacked GC Columns (0.53 mm ID)

- Available with a variety of packing materials.
- High capacity and retention for volatile compounds.
- Can be coiled to fit any GC.

	Mesh	ID	OD	Temp. Range	1-Meter	2-Meter
HayeSep Q	80/100	0.53 mm	0.74 mm	up to 275 °C		19042
Molesieve 5A	80/100	0.53 mm	0.74 mm	up to 300 °C		19041
Rt-XLSulfur	100/120	0.53 mm	0.74 mm	up to 300 °C		19044
ShinCarbon ST	80/100	0.53 mm	0.74 mm	up to 330 °C	19045	19043

Micropacked GC Columns (0.75 mm ID)

	ID	OD	Temp. Range	0.56-Meter
20% TCEP on 80/100 Chromosorb PAW	0.75 mm	1/16"	0–175 °C	19040

	Mesh	ID	OD	Temp. Range	1-Meter	2-Meter
HayeSep R	100/120	0.75 mm	0.95 mm	up to 250 °C	19014	19015
HayeSep Q	100/120	0.75 mm	0.95 mm	up to 275 °C	19018	19019
HayeSep N	100/120	0.75 mm	0.95 mm	up to 165 °C	19022	19023
HayeSep S	100/120	0.75 mm	0.95 mm	up to 250 °C	19010	19011
Molesieve 5A	80/100	0.75 mm	0.95 mm	up to 300 °C	19002	19003
Molesieve 13X	80/100	0.75 mm	0.95 mm	up to 350 °C	19006	19007

Micropacked GC Columns (1.00 mm ID)

	Mesh	ID	OD	Temp. Range	1-Meter	2-Meter
HayeSep R	100/120	1.00 mm	1/16"	up to 250 °C	19012	19013
HayeSep Q	100/120	1.00 mm	1/16"	up to 275 °C	19016	19017
HayeSep N	100/120	1.00 mm	1/16"	up to 165 °C	19020	19021
HayeSep S	100/120	1.00 mm	1/16"	up to 250 °C	19008	19009
Molesieve 5A	80/100	1.00 mm	1/16"	up to 300 °C	19000	19001
Molesieve 13X	80/100	1.00 mm	1/16"	up to 350 °C	19004	19005

Custom

Packed/Micropacked
Column Request FormSee **page 134** or visitwww.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.
- Listed in the appendix of ASTM Method D3606 as an acceptable alternative to TCEP columns—get better separation of benzene and ethanol while still following ASTM method requirements.

Conforms to the specifications established in ASTM method D3606-10 for the quantitation of benzene and toluene in spark ignition fuel containing ethanol.

Description	cat.#*
D3606 Application Column (2 column set)**	
Column 1: 6' (1.8 m), 1/8" OD, 2.0 mm ID, nonpolar Rtx-1	83606-
Column 2: 16' (4.9 m), 1/8" OD, 2.0 mm ID, proprietary packing material	

*Please add column instrument configuration suffix number to cat.# when ordering. See page 119.

**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.



free literature

Resolve Benzene and Toluene
in Spark Ignition Fuels
Containing Ethanol

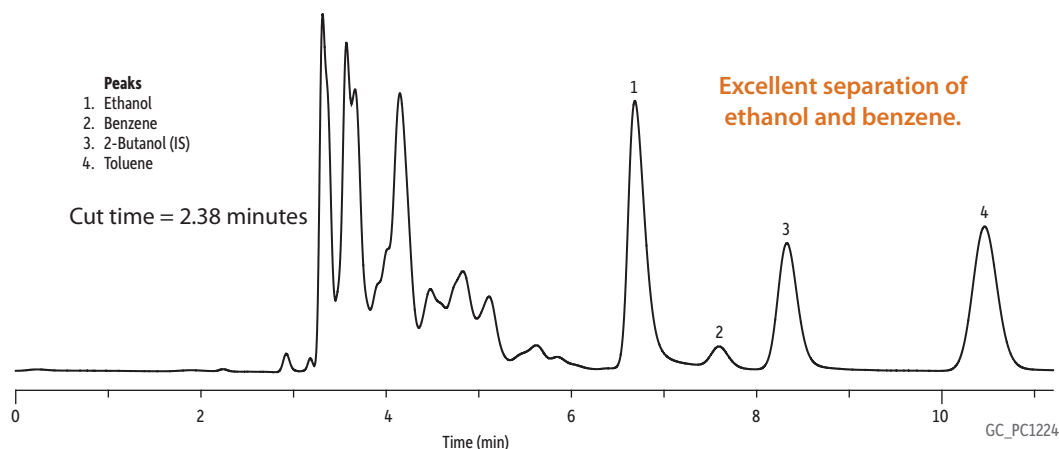
Download your
free copy from

www.restek.com

lit. cat.#
PCTS1408-UNV



Gasoline Containing Ethanol on D3606 Application Column Set by ASTM D3606-10 (Modified)



Column	D3606 application column (2 column set). Column 1: 6' (1.8 m), 1/8" OD, 2.0 mm ID, nonpolar Rtx®-1; Column 2: 16' (4.9 m), 1/8" OD, 2.0 mm ID, proprietary packing material (cat.# 83606-800)
Sample	Ethanol-containing gasoline with internal standard (IS)
Diluent:	
Injection	Sample valve
Sample Loop Vol.:	1.5 µL
Valve Temp.:	150 °C
Oven	
Oven Temp.:	135 °C (hold 12 min)
Carrier Gas	He, constant flow
Flow Rate:	20.0 mL/min
Detector	TCD @ 200 °C
Notes	2.38 minute backflush (must be determined for each GC system).

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 three-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.#
<i>n</i> -Octane on Res-Sil C, 80/100 (20', 2.0 mm ID, 1/8" Silcosmooth OD)	80436-
OPN on Res-Sil C, 80/100 (12', 2.0 mm ID, 1/8" Silcosmooth OD)	80437-
2abc Refinery Gas Column Set (3 column set)**	88000-
2.1% Carbowax 1540 Porasil C (backflush column)***	88004-875

*Please add column instrument configuration suffix number to cat.# when ordering. See chart on this page.

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

***To be used with 2abc refinery gas column set (cat.# 88000-) to backflush and prevent C6+ hydrocarbons from entering column set.

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

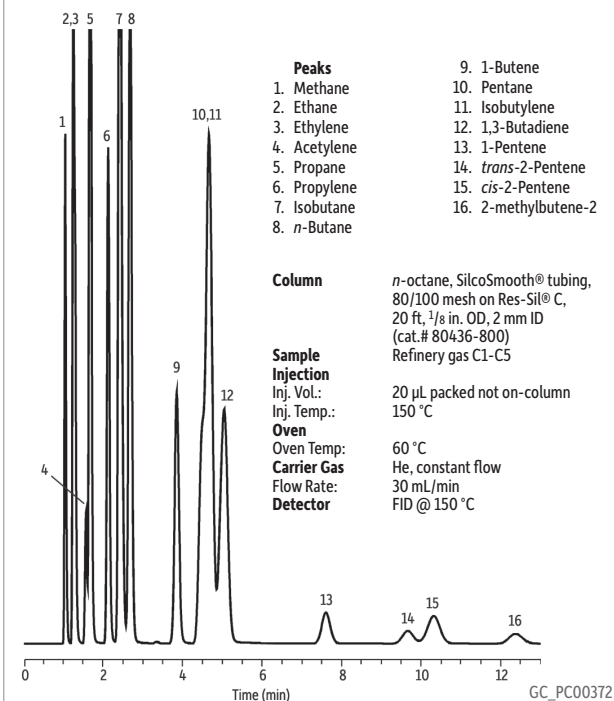


Figure 2: OPN on Res-Sil® C packing demonstrates unique selectivity for *cis*-2-butene and 1,3-butadiene.

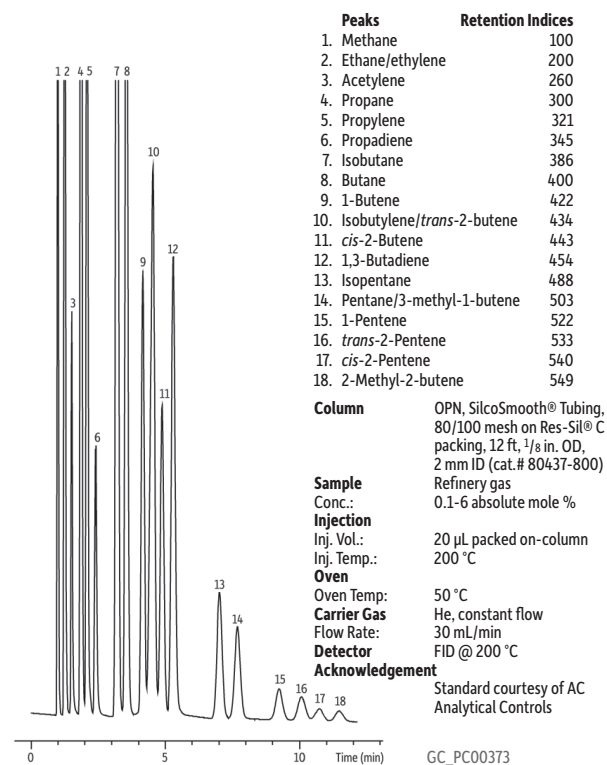
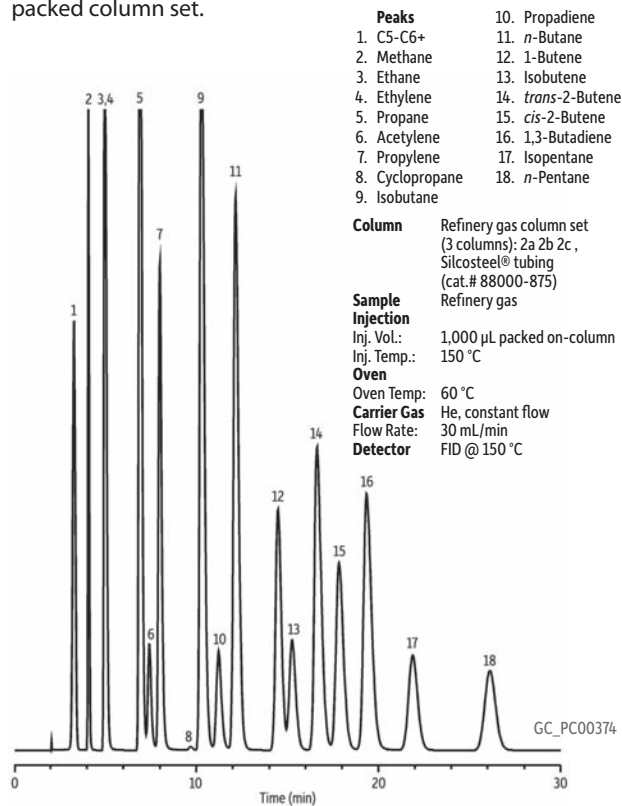


Figure 3: Refinery gas calibration standard on refinery gas packed column set.



for more info

See **page 128** 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.
- Maximum temperature of 280 °C/300 °C.

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 300 °C upper programmed 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, reduces downtime.

ShinCarbon ST Columns (packed) (SilcoSmooth® Stainless Steel)*

OD	ID	Mesh	2-Meter
1/8" Silcosmooth	2.0 mm	80/100	80486-

*Please add column instrument configuration suffix number to cat.# when ordering. See chart on the next page.

ShinCarbon ST Columns (micropacked) (SilcoSmooth® Stainless Steel)**

OD	ID	Mesh	1-Meter	2-Meter
1/16"	1.0 mm	100/120	19809	19808
0.95 mm	0.75 mm	100/120	19810	
0.74 mm	0.53 mm	80/100	19045	19043

**Does not include column nuts and ferrules. Optional installation kits can be ordered separately—see page 125.

it's a fact

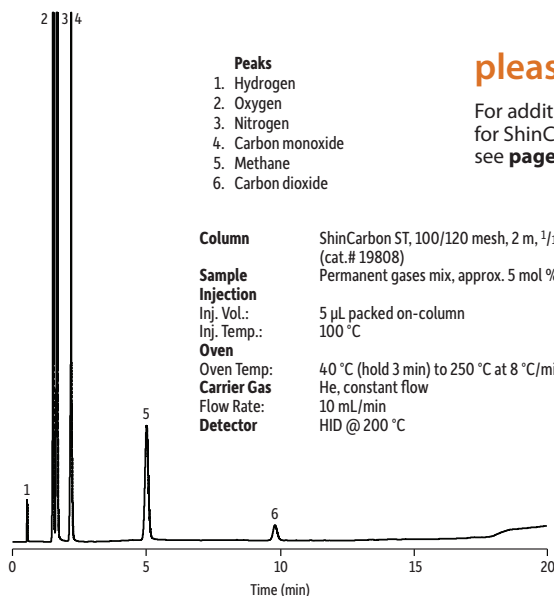
ShinCarbon ST is an ideal packing material for permanent gases, low molecular weight hydrocarbons, sulfur dioxide, and Freon® gases.

also available

For adapter kits for installing packed/micropacked columns, see **page 125**.



Permanent Gases on ShinCarbon ST



please note

For additional chromatograms for ShinCarbon ST columns, see **pages 659 and 677**.

free literature

ShinCarbon ST
Micropacked GC Columns
Above-Ambient Analyses of
Permanent Gases and
Light Hydrocarbons

Download your free copy from

www.restek.com

lit. cat.#

PCTS1472-UNV



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 125**.

free literature

Rt®-XLSulfur Packed Column
Specialized packed and micropacked columns for eXtra-Low Sulfur analysis

Download your free copy from

www.restek.com

lit. cat.#
PCTS1500-UNV



Sulfur Analysis

Rt®-XLSulfur Packed/Micropacked Columns

- Optimized columns for low ppbv sulfur analyses.
- Eliminate the need for PTFE tubing.
- Column and end fittings are Sulfinert® treated for maximum inertness.
- Maximum temperature of 290 °C.

Sulfur analyses are traditionally performed using PTFE tubing to improve column inertness. Unfortunately, PTFE 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 PTFE. The extra care taken to manufacture this column ensures more accurate analyses of sulfur compounds.

Rt®-XLSulfur Columns (packed)*

OD	ID	Mesh	1-Meter	2-Meter
1/8"	2.0 mm	100/120	80484-	80485-
3/16"	3.2 mm	100/120	80482-	80483-

*Please add column instrument configuration suffix number to cat.# when ordering. See chart on this page.

Rt®-XLSulfur Columns (micropacked)**

OD	ID	Mesh	1-Meter	2-Meter
1/16"	1.0 mm	100/120	19804	19805
0.95 mm	0.75 mm	100/120	19806	19807
0.74 mm	0.53 mm	100/120		19044

**Does not include column nuts and ferrules. Optional installation kits can be ordered separately—see page 125.

Column Instrument Configurations



General Configuration
Suffix -800



Agilent 5880, 5890, 5987,
6890, 7890:
Suffix -810*



Bruker 430, 3700, Vista Series, FID:
Suffix -820



PE 900-3920, Sigma 1,2,3:
Suffix -830



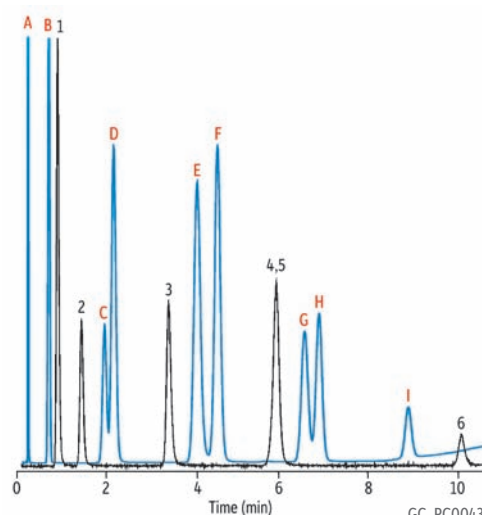
PE Auto System 8300, 8400, 8700
Suffix -840

See page 135 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.

Sulfur Compounds and Hydrocarbons on Rt®-XLSulfur



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 Sample

Conc.: 50 ppb each
Injection: packed not on-column

Oven

Oven Temp: 60 °C to 230 °C at 15 °C/min

Carrier Gas

He, constant flow

Flow Rate:

9 mL/min

Detector

SCD/FID

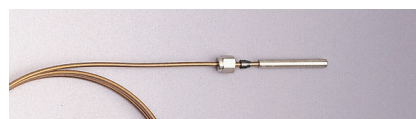
Acknowledgement

Sulfur standards courtesy of DCG Partnership 1 Ltd., Pearland, TX.

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 and ferrules used to attach tubing to the injector or detector.

Description	For 1/8" Columns		For 3/16" Columns	
	qty.	cat.#	qty.	cat.#
Packed Column Inlet Adaptor Kit for 1/4" Injection Ports	kit	21651	kit	21650



Adaptor kit centers the packed column in the injection port, so the syringe will not scrape the sides of the column.

Installation Kits for Micropacked Columns

Description	qty.	cat.#
Micropacked Column Installation Kit for 1 mm 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 1 mm 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



21065

Installation Kit for Packed Columns

Description	qty.	cat.#
Packed Column Installation Kit for 2 mm ID columns; for valve applications. Kit contains: 1/8" stainless steel nut (1), stainless steel Valco nut (1), 1/8" Vespel/graphite ferrule (1), stainless steel Valco ferrule (1), 1/8" stainless steel front ferrule (1), 1/8" stainless steel back ferrule (1).	kit	21067



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, 6890, and 7890 GCs.
- Sample pathways deactivated for ultimate inertness.

Description	qty.	cat.#
Micropacked Column Adaptor Kit for Split/Splitless Injection* <i>Complete kit with FID and injection port adaptors</i> Kit includes: dual Vespel ring inlet seal, large bore; reducing nut, large bore; FID adaptor, large bore; 1/4" ferrule, Vespel/graphite; 1/4" nut, stainless steel; 1/16" ferrules, Vespel/graphite (2); 4 mm splitless liner, intermediate polarity deactivated; 1/16" nuts, stainless steel (2)	kit	22424
Micropacked Column Adaptor Kit for On-Column Injection* <i>Complete kit with FID and injection port adaptors</i> Kit includes: dual Vespel ring inlet seal, large bore; reducing nut, large bore; FID adaptor, large bore; 1/4" ferrule, Vespel/graphite; 1/4" nut, stainless steel; 1/16" ferrules, Vespel/graphite (2); Siltek treated metal liner installation guide; 1/16" nuts, stainless steel (2)	kit	22425
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; 4 mm 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
Micropacked Column Adaptor Kit for FID* <i>FID Adaptor Kit</i> Kit includes: FID adaptor, large bore; 1/4" ferrule, Vespel/graphite; 1/4" nut, stainless steel; 1/16" nut, stainless steel; 1/16" ferrule, Vespel/graphite	kit	22428
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 4 mm Splitless Liner	ea.	20772

*For use with packed column FIDs only.



Large-Bore Dual Vespel® Ring Inlet Seals



1/4" SS Nut

Large-Bore FID Adaptor



1/4" Vespel®/Graphite Ferrule



1/16" SS Nuts



Large-Bore Reducing Nut



1/16" Vespel®/Graphite Ferrules



22430

20772

restek
innovation!



did you know?

Silcoport support replaces

- Supelcoport
- Chromosorb® W HP
- GasChrom Q 2

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 require a solid support to meet the challenging demands faced by analysts. Unlike conventional dimethyldichlorosilane (DMDCS) deactivation, Silcoport® incorporates our proprietary fused silica deactivation technology on diatomaceous earth solid supports. Silcoport® supports were developed using a special mixture of deactivants that yields the highest inertness without changing the polarity of the stationary phase. Silcoport® supports from Restek are the perfect match for highly inert SilcoSmooth® tubing.

Description	Temp. Limit	Mesh	Min. Qty.†	cat. #
Silcoport P*	400 °C	80/100	100 g	25641
	400 °C	100/120	100 g	25642

*Prepared from Chromosorb P; Restek acid washed deactivation.

†Bulk quantities are available.

**Please call for
availability.**

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.

Custom

Packed/Micropacked Column Request Form



See **page 134** or visit

www.restek.com/packed



CarboBlack Packing Materials

- CarboBlack B supports up to 10% loading of a nonsilicone liquid phase.
- CarboBlack C supports up to 1% loading of a nonsilicone liquid phase.
- Equivalent to Supelco's CarboPack™ packings.

Graphitized carbon black offers unique selectivity and very little adsorption for alcohol analyses. Two types of CarboBlack supports are available, CarboBlack B and CarboBlack C. CarboBlack B support, with its higher surface area, can hold up to a 10% loading of a nonsilicone liquid phase. CarboBlack C support can hold up to a 1% loading of a nonsilicone liquid phase. Many Carbowax® 20M-loaded CarboBlack packings are available. CarboBlack packings are treated with KOH or picric acid for basic or acidic compounds, and special alcoholic beverage loadings are available. CarboBlack supports provide resolution and retention similar to CarboPack™ and Carbograph supports.

Description	Temp. Limit	Mesh	Min. Qty.	cat. #
CarboBlack B	500 °C	60/80	10 g	25500
	500 °C	80/120	10 g	25501
CarboBlack C	500 °C	60/80	10 g	25502
	500 °C	80/100	10 g	25503
CarboBlack BHT-100	150 °C	40/60	10 g	25504
CarboBlack III (F)	175 °C	80/100	10 g	25506
5% Carbowax 20m on CarboBlack B	225 °C	80/120	10 g	25507
6.6% Carbowax 20m on CarboBlack B	225 °C	80/120	10 g	25508
4% Carbowax 20m / 0.8% KOH on CarboBlack B	220 °C	60/80	10 g	25509
0.19% picric acid on CarboBlack C	120 °C	80/100	10 g	25510
4% Carbowax 20m on CarboBlack B-DA	200 °C	80/120	10 g	25511

Minimum order of 10 grams. Price is per gram.

did you know?**CarboBlack supports replace**

- CarboPack™
- Carbograph



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 with everything from setup 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: 1-814-353-1568 • e-mail: support@restek.com

Hours of operation (Eastern Time):

Monday - Thursday, 8:00 a.m. to 6:00 p.m.

Friday, 8:00 a.m. to 5:00 p.m.

Outside the U.S.? Contact your Restek representative.

also available

Custom packing materials are also available. See **page 132**.

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 122). 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 and to ensure there are no retention shifts. Column bleed is also evaluated to ensure that baselines remain low.

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	Mesh	Min. Qty.	cat. #
Res-Sil C	300 °C	60/80	10 g	25400
	300 °C	80/100	10 g	25028
Res-Sil B	300 °C	60/80	10 g	25401
	300 °C	80/100	10 g	25080
1% TCEP on Res-Sil B	175 °C	80/100	10 g	25081
OPN on Res-Sil C	150 °C	80/100	10 g	25042
<i>n</i> -Octane on Res-Sil C	150 °C	80/100	10 g	25030
2% Carbowax 1540 on Res-Sil C	150 °C	80/100	10 g	25044

Minimum order of 10 grams. Price is per gram.

¹N.C. Saha, S.K. Jain, and R.K. Dua. J. Chromat. Sci 1978, 323-328.

did you know?

Res-Sil® replaces

- Porasil B
- Porasil C

Custom

Packed/Micropacked Column Request Form

See **page 134** or visit

www.restek.com/packed



Chromosorb® Century Packings

Description	Temp. Limits	g/btl.	Mesh 60/80 Mesh 80/100		Mesh 100/120
			cat.#	cat.#	cat.#
Chromosorb 101	275/325 °C	50 g	25608	25609	25610
Chromosorb 102	250/300 °C	50 g	25611	25612	25613
Chromosorb 103	275/300 °C	50 g	25614	25615	25616
Chromosorb 104	(equivalent to HayeSep C)				
Chromosorb 106	250/275 °C	50 g	25620	25621	25622
Chromosorb 107	250/275 °C	50 g	25623	25624	25625
Chromosorb 108	250/275 °C	50 g	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.#	cat.#	cat.#
Porapak P	250 °C	20 g	25576	25577	25578
Porapak PS	250 °C	20 g	25579	25580	25581
Porapak Q	250 °C	26 g	25582	25583	25584
Porapak QS	250 °C	26 g	25585	25586	25587
Porapak R	250 °C	24 g	25588	25589	25590
Porapak S	250 °C	26 g	25591	25592	25593
Porapak N	190 °C	29 g	25594	25595	25596
Porapak T	190 °C	31 g	25597	25598	25599

also available

Custom packing materials are also available. See **page 132**.

HayeSep® Series Packings

Description	Temp. Limit	g/btl.	Mesh 60/80	Mesh 80/100	Mesh 100/120
			cat.#	cat.#	cat.#
HayeSep A	165 °C	24 g	22560	25032	25033
HayeSep B	190 °C	24 g	25561	25034	25035
HayeSep C	250 °C	24 g	25562	25036	25037
HayeSep D	290 °C	24 g	25563	25038	25039
HayeSep DIP	290 °C	24 g	25564	25565	25566
HayeSep DB	290 °C	24 g	25567	25568	25569
HayeSep DOX	(Use HayeSep DB)				
HayeSep N	165 °C	24 g	25570	25045	25046
HayeSep P	250 °C	24 g	25571	25047	25048
HayeSep Q	275 °C	24 g	25572	25049	25050
HayeSep R	250 °C	24 g	25573	25051	25052
HayeSep S	250 °C	24 g	25574	25053	25054
HayeSep T	165 °C	24 g	25575	25055	25056

Tenax® Packings

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

Restek's Learning Network

Sign up for our widely acclaimed seminars today!

Learn more at www.restek.com/seminars



Liquid Phases for Custom Columns

We can prepare packed and micropacked 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	Polyethylene 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 900	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 U.S. 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	Nonylphenoxy poly(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 50 m ² /g and an average pore diameter of 0.3 to 0.4 µm	Chromosorb 101
S3	Ethylvinylbenzene-divinylbenzene copolymer with nominal surface area of 500 to 600 m ² /g and an average pore diameter of 0.0075 µm	Hayesep Q
S4	Styrene-divinylbenzene copolymer with aromatic -O and -N groups having a nominal surface area of 400 to 600 m ² /g and an average pore diameter of 0.0076 µm	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 350 m ² /g and an average pore diameter of 0.0091 µm	Chromosorb 102
S7	Graphitized carbon having a nominal surface area of 12 m ² /g	CarboBlack C
S8	Copolymer of 4-vinyl-pyridine and styrene-divinylbenzene	Hayesep S
S9	Porous polymer based on 2,6-diphenyl-p-phenylene oxide	Tenax TA
S10	Highly cross-linked copolymer of acrylonitrile and divinylbenzene	HayeSep C
S11	Graphitized carbon having a nominal surface area of 100 m 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 100 m ² /g	CarboBlack B

Technical Service

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: 1-814-353-1568
e-mail: support@restek.com

Hours of operation (Eastern Time):

Monday - Thursday,
8:00 a.m. to 6:00 p.m.
Friday, 8:00 a.m. to 5:00 p.m.

Outside the U.S.? Find a distributor at

www.restek.com/distributor

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 130 and the coating ranges are listed in the chart. Coated packings are available in minimum orders of 20 grams.

To order, contact 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
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)	45/60, 60/80, 80/100, 100/120
Chromosorb G, P or W (AW or DMDCS)***	10% (G) 25% (W)	45/60, 60/80, 80/100, 100/120
Chromosorb T	15%	40/60
Silcoport P	30%	80/100, 100/120
Silcoport W BW	20%	80/100, 100/120
Silcoport W (replacement for Chromosorb 750)	20%	80/100, 100/120

*Nonsilicone phase.

**Silicone phase.

***Note: Chromosorb W (AW only) maximum coating is 25%.

NAW—nonacid washed

AW—acid washed

DMDCS—dimethyldichlorosilane

BW—base washed

For coatings over 15% or quantities over 50 grams, please call your Restek representative.

ordering note

Mesh Size

When ordering a packed column solid support, please specify mesh size. Refer to this chart to convert microns to mesh size.

Example:

150–180 micron particles = 80/100 mesh

(μm)	Mesh Size
850	20
710	25
600	30
500	35
425	40
355	45
300	50
250	60
212	70
180	80
150	100
125	120
106	140
90	170
75	200
63	230
53	270

ordering note

Special phases that require a surcharge:

OV®-275, OV®-330, OV®-225, BMBT, 2,4-dimethylsulfolane, Silar, OV®-1701, and XE-60. Call your Restek representative for pricing.

Custom Packed 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 134 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.

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 125), 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 134 or visit
www.restek.com/packed

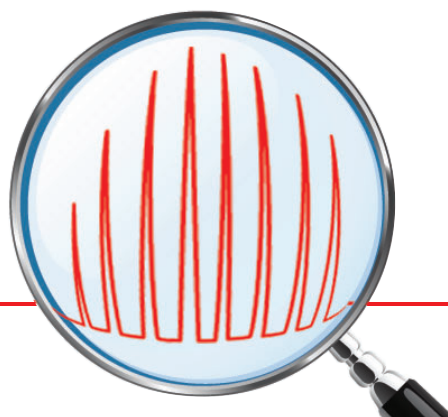
ordering note

For international pricing on custom packed or micropacked columns, please contact your Restek representative.

Chromatogram Search Tool

Search by **compound name**,
synonym, **CAS #**, or **keyword**

www.restek.com/chromatograms



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 ☐ PTFE

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 _____" voidDo you want this column preconditioned? ☐ Yes (additional charge) ☐ No

Standard configuration suffix number (next page):

Frits ☐ Hastelloy® ☐ Siltek®

Special configuration (next page): Figure: _____ Dimensions: _____

Welded Tubing Reducers ☐ (additional charge)

Special Instructions: _____

Fittings (check appropriate circle)☐ **KIT 1S** $\frac{1}{4}$ " brass nuts $\frac{1}{4}$ " to $\frac{1}{8}$ " V/G reducing ferrules

No additional charge

☐ **KIT 2S** $\frac{1}{4}$ " brass nuts $\frac{1}{4}$ " to $\frac{3}{16}$ " V/G reducing ferrules

No additional charge

☐ **KIT A** $\frac{1}{8}$ " brass nuts $\frac{1}{8}$ " V/G ferrules

No additional charge

☐ **KIT B** $\frac{1}{8}$ " brass nuts $\frac{1}{8}$ " brass front & back ferrules

No additional charge

V/G = Vespel®/graphite

☐ **KIT C** $\frac{1}{8}$ " stainless steel nuts $\frac{1}{8}$ " stainless steel front & back ferrules

Additional charge

☐ **KIT D** $\frac{1}{8}$ " stainless steel nuts $\frac{1}{8}$ " V/G ferrules

Additional charge

☐ **KIT E** $\frac{1}{4}$ " stainless steel nuts $\frac{1}{4}$ " to $\frac{1}{8}$ " V/G reducing ferrules

Additional charge

☐ **KIT F** $\frac{1}{4}$ " stainless steel nuts $\frac{1}{4}$ " to $\frac{3}{16}$ " V/G reducing ferrules

Additional charge

☐ **KIT V** $\frac{1}{8}$ " VCR fitting

check appropriate circle:

☐ Stainless Steel (additional charge)☐ Nickel (additional charge)**for a quote:**

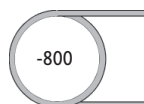
Complete this form and fax to Restek at 814-353-1309, or to your Restek representative.

This form is also available online at:

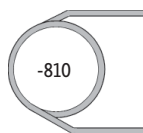
www.restek.com/packed

Standard Configurations (choose one)

General Configuration



Agilent 5880, 5890, 5987, 6890, 7890



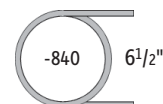
Bruker 430, 450 (Varian 3700, Vista Series, FID)



PE 900-3920, Sigma 1,2,3



PE Auto System 8300, 8400, 8700



-810 Agilent 5880, 5890, 5987, 6890, 7890

-811 Agilent 6850

-820 Bruker 430, 450 (Varian 3700, Vista Series, FID)

-821 Bruker 430, 450 (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 134, or at www.restek.com/packed)

Figure 1

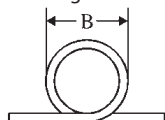


Figure 2

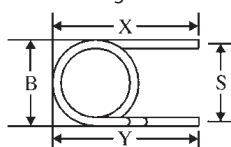


Figure 3



Figure 4



Figure 5

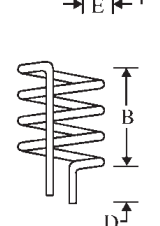
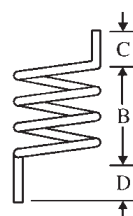
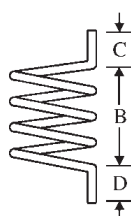
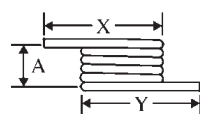


Figure 6

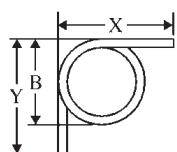


Figure 7

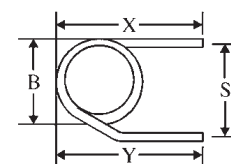


Figure 8

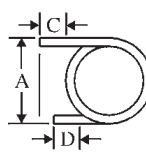


Figure 9

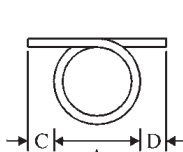


Figure 10

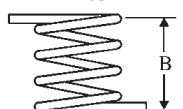
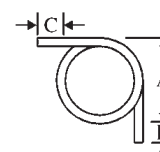


Figure 11

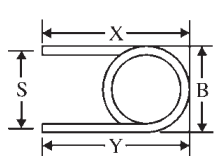


Figure 12

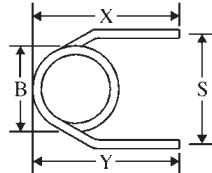


Figure 13

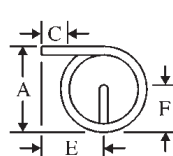


Figure 14

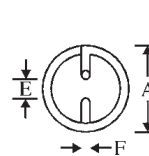


Figure 15

