RESTEK®

Pure Chromatography



30 YEARS

1985–2015

GC Columns

Detailed Table of Contents 7–9
Selecting a GC Column 10–15
Stationary Phase Cross-References 16–17
Guard/Retention Gap Columns Overview 18–19

Fused Silica Capillary

Guard/Retention Gap Columns 21–23
High-Performance Rxi® Columns 24–39
General Purpose Columns 40–59
GCxGC Columns 60–62
Fast GC 63
Application-Specific Columns 64–103

Metal MXT® Capillary

Overview 105
Guard/Retention Gap Columns 106
General-Purpose Columns 107–110
Application-Specific Columns 111–115

PLOT

PLOT Column Selection 117–119
Rt®-Silica BOND Columns 120
Alumina BOND Columns 121–124
Molecular Sieve 5A Columns 125
Porous Polymer Columns 126–128
PLOT Column Particle Trap 128
Metal MXT® PLOT Columns 129

Packed/Micropacked

Overview 131
Bonded Stationary Phases 132–133
Packed Column Tubing 134
Stock Packed Columns 135–136
Stock Micropacked Columns 137
Application-Specific Columns 138–141
Packed/Micropacked Column Installation Kits 142
Packed Column Packing Materials 143–145
Liquid Phases for Custom Columns 146
USP Cross-Reference 147
Custom Coated Packing Materials 148
Custom Packed/Micropacked Columns 149–150
Column Configurations 151



GC Columns

Selecting a GC Column 10-15
Stationary Phase Cross-References 16-17
Guard/Retention Gap Columns Overview 18-19

Fused Silica Capillary Columns (WCOT)

Guard/Retention Gap Columns
Overview 18-19
Rxi®, Intermediate-Polarity, Polar, Base, Hydroguard® Water-Resistant, Integrated 21-23
High-Performance Rxi® Columns
Overview 24-28
Guard Columns 28
Rxi®-1ms 29
Rxi®-5ms 30
Rxi®-XLB 31, 71
Rxi®-5Sil MS 32-33, 67, 75, 77, 85-86
Rxi®-35Sil MS 34, 82
Rxi®-17 35
Rxi®-17Sil MS 36, 76
Rxi®-PAH 37, 84
Rxi®-624Sil MS 38, 81, 87-88, 94
Rxi®-1HT 39
Rxi®-5HT 39
General Purpose Columns
Rtx®-1 41
Rtx®-5 ..... 42-43, 96
Rtx®-5MS 44
Rtx®-20 45
Rtx®-35 46
Rtx®-50 47
Rtx®-65 47
Rtx®-200, Rtx®-200MS 48-49
Rtx®-440 50
Rtx®-1301 51
Rtx®-624 52
Rtx®-1701 53
Rtx®-225 54
Rtx®-2330 55
Rt®-2560 ..... 56, 83
Rtx®-Wax 57
Stabilwax® 58, 95
Stabilwax®-MS 59
GCxGC Columns
GCxGC 60-62
Fast GC
Fast GC 63
Application-Specific Columns
Clinical, Forensic, & Toxicology
Blood Alcohol Analysis 65
Rtx®-BAC Plus 1, Rtx®-BAC Plus 2
Environmental
Brominated Flame Retardants Analysis 66
Rtx®-1614
Dioxin & Furan Analysis 67-68
Rxi®-5Sil MS, Rtx®-Dioxin2
Mineral Oils/Extractable Petroleum Hydrocarbon Analysis 69
Rtx®-Mineral Oil
PCB Congeners Analysis 70-71
Rtx®-PCB, Rxi®-XLB
Pesticides Analysis (Chlorinated) 72-73
Rtx®-CLPesticides, Rtx®-CLPesticides2
Pesticides Analysis (Organophosphorus) 74
Rtx®-OPPesticides, Rtx®-OPPesticides2

Continued on next page.



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

www.restek.com

For an alphabetical listing of phases, please see the Alphabetical Index on pages 612–623.

Polycyclic Aromatic Hydrocarbons (PAHs) Analysis 75-76
Rxi®-5Sil MS, Rxi®-17Sil MS
Semivolatiles Analysis 77
Rxi®-5Sil MS
Volatile Organics Analysis 78-81
Rtx®-VMS, Rtx®-VRX, Rtx®-502.2, Rtx®-Volatiles, Rxi®-624Sil MS
Foods, Flavors, & Fragrances
Cannabis Potency Analysis 82
Rxi®-35Sil MS
FAME Analysis (*cis/trans*) 83
Rt®-2560
FAME Analysis (Polyunsaturated) 83
FAMEWAX
PAHs in Foods Analysis 84
Rxi®-PAH
Pesticide Analysis in Cannabis 85
Rxi®-5Sil MS
Pesticide Residues in Food Analysis 86
Rxi®-5Sil MS
Residual Solvent Analysis for Cannabis Concentrates 87
Rxi®-624Sil MS
Terpenes Analysis for Cannabis and Hops 88
Rxi®-624Sil MS
Triglycerides in Foods Analysis 89
Rtx®-65TG
Petroleum & Petrochemical
Aromatics & Oxygenates in Gasoline Analysis 90
Rt®-TCEP
Biodiesel Fuels Analysis 91
Rtx®-Biodiesel TG
Detailed Hydrocarbon Analysis (DHA) 92
Rtx®-DHA, Rtx®-5 DHA (Tuning Column)
Simulated Distillation Analysis (C5-C44) 93
Rtx®-2887
Pharmaceutical
Organic Volatile Impurities (OVI) Analysis 94-97
Rxi®-624Sil MS, Stabilwax®, Rtx®-5, Rtx®-G27, Rtx®-G43
Specially Deactivated
Acidic Compounds Analysis 98
Stabilwax®-DA
Basic Compounds Analysis 99-102
Rtx®-Volatile Amine, Rtx®-5 Amine, Rtx®-35 Amine, Stabilwax®-DB
Chiral Analysis 103
Rt®-γDEXsa, Rt®-βDEXm, Rt®-βDEXsm, Rt®-βDEXse, Rt®-βDEXsp, Rt®-βDEXsa, Rt®-βDEXcst

For an alphabetical listing of phases, please see the Alphabetical Index on pages 612–623.

Metal (MXT®) Capillary Columns

Overview 105
Guard/Retention Gap Columns
Intermediate-Polarity, Hydroguard®-Treated 106
General Purpose Columns
MXT®-1 107
MXT®-5 108
MXT®-50 109
MXT®-1301 109
MXT®-1701 109
MXT®-200 110
MXT®-WAX 110
Application-Specific Columns
Environmental
Volatile Organics Analysis 111
MXT®-502.2, MXT®-Volatiles, MXT®-624
Foods, Flavors, & Fragrances
Triglycerides in Foods Analysis 112
MXT®-65TG

Petroleum & Petrochemical
Biodiesel Fuels Analysis 113
MXT®-Biodiesel TG
Simulated Distillation Analysis (C5-C44) 113
MXT®-2887
Simulated Distillation Analysis (C5-C110) 114-115
MXT®-1HT SimDist, MXT®-500 SimDist

PLOT Columns

PLOT Column Selection 117-119
Silica BOND Columns
Rt®-Silica BOND 120
Fused Silica Alumina Columns
Rt®-Alumina BOND 121-124
Rt®-Alumina BOND/Na_2SO_4, Rt®-Alumina BOND/KCl, Rt®-Alumina BOND/CFC, Rt®-Alumina BOND/MAPD
Fused Silica Molecular Sieve 5A Columns
Rt®-Msieve 5A 125
Fused Silica Porous Polymer Columns
Rt®-Q-BOND 126
Rt®-QS-BOND 127
Rt®-S-BOND 127
Rt®-U-BOND 128
PLOT Column Particle Trap 128
Metal MXT® PLOT Columns
MXT®-Msieve 5A, MXT®-Alumina BOND/ Na_2SO_4, MXT®-Alumina BOND MAPD, MXT®-Q-BOND, MXT®-S-BOND 129

Packed/Micropacked Columns & Packing Materials

Overview 131
Bonded Stationary Phases 132-133
Packed Column Tubing 134
Stock Packed Columns 135-136
Chromosorb-Based (Bonded and Non-Bonded), Porous Polymers, CarboBlack, Molecular Sieves
Stock Micropacked Columns 137
Application-Specific Packed/Micropacked Columns
Aromatics Analysis 138
D3606 Application Column Set
Light Hydrocarbon Analysis 139
n-Octane on Res-Sil® C, OPN on Res-Sil® C, 2abc Refinery Gas Set
Permanent Gases & Hydrocarbon Analysis 140
ShinCarbon ST
Sulfur Analysis 141
Rt®-XLSulfur
Packed/Micropacked Column Installation Kits 142
Packed Column Packing Materials 143-145
CarboBlack, Res-Sil®, Porapak, HayseSep®, Tenax®
Liquid Phases for Custom Columns 146
USP Liquid Phase & Solid Support Cross-Reference 147
Custom Packed/Micropacked Columns
Custom Coated Packing Materials 148
Custom Packed/Micropacked Columns 149
Custom Order Form 150
Column Configurations 151



At Restek, we are dedicated to your success.

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

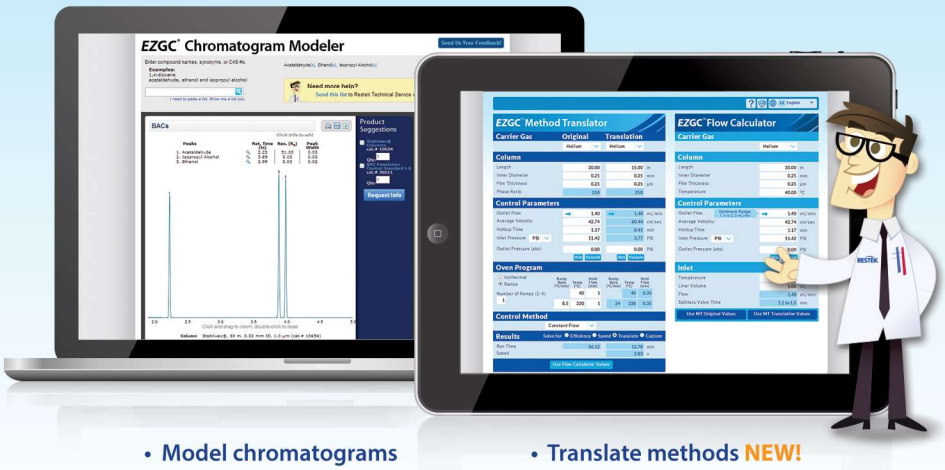
A measure of Retention. This term is affected by:
- Inner diameter
- Film thickness
- Temperature

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.

Speed Up and Simplify GC Method Development with
Restek's *EZGC*® Online Suite



- Model chromatograms
- Get column recommendations
- Translate methods NEW!
- Calculate flows NEW!

Download these FREE web apps today! www.restek.com/ezgc

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 15. 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: Retention Indices for Restek Phases

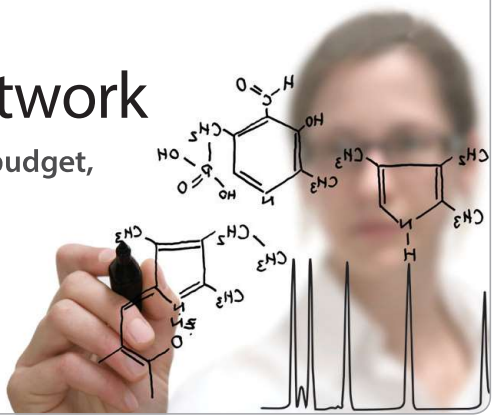
Phase	Benzene	Butanol	Pentanone	Nitropropane
Rtx-1	651	651	667	705
Rtx-5/Rtx-5MS	667	667	689	743
Rtx-20	711	704	740	820
Rtx-1301/Rtx-624	689	729	739	816
Rtx-35	746	733	773	867
Rtx-200	738	758	884	980
Rtx-50	778	769	813	921
Rtx-1701	721	778	784	881
Rtx-65TG	794	779	825	938
Rtx-225	847	937	958	958
Stabilwax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

Restek's Learning Network

Solutions to fit every level of expertise, budget, schedule, and analytical topic.

Learn more at www.restek.com/seminars



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.

Chromatogram Search Tool

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

www.restek.com/**chromatograms**



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

	Column Inner Diameter (mm)					
Characteristic	**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 Capillary & PLOT Column Ferrule Guide

GC Column ID	Ferrule ID
0.15 mm	0.4
0.18 mm	0.4
0.25 mm	0.4
0.32 mm	0.5
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.

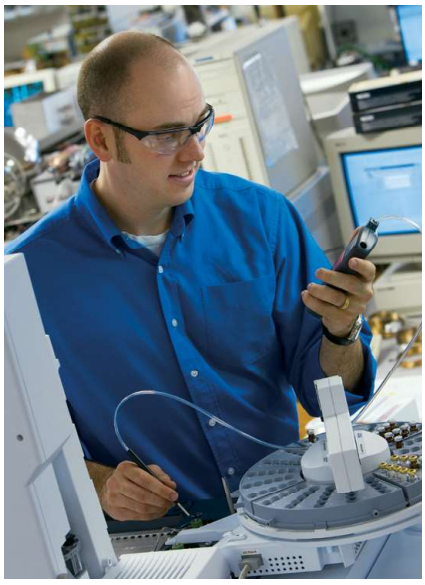
Phone: 1-800-356-1688, ext. 4
e-mail: support@restek.com

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 International Technical Service at intltechsupp@restek.com or find a local distributor at **www.restek.com/distributor**

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.



Checking for leaks, using a Restek® electronic leak detector, is an easy way to protect your instrument and column from damage.

Table III: Phase Ratio (β) Values for Common Column Dimensions*

	Film Thickness (d_f) / β Value						
Column ID	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

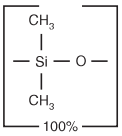
The second temperature is the **maximum temperature-programmed operating temperature**, the temperature to which the column can be heated for short periods of time (i.e., during a temperature-programmed analysis). If only one temperature is listed, it is both the isothermal and the maximum temperature.

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 bleed specification (i.e., lowest bleed level).

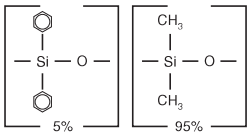
Structures, Polarities, Properties, and Uses for Restek® Capillary Column Phases, in Order of Increasing Polarity

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



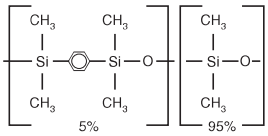
Similar to: (100%-methyl)-polysiloxane
Polarity: nonpolar
Uses: solvents, petroleum products, pharmaceutical samples, waxes
[G1] [G2] [G38]

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



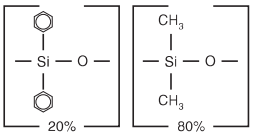
Similar to: (5%-phenyl)-methylpolysiloxane
Polarity: slightly polar
Uses: flavors, environmental, aromatic hydrocarbons
[G27] [G36]

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



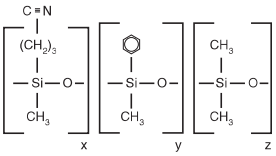
Similar to: (5%-phenyl)-methylpolysiloxane
Polarity: slightly polar
Uses: flavors, environmental, pesticides, PCBs, aromatic hydrocarbons

Rtx®-20
Diphenyl dimethyl polysiloxane



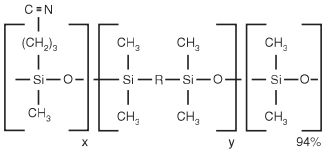
Similar to: (20%-phenyl)-methylpolysiloxane
Polarity: slightly polar
Uses: volatile compounds, alcohols
[G28] [G32]

Rtx®-1301, Rtx®-624, Rtx®-G43
Cyanopropylmethyl phenylmethyl polysiloxane



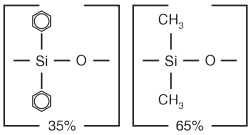
Similar to: (6%-cyanopropylphenyl)-methylpolysiloxane
Polarity: intermediately polar
Uses: volatile compounds, insecticides
[G43]

Rxi®-624Sil MS



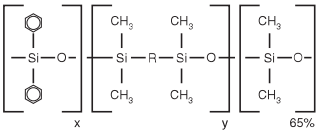
Similar to: (6%-cyanopropylphenyl)-methylpolysiloxane
Polarity: intermediately polar
Uses: volatile compounds, insecticides, residue solvents in pharmaceutical products

Rtx®-35
Diphenyl dimethyl polysiloxane



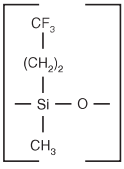
Similar to: (35%-phenyl)-methylpolysiloxane
Polarity: intermediately polar
Uses: pesticides, PCBs, amines, nitrogen-containing herbicides
[G42]

Rxi®-35Sil MS



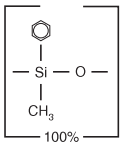
Similar to: (35%-phenyl)-methylpolysiloxane
Polarity: intermediately polar
Uses: pesticides, PCBs, amines, nitrogen-containing herbicides

Rtx®-200
Trifluoropropylmethyl polysiloxane



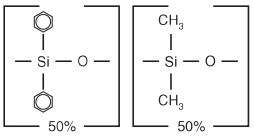
Similar to: (trifluoropropyl)-methylpolysiloxane
Polarity: selective for lone pair electrons
Uses: environmental, solvents, Freon® gases, drugs, ketones, alcohols
[G6]

Rtx®-50
Phenyl methyl polysiloxane



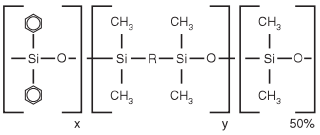
Similar to: (50%-phenyl)-methylpolysiloxane
Polarity: intermediately polar
Uses: FAMEs, carbohydrates
[G3]

Rxi®-17
Diphenyl dimethyl polysiloxane



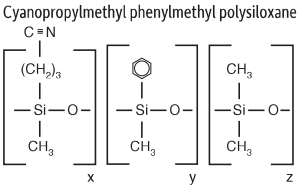
Similar to: (50%-phenyl)-methylpolysiloxane
Polarity: intermediately polar
Uses: triglycerides, phthalate esters, steroids, phenols
[G3]

Rxi®-17Sil MS



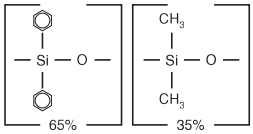
Similar to: (50%-phenyl)-methylpolysiloxane
Polarity: intermediately polar
Uses: triglycerides, phthalate esters, steroids, phenols
[G3]

Rtx®-1701
Cyanopropylmethyl phenylmethyl polysiloxane



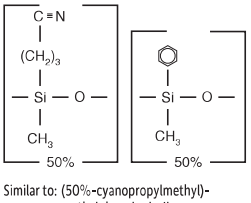
Similar to: (14%-cyanopropylphenyl)-methylpolysiloxane
Polarity: intermediately polar
Uses: pesticides, PCBs, alcohols, oxygenates
[G46]

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



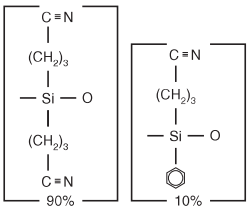
Similar to: (65%-phenyl)-methylpolysiloxane
Polarity: intermediately polar
Uses: triglycerides, rosin acids, free fatty acids
[G17]

Rtx®-225
Cyanopropylmethyl phenylmethyl polysiloxane



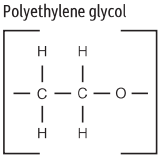
Similar to: (50%-cyanopropylmethyl)-methylphenylpolysiloxane
Polarity: polar
Uses: FAMEs, carbohydrates
[G7] [G19]

Rtx®-2330
Biscyanopropyl cyanopropylphenyl polysiloxane



Similar to: (95%-cyanopropyl)-phenyl polysiloxane
Polarity: polar
Uses: *cis/trans* FAMEs, dioxin isomers, rosin acids
[G8] [G48]

Stabilwax®, Rtx®-Wax, Stabilwax®-MS
Polyethylene glycol



Polarity: polar
Uses: FAMEs, flavors, acids, amines, solvents, xylene isomers
[G14] [G15] [G16] [G20] [G39]

note

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

Columns by Phase

Restek	Phase Description	USP Nomenclature*	Agilent	SGE	Phenomenex	Macherey-Nagel	Supelco	Alltech	Quadrex
Rtx-1 (p. 41) MXT-1 (p. 107)	dimethyl polysiloxane	G1, G2, G38	HP-1, DB-1, CP-Sil 5 CB	BP1	ZB-1	OPTIMA 1	SPB-1	AT-1, EC-1	007-1
Rxi-1HT (p. 39)	dimethyl polysiloxane		DB-1ht		ZB-1HTinferno			AT-1ht	
Rxi-1ms (p. 29)	dimethyl polysiloxane (low bleed)	G1, G2, G38	HP-1ms, HP-1msUI, DB-1ms, DB-1msUI, VF-1ms, Ultra 1	BP1	ZB-1, ZB-1ms	OPTIMA 1 MS, OPTIMA 1 MS Accent	SPB-1, Equity-1	AT-1ms	007-1
Rtx-5MS (p. 44) Rtx-5 (p. 42-43, 96) MXT-5 (p. 108)	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. 39)	diphenyl dimethyl polysiloxane		DB-5ht, VF-5ht	HT5	ZB-5HTinferno	OPTIMA 5HT			
Rxi-5ms (p. 30)	diphenyl dimethyl polysiloxane (low bleed)	G27, G36	HP-5msSV, HP-5ms, HP-5msUI, DB-5, Ultra-2, CP-Sil 8 CB	BP5ms	ZB-5, ZB-5msi	OPTIMA 5, OPTIMA 5 MS	SPB-5, Equity-5	AT-5ms	007-5
Rxi-5Sil MS (p. 32, 67, 75, 77, 85)	1,4-bis(dimethylsiloxy)phenylene dimethyl polysiloxane		DB-5ms, DB-5msUI, VF-5ms	BPX5	ZB-5ms, ZB- SemiVolatiles	OPTIMA 5MS Accent	SLB-5ms		007-5MS
Rxi-XLB (p. 31, 71)	proprietary phase		DB-XLB, VF-Xms		MR1, ZB-XLB	OPTIMA XLB			
Rtx-20 (p. 45)	diphenyl dimethyl polysiloxane	G28, G32					SPB-20	EC-20, AT-20	007-20
Rtx-35 (p. 46)	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, 82)	proprietary phase		DB-35ms, DB35msUI, VF-35ms	BPX35	MR2	OPTIMA 35 MS			
Rtx-50 (p. 47) MXT-50 (p. 109)	phenyl methyl polysiloxane	G3	HP-50+, CP-Sil 24 CB				SPB-50	AT-50	007-17
Rxi-17 (p. 35)	diphenyl dimethyl polysiloxane	G3	HP-17, DB-17, DB-17ht, DB-608		ZB-50	OPTIMA 17	SPB-17		
Rxi-17Sil MS (p. 36, 76)	proprietary phase	G3	DB-17ms, VF-17ms	BPX50		OPTIMA 17 MS			
Rtx-65 (p. 47)	diphenyl dimethyl polysiloxane								007-65HT
Rxi-624Sil MS (p. 38, 81, 87, 94)	proprietary phase	G43	DB-624, VF-624ms, CP-Select 624 CB	BP624		OPTIMA 624 LB			
Rtx-1301 (p. 51) Rtx-624 (p. 52) MXT-1301 (p. 109)	cyanopropylmethyl phenylmethyl polysiloxane	G43	DB-1301, DB-624, DB-624UI, 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. 53) MXT-1701 (p. 109)	cyanopropylmethyl phenylmethyl polysiloxane	G46	DB-1701P, 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. 48) MXT-200 (p. 110)	trifluoropropylmethyl polysiloxane	G6	DB-210, DB-200, VF-200ms			OPTIMA 210		AT-210	
Rtx-200MS (p. 48–49)	trifluoropropylmethyl polysiloxane (low bleed)	G6	VF-200ms						
Rtx-225 (p. 54)	cyanopropylmethyl phenylmethyl polysiloxane	G7, G19	DB-225ms, CP-Sil 43 CB	BP225		OPTIMA 225	SPB-225	AT-225	007-225
Rtx-440 (p. 50)	proprietary phase		**Restek innovation**						
Rtx-2330 (p. 55)	biscyanopropyl cyanopropylphenyl polysiloxane	G8, G48	VF-23ms	BPX70			SP-2330, SP-2331, SP-2380	AT-Silar90	007-23
Rt-2560 (p. 56, 83)	bicyanopropyl polysiloxane		HP-88, CP-Sil 88				SP-2560		
Rtx-Wax (p. 57)	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. 58, 95) Stabilwax-MS (p. 59) MXT-WAX (p. 110)	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 117 for Restek PLOT Column Phase Cross-Reference chart.

*See page 147 for our USP Liquid Phase and Solid Support Cross-Reference.

Application-Specific Columns by 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. 103)	Chiral compounds						
Clinical, Forensic, & Toxicology							
Rtx-BAC Plus 1 (p. 65)	Blood alcohol testing	DB-ALC1					ZB-BAC1
Rtx-BAC Plus 2 (p. 65)		DB-ALC2					ZB-BAC2
Environmental							
Rxi-5Sil MS (p. 67, 75, 77)	Semivolatiles - EPA Methods 8270, 625, 525	DB-5ms, DB-5msUI, VF-5ms	SLB-5ms	OPTIMA 5MS Accent	BPX5		ZB-5ms, ZB-SemiVolatiles
Rtx-VMS (p. 78)	Volatiles - EPA Methods 8260, 624, 524	Restek innovation					
Rxi-624Sil MS (p. 81)	Volatiles - EPA Method 624	DB-624, VF-624ms, CP-Select 624 CB		OPTIMA 624 LB	BP624		
Rtx-502.2 (p. 80)	Volatiles - EPA Methods 8010, 8020, 502.2, 601, 602	DB-502.2	VOCOL			AT-502.2	
Rtx-Volatiles (p. 80)			VOCOL				
Rtx-VRX (p. 79)		DB-VRX					
Rtx-CLPesticides (p. 72)	Organochlorine pesticides - EPA Methods 8081, 8082, 608, 505, 508	DB-CLP1					ZB-CLP1
Rtx-CLPesticides2 (p. 72)		DB-CLP2					ZB-CLP2
Rtx-1614 (p. 66)	Brominated flame retardants	Restek innovation					
Rtx-PCB (p. 70)	Polychlorinated biphenyl - EPA Methods 8082, 608, PCB congeners	Restek innovation					
Rxi-XLB (p. 71)		DB-XLB, VF-XMS					MR1, ZB-XLB
Rtx-OPPesticides (p. 74)	Organophosphorus pesticides - EPA Method 8141	Restek innovation					
Rtx-OPPesticides2 (p. 74)		Restek innovation					
Rtx-Dioxin2 (p. 68)	Dioxin & Furans - EPA Methods	Restek innovation					
Rtx-Mineral Oil (p. 69)	DIN EN ISO 9377-2	Select Mineral Oil					
Rxi-17Sil MS (p. 76)	Polycyclic aromatic hydrocarbons	DB-17ms, VF-17ms		OPTIMA 17 MS	BPX50		
Foods, Flavors, & Fragrances							
Rt-2560 (p. 83)	*cis*/*trans* FAMEs	HP-88	SPB-2560				
FAMEWAX (p. 83)	Marine oils	Select FAME	Omegawax			AT-AquaWax, AT-FAME	
Rxi-PAH (p. 84)	PAHs	Restek innovation					
Rtx-65 TG (p. 89)	Triglycerides	Restek innovation					
Petroleum & Petrochemical							
Rt-Alumina BOND/CFC (p. 123)	Chlorinated fluorocarbons (CFCs)						
Rtx-DHA (p. 92)	Detailed hydrocarbon analysis	HP-PONA, DB-Petro, CP-Sil PONA CB	Petrocol DH		BP1PONA		
Rtx-2887 (p. 93) MXT-2887 (p. 113)	Hydrocarbons - ASTM 2887	DB-2887	Petrocol 2887, Petrocol EX2887			AT-2887	
D3606 (p. 138)	Ethanol - ASTM 3606	Restek innovation					
Rt-TCEP (p. 90)		CP-TCEP	TCEP				
MXT-1HT SimDist (p. 114)	Simulated distillation	DB-HT-SimDis, CP-SimDist, CP-SimDst Ultimetal			BPX1	AT-3710	ZB-1XT SimDist
MXT-500 SimDist (p. 115)		Restek innovation					
Rtx-Biodiesel TG (p. 91) MXT-Biodiesel TG (p. 113)	Triglycerides in biodiesel	Biodiesel, Select Biodiesel		OPTIMA Biodiesel			ZB-Bioethanol
Pharmaceutical							
Rtx-G27 w/IntegraGuard (p. 97)	Organic volatile impurities (OVI) - USP 467						
Rtx-G43 w/IntegraGuard (p. 97)			OVI-G43				
Rxi-624Sil MS (p. 94)		DB-624, VF-624ms, CP-Select 624 CB		OPTIMA 624 LB	BP624		
Rtx-5 (G27) (p. 96)		HP-5, DB-5, CP-Sil 8 CB	SPB-5	OPTIMA 5	BP5	EC-5, AT-5	ZB-5
Stabilwax (G16) (p. 95)		HP-INNOWax, CP-Wax 52 CB, VF-WAX MS	Supelcowax-10	OPTIMA WAXplus		AT-WAX	ZB-WAXplus
Specially deactivated phases							
Rtx-Volatile Amine (p. 99)	Volatile amines	CP-Volamine					
Rtx-5Amine (p. 100)	Amines			OPTIMA 5 Amine			
Rtx-35Amine (p. 101)		Restek innovation					
Stabilwax-DB (p. 102)		CAM, CP-WAX 51 for Amines	Carbowax Amine	FS-CW 20 M-AM		AT-CAM	
Stabilwax-DA (p. 98)	Free fatty acids	HP-FFAP, DB-FFAP, CP-WAX 58 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 23 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

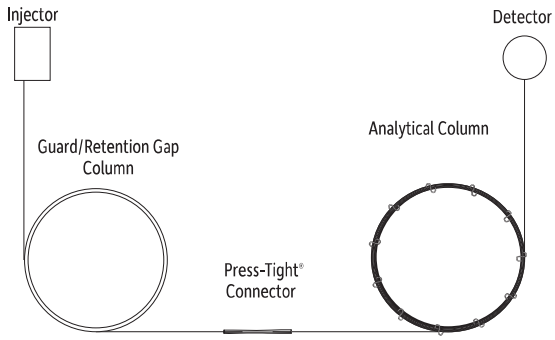
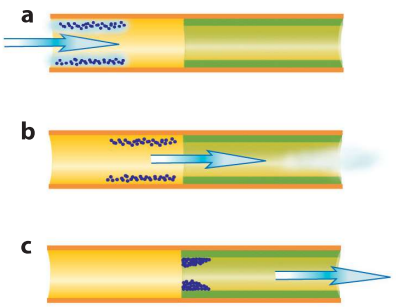


Figure 2: Retention gaps are used to focus components in a tight band at the beginning of the analytical column.



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

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

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

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 nonvolatile 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 227 to 233 for information about these connectors.)

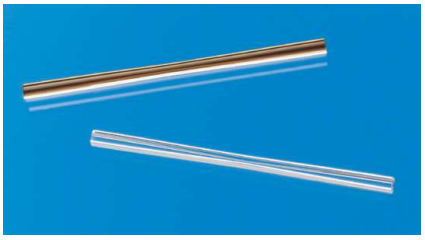
it's a fact

To eliminate leaky connections and to ensure longer column lifetime, use our unique Integra-Guard® column. (See **page 23**.)

Connectors for Fused Silica Columns



Vu2 Union® Connector
(See page 229.)



Press-Tight® Connectors
(See pages 227–228.)



MXT® Union Connector Kit
for Fused Silica
(See page 231.)

GC Columns

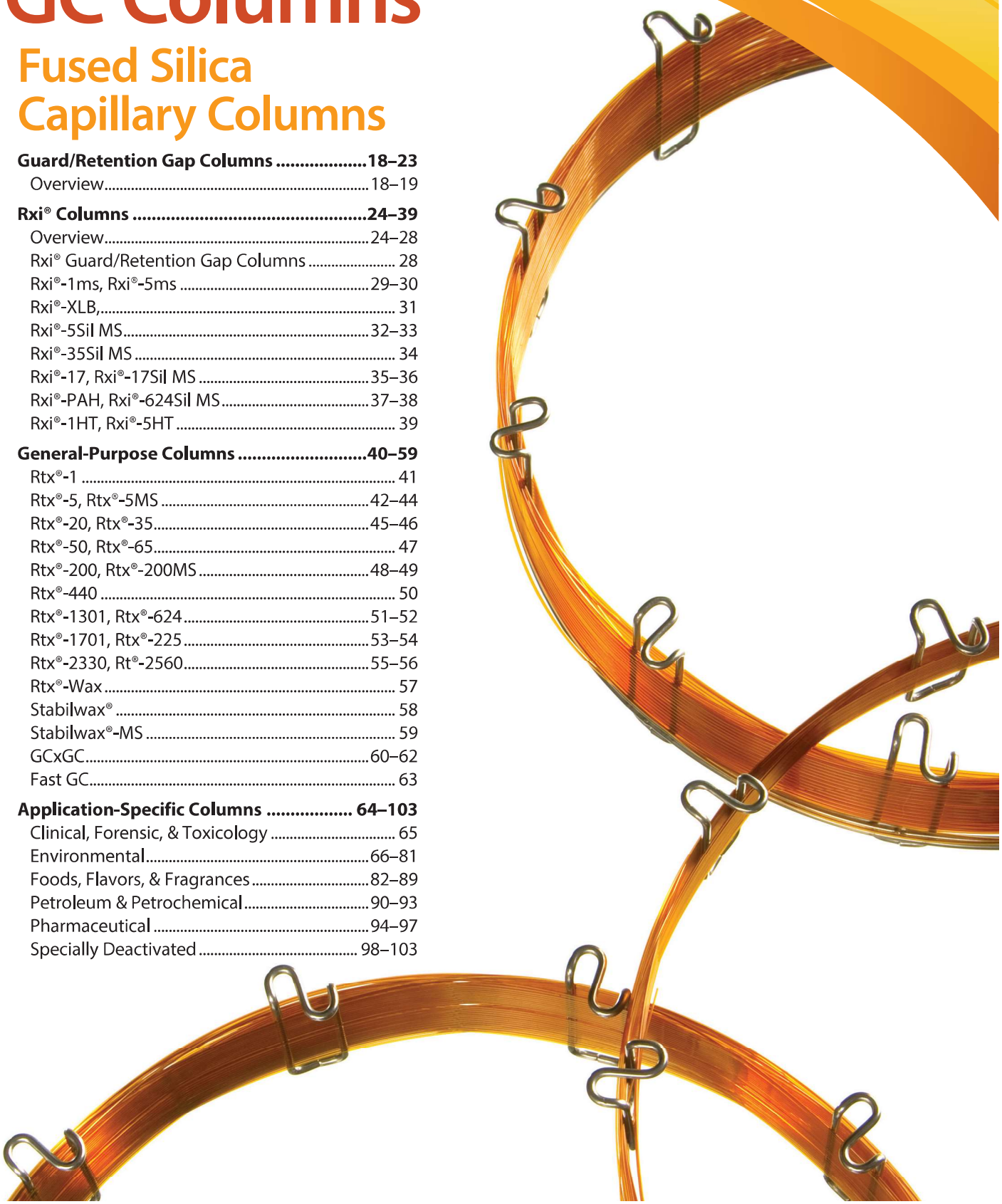
Fused Silica Capillary Columns

Guard/Retention Gap Columns 18–23
Overview 18–19

Rxi® Columns 24–39
Overview 24–28
Rxi® Guard/Retention Gap Columns 28
Rxi®-1ms, Rxi®-5ms 29–30
Rxi®-XLB, ... 31
Rxi®-5Sil MS 32–33
Rxi®-35Sil MS 34
Rxi®-17, Rxi®-17Sil MS 35–36
Rxi®-PAH, Rxi®-624Sil MS 37–38
Rxi®-1HT, Rxi®-5HT 39

General-Purpose Columns 40–59
Rtx®-1 41
Rtx®-5, Rtx®-5MS 42–44
Rtx®-20, Rtx®-35 45–46
Rtx®-50, Rtx®-65 47
Rtx®-200, Rtx®-200MS 48–49
Rtx®-440 50
Rtx®-1301, Rtx®-624 51–52
Rtx®-1701, Rtx®-225 53–54
Rtx®-2330, Rt®-2560 55–56
Rtx®-Wax 57
Stabilwax® 58
Stabilwax®-MS 59
GCxGC 60–62
Fast GC 63

Application-Specific Columns 64–103
Clinical, Forensic, & Toxicology 65
Environmental 66–81
Foods, Flavors, & Fragrances 82–89
Petroleum & Petrochemical 90–93
Pharmaceutical 94–97
Specially Deactivated 98–103



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 cat.#	5-Meter/6-pk. cat.#	10-Meter cat.#	10-Meter/6-pk. cat.#
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

it's a fact

To eliminate connections, use an Integra-Guard® column. (See **page 23**.)

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 cat.#	5-Meter cat.#	5-Meter/6-pk. cat.#
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 cat.#	10-Meter/6-pk. cat.#	30-Meter* cat.#	60-Meter*† cat.#
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.



it's a fact

Use guard columns to:

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

Certificates of analysis for 5 m and 10 m Restek® guard columns are now provided electronically. To view and download your 5 m or 10 m guard column certificate, simply visit www.restek.com/documentation then enter your catalog # and serial #.

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 cat.#	10-Meter cat.#	30-Meter* cat.#
0.25 mm	0.37 ± 0.04 mm	10065	10068	10014
0.32 mm	0.45 ± 0.04 mm	10066	10069	
0.53 mm	0.69 ± 0.05 mm	10067	10070	10034

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

Fused Silica Capillary & PLOT Column Ferrule Guide

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



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 106.**

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 cat.#	5-Meter/6-pk. cat.#
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 surface beneath. Use Hydroguard® tubing for connecting GCs to these devices:

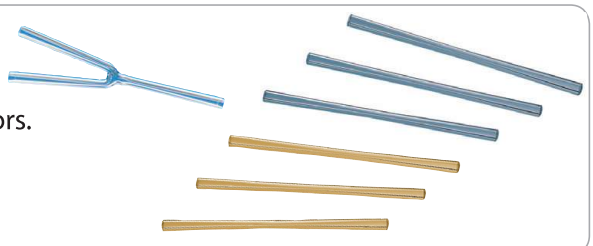
- Headspace analyzers.
- Air analysis equipment and concentrator units.
- Purge-and-trap systems.

Nominal ID	Nominal OD	5-Meter cat.#	5-Meter/6-pk. cat.#	10-Meter cat.#	30-Meter* cat.#	60-Meter*† cat.#
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

Press-Tight connectors.



See **pages 227–228.**

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 a guard column and an 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

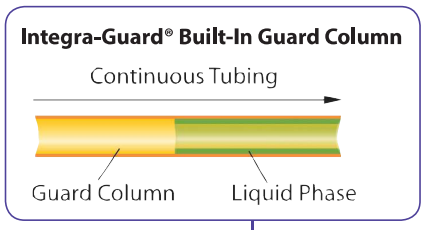
Integra-Guard® columns are available for all phases listed for columns with 0.25, 0.32, or 0.53 mm ID.
If you don't see what you need here, contact Customer Service.

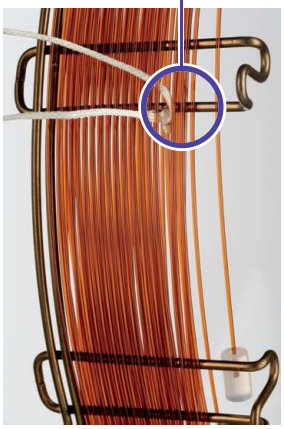
Restek innovation!

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

similar guards

DuraGuard, EZ-Guard, Guardian





String indicates where the analytical column begins.



Tag indicates guard column end.

High-Performance Rxi® GC Columns

Overview 24–28
Rxi® Guard/Retention Gap Columns 28
Rxi®-1ms, Rxi®-5ms 29–30
Rxi®-XLB 31
Rxi®-5Sil MS 32–33
Rxi®-35Sil MS 34
Rxi®-17, Rxi®-17Sil MS 35–36
Rxi®-PAH, Rxi®-624Sil MS 37–38
Rxi®-1HT, Rxi®-5HT 39

Rxi GC Columns





Lower Detection Limits with Groundbreaking 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 Groundbreaking 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 these benefits:

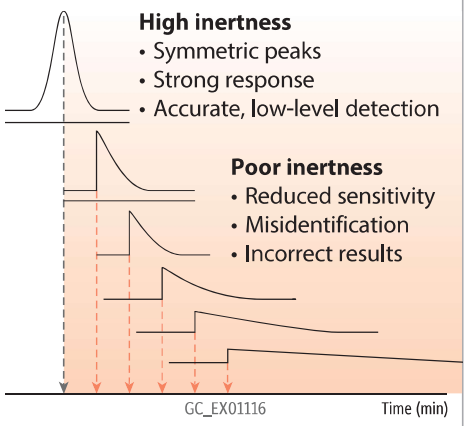
- Increased signal-to-noise ratios to improve low-level detection.
- Reproducible retention times for positive identifications.
- Improved response for polar, acidic, and basic compounds.

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.

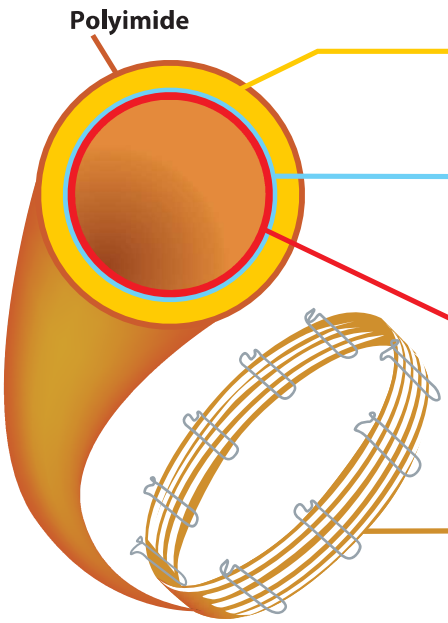


free literature
Rxi® GC Columns
To learn more, download your free copy from
www.restek.com
lit. cat.# GNBR1843-UNV



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

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



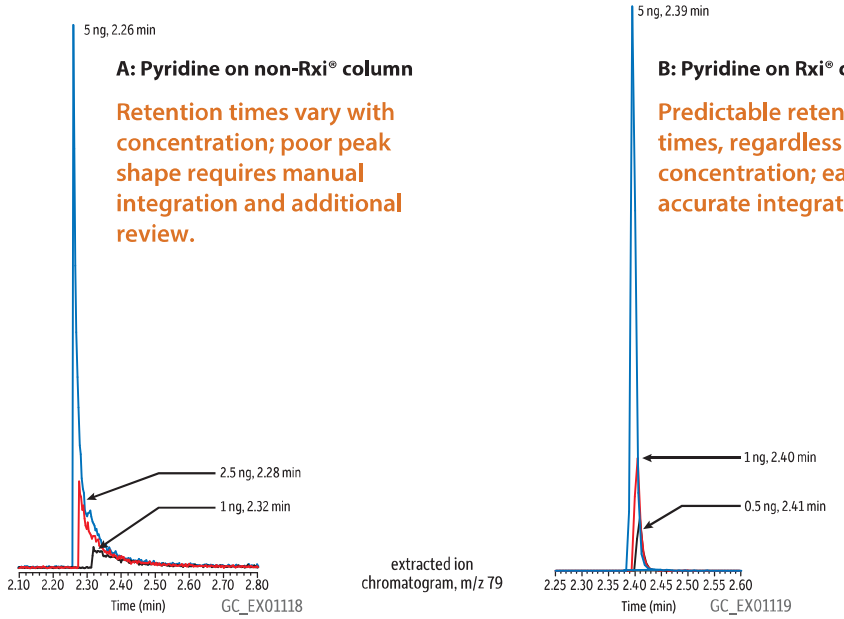
Restek® Fused Silica
We make our own tubing to ensure high quality and an uninterrupted supply!

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.

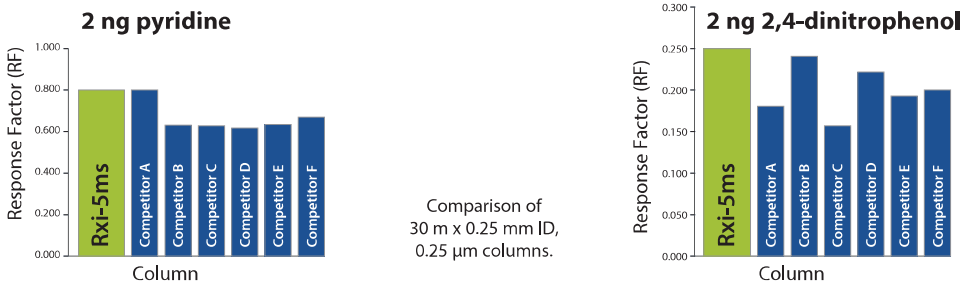
Figure 2: Compared to conventional GC columns, Rxi® columns show excellent inertness and produce good peak shape and reproducible retention for challenging compounds.



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).

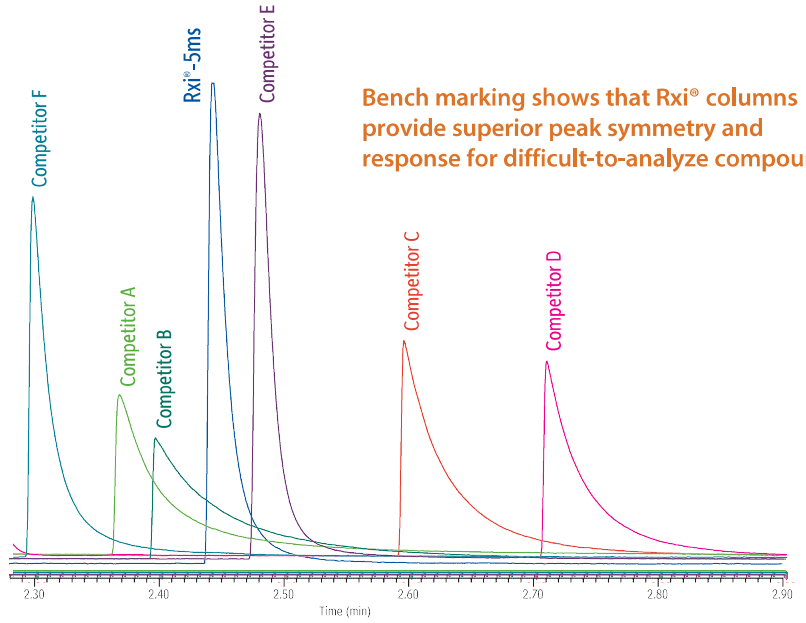
Figure 3: An Rxi® column gives the best overall performance for both basic and acidic compounds.



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.



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

Innovation & Service

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

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

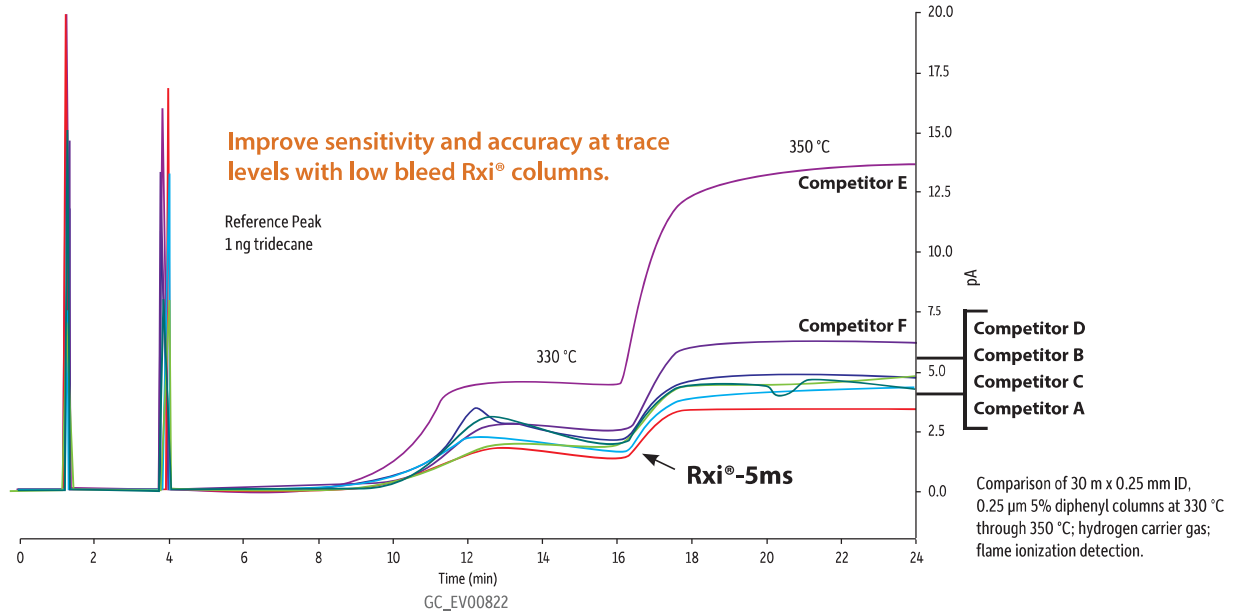
How can we help you today?
Contact support@restek.com or your local Restek representative for helpful, knowledgeable technical support.

Lowest Bleed

Rxi® columns are more stable at high temperatures than other manufacturers' columns, 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 the following:

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

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

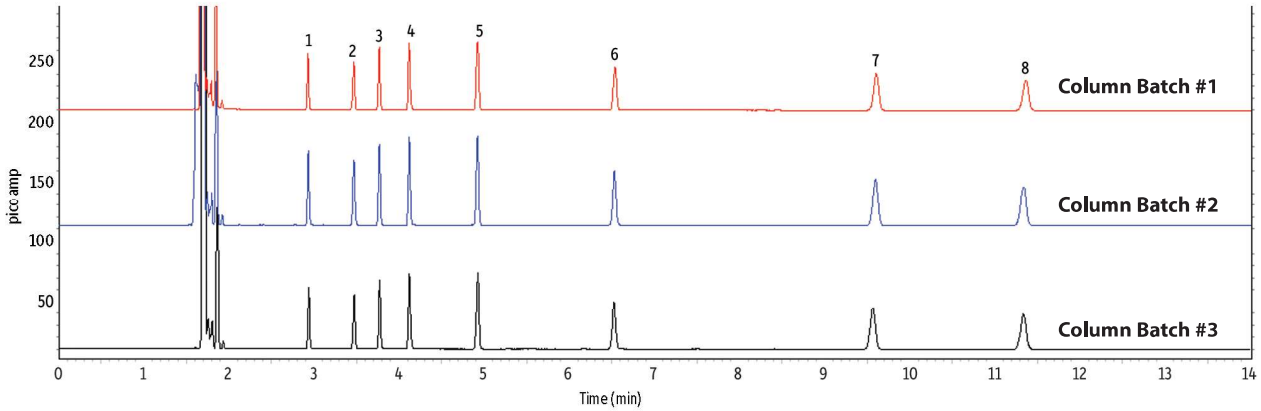


Comparison of 30 m x 0.25 mm ID, 0.25 µm 5% diphenyl columns at 330 °C through 350 °C; hydrogen carrier gas; flame ionization detection.

Exceptional Reproducibility

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

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



1. 1,6-Hexanediol
2. 4-Chlorophenol
3. Methyl nonanoate
4. 1-Decylamine
5. Tridecane
6. 1-Undecanol
7. Acenaphthylene
8. Pentadecane

Column Rxi®-5ms, 30 m, 0.25 mm ID, 0.25 µm (cat.# 13423)
Sample Isothermal column test mix
Diluent: Toluene
Conc.: 500 µg/mL
Injection
Inj. Vol.: 1.0 µL split (split ratio 100:1)
Liner: Splitless taper (4 mm) w/wool (cat.# 22405)
Inj. Temp.: 250 °C

Oven
Oven Temp.: 135 °C
Carrier Gas H_2, constant linear velocity
Linear Velocity: 38 cm/sec @ 135 °C
Detector FID @ 330 °C

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 cat.#	5-Meter/6-pk. cat.#	10-Meter cat.#	10-Meter/6-pk. cat.#
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)

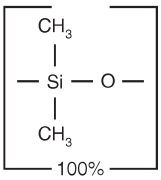
(nonpolar phase; Crossbond® dimethyl polysiloxane)

- 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.
- Equivalent to USP G1, G2, and G38 phases.

ID	df	temp. limits	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#
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 cat.#	12-Meter cat.#	20-Meter cat.#	25-Meter cat.#	50-Meter cat.#
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®-1ms Structure



Similar to: (100%-methyl)-polysiloxane

similar phases

HP-1ms, HP-1msUI, DB-1ms, DB-1msUI, Ultra-1, VF-1ms, ZB-1, ZB-1ms

free literature

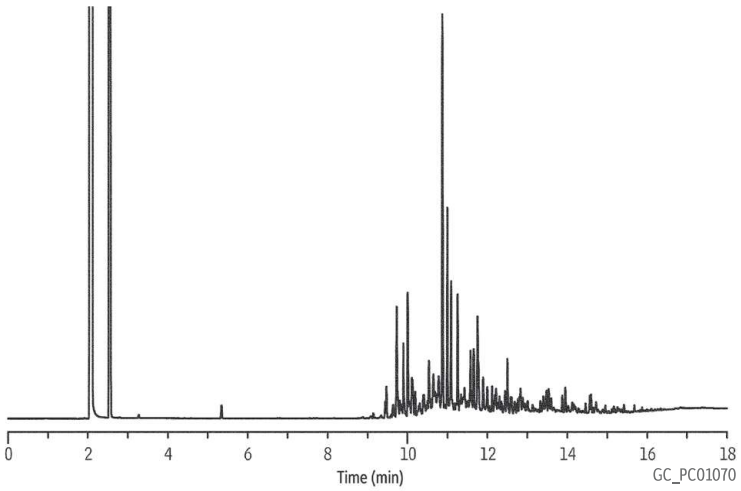
Why Derivatize?
Improve GC Separations with Derivatization

Download your free copy from www.restek.com

lit. cat.# CFTS1269

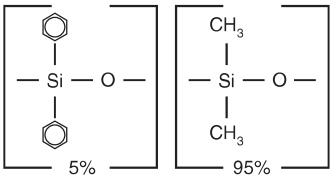


99% Weathered Unleaded Gasoline on Rxi®-1ms



Column	Rxi®-1ms, 30 m, 0.25 mm ID, 0.25 µm (cat.# 13323)
Sample	Unleaded gasoline: 99% weathered (cat.# 30436)
Diluent:	Methanol
Conc.:	5,000 µg/mL
Injection	
Inj. Vol.:	1.0 µL split (split ratio 20:1)
Liner:	Splitless taper (4 mm) w/wool (cat.# 22405)
Inj. Temp.:	250 °C
Oven	
Oven Temp.:	50 °C (hold 2 min) to 75 °C at 10 °C/min to 300 °C at 20 °C/min (hold 5 min)
Carrier Gas	He, constant flow
Linear Velocity:	28 cm/sec
Detector	FID @ 300 °C

Rxi®-5ms Structure



Similar to: (5%-phenyl)-methylpolysiloxane

similar phases

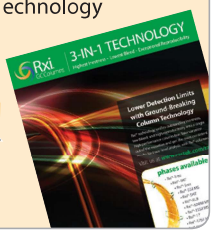
HP-5ms SemiVolatiles, HP-5ms, HP-5msUI, DB-5, Ultra-2, CP-Sil 8 CB, ZB-5, ZB-5msi

free literature

Rxi® Columns
Lower Detection Limits with Ground-Breaking Column Technology

Download your free copy from
www.restek.com

lit. cat.#
GNFL1173A



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.
- Equivalent to USP G27 and G36 phases.

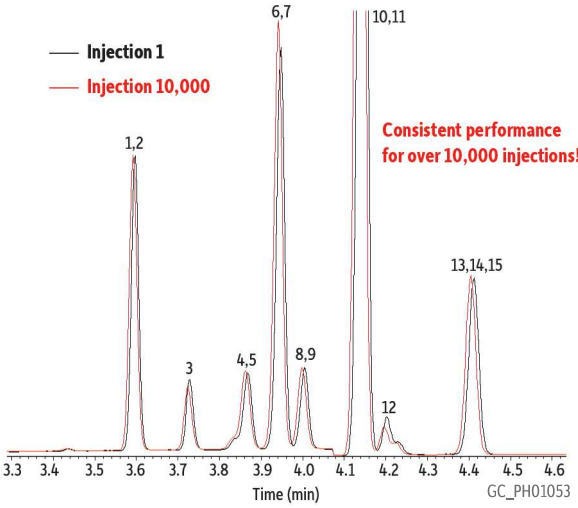
ID	df	temp. limits	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#
0.25 mm	0.25 µm	-60 to 330/350 °C	13420	13423	13426
	0.40 µm	-60 to 330/350 °C		13481	
	0.50 µm	-60 to 330/350 °C	13435	13438	13441
	1.00 µm	-60 to 330/350 °C	13450	13453	13456
0.32 mm	0.25 µm	-60 to 330/350 °C	13421	13424	13427
	0.50 µm	-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 cat.#	20-Meter cat.#	25-Meter cat.#	50-Meter cat.#
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



Stringent quality testing ensures consistent performance, column to column and injection to injection.

Over 10,000 Injections of Lipidomics on Rxi®-5ms



Peaks	m/z
1. Coprostanol	370.40
2. d5-cholestanol (IS)	220.20
3. 7α-hydroxycholesterol	456.40
4. Cholestanol	306.30
5. d5-epicholestanol (IS)	220.20
6. 7-Dehydrocholesterol	325.25
7. Desmosterol	343.25
8. Lathosterol	458.35
9. d4-lathosterol (IS)	462.40
10. Campesterol	382.35
11. 4-Cholestenone	382.30
12. Stigmasterol	394.15
13. Lanosterol	393.35
14. β-Sitosterol	396.35
15. d7-β-sitosterol (IS)	403.45

Column	Rxi®-5ms, 30 m, 0.25 mm ID, 0.25 µm (cat.# 13423)
Sample	Lipid plasma extract as trimethylsilyl derivatives
Injection	
Inj. Vol.:	1 µL split (split ratio 10:1)
Liner:	4 mm split liner gooseneck with wool
Inj. Temp.:	310 °C
Oven	
Oven Temp.:	250 °C (hold 1 min) to 320 °C at 30 °C/min (hold 1.6 min)
Carrier Gas	He, constant flow
Flow Rate:	1.0 mL/min
Detector	MS
Mode:	SIM
Transfer Line Temp.:	330 °C
Ionization Mode:	EI

Rxi®-XLB Columns (fused silica)

(low-polarity proprietary phase)

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

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

ID	df	temp. limits*	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#
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	

ID	df	temp. limits	20-Meter cat.#
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.

similar phases

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

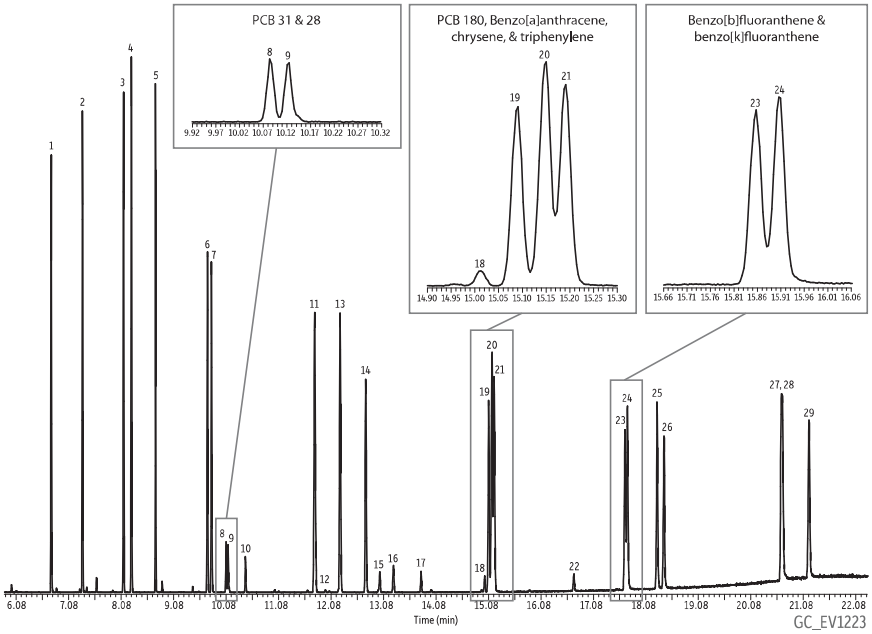
tech tip

Rxi®-XLB columns for Method 525

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 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.

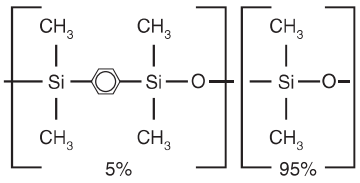
PAHs and PCB Congeners on Rxi®-XLB



Peaks	Conc. (µg/mL)
1. Naphthalene	5
2. 2-Methylnaphthalene	5
3. Acenaphthylene	5
4. Acenaphthene	5
5. Fluorene	5
6. Phenanthrene	5
7. Anthracene	5
8. PCB 31	1
9. PCB 28	1
10. PCB 52	1
11. Fluoranthene	5
12. PCB 101	1
13. Pyrene	5
14. 2-Methylfluoranthene	5
15. PCB 118	1
16. PCB 153	1
17. PCB 138	1
18. PCB 180	1
19. Benzo[a]anthracene	5
20. Chrysene	5
21. Triphenylene	5
22. PCB 194	1
23. Benzo[b]fluoranthene	5
24. Benzo[k]fluoranthene	5
25. Benzo[e]pyrene	5
26. Benzo[a]pyrene	5
27. Dibenzo[a,h]anthracene	5
28. Indeno[1,2,3-cd]pyrene	5
29. Benzo[g,h,i]perylene	5

Column	Rxi®-XLB, 30 m, 0.25 mm ID, 0.25 µm (cat.# 13723)
Sample	SV calibration mix #5 / 610 PAH mix (cat.# 31011) Benzo(e)pyrene (cat.# custom) Triphenylene (cat.# custom) 2-Methylnaphthalene (cat.# 31285) 2-Methylfluoranthene (cat.# custom) PCB congener standard #2 (cat.# 32294) PCB 31 (cat.# custom)
Diluent:	Dichloromethane
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
Solvent Delay Time:	4 min
Tune Type:	manual
Ionization Mode:	EI
Scan Range:	45-550 amu
Scan Rate:	5 scans/sec
Instrument	PE Clarus 500 GC & Clarus 500 MS

Rxi®-5Sil MS Structure



Similar to: (5%-phenyl)-methylpolysiloxane

similar phases

DB-5ms, DB-5msUI, VF-5ms, ZB-5ms, ZB-SemiVolatiles, Rtx-5Sil MS

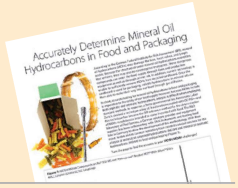
free literature

Rxi®-5Sil MS Columns
Assured Performance for Forensic Applications



lit. cat.# CFBR1302A

Accurately Determine Mineral Oil Hydrocarbons in Food and Packaging



lit. cat.# FFTS1921-UNV

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 cat.#	30-Meter cat.#	60-Meter cat.#
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	

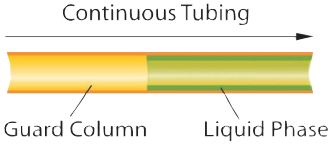
ID	df	temp. limits	10-Meter cat.#	20-Meter cat.#	40-Meter cat.#	60-Meter cat.#
0.15 mm	0.15 µm	-60 to 320/350 °C	43815	43816		
	2.0 µm	-60 to 320/350 °C		43817		
0.18 mm	0.10 µm	-60 to 320/350 °C				43607
	0.18 µm	-60 to 320/350 °C		43602	43605	
	0.36 µm	-60 to 320/350 °C		43604		

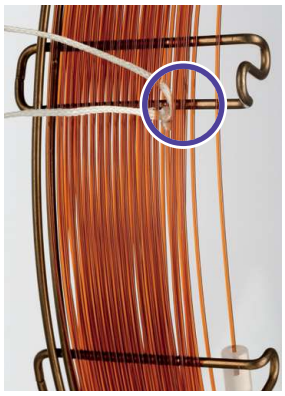
Rxi®-5Sil MS with Integra-Guard®

- 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

Integra-Guard® Built-In Guard Column

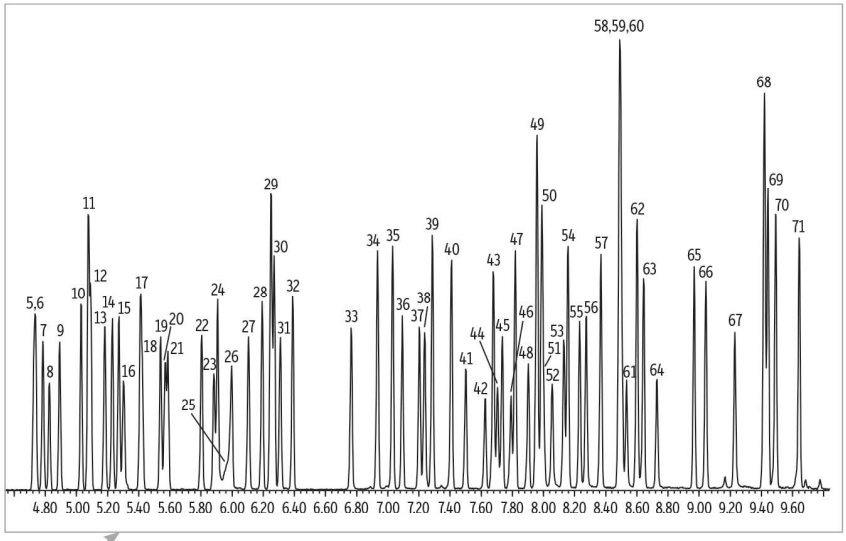


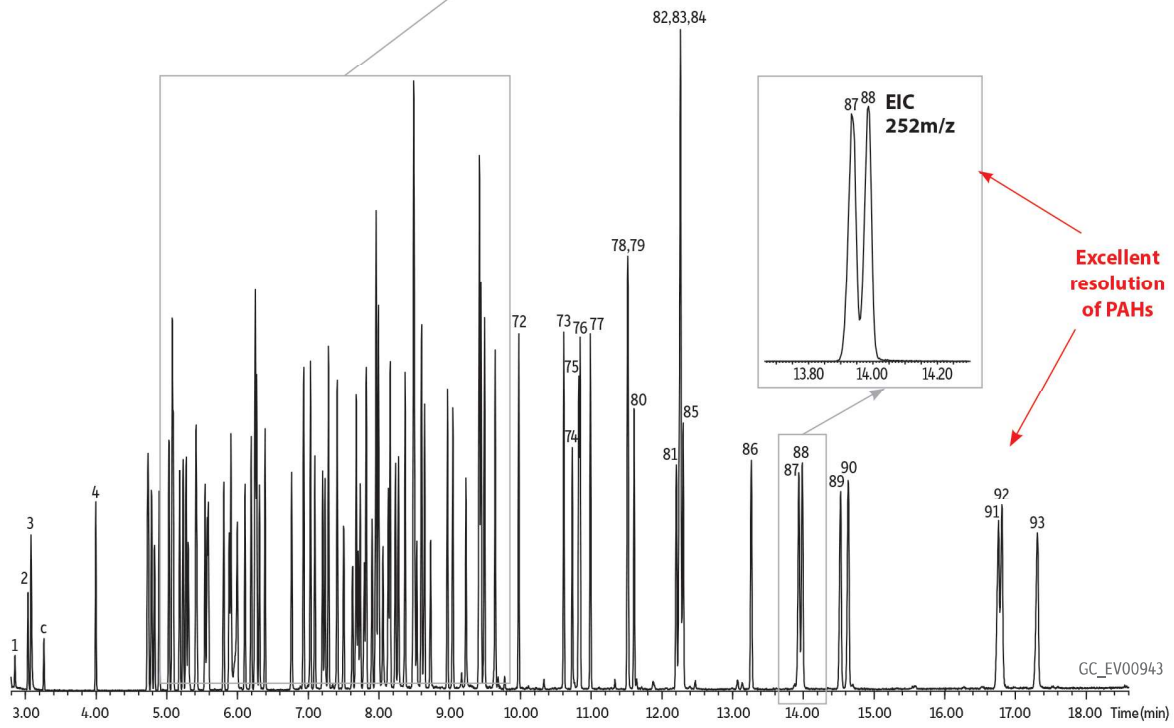


String indicates where the analytical column begins.

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)
Conc.:	10 µg/mL (IS 40 µg/mL)
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)
Carrier Gas	He, constant flow
Flow Rate:	1.2 mL/min
Detector	MS
Mode:	Scan
Transfer Line Temp.:	280 °C
Ionization Mode:	EI
Scan Range:	35-550 amu





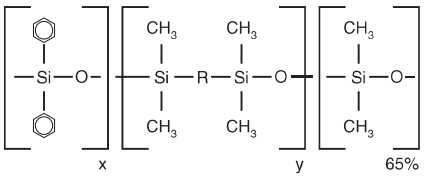
Peaks

1. 1,4-Dioxane
2. N-Nitrosodimethylamine
3. Pyridine
4. 2-Fluorophenol (SS)
5. Phenol-d6 (SS)
6. Phenol
7. Aniline
8. Bis(2-chloroethyl) ether
9. 2-Chlorophenol
10. 1,3-Dichlorobenzene
11. 1,4-Dichlorobenzene-d4 (IS)
12. 1,4-Dichlorobenzene
13. Benzyl alcohol
14. 1,2-Dichlorobenzene
15. 2-Methylphenol
16. Bis(2-chloroisopropyl) ether
17. 4-Methylphenol/3-methylphenol
18. N-Nitrosodi-N-propylamine
19. Hexachloroethane
20. Nitrobenzene-d5 (SS)
21. Nitrobenzene
22. Isophorone
23. 2-Nitrophenol
24. 2,4-Dimethylphenol
25. Benzoic acid
26. Bis(2-chloroethoxy) methane
27. 2,4-Dichlorophenol
28. 1,2,4-Trichlorobenzene
29. Naphthalene-d8 (IS)
30. Naphthalene
31. 4-Chloroaniline
32. Hexachlorobutadiene
33. 4-Chloro-3-methylphenol
34. 2-Methylnaphthalene
35. 1-Methylnaphthalene
36. Hexachlorocyclopentadiene
37. 2,4,6-Trichlorophenol
38. 2,4,5-Trichlorophenol
39. 2-Fluorobiphenyl (SS)
40. 2-Chloronaphthalene
41. 2-Nitroaniline
42. 1,4-Dinitrobenzene
43. Dimethyl phthalate
44. 1,3-Dinitrobenzene
45. 2,6-Dinitrotoluene
46. 1,2-Dinitrobenzene
47. Acenaphthylene
48. 3-Nitroaniline
49. Acenaphthene-d10 (IS)
50. Acenaphthene
51. 2,4-Dinitrophenol
52. 4-Nitrophenol
53. 2,4-Dinitrotoluene
54. Dibenzofuran
55. 2,3,5,6-Tetrachlorophenol
56. 2,3,4,6-Tetrachlorophenol
57. Diethyl phthalate
58. 4-Chlorophenyl phenyl ether
59. Fluorene
60. 4-Nitroanaline
61. 4,6-Dinitro-2-methylphenol
62. *n*-Nitroso-diphenylamine (diphenylamine)
63. 1,2-Diphenylhydrazine (as azobenzene)
64. 2,4,6-Tribromophenol (SS)
65. 4-Bromophenyl phenyl ether
66. Hexachlorobenzene
67. Pentachlorophenol
68. Phenanthrene-d10 (IS)
69. Phenanthrene
70. Anthracene
71. Carbazole
72. di-*n*-Butyl phthalate
73. Fluoranthene
74. Benzidine
75. Pyrene-d10 (SS)
76. Pyrene
77. *p*-Terphenyl-d14 (SS)
78. 3,3'-Dimethylbenzidine
79. Butyl benzyl phthalate
80. Bis(2-ethylhexyl) adipate
81. 3,3'-Dichlorobenzidine
82. Benzo[a]anthracene
83. Bis(2-ethylhexyl)phthalate
84. Chrysene-d12 (IS)
85. Chrysene
86. Di-*n*-octyl phthalate
87. Benzo[b]fluoranthene
88. Benzo[k]fluoranthene
89. Benzo[a]pyrene
90. Perylene-d12 (IS)
91. Indeno[1,2,3-cd]pyrene
92. Dibenzo[a,h]anthracene
93. Benzo[ghi]perylene

c = contaminant (toluene)

Rxi®-35Sil MS

Rxi®-35Sil MS Structure



Similar to: (35%-phenyl)-methylpolysiloxane

similar phases

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

Rxi®-35Sil MS Columns (fused silica)

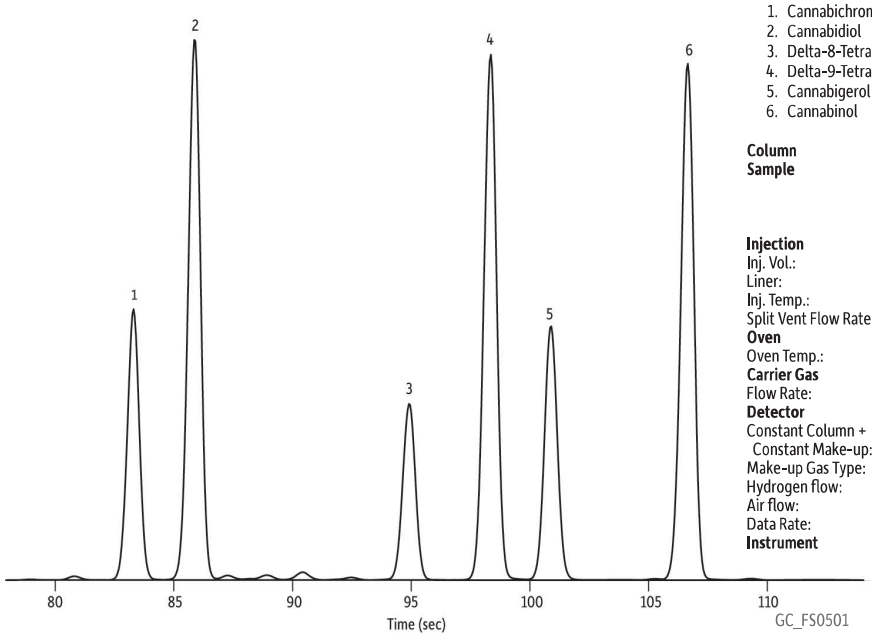
(midpolarity Crossbond® phase)

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

ID	df	temp. limits*	15-Meter cat.#	30-Meter cat.#
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

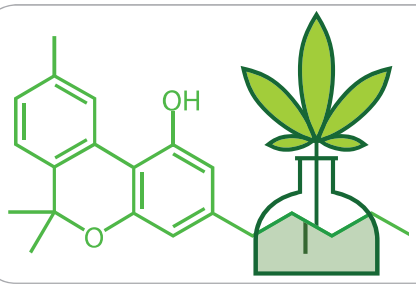
*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

Cannabinoids on Rxi®-35Sil MS Using Hydrogen Carrier Gas by GC-FID



	Peaks	tR (sec)
1.	Cannabichromene	83.3
2.	Cannabidiol	85.9
3.	Delta-8-Tetrahydrocannabinol	94.9
4.	Delta-9-Tetrahydrocannabinol	98.4
5.	Cannabigerol	100.9
6.	Cannabinol	106.7

Column	Rxi®-35Sil MS, 15 m, 0.25 mm ID, 0.25 µm (cat.# 13820)
Sample	Cannabinoids standard (cat.# 34014) Cannabichromene (cat.# 34092) delta-8-Tetrahydrocannabinol (THC) (cat.# 34090) Cannabigerol (cat.# 34091)
Injection	
Inj. Vol.:	1 µL split (split ratio 50:1)
Liner:	Sky® 4 mm Precision® liner w/wool (cat.# 23305.5)
Inj. Temp.:	250 °C
Split Vent Flow Rate:	125 mL/min
Oven	
Oven Temp.:	225 °C (hold 0.1 min) to 330 °C at 35 °C/min (hold 0.9 min)
Carrier Gas	H_2, constant flow
Flow Rate:	2.5 mL/min
Detector	FID @ 350 °C
Constant Column + Constant Make-up:	50 mL/min
Make-up Gas Type:	N_2
Hydrogen flow:	40 mL/min
Air flow:	450 mL/min
Data Rate:	20 Hz
Instrument	Agilent/HP6890 GC



Growing Analytical Solutions for Medical Cannabis Labs

PRODUCTS AND EXPERTISE FOR ACCURATE, RELIABLE RESULTS EVERY TIME

www.restek.com/cannabis

Rxi®-17 Columns (fused silica)

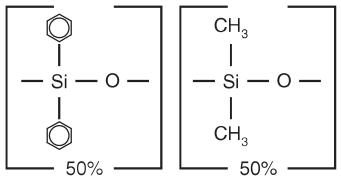
(midpolarity phase; Crossbond® diphenyl dimethyl polysiloxane)

- 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 cat.#	30-Meter cat.#
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		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 cat.#
0.18 mm	0.18 µm	40 to 280/320 °C	13502

Rxi®-17 Structure



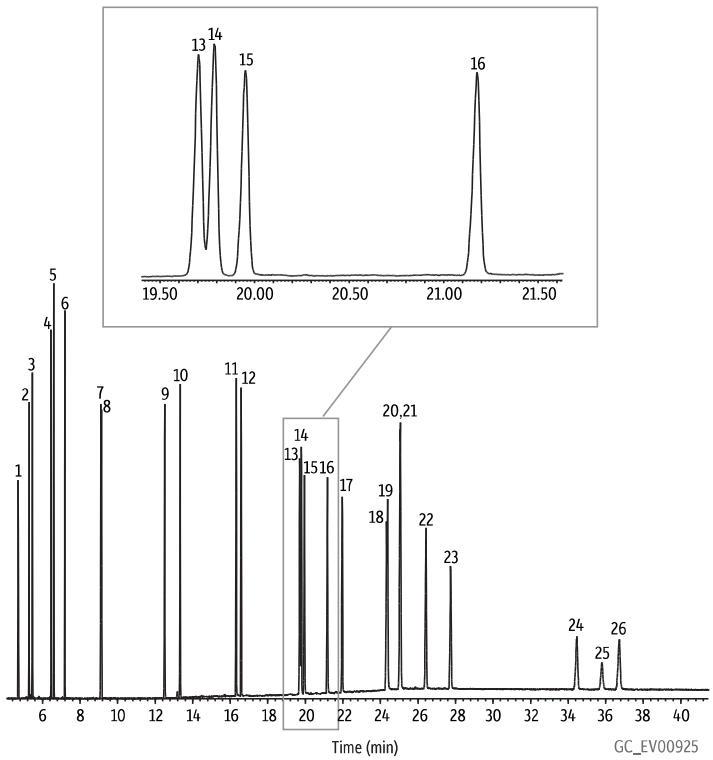
Similar to: (50%-phenyl)-methylpolysiloxane

similar phases

HP-17, DB-17, DB-17ht, DB-608, ZB-50

Polycyclic Aromatic Hydrocarbons on Rxi®-17 column

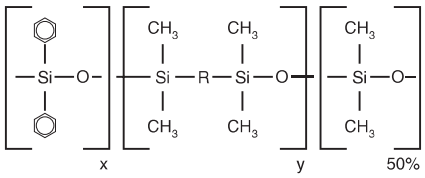
Completely resolve benzo(j)fluoranthene.



Column	Rxi®-17, 30 m, 0.25 mm ID, 0.25 µm (cat.# 13523)
Sample	SV Calibration Mix #5 / 610 PAH Mix (cat.# 31011) PAH Supplement Mix for Method 8100 (cat.# 31857) 1-methylnaphthalene (cat.# 31283) 2-methylnaphthalene (cat.# 31285)
Conc.:	20 µg/mL each component
Injection	
Inj. Vol.:	1.0 µL pulsed splitless (hold 0.2 min)
Liner:	Drilled Uniliner® (hole near top) (cat.# 21055)
Inj. Temp.:	300 °C
Pulse Pressure:	20 psi (137.9 kPa)
Pulse Time:	0.3 min
Purge Flow:	40 mL/min
Oven	
Oven Temp.:	90 °C (hold 1.0 min) to 215 °C at 25 °C/min (hold 0.5 min) to 235 °C at 4 °C/min (hold 0 min) to 280 °C at 15 °C/min (hold 0 min) to 320 °C at 4 °C/min (hold 20 min)
Carrier Gas	He, constant flow
Flow Rate:	1.2 mL/min
Detector	MS
Mode:	Scan
Analyzer Type:	Quadrupole
Solvent Delay Time:	4.0 min
Tune Type:	DFTPP
Ionization Mode:	EI
Scan Range:	50–550 amu
Instrument	HP6890 GC & 5973 MSD

Peaks	tR (min)
1. Naphthalene	4.70
2. 1-Methylnaphthalene	5.28
3. 2-Methylnapthalene	5.46
4. Acenaphthylene	6.45
5. Acenaphthene	6.60
6. Fluorene	7.18
7. Phenanthrene	9.10
8. Anthracene	9.14
9. Fluoranthene	12.50
10. Pyrene	13.33
11. Benz[a]anthracene	16.32
12. Chrysene	16.58
13. Benzo[b]fluoranthene	19.70
14. Benzo[k]fluoranthene	19.78
15. Benzo(j)fluoranthene	19.95
16. Benzo[a]pyrene	21.17
17. 3-Methylcholanthrene	21.97
18. Dibenz(a,h)acridine	24.33
19. Dibenz[a,j]acridine	24.39
20. Indeno(1,2,3-cd)pyrene	25.04
21. Dibenz[a,h]anthracene	25.07
22. Benzo[ghi]perylene	26.43
23. 7H-Dibenzo(c,g)carbazole	27.75
24. Dibenzo(a,E)pyrene	34.46
25. Dibenzo(a,i)pyrene	35.80
26. Dibenzo(a,h)pyrene	36.73

Rxi®-17Sil MS Structure



Similar to: (50%-phenyl)-methylpolysiloxane

similar phases

DB-17ms, VF-17ms

Rxi®-17Sil MS Columns (fused silica)

(midpolarity Crossbond® phase)

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

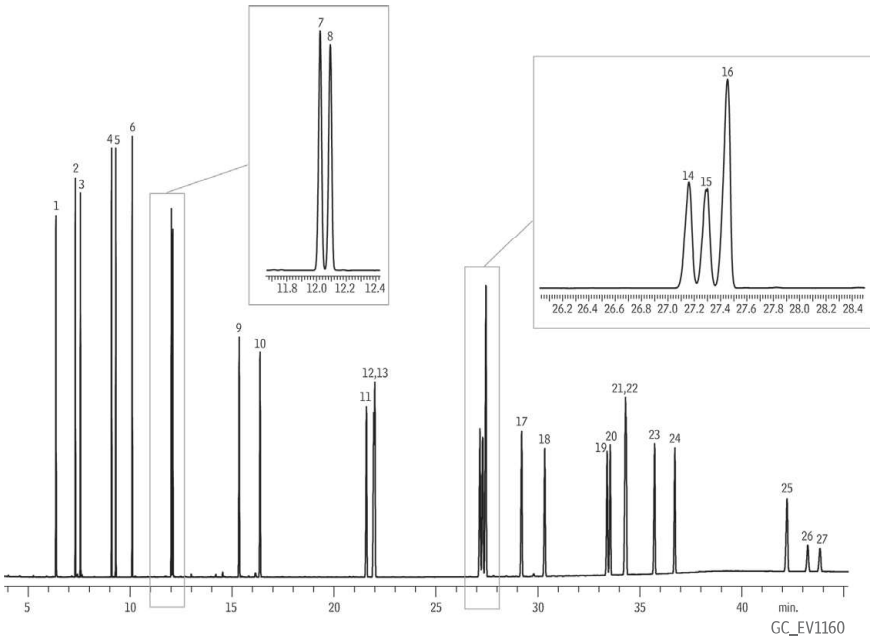
ID	df	temp. limits*	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#
0.25 mm	0.25 µm	40 to 340/360 °C	14120	14123	14126
0.32 mm	0.25 µm	40 to 340/360 °C	14121	14124	

ID	df	temp. limits	10-Meter cat.#	20-Meter cat.#
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.

Polycyclic Aromatic Hydrocarbons on Rxi®-17Sil MS

Excellent resolution and peak shape for PAHs that cannot be resolved by 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	Rxi®-17Sil MS, 30 m, 0.25 mm ID, 0.25 µm (cat.# 14123)
Sample	PAH supplement mix for method 8100 (cat.# 31857) EPA Method 8310 PAH mixture (cat.# 31841) Triphenylene (custom)
Diluent:	Dichloromethane
Conc.:	10 ppm
Injection	
Inj. Vol.:	0.5 µL splitless (hold 1.75 min)
Liner:	Auto SYS XL PSS split/splitless w/wool (cat.# 21718)
Inj. Temp.:	320 °C
Purge Flow:	75 mL/min
Oven	
Oven Temp.:	65 °C (hold 0.5 min) to 220 °C at 15 °C/min to 330 °C at 4 °C/min (hold 15 min)
Carrier Gas	He, constant flow
Flow Rate:	2.0 mL/min
Detector	FID @ 320 °C
Instrument	PE Clarus 600 GC
Acknowledgement	Instrument provided by PerkinElmer

Rxi®-PAH Columns (fused silica)

(midpolarity proprietary phase)

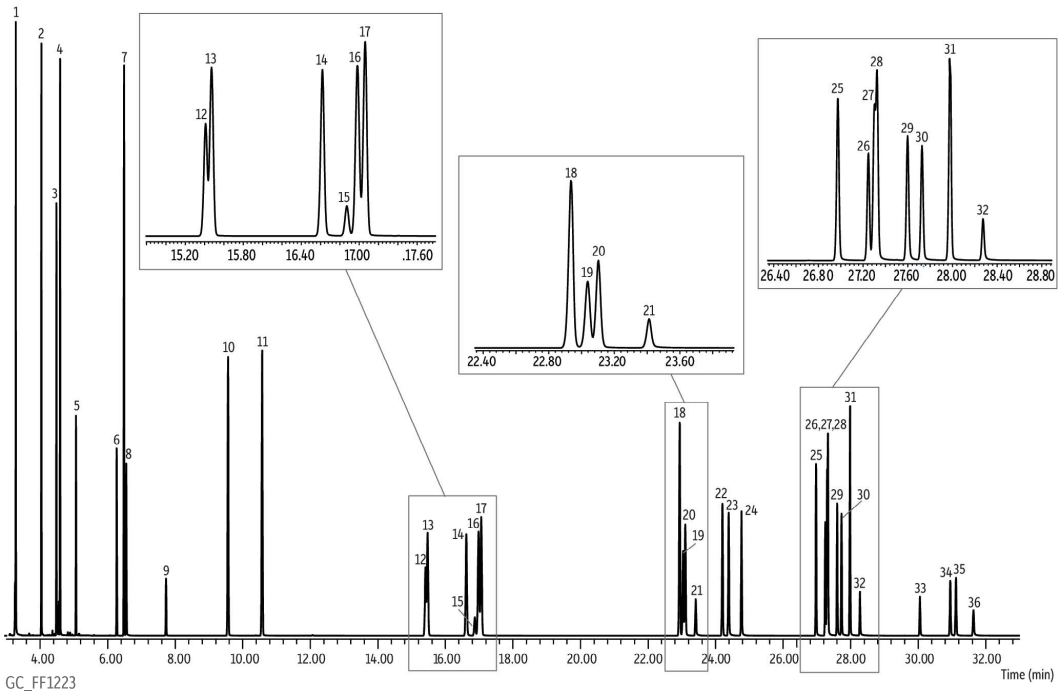
- Ideal for EFSA PAH4 analysis—separates all priority compounds: benz[a] anthracene, chrysene, benzo[b]fluoranthene, and benzo[a]pyrene.
- Best resolution of chrysene from interfering PAHs, triphenylene, and cyclopenta[cd]pyrene.
- Complete separation of benzo [b], [k], [j], and [a] fluoranthenes.
-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

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



See **pages 193–202.**

NIST SRM 2260a PAH Mix on Rxi®-PAH



GC_FF1223

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. Benz[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. Dibenzo[b,k]fluoranthene
34. Dibenzo[a,e]pyrene
35. Coronene
36. Dibenzo[a,h]pyrene

Column	Rxi®-PAH, 40 m, 0.18 mm ID, 0.07 µm (cat.# 49316)
Sample	NIST SRM 2260a PAH mix
Diluent:	Toluene
Conc.:	0.2 - 2 µg/mL (SRM 2260a PAH mix was diluted 5x in toluene)
Injection	
Inj. Vol.:	0.5 µL pulsed splitless (hold 0.58 min)
Liner:	Sky® 2 mm single taper w/wool (cat.# 23316.1)
Inj. Temp.:	275 °C
Pulse Pressure:	80 psi (551.6 kPa)
Pulse Time:	0.6 min
Purge Flow:	40 mL/min
Oven	
Oven Temp.:	110 °C (hold 1 min) to 210 °C at 37 °C/min to 260 °C at 3 °C/min to 350 °C at 11 °C/min (hold 4.5 min)
Carrier Gas	He, constant flow
Flow Rate:	1.4 mL/min

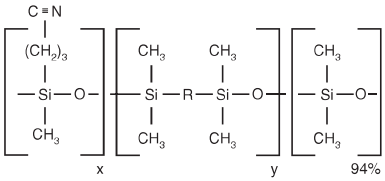
Detector	MS
Mode:	SIM
SIM Program:	

Group	Start Time (min)	Ion(s) (m/z)	Dwell (ms)
1	3.00	128, 152, 153, 154, 165	40
2	5.50	178, 184, 190, 202	50
3	13.00	226, 228	100
4	20.00	252	200
5	26.00	276, 278	100
6	29.00	300, 302	150

Transfer Line Temp.:	350 °C
Analyzer Type:	Quadrupole
Source Temp.:	350 °C
Quad Temp.:	200 °C
Solvent Delay Time:	3.00 min
Tune Type:	PFTBA
Ionization Mode:	EI
Instrument	Agilent 7890A GC & 5975C MSD

Rxi®-624Sil MS

Rxi®-624Sil MS (G43) Structure



Similar to: (6%-cyanopropylphenyl)-methylpolysiloxane

similar phases

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

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—G43 phase 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 cat.#	30-Meter cat.#	60-Meter cat.#	75-Meter cat.#	105-Meter cat.#
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



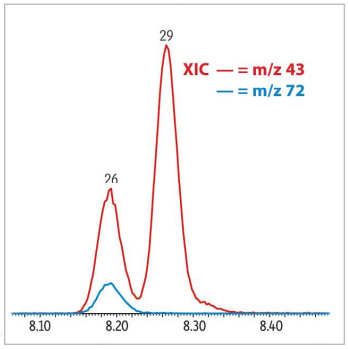
free literature

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

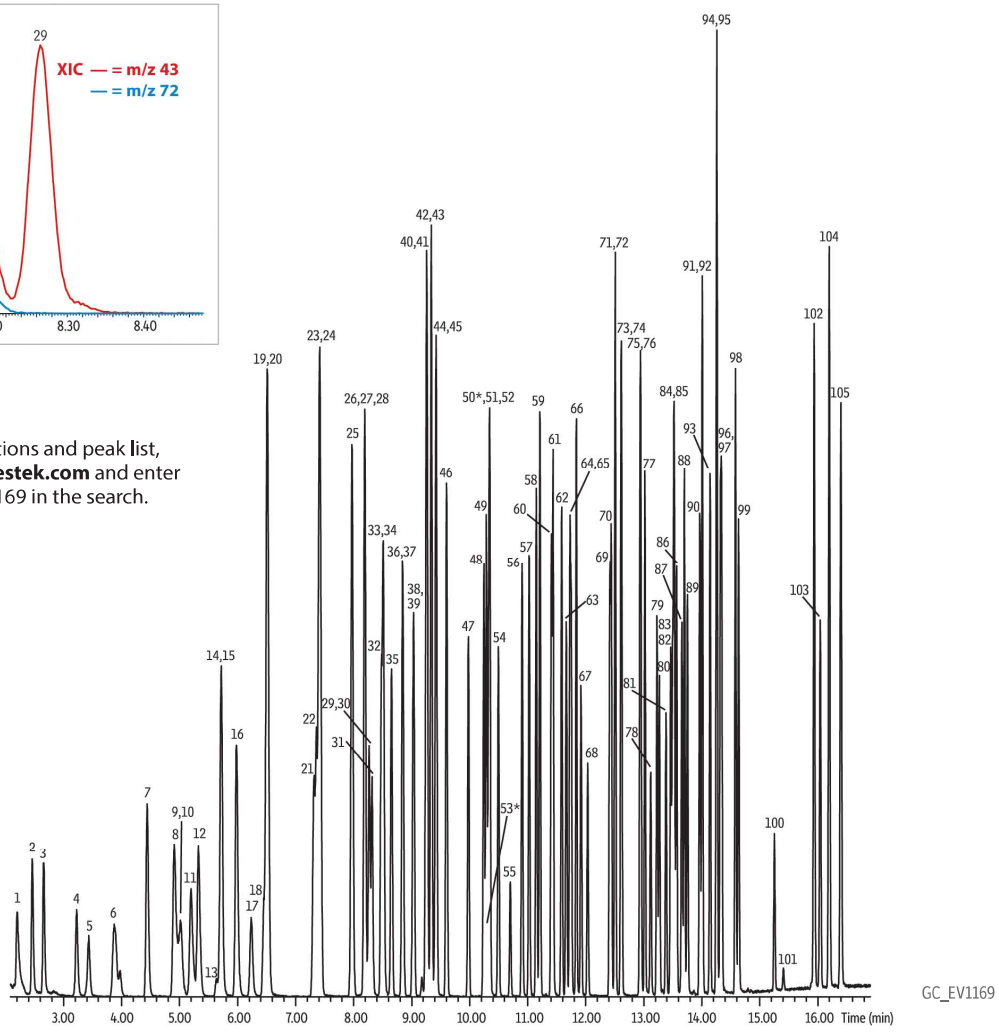
Download your free copy from **www.restek.com**

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.



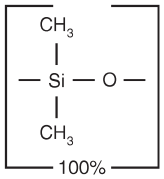
Rxi®-1HT Columns (fused silica)

(nonpolar phase; dimethyl polysiloxane)

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

ID	df	temp. limits	15-Meter cat.#	30-Meter cat.#
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

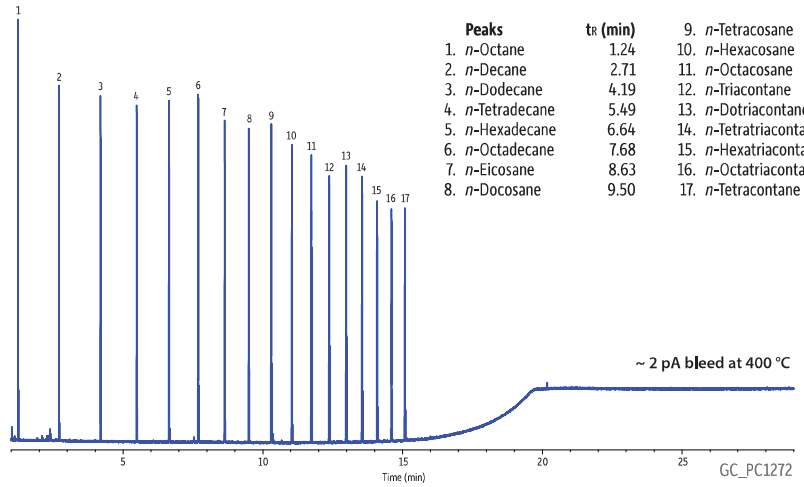


Similar to: (100%-methyl)-polysiloxane

similar phases

DB-1ht, ZB-1HTinferno

Florida TRPH Standard Mix on Rxi®-1HT



Peaks	tR (min)		
1. *n*-Octane	1.24	9. *n*-Tetracosane	10.30
2. *n*-Decane	2.71	10. *n*-Hexacosane	11.04
3. *n*-Dodecane	4.19	11. *n*-Octacosane	11.73
4. *n*-Tetradecane	5.49	12. *n*-Triacontane	12.38
5. *n*-Hexadecane	6.64	13. *n*-Dotriacontane	12.98
6. *n*-Octadecane	7.68	14. *n*-Tetratriacontane	13.55
7. *n*-Eicosane	8.63	15. *n*-Hexatriacontane	14.09
8. *n*-Docosane	9.50	16. *n*-Octatriacontane	14.60
		17. *n*-Tetracontane	15.08

Column	Rxi®-1HT, 15 m, 0.25 mm ID, 0.10 µm (cat.# 13950)
Sample	Florida TRPH standard (cat.# 31266)
Diluent:	Hexane
Conc.:	50 ppm (1.25 ng on-column)
Injection	
Inj. Vol.:	1.0 µL split (split ratio 40:1)
Liner:	Sky® 4.0 mm ID Precision® inlet liner w/ wool (cat.# 23305.1)
Inj. Temp.:	275 °C
Oven	
Oven Temp.:	40 °C (hold 1.0 min) to 400 °C at 20 °C/min (hold 10 min)
Carrier Gas	He, constant flow
Linear Velocity:	55 cm/sec
Detector	FID @ 400 °C
Make-up Gas Flow Rate:	45 mL/min
Make-up Gas Type:	N_2
Hydrogen flow:	40 mL/min
Air flow:	450 mL/min
Data Rate:	50 Hz
Instrument	Agilent/HP6890 GC

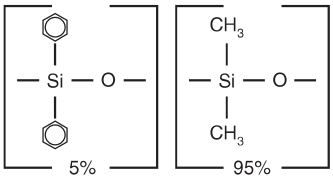
Rxi®-5HT Columns (fused silica)

(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 cat.#	30-Meter cat.#
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

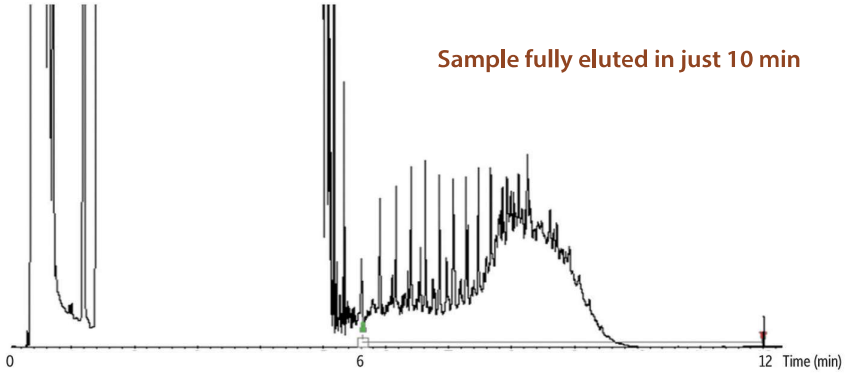


Similar to: (5%-phenyl)-methylpolysiloxane

similar phases

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

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

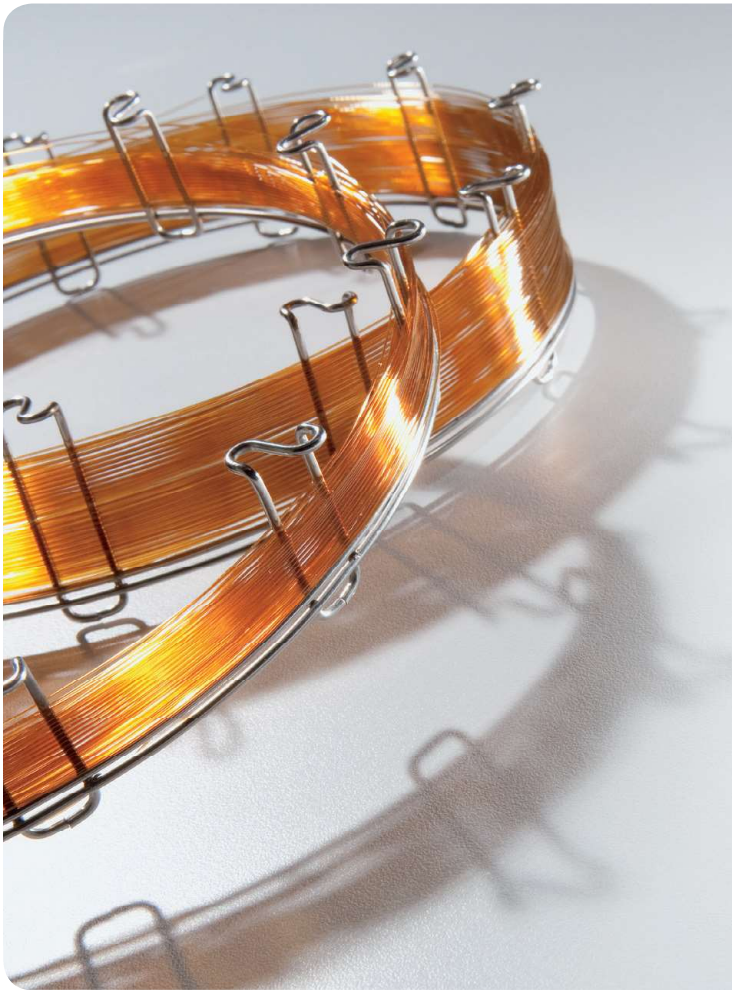


Column	Rxi®-5HT, 15 m, 0.32 mm ID, 0.10 µm (cat.# 13906)
Sample	Mineral oil
Diluent:	Hexane
Conc.:	25 ppm
Injection	
Inj. Vol.:	100 µL ptv splitless
Inlet Temp. Program:	45 °C (hold 0.45 min) to 350 °C at 200 °C/min (hold 10 min)
Oven	
Oven Temp.:	35 °C (hold 4 min) to 150 °C at 60 °C/min to 250 °C at 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 41
Rtx®-5, Rtx®-5MS 42–44
Rtx®-20, Rtx®-35 45–46
Rtx®-50, Rtx®-65 47
Rtx®-200, Rtx®-200MS 48–49
Rtx®-440 50
Rtx®-1301, Rtx®-624 51–52
Rtx®-1701, Rtx®-225 53–54
Rtx®-2330, Rt®-2560 55–56
Rtx®-Wax 57
Stabilwax® 58
Stabilwax®-MS 59
GCxGC 60–62
Fast GC 63





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.
- Long lifetime and very low bleed at high operating temperatures.
- Temperature range: -60 °C to 350 °C.
- Equivalent to USP G1, G2, G38 phases.

ID	df	temp. limits*	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#	105-Meter cat.#
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	

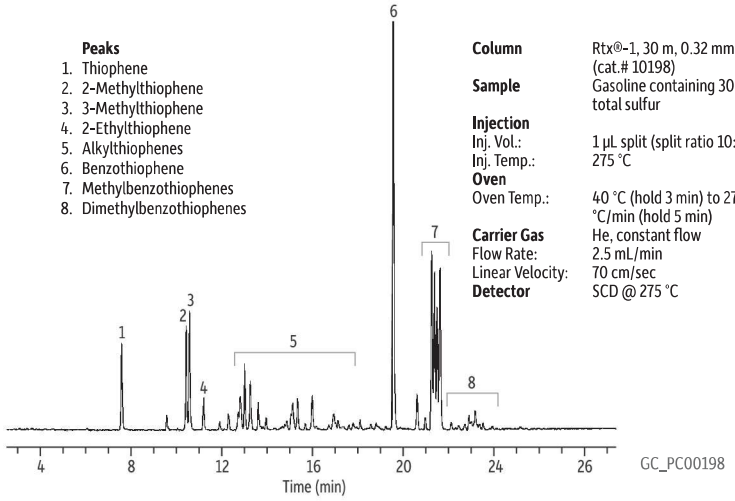
ID	df	temp. limits	10-Meter cat.#	20-Meter cat.#	40-Meter cat.#
0.18 mm	0.20 µm	-60 to 330/350 °C	40101	40102	40103
	0.40 µm	-60 to 330/340 °C	40110	40111	40112

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

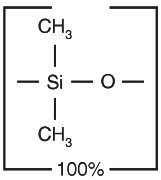
Rtx®-1 with Integra-Guard® Column

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

Sulfur in Gasoline on Rtx®-1



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 107.**

free literature

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

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

lit. cat.# PCAN1499-UNV



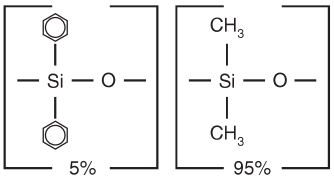
crossbond® technology

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

Fused Silica Capillary & PLOT Column Ferrule Guide

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

Rtx®-5 Structure



Similar to: (5%-phenyl)-methylpolysiloxane

similar phases

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

Rtx®-5 (G27) 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 monomodal distribution and extremely low bleed.

ID	df	temp. limits*	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#	105-Meter cat.#
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		
	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 cat.#	20-Meter cat.#	40-Meter cat.#
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.



also available

Metal MXT® Columns

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

MXT®-5 columns .....page 108

also available

Rtx®-5 Amine columns.....page 100

Six columns for the price of five!

Other phases and configurations available on request.

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

Speed Up and Simplify GC Method Development With

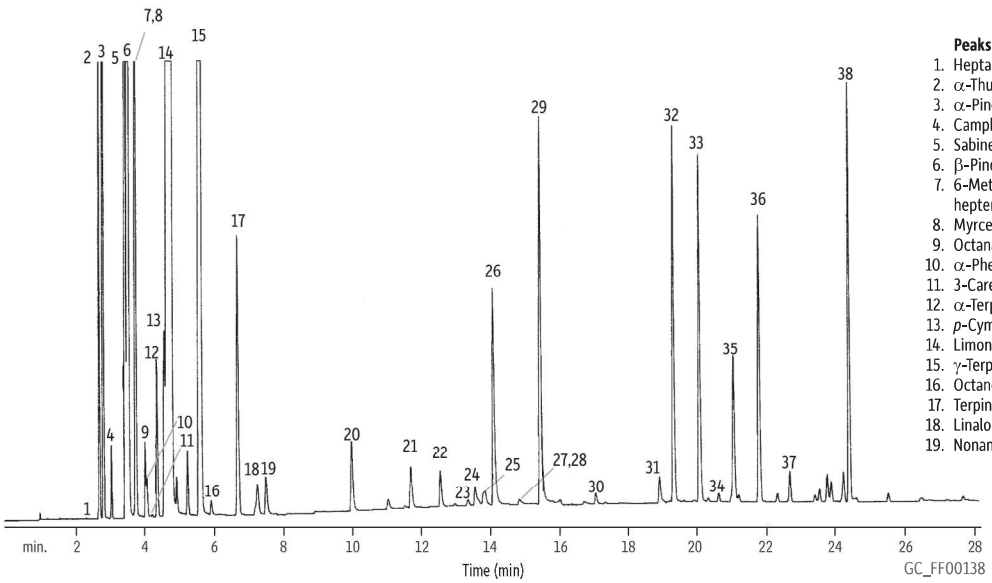
Restek's *EZGC*® Online Suite

- Model chromatograms
- Get column recommendations
- Translate methods NEW!
- Calculate flows NEW!

Download today at www.restek.com/ezgc



Lemon Oil on Rtx®-5



Peaks
1. Heptanol
2. α-Thujene
3. α-Pinene
4. Camphene
5. Sabinene
6. β-Pinene
7. 6-Methyl-5-hepten-2-one
8. Myrcene
9. Octanal
10. α-Phellandrene
11. 3-Carene
12. α-Terpinene
13. *p*-Cymene
14. Limonene
15. γ-Terpinene
16. Octanol
17. Terpinolene
18. Linalool
19. Nonanal
20. Citronellal
21. Terpinene-4-ol
22. α-Terpineol
23. Decanol
24. Octyl acetate
25. Nerol
26. Neral
27. Carvone
28. Geraniol
29. Geranial
30. Nonyl acetate
31. Citronellyl acetate
32. Neryl acetate
33. Geranyl acetate
34. Dodecanal
35. β-Caryophyllene
36. *trans*-α-Bergamotene
37. α-Humulene
38. β-Bisabolene

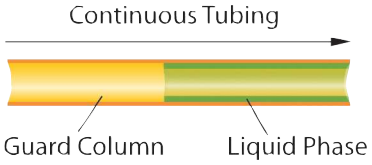
Column	Rtx®-5, 30 m, 0.32 mm ID, 0.25 µm (cat.# 10224)	**Carrier Gas**	H_2, constant flow
Sample	Wet needle split injection of a neat lemon oil	Flow Rate:	3.2 mL/min
Injection	Split (split ratio 100:1)	Linear Velocity:	40 cm/sec
Inj. Temp.:	250 °C	**Detector**	FID @ 250 °C
Oven		**Notes**	FID sensitivity: 2 x 10^{-11} AFS
Oven Temp.:	75 °C (hold 8 min) to 250 °C at 4 °C/min		

Rtx®-5 with Integra-Guard® Columns

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

Description	qty.	cat.#
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

Integra-Guard® Built-In Guard Column

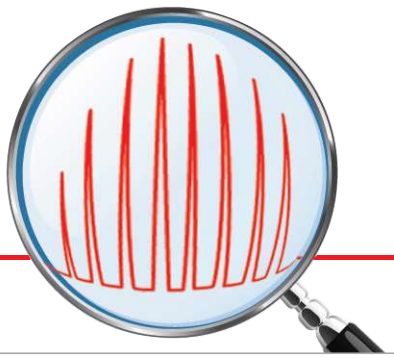


Get the protection without the connection!

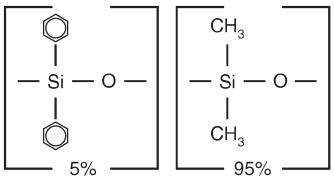
Chromatogram Search Tool

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

www.restek.com/**chromatograms**



Rtx®-5MS Structure



similar phases

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

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

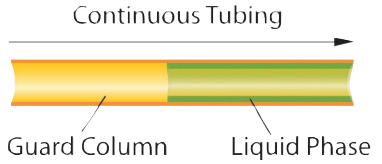
(low-polarity phase; Crossbond® diphenyl dimethyl polysiloxane)

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

ID	df	temp. limits	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#
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	
	0.25 µm	-60 to 330/350 °C	12621	12624	12627
	0.50 µm	-60 to 330/350 °C		12639	12642
	1.00 µm	-60 to 325/350 °C		12654	
0.53 mm	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	

Note: The DB-5MS is a silarylene-based polymer equivalent to the Rxi-5Sil MS.
*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

Integra-Guard® Built-In Guard Column



Get the protection without the connection!

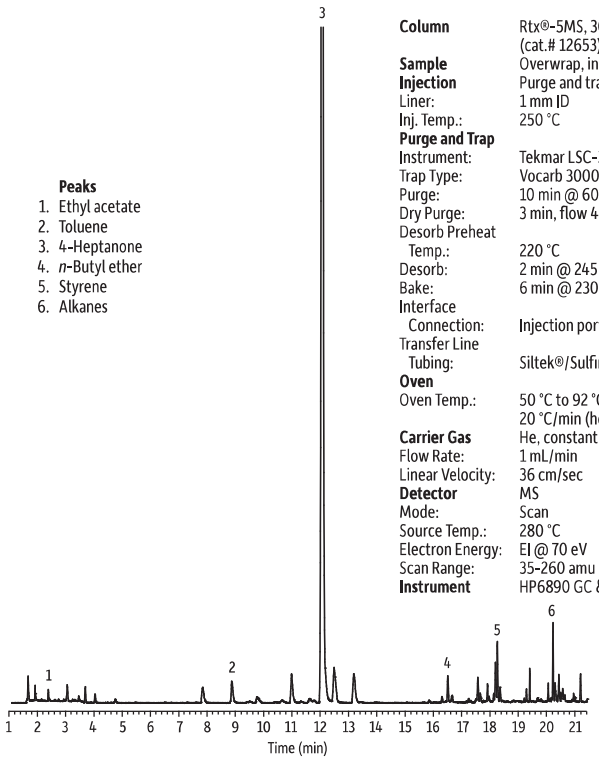
Rtx®-5MS with Integra-Guard® Columns

Description	qty.	cat.#
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



We carefully manage inventory so we have what you need when you need it.

Food Packaging Volatiles by Purge & Trap GC-MS on Rtx®-5MS



Rtx®-20 Columns (fused silica)

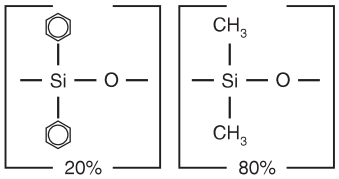
(low- to midpolarity phase; Crossbond® diphenyl dimethyl polysiloxane)

- 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 monomodal distribution and extremely low bleed.

ID	df	temp. limits	30-Meter cat.#
0.25 mm	0.25 µm	-20 to 300/320 °C	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	10355

Rtx®-20 Structure

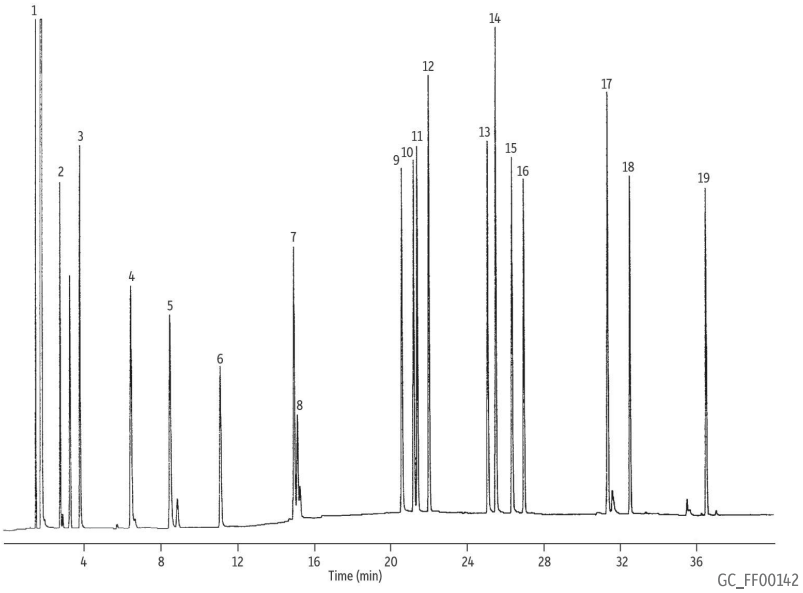


Similar to: (20%-phenyl)-methylpolysiloxane

similar phases

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

Mushroom Aroma (Synthetic) on Rtx®-20

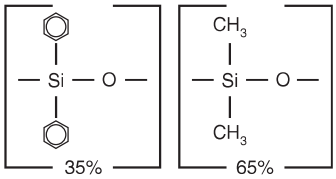


Peaks
1. Acetone
2. Ethyl Acetate
3. 1-Butanol
4. 3-Methyl-1-butanol
5. 1-Pentanol
6. Hexanal
7. Furfural
8. Amyl acetate
9. 1-Octen-3-ol
10. 3-Octanol
11. 3-Octanone
12. Benzaldehyde
13. Octyl alcohol
14. Benzyl Alcohol
15. Phenylacetaldehyde
16. Nonanal
17. α-terpineol
18. 2,4-Nonadienal
19. 2,4-Decadienal

Column	Rtx®-20, 30 m, 0.32 mm ID, 1.00 µm (cat.# 10354)
Sample	synthetic mushroom aroma
Conc.:	10 ng per component
Injection	
Inj. Vol.:	1.0 µL split (split ratio 100:1)
Inj. Temp.:	260 °C
Oven	
Oven Temp.:	45 °C (hold 8 min) to 250 °C at 4 °C/min
Carrier Gas	H_2, constant pressure
Linear Velocity:	40 cm/sec
Detector	FID @ 260 °C
Notes	FID sensitivity: 4 x 10^{-11} AFS



Rtx®-35 Structure



Similar to: (35%-phenyl)-methylpolysiloxane

similar phases

HP-35, DB-35, ZB-35

also available

Rtx®-35 Amine columns .....page 101

Rtx®-35 Columns (fused silica)

(midpolarity phase; Crossbond® diphenyl dimethyl polysiloxane)

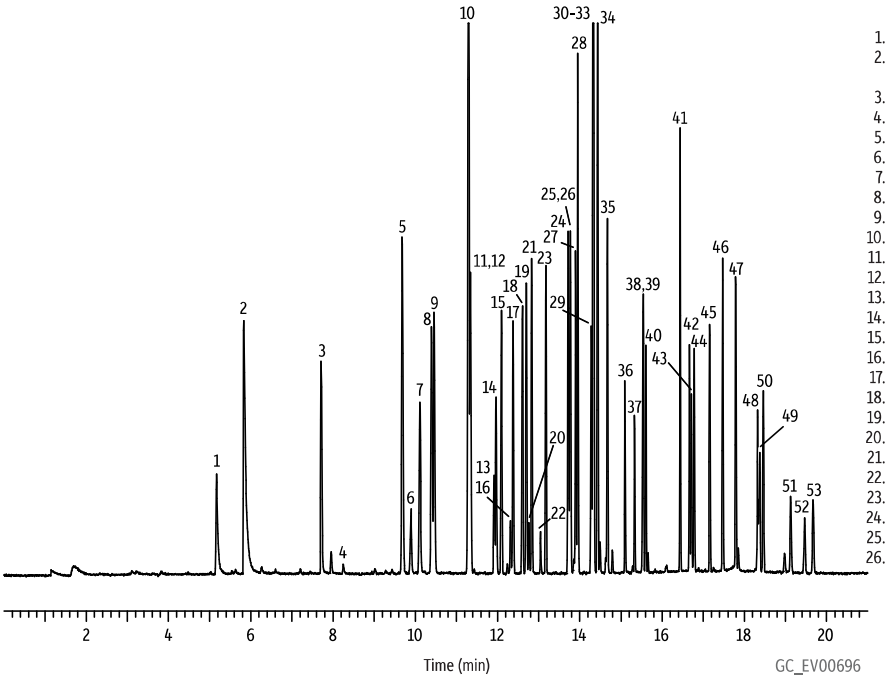
- General-purpose columns for organochlorine pesticides, PCB congeners (e.g., Aroclor mixes), herbicides, pharmaceuticals, sterols, rosin acids, phthalate esters.
- Temperature range: 40 °C to 320 °C.
- Equivalent to USP G42 phase.

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 cat.#	30-Meter cat.#
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		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 cat.#	20-Meter cat.#
0.18 mm	0.20 µm	40 to 300/320 °C		40402
	0.40 µm	40 to 290/310 °C	40410	40411

Organophosphorus Pesticides US EPA Method 8140/8141/8141A on Rtx®-35



Peaks

1. Dichlorvos
2. Hexamethyl phosphoramide
3. Mevinphos
4. Trichlorfon
5. Tributyl phosphate (SS)
6. Demeton-o
7. TEPP
8. Thionazin
9. Ethoprop
10. Sulfotepp
11. Naled
12. Phorate
13. Dicrotophos
14. Demeton-S
15. Terbufos
16. Monocrotophos
17. Diazinon
18. Fonophos
19. Disulfoton
20. Dioxathion
21. Dimethoate
22. Phosphamidon isomer
23. Dichlorofenthion
24. Chlorpyrifos methyl
25. Phosphamidon
26. Ronnel
27. Methyl parathion
28. Aspon
29. Trichloronate
30. Chlorpyrifos
31. Fenitrothion
32. Merphos
33. Malathion
34. Parathion-ethyl
35. Fenthion
36. Chlorfenvinphos
37. Crotoxyphos
38. Merphos oxone
39. Prothiofos
40. Stirofos
41. Ethion
42. Sulprofos
43. Fensulfothion
44. Carbofenothion
45. Famphur
46. Triphenyl phosphate (SS)
47. Epn
48. Phosmet
49. Leptophos
50. Tri-o-cresyl phosphate
51. Azinphos-methyl
52. Azinphos-ethyl
53. Coumaphos

Column Rtx®-35, 30 m, 0.32 mm ID, 0.25 µm (cat.# 10424)
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.: 0.1µg/mL US EPA Method 8141A Custom Standard Mixes (100ng/mL)
Injection
Inj. Vol.: 0.5 µL splitless (hold 5 min)
Liner: Drilled Uniliner (hole near top) (cat.# 21054-214.1)
Inj. Temp.: 220 °C

Oven
Oven Temp.: 100 °C to 180 °C at 10 °C/min (hold 2 min) to 300 °C at 18 °C/min (hold 10 min)
Carrier Gas He, constant pressure
Linear Velocity: 42 cm/sec @ 60 °C
Detector FPD @ 280 °C

Rtx®-50 Columns (fused silica)

(midpolarity phase; Crossbond® phenyl methyl polysiloxane)

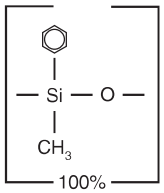
- General-purpose columns for pesticides, herbicides, rosin acids, phthalate esters, sterols.
- Temperature range: 40 °C to 320 °C.
- Equivalent to USP G3 phase.

The high thermal stability of Rtx®-50 columns makes dual-column analysis possible with common phases such as Rtx®-1 or Rtx®-5MS.

ID	df	temp. limits	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#
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	
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	

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

Rtx®-50 Structure



Similar to: (50%-phenyl)-methylpolysiloxane

similar phases

HP-50+, CP-Sil 24 CB, 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 columns .....page 109

Rtx®-65 Columns (fused silica)

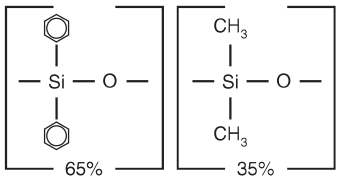
(mid- to high-polarity phase; Crossbond® diphenyl dimethyl polysiloxane)

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

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 cat.#
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

Rtx®-65 Structure



Similar to: (65%-phenyl)-methylpolysiloxane

similar phases

007-65HT

crossbond® technology

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

also available

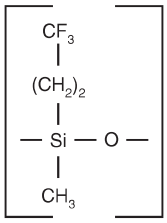


Rtx®-65TG Columns

Tested specifically for triglycerides.

See **page 89.**

Rtx®-200 Structure



Similar to: (trifluoropropyl)-methylpolysiloxane

similar phases

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



also available

Metal MXT® Columns

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

MXT®-200 columns..... page 110

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 cat.#	30-Meter cat.#	60-Meter cat.#	105-Meter cat.#
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 cat.#	20-Meter cat.#	40-Meter cat.#
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.

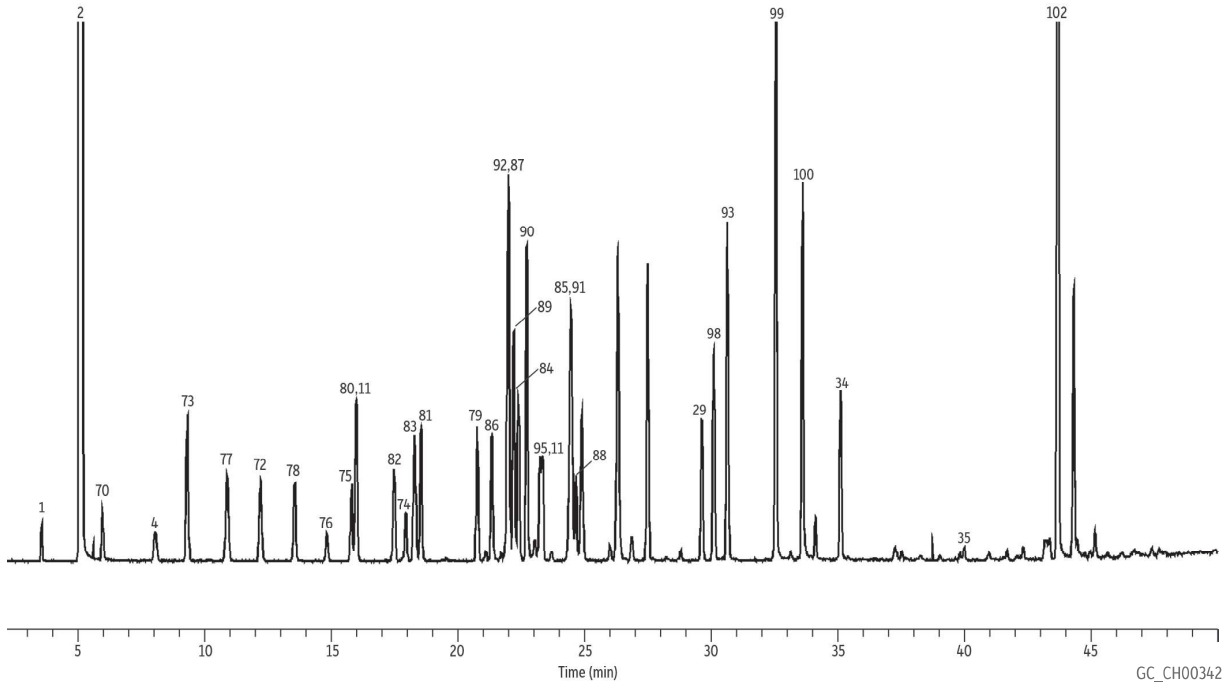
Speed Up and Simplify GC Method Development With
Restek's *EZGC*® Online Suite

- Model chromatograms
- Column recommendations
- Translate methods NEW!
- Calculate flows NEW!

Download today at
www.restek.com/ezgc



Solvent Mixture #3 on Rtx®-200



Column	Rtx®-200, 60 m, 0.53 mm ID, 3.00 µm (cat.# 15088)
Sample	Solvent mix #3
Injection	
Inj. Vol.:	1.0 µL split
Inj. Temp.:	275 °C
Split Vent Flow Rate:	50 mL/min
Oven	
Oven Temp.:	40 °C (hold 5 min) to 285 °C at 5 °C/min
Carrier Gas	He, constant flow
Linear Velocity:	40 cm/sec
Detector	MS
Mode:	Scan
Source Temp.:	285 °C

Peaks

1. Pentane
2. Methylene chloride
3. Ethylene glycol
4. Heptane
5. Cyclopentanol
6. 3-Hexanol
7. Acetamide
8. 2-Methyl-1-pentanol
9. Furfuryl alcohol
10. Butyl ether
11. Nonane
12. Cumene
13. Ethyl amyl ketone
14. Heptanol
15. Butyl butanoate
16. Unknown
17. Benzyl alcohol
18. Dipropylene glycol
19. Benzene, diethyl-
20. Unknown
21. Unknown
22. Hexachloroethane
23. Undecane
24. 1-Nonanol
25. *p*-Methoxyphenol
26. Triethylene glycol
27. Dodecane
28. Undecanal
29. Tridecane
30. Unknown
31. Dodecanal
32. Dicyclohexylamine
33. bis(2,2-methoxy)ethyl ether
34. Pentadecane
35. Heptadecane
36. Octadecane
37. Nonadecane
38. Eicosane
39. Acetyl tributyl citrate
40. 2-Buten-1-ol
41. Formamide
42. 3-Pentanol
43. 1-Nitropropane
44. Dimethylformamide
45. 2-Methyl-3-pentanol
46. Toluene
47. Ethyl chloroacetate
48. Dimethylacetamide
49. *p*-Xylene
50. *sec*-tetrachloroethane
51. Benzaldehyde
52. α-Chlorotoluene
53. 2,6-Dimethyl-4-heptanone
54. 2-Octanone
55. *o*-Cresol
56. α-Methylbenzyl alcohol
57. 5-Nonanone
58. Nonanal
59. Decanal
60. Unknown
61. 1-Decanol
62. 1-Undecanol
63. 2-Dodecanone
64. 1-Dodecanol
65. Tetraethylene glycol
66. Dibenzyl
67. Diethyl Phthalate
68. Tributyl phosphate
69. Diphenyl sulfone
70. Allyl alcohol
71. Unknown
72. Isopropyl acetate
73. Benzene
74. 2-Nitropropane
75. Nitroethane
76. Pentanal
77. 2-Bromobutane
78. 1-Chloropentane
79. Cyclopentanone
80. 2-Hexanol
81. Butyl acetate
82. 2-Ethyl-1-butanol
83. 3-Ethyl-3-pentanol
84. 1,4-Dichlorobutane
85. 2-Methyl-2,4-pentanediol
86. Butoxyethanol
87. 1,2,3-Trichloropropane
88. 1,4-Butanediol
89. Methyl hexanoate
90. 1,2,4-Trimethylbenzene
91. 2-Ethyl-1-hexanol
92. Dipentene/Limonene
93. Tetrahydrofurfuryl acetate
94. Unknown
95. Decahydronaphthalene
96. Unknown
97. Unknown
98. 2-Decanol
99. 1,2-Bis(2-methoxyethoxy) ethane
100. 2-Phenoxyethanol
101. Unknown
102. Benzyl ether

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 cat.#
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

Restek innovation!

Speed Up & Simplify GC Method Development
Restek's *EZGC*® Online Suite
www.restek.com/ezgc

Rtx®-440 Columns (fused silica)
(midpolarity proprietary Crossbond® phase)

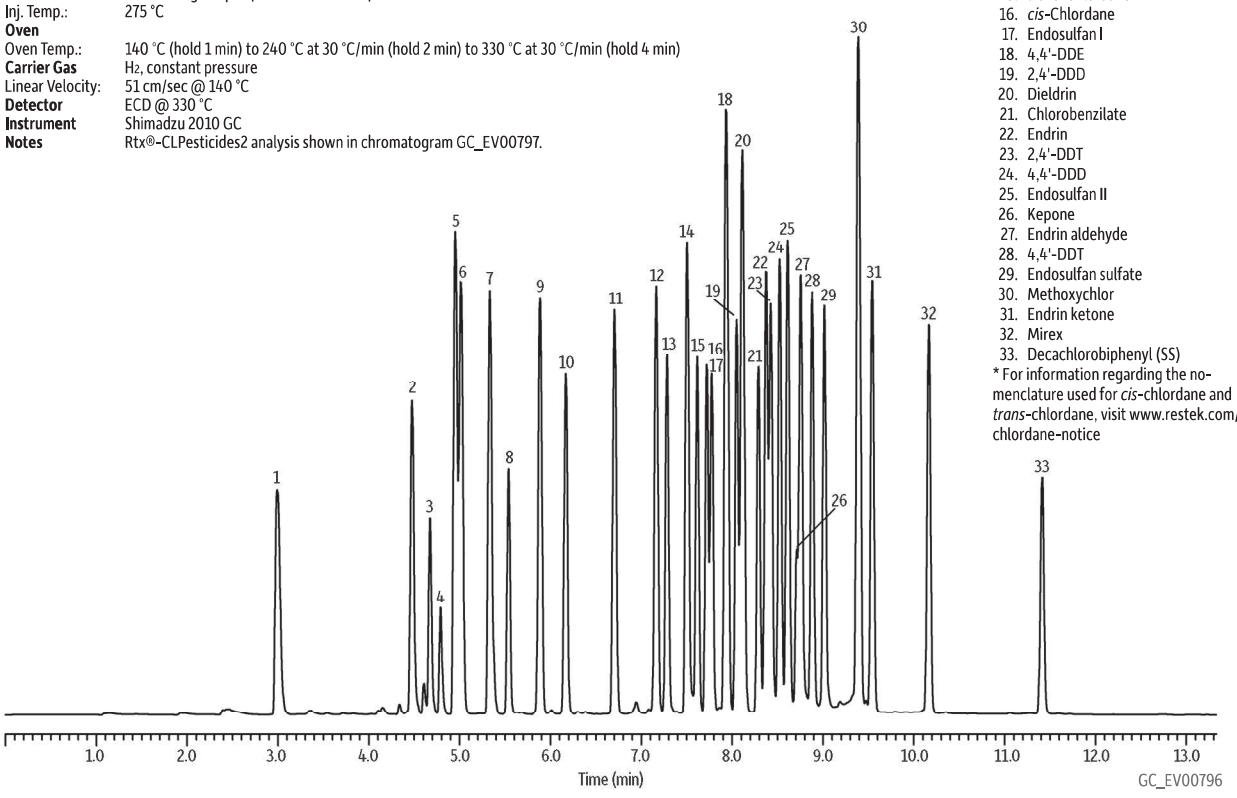
- General-purpose columns with unique selectivity for pesticides, PAHs, or other semivolatiles. Ideal for low/trace-level analyses.
- Low-bleed, high-resolution columns with unique selectivity.
- Wide temperature range: 20 °C to 340 °C.

ID	df	temp. limits	30-Meter cat.#
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

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

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

Column Rtx®-440, 30 m, 0.32 mm ID, 0.50 µm (cat.# 12939)
Sample 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)
Diallate (*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 H_2, 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*-Diallate
4. *trans*-Diallate
5. α-BHC
6. Hexachlorobenzene
7. γ-BHC
8. β-BHC
9. δ-BHC
10. Heptachlor
11. Aldrin
12. Isodrin
13. Heptachlor epoxide
14. 2,4'-DDE
15. *trans*-Chlordane
16. *cis*-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)

* For information regarding the nomenclature used for *cis*-chlordane and *trans*-chlordane, visit www.restek.com/chlordane-notice

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

(low- to midpolarity phase)

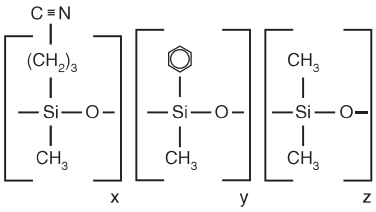
- General-purpose columns for residual solvents, alcohols, oxygenates, and volatile organic compounds.
- Temperature range: -20 °C to 280 °C.
- Equivalent to USP G43 phase.

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 cat.#	30-Meter cat.#	60-Meter cat.#	75-Meter cat.#	105-Meter cat.#
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®-1301 Structure



Similar to: (6%-cyanopropylphenyl)-methylpolysiloxane

similar phases

DB-1301, DB-624, DB-624UI, 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.

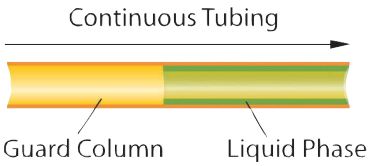
MXT®-1301 columns .....page 109

Rtx®-1301 with Integra-Guard® Columns

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

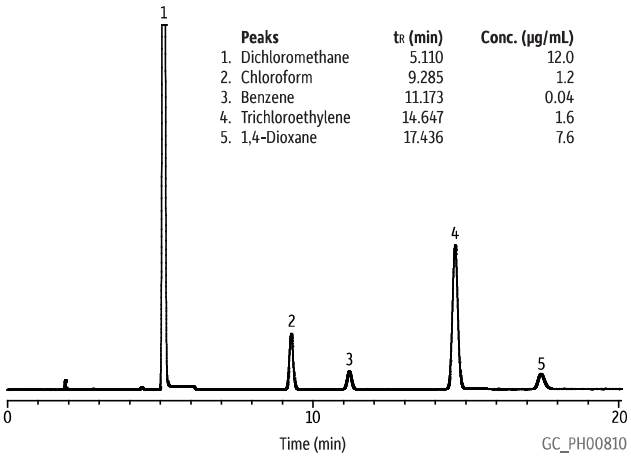
Description	qty.	cat.#
30 m, 0.53 mm ID, 3.00 µm Rtx-1301 w/5 m Integra-Guard Column	ea.	16085-126

Integra-Guard® Built-In Guard Column



Get the protection without the connection!

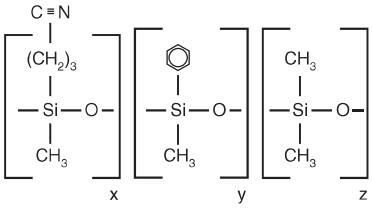
USP <467> Residual Solvents on Rtx®-1301 (G43) by Static Headspace



Peaks	tR (min)	Conc. (µg/mL)
1. Dichloromethane	5.110	12.0
2. Chloroform	9.285	1.2
3. Benzene	11.173	0.04
4. Trichloroethylene	14.647	1.6
5. 1,4-Dioxane	17.436	7.6

Column	Rtx®-1301 w/5 m Integra-Guard® , 30 m, 0.53 mm ID, 3.00 µm (cat.# 16085-126)
Sample	USP <467> Calibration Mixture #5 (cat.# 36007)
Diluent:	DMSO
Conc.:	To each 22 mL headspace vial 5ml water, ~ 1.0 g of sodium sulfate and 100 µL of stock standard were added.
Injection	headspace-loop split (split ratio 2:1)
Headspace-Loop	
Inj. Port Temp.:	180 °C
Instrument:	Teledyne Tekmar HT3
Inj. Time:	1.0 min
Transfer Line Temp.:	150 °C
Valve Oven Temp.:	150 °C
Standby flow rate:	10 mL/min
Sample Temp.:	80 °C
Platen temp equil. time:	2.0 min
Sample Equil. Time:	15.0 min
Mixer time:	2.0 min
Mixing level:	5
Mixer stabilize time:	0.5 min
Vial Pressure:	15 psi
Pressurize Time:	2.0 min
Pressure Equilibration Time:	0.5 min
Loop Pressure:	5 psi
Loop Fill Time:	2.0 min
Loop fill equil. time:	0.5 min
Oven	
Oven Temp.:	40 °C (hold 20 min) to 240 °C at 25 °C/min (hold 10 min)
Carrier Gas	He, constant flow
Flow Rate:	5 mL/min
Detector	FID @ 250 °C
Make-up Gas Flow Rate:	45 mL/min
Notes	**FID conditions:** hydrogen flow: 40 mL/min air flow: 450 mL/min

Rtx®-624 Structure



Similar to: (6%-cyanopropylphenyl)-methylpolysiloxane

similar phases

DB-1301, DB-624, DB-624UI, 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®-624 columns.....page 111

Rtx®-624 Columns (fused silica)

(low- to midpolarity phase)

- 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.

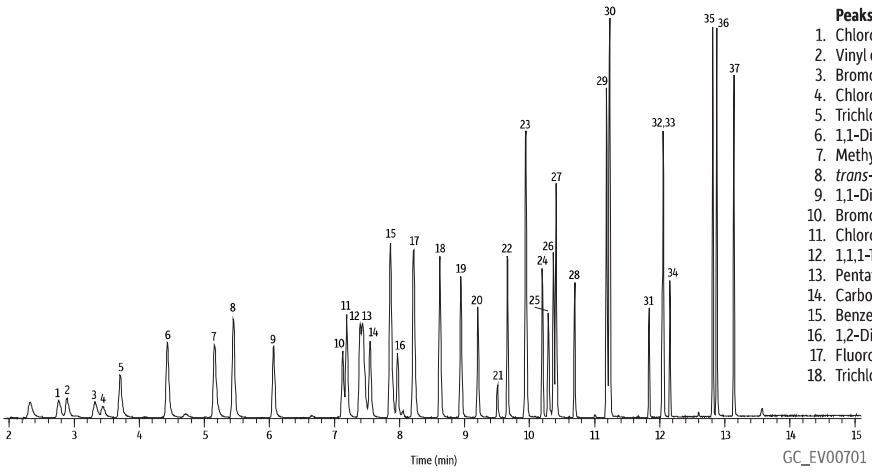
The unique polarity of the Rtx®-624 column makes it ideal for analyzing volatile organic pollutants. Although the Rtx®-502.2 column is recommended in many methods, the Rtx®-624 column offers better resolution of early eluting compounds. The Rtx®-624 phase produces greater than 90% resolution of the first 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 cat.#	60-Meter cat.#	75-Meter cat.#	105-Meter cat.#
0.25 mm	1.40 µm	-20 to 240 °C	10968	10969		
0.32 mm	1.80 µm	-20 to 240 °C	10970	10972		
0.53 mm	3.00 µm	-20 to 240 °C	10971	10973	10974	10975

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

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

Volatiles US EPA Method 624 on Rtx®-624



Peaks

1. Chloromethane
2. Vinyl chloride
3. Bromomethane
4. Chloroethane
5. Trichlorofluoromethane
6. 1,1-Dichloroethene
7. Methylene Chloride
8. *trans*-1,2-Dichloroethene
9. 1,1-Dichloroethane
10. Bromochloromethane
11. Chloroform
12. 1,1,1-Trichloroethane
13. Pentafluorobenzene
14. Carbon Tetrachloride
15. Benzene
16. 1,2-Dichloroethane
17. Fluorobenzene
18. Trichloroethene
19. 1,2-Dichloropropane
20. Bromodichloromethane
21. 2-Chloroethyl vinyl ether
22. *cis*-1,3-Dichloropropene
23. Toluene
24. 2-Bromo-1-chloropropane
25. 1,1,2-Trichloroethane
26. Tetrachloroethene
27. Dibromochloromethane
28. *trans*-1,3-Dichloropropene
29. Chlorobenzene
30. Ethylbenzene
31. Bromoform
32. 1,4-Dichlorobutane
33. 4-Bromofluorobenzene
34. 1,1,2,2-Tetrachloroethane
35. 1,3-Dichlorobenzene
36. 1,4-Dichlorobenzene
37. 1,2-Dichlorobenzene

Column	Rtx®-624, 40 m, 0.18 mm ID, 1.00 µm (cat.# 40925)
Sample	624 Internal Standard Mix (cat.# 30023) 624 Surrogate Standard Mix (cat.# 30243) Volatiles MegaMix™, EPA Method 624 (cat.# 30497)
Conc.:	compounds at 50 ppb (IS @ 40ppb) in 5mL of RO water
Injection	purge and trap split (split ratio 40:1)
Inj. Temp.:	250 °C
Purge and Trap	
Instrument:	Tekmar LSC-3100 Purge and Trap
Trap Type:	Vocarb 3000 (type K)
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 10 mL/min
Bake:	8 min @ 260 °C
Interface Connection:	injection port
Transfer Line Tubing:	Silcosteel® transfer line, 1mm ID sleeve

Oven	
Oven Temp.:	50 °C (hold 4 min) to 100 °C at 12 °C/min to 230 °C at 27 °C/min (hold 2 min)
Carrier Gas	He, constant flow
Flow Rate:	1.1 mL/min
Dead Time:	2.06 min @ 50 °C
Detector	Agilent 5971A GC/MS
Transfer Line Temp.:	280 °C
Analyzer Type:	Quadrupole
Tune Type:	PFTBA/BFB
Ionization Mode:	EI
Scan Range:	35-260 amu
Notes	(MCS bypassed using Silcosteel® tubing)

Rtx®-1701 Columns (fused silica)

(midpolarity Crossbond® phase)

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

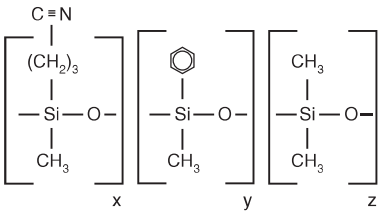
Rtx®-1701 is one of the more popular stationary phases used in capillary GC. The mix of cyano and phenyl functional groups increases the polarity and offers a different elution order relative to less polar Rtx®-1 or Rtx®-5 columns. An Rtx®-1701 column is ideal for confirmation analysis in combination 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 cat.#	30-Meter cat.#	60-Meter cat.#
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 cat.#	20-Meter cat.#	40-Meter cat.#
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®-1701 Structure



Similar to: (14%-cyanopropylphenyl)-methylpolysiloxane

similar phases

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

also available



Metal MXT® Columns

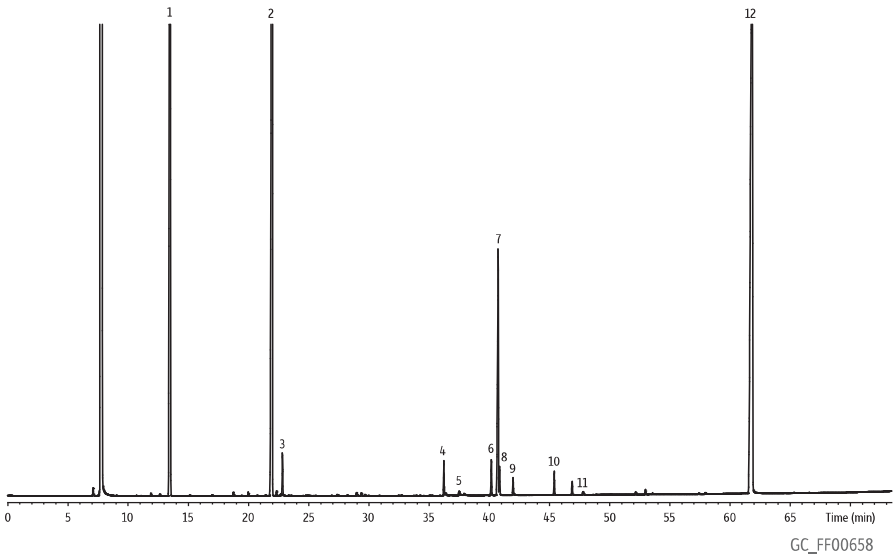
Rugged, flexible, Siltek®-treated stainless steel tubing; inertness comparable to fused silica tubing.

MXT®-1701 columns .....page 109

Rtx®-1701 with Integra-Guard® Columns

Description	qty.	cat.#
30 m, 0.25 mm ID, 0.25 µm Rtx-1701 w/5 m Integra-Guard Column	ea.	12023-124

5% Fragrance Materials Association Mix on Rtx®-1701

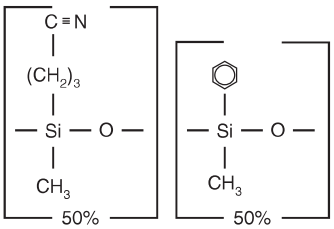


GC_FF00658

Peaks	Conc. (wt.%)
1. Ethyl butyrate	35.7
2. Limonene	20.0
3. Eucalyptol	0.5
4. Geraniol	0.6
5. Benzoic acid	1.0
6. Cinnamic aldehyde	0.5
7. Hydroxycitronellal	5.0
8. Thymol	0.3
9. Cinnamyl alcohol	0.3
10. Cinnamyl acetate	0.3
11. Vanillin	0.1
12. Benzyl salicylate	35.7

Column	Rtx®-1701, 60 m, 0.25 mm ID, 0.25 µm (cat.# 12026)
Sample	Fragrance materials test mix (cat.# 31807)
Conc.:	5% FMA mix in acetone
Injection	
Inj. Vol.:	1 µL split (split ratio 40:1)
Liner:	Splitless (4 mm ID) (cat.# 20814)
Inj. Temp.:	285 °C
Oven	
Oven Temp.:	50 °C to 270 °C at 3 °C/min
Carrier Gas	He, constant flow
Flow Rate:	0.6 mL/min
Detector	FID @ 300 °C

Rtx®-225 Structure



Similar to: (50%-cyanopropylmethyl)-methylphenylpolysiloxane

similar phases

DB-225ms, CP-Sil 43 CB

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 cat.#	30-Meter cat.#	60-Meter cat.#
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.



Our personal commitment to your satisfaction drives everything we do from innovative product development to speedy service and shipping.

Speed Up and Simplify GC Method Development with
Restek's *EZGC*® Online Suite



- Model chromatograms
- Get column recommendations
- Translate methods NEW!
- Calculate flows NEW!

Download these FREE web apps today!

www.restek.com/ezgc

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.

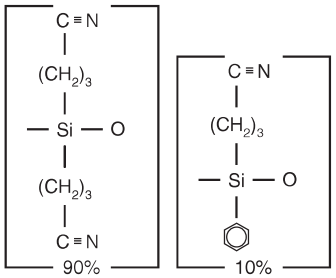
Rtx®-2330 is one of the most polar capillary column stationary phases. Cyano groups on both sides of the polymer backbone give the phase a strong dipole moment and high selectivity for *cis*/*trans* compounds or compounds with conjugated double bonds. Highly polar columns typically exhibit poor column 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.

ID	df	temp. limits*	30-Meter cat.#	60-Meter cat.#	105-Meter cat.#
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	0.20 µm	0 to 260/275 °C	10725	10728	

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

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

Rtx®-2330 Structure



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

similar phases

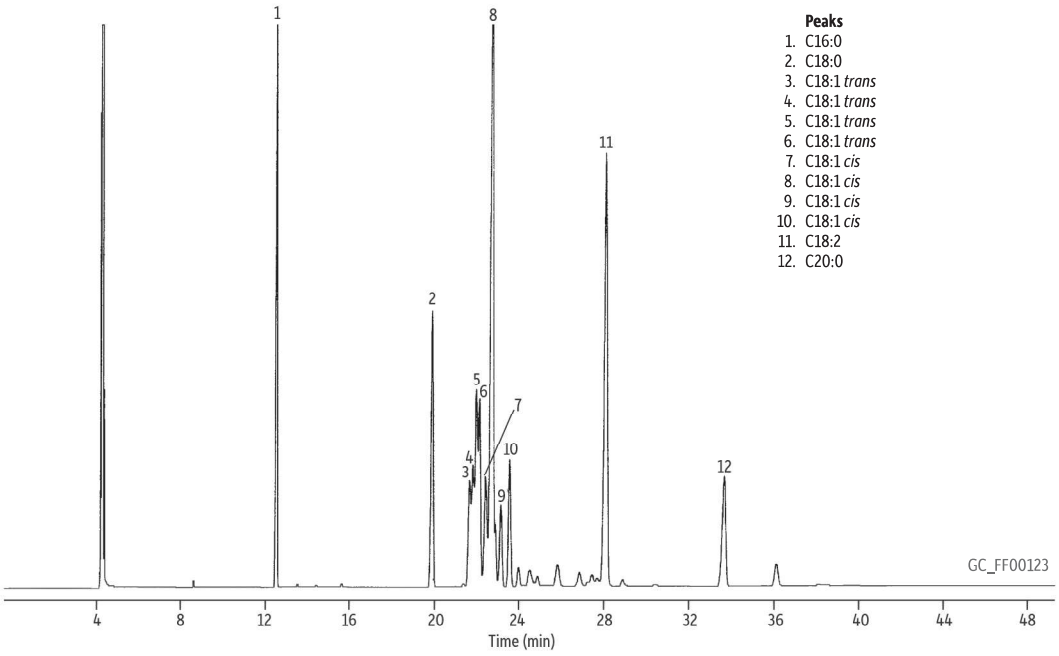
VF-23ms

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.

FAMEs (Commercial Margarine) on Rt®-2330

(split injection)



Peaks
1. C16:0
2. C18:0
3. C18:1 *trans*
4. C18:1 *trans*
5. C18:1 *trans*
6. C18:1 *trans*
7. C18:1 *cis*
8. C18:1 *cis*
9. C18:1 *cis*
10. C18:1 *cis*
11. C18:2
12. C20:0

Column	Rt®-2330, 105 m, 0.25 mm ID, 0.20 µm (cat.# 10729)	**Oven**	
Sample	Commercial margarine mixture	Oven Temp.:	165 °C
Conc.:	Approximately 5 µg	**Carrier Gas**	H_2, constant pressure
Injection		Linear Velocity:	40 cm/sec
Inj. Vol.:	1.0 µL split (split ratio 50:1)	**Detector**	FID @ 275 °C
Inj. Temp.:	275 °C	**Notes**	FID sensitivity: 4 x 10^{-11} AFS

similar phases

HP-88, CP-Sil 88, SPB-2560

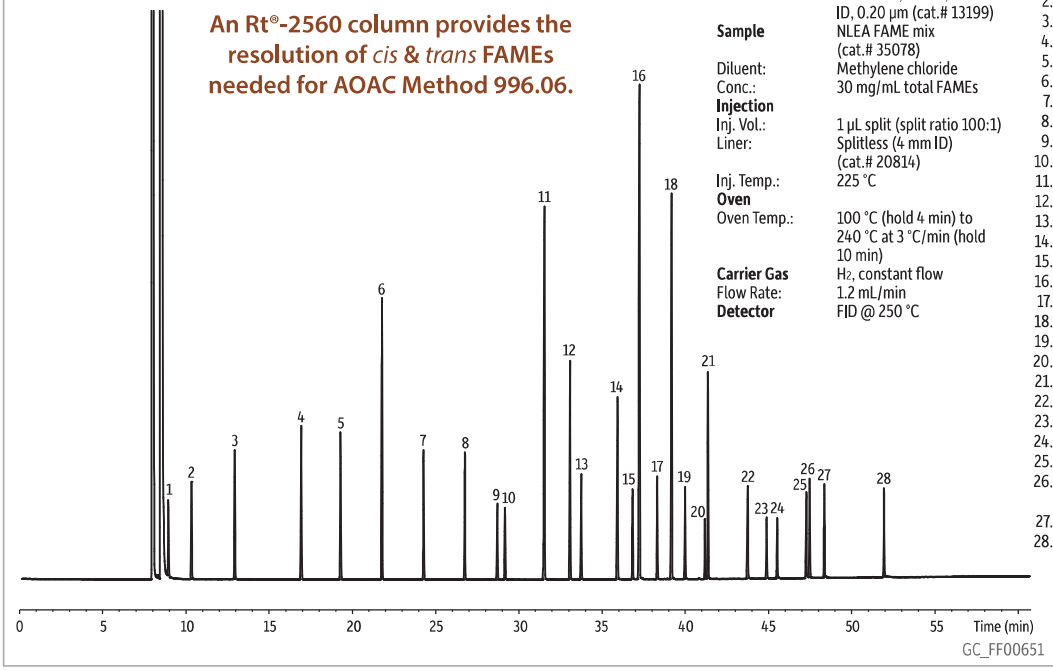
Rt®-2560 Column (fused silica)
(highly polar phase; biscyanopropyl polysiloxane—not bonded)

- 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 cat.#
0.25 mm	0.20 µm	20 to 250 °C	13199

FAMEs (NLEA Mix) on Rt®-2560



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 linoelaidate (*trans*-9,12)
18. C18:2 methyl linoleate (*cis*-9,12)
19. C20:0 methyl arachidate
20. C20:1 methyl eicosenoate (*cis*-11)
21. C18:3 methyl linolenate (*cis*-9,12,15)
22. C22:0 methyl behenate
23. C22:1 methyl erucate (*cis*-13)
24. C23:0 methyl tricosanoate
25. C24:0 methyl lignocerate
26. C20:5 methyl eicosapentaenoate (*cis*-5,8,11,14,17)
27. C24:1 methyl nervonate (*cis*-15)
28. C22:6 methyl docosahexaenoate (*cis*-4,7,10,13,16,19)



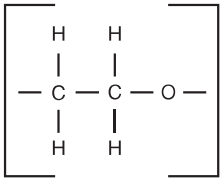
Rtx®-Wax Columns (fused silica)

(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.

Rtx®-Wax Structure



similar phases

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

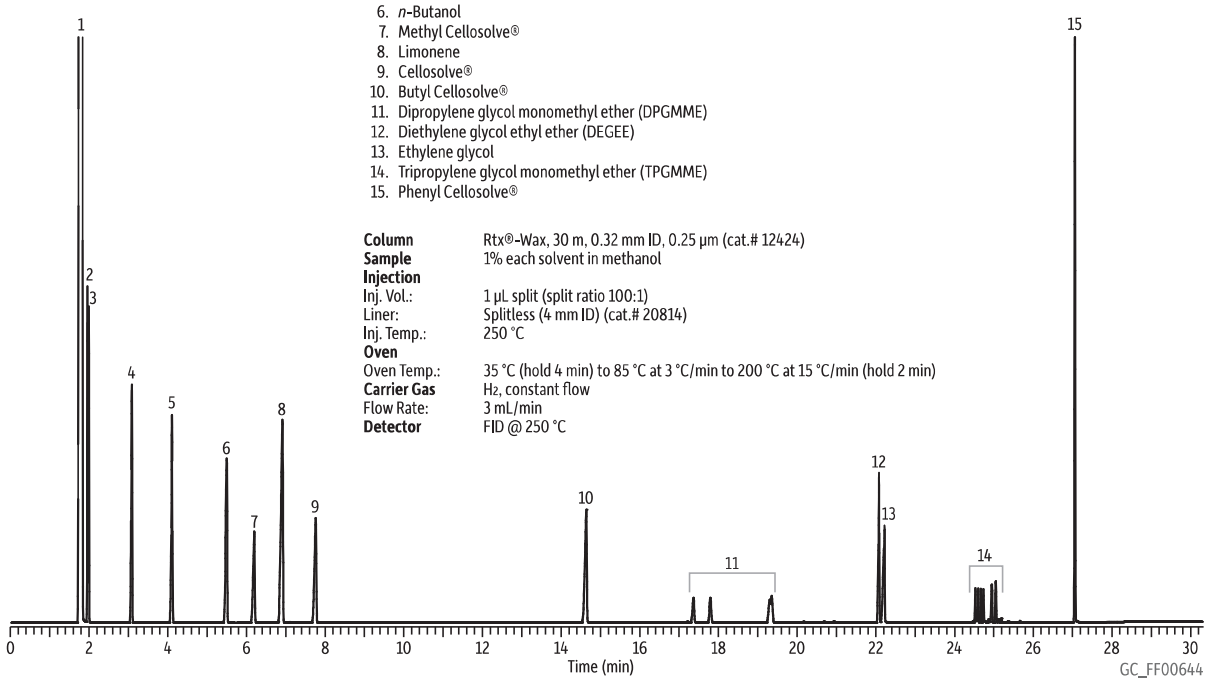
ID	df	temp. limits*	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#
0.25 mm	0.25 µm	20 to 250 °C	12420	12423	12426
	0.50 µm	20 to 250 °C	12435	12438	12441
0.32 mm	0.25 µm	20 to 250 °C		12424	12427
	0.50 µm	20 to 250 °C	12436	12439	12442
	1.00 µm	20 to 240/250 °C	12451	12454	12457
0.53 mm	0.25 µm	20 to 250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

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

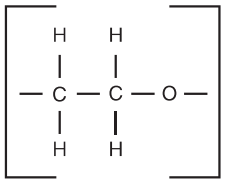
Cleaning Solvents on Rtx®-Wax

Peaks
1. Methanol
2. Isopropanol
3. Ethanol
4. *n*-Propanol
5. Isobutanol
6. *n*-Butanol
7. Methyl Cellosolve®
8. Limonene
9. Cellosolve®
10. Butyl Cellosolve®
11. Dipropylene glycol monomethyl ether (DPGMME)
12. Diethylene glycol ethyl ether (DEGEE)
13. Ethylene glycol
14. Tripropylene glycol monomethyl ether (TPGMME)
15. Phenyl Cellosolve®

Column	Rtx®-Wax, 30 m, 0.32 mm ID, 0.25 µm (cat.# 12424)
Sample	1% each solvent in methanol
Injection	
Inj. Vol.:	1 µL split (split ratio 100:1)
Liner:	Splitless (4 mm ID) (cat.# 20814)
Inj. Temp.:	250 °C
Oven	
Oven Temp.:	35 °C (hold 4 min) to 85 °C at 3 °C/min to 200 °C at 15 °C/min (hold 2 min)
Carrier Gas	H_2, constant flow
Flow Rate:	3 mL/min
Detector	FID @ 250 °C



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. 3, 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 columns .....page 110

Stabilwax® Columns (fused silica)

(polar phase; Crossbond® polyethylene glycol)

- Rugged enough to withstand repeated water injections.
- Low-bleed PEG column ensures 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.

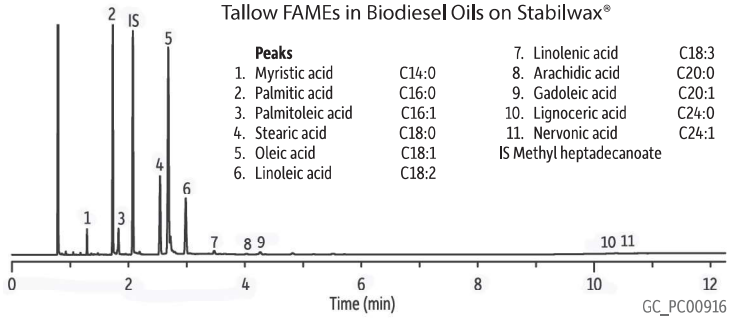
ID	df	temp. limits	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#
0.25 mm	0.10 µm	40 to 250/260 °C	10605	10608	10611
	0.25 µm	40 to 250/260 °C	10620	10623	10626
	0.50 µm	40 to 250/260 °C	10635	10638	10641
0.32 mm	0.25 µm	40 to 250/260 °C	10621	10624	10627
	0.50 µm	40 to 250/260 °C	10636	10639	10642
	1.00 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 cat.#	20-Meter cat.#
0.15 mm	0.15 µm	40 to 250/260 °C	43830	43831
0.18 mm	0.18 µm	40 to 250 °C		40602

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

FAMEs in Biodiesel Oils on Stabilwax®

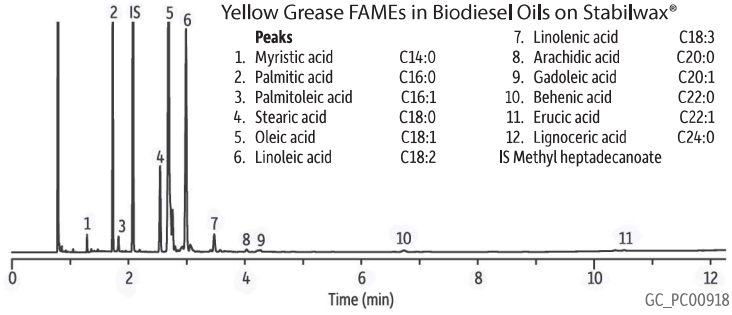
Tallow FAMEs in Biodiesel Oils on Stabilwax®



GC_PC00916

Peaks			
1. Myristic acid	C14:0	7. Linolenic acid	C18:3
2. Palmitic acid	C16:0	8. Arachidic acid	C20:0
3. Palmitoleic acid	C16:1	9. Gadoleic acid	C20:1
4. Stearic acid	C18:0	10. Lignoceric acid	C24:0
5. Oleic acid	C18:1	11. Nervonic acid	C24:1
6. Linoleic acid	C18:2	IS Methyl heptadecanoate	

Yellow Grease FAMEs in Biodiesel Oils on Stabilwax®



GC_PC00918

Peaks			
1. Myristic acid	C14:0	7. Linolenic acid	C18:3
2. Palmitic acid	C16:0	8. Arachidic acid	C20:0
3. Palmitoleic acid	C16:1	9. Gadoleic acid	C20:1
4. Stearic acid	C18:0	10. Behenic acid	C22:0
5. Oleic acid	C18:1	11. Erucic acid	C22:1
6. Linoleic acid	C18:2	12. Lignoceric acid	C24:0
		IS Methyl heptadecanoate	

Column	Stabilwax®, 30 m, 0.32 mm ID, 0.25 µm (cat.# 10624)
Sample	Tallow source 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	
Flow Rate:	3 mL/min
Linear Velocity:	60 cm/sec
Detector	FID @ 250 °C

Visit **www.restek.com** for soy FAMEs and rapeseed FAMEs analyses.

Stabilwax®-MS Columns (fused silica)

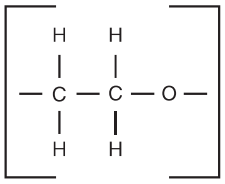
NEW!

- High-polarity, stable polyethylene glycol (PEG) stationary phase.
- Low bleed and rugged enough to withstand repeated temperature cycles without retention time shifting.
- Ideal for food, flavor, fragrance, and industrial chemical and solvent analysis.
- Temperature range: 40 °C to 250/260 °C.
- Equivalent to USP G14, G15, G16, G20, and G39 phases.

New Stabilwax®-MS columns ensure reproducible retention times from run to run, even with temperature cycling. When methods require trace analysis, this highly polar, low-bleed stationary phase produces excellent signal-to-noise levels! Ideal for food and flavor analysis (e.g., essential oils), fragrance and allergen analysis, as well as industrial solvent and chemical analysis.

ID	df	30-Meter cat.#
0.25 mm	0.25 µm	10673
0.32 mm	0.25 µm	10674

Stabilwax®-MS Structure



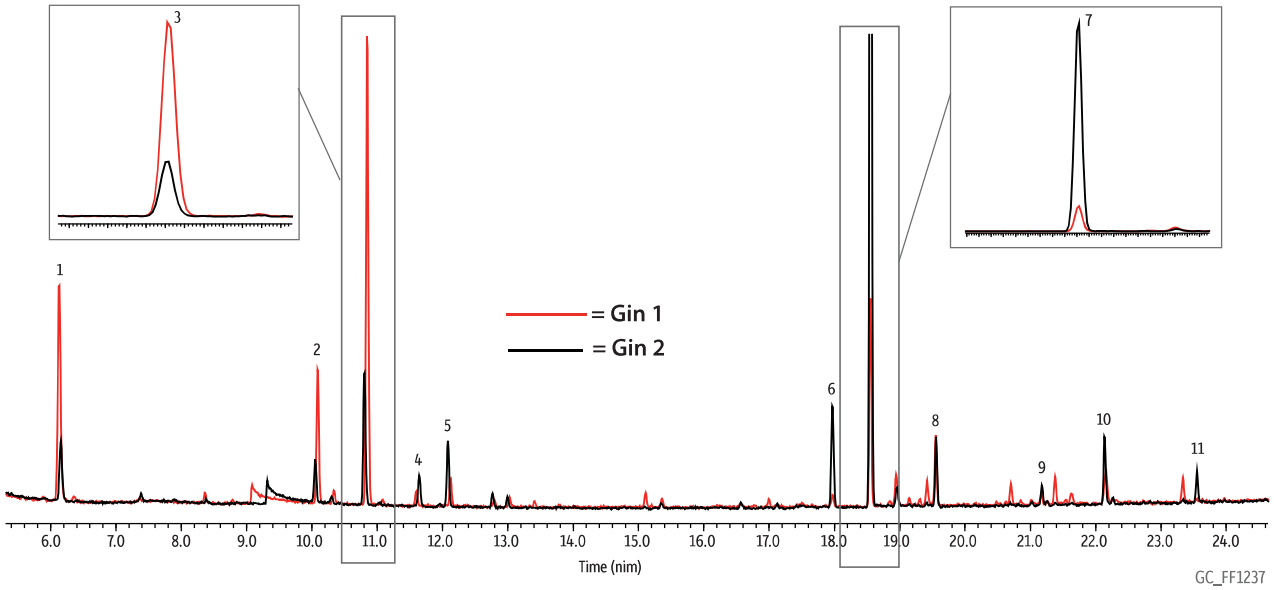
also available

Stabilwax®-DA and Stabilwax®-DB Columns

See **pages 98 and 102.**



Two Brands of Gin on Stabilwax®-MS (Overlay)



Column	Stabilwax®-MS, 30 m, 0.25 mm ID, 0.25 µm (cat.# 10673)
Sample	Two different brands of gin
Conc.:	Neat
Injection	
Inj. Vol.:	1 µL split (split ratio 20:1)
Liner:	Sky® 3.5 mm Precision® liner w/wool (cat.# 23320.1)
Inj. Temp.:	250 °C
Oven	
Oven Temp.:	35 °C (hold 5 min) to 250 °C at 7 °C/min (hold 5 min)
Carrier Gas	He, constant linear velocity
Linear Velocity:	36 cm/sec
Detector	MS
Mode:	Scan

Scan Program:

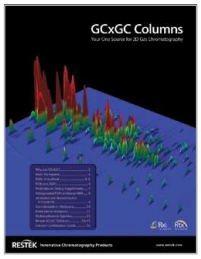
Group	Start Time (min)	Scan Range (amu)	Scan Rate (scans/sec)
1	0.5	40–550	2

Transfer Line Temp.:	260 °C
Analyzer Type:	Quadrupole
Source Temp.:	250 °C
Solvent Delay Time:	0.5 min
Ionization Mode:	EI
Instrument	Shimadzu 2010 GC & QP2010+ MS

Peaks	t_R (min)
1. α-Pinene	6.16
2. Beta-myrcene	10.05
3. D-Limonene	10.81
4. Isoamyl alcohol*	11.64
5. γ-Terpinene	12.08
6. Camphor*	17.97
7. Linalool	18.56
8. 4-Terpineol	19.56
9. α-Terpineol*	21.18
10. Nerol acetate*	22.14
11. Geraniol*	23.55

* Not found in gin represented by red trace.

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



free literature

GCxGC Columns: Your One Source for 2D Gas Chromatography

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

lit. cat.# GNBR1585-UNV

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).

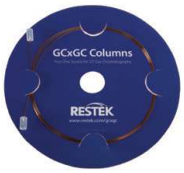
So, why use GCxGC? Because comprehensive two-dimensional gas chromatography allows you to perform separations that are simply not possible using standard one-dimensional chromatography!

Why Use Restek GCxGC Columns?

- Wide range of stationary phases offers orthogonal separations.
- High thermal stability increases system ruggedness.
- Unrivaled 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.



To order Restek GCxGC columns and accessories, see **page 62**.

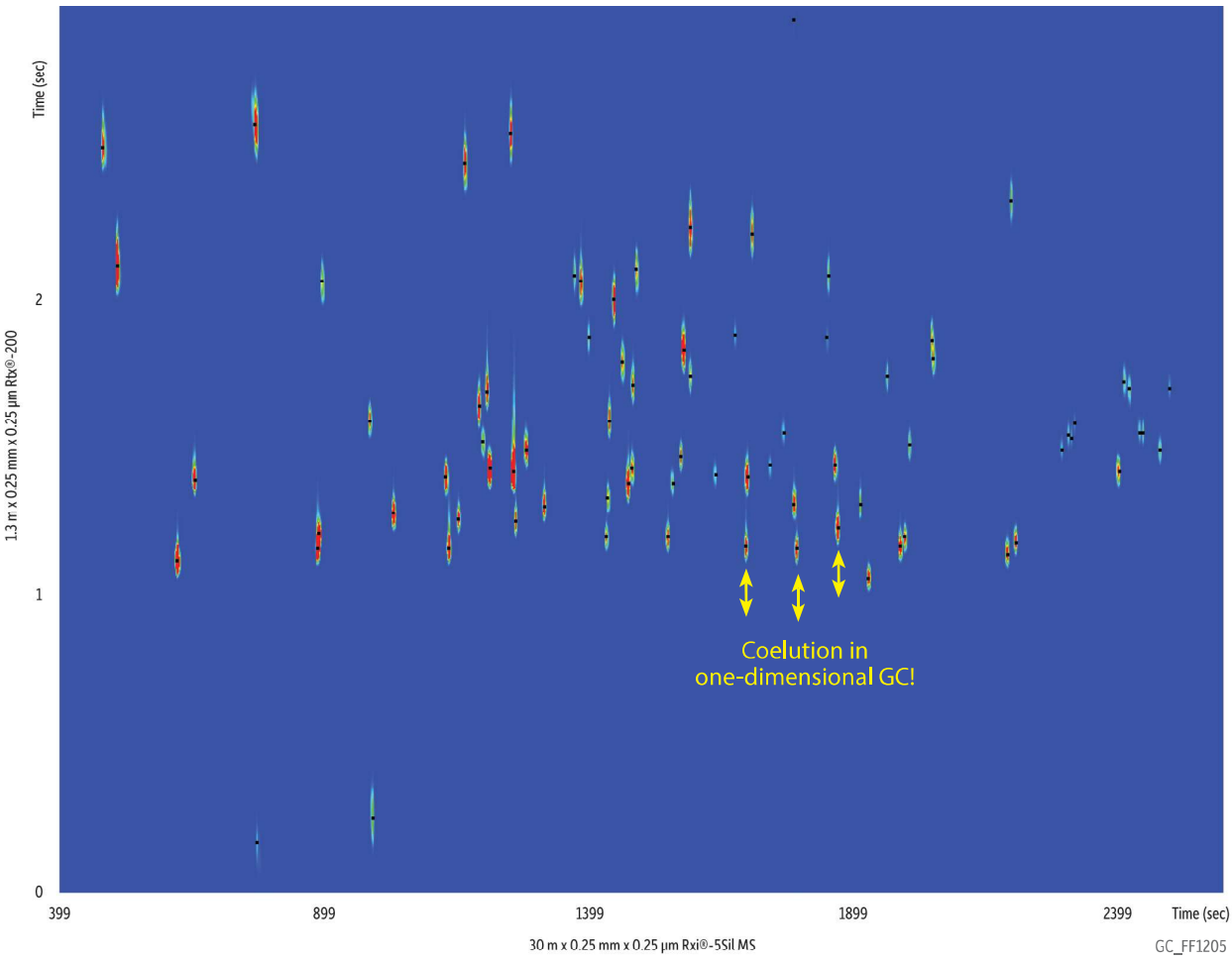
To get additional assistance in choosing a column pair, visit **www.restek.com/gcxgc**

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.

	Primary Column		Secondary Column	
Application Area	**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

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 60!

GCxGC



To choose the perfect primary/ secondary column combination for your application, use our guide on page 60!

Primary GCxGC Columns (In order of increasing polarity)

Phase	Length	ID	df	temp. limits	cat.#
Rxi-1ms	30 m	0.25 mm	0.25 µm	-60 to 330/350 °C	13323
Rxi-5Sil MS	30 m	0.25 mm	0.25 µm	-60 to 320/350 °C	13623
Rxi-XLB	30 m	0.25 mm	0.25 µm	30 to 340/360 °C	13723
Rxi-17Sil MS	30 m	0.25 mm	0.25 µm	40 to 340/360 °C	14123
Rtx-200	30 m	0.25 mm	0.25 µm	-20 to 320/340 °C	15023
Stabilwax	30 m	0.25 mm	0.25 µm	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 µm	-60 to 330/350 °C	15114
	2 m	0.18 mm	0.18 µm	-60 to 330/350 °C	15120
	2 m	0.25 mm	0.25 µm	-60 to 330/350 °C	15127
Rxi-5Sil MS	2 m	0.15 mm	0.15 µm	-60 to 330/350 °C	15113
	2 m	0.18 mm	0.18 µm	-60 to 330/350 °C	15119
	2 m	0.25 mm	0.25 µm	-60 to 330/350 °C	15126
Rxi-XLB	2 m	0.15 mm	0.15 µm	30 to 340/360 °C	15115
	2 m	0.18 mm	0.18 µm	30 to 340/360 °C	15121
	2 m	0.25 mm	0.25 µm	30 to 340/360 °C	15128
Rxi-17Sil MS	2 m	0.15 mm	0.15 µm	40 to 340/360 °C	15110
	2 m	0.18 mm	0.18 µm	40 to 340/360 °C	15116
	2 m	0.25 mm	0.25 µm	40 to 340/360 °C	15123
Rtx-200	2 m	0.15 mm	0.15 µm	-20 to 320/340 °C	15111
	2 m	0.18 mm	0.18 µm	-20 to 320/340 °C	15117
	2 m	0.25 mm	0.25 µm	-20 to 320/340 °C	15124
Stabilwax	2 m	0.15 mm	0.15 µm	40 to 250/260 °C	15112
	2 m	0.18 mm	0.18 µm	40 to 250/260 °C	15118
	2 m	0.25 mm	0.25 µm	40 to 250/260 °C	15125



- 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.

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 µm	ea.	15114
Rxi-5Sil MS	2 m x 0.15 mm x 0.15 µm	ea.	15113
Rxi-XLB	2 m x 0.15 mm x 0.15 µm	ea.	15115
Rxi-17Sil MS	2 m x 0.15 mm x 0.15 µm	ea.	15110
Rtx-200	2 m x 0.15 mm x 0.15 µm	ea.	15111
Stabilwax	2 m x 0.15 mm x 0.15 µm	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 µm	ea.	15120
Rxi-5Sil MS	2 m x 0.18 mm x 0.18 µm	ea.	15119
Rxi-XLB	2 m x 0.18 mm x 0.18 µm	ea.	15121
Rxi-17Sil MS	2 m x 0.18 mm x 0.18 µm	ea.	15116
Rtx-200	2 m x 0.18 mm x 0.18 µm	ea.	15117
Stabilwax	2 m x 0.18 mm x 0.18 µm	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 µm	ea.	15127
Rxi-5Sil MS	2 m x 0.25 mm x 0.25 µm	ea.	15126
Rxi-XLB	2 m x 0.25 mm x 0.25 µm	ea.	15128
Rxi-17Sil MS	2 m x 0.25 mm x 0.25 µm	ea.	15123
Rtx-200	2 m x 0.25 mm x 0.25 µm	ea.	15124
Stabilwax	2 m x 0.25 mm x 0.25 µm	ea.	15125
Universal Press-Tight Connectors	Deactivated	5-pk.	20429

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 cat.#	20-Meter cat.#
0.15 mm	0.15 µm	-60 to 330/350 °C	43800	43801

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 cat.#	20-Meter cat.#
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 cat.#	20-Meter cat.#
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 cat.#	20-Meter cat.#
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 cat.#	20-Meter cat.#
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.....65
Environmental.....66–81
Foods, Flavors, & Fragrances.....82–89
Petroleum & Petrochemical.....90–93
Pharmaceutical.....94–97
Specially Deactivated.....98–103





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, & Toxicology
- Environmental
- Foods, Flavors, & 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.
- Stable to 260 °C.

similar phases

DB-ALC1, ZB-BAC1
DB-ALC2, ZB-BAC2

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.

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



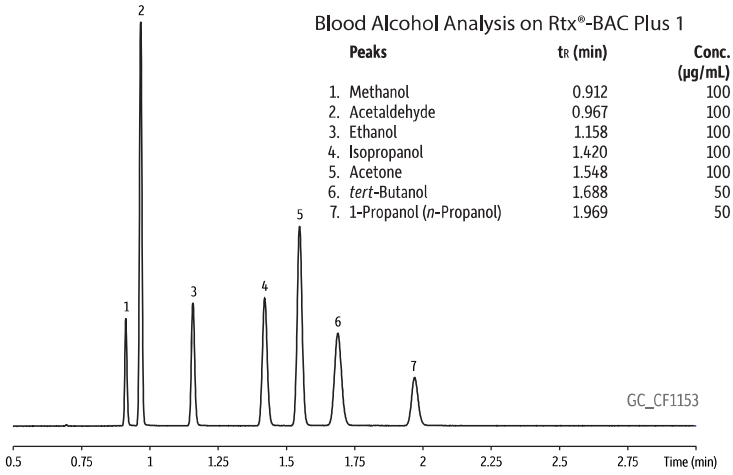
Rtx®-BAC Plus 1 Columns (fused silica)

ID	df	temp. limits	30-Meter cat.#
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)

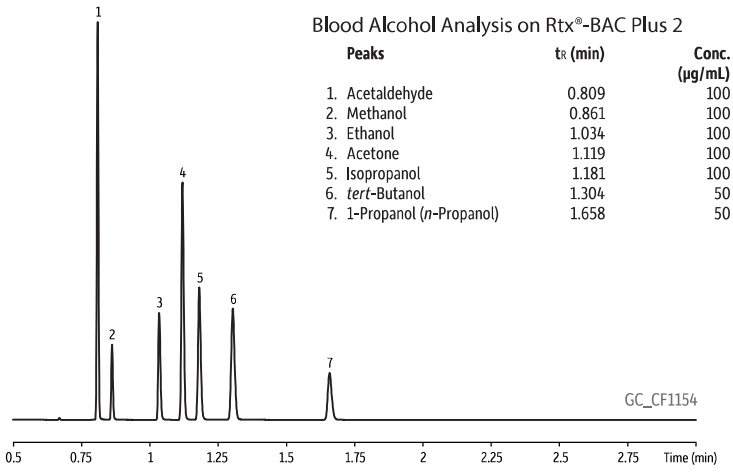
ID	df	temp. limits	30-Meter cat.#
0.32 mm	0.6 µm	-20 to 240/260 °C	18006
0.53 mm	1.0 µm	-20 to 240/260 °C	18007

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



Blood Alcohol Analysis on Rtx®-BAC Plus 1

Peaks	t_R (min)	Conc. (µg/mL)
1. Methanol	0.912	100
2. Acetaldehyde	0.967	100
3. Ethanol	1.158	100
4. Isopropanol	1.420	100
5. Acetone	1.548	100
6. *tert*-Butanol	1.688	50
7. 1-Propanol (*n*-Propanol)	1.969	50



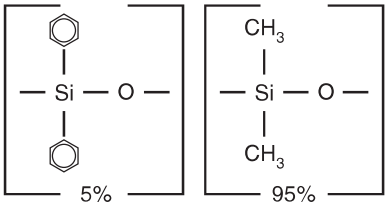
Blood Alcohol Analysis on Rtx®-BAC Plus 2

Peaks	t_R (min)	Conc. (µg/mL)
1. Acetaldehyde	0.809	100
2. Methanol	0.861	100
3. Ethanol	1.034	100
4. Acetone	1.119	100
5. Isopropanol	1.181	100
6. *tert*-Butanol	1.304	50
7. 1-Propanol (*n*-Propanol)	1.658	50

Column	Rtx®-BAC Plus 1, 30 m, 0.32 mm ID, 1.8 µm (cat.# 18004)
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

Rtx®-1614 Structure



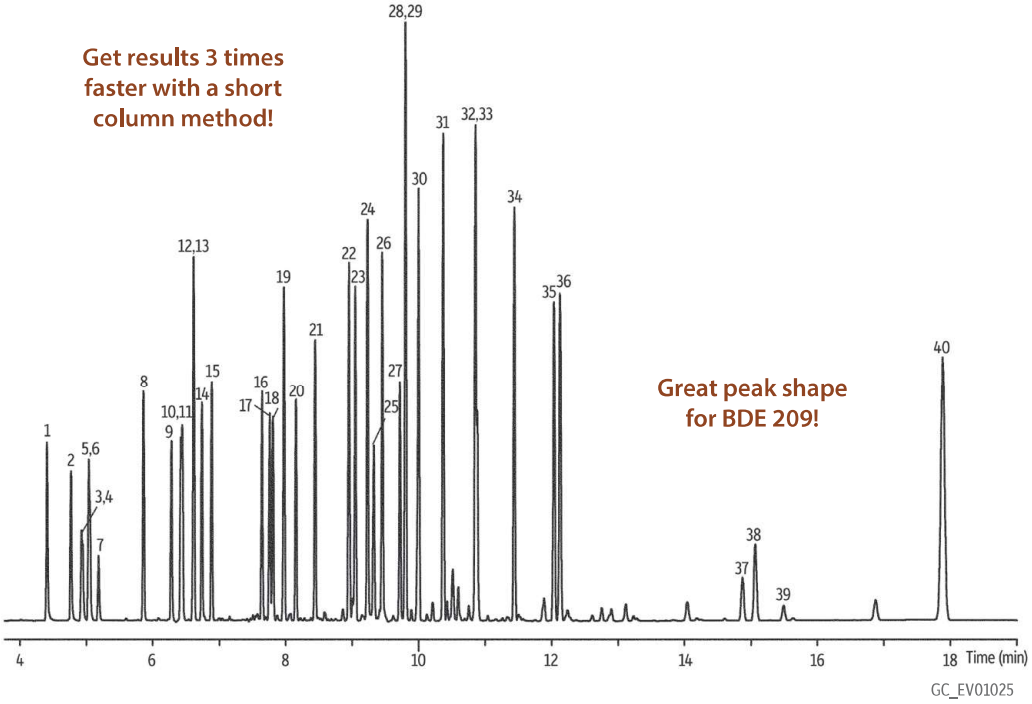
Rtx®-1614 Columns (fused silica)

(5% diphenyl, 95% dimethyl polysiloxane)

- 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 than competitor columns, for greater analytical sensitivity.
- Exceeds EPA Method 1614 resolution criteria for BDE-49 and BDE-71.
- Stable to 360 °C.

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

Brominated Flame Retardants on Rtx®-1614



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 taper (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

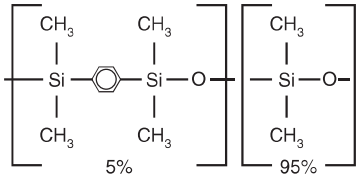
Rxi®-5Sil MS Columns (fused silica)
(low-polarity phase; Crossbond® 1,4-bis(dimethylsiloxy)phenylene dimethyl polysiloxane)

- 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.

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

Rxi®-5Sil MS Structure

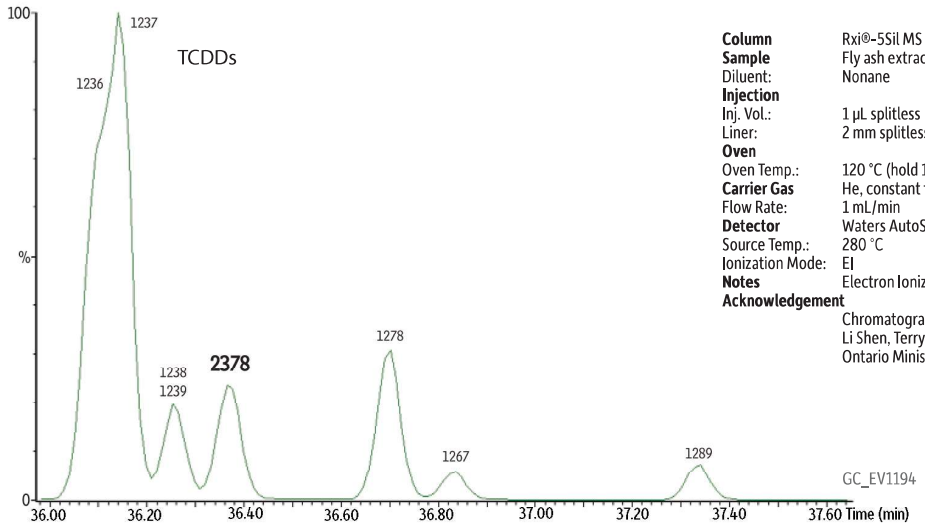


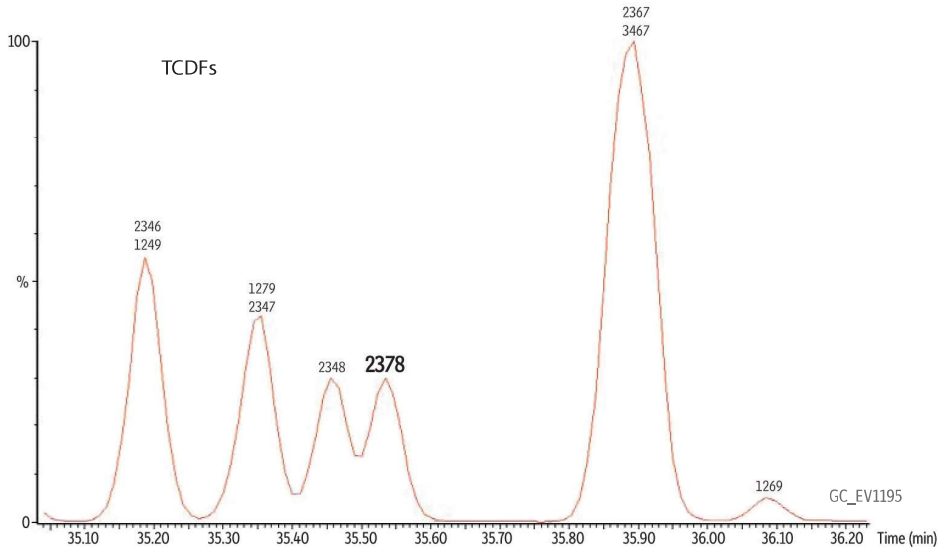
Similar to: (5%-phenyl)-methylpolysiloxane

similar phases

DB-5ms, DB-5msUI, VF-5ms, ZB-5ms, ZB-SemiVolatiles, Rtx-5Sil MS

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
Flow Rate: 1 mL/min
Detector
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

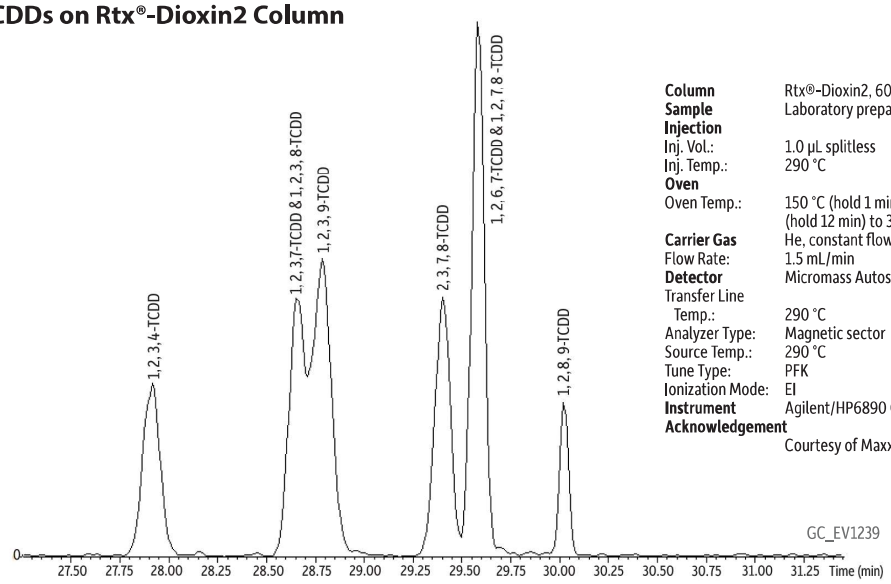
Dioxin & Furan Analysis

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.

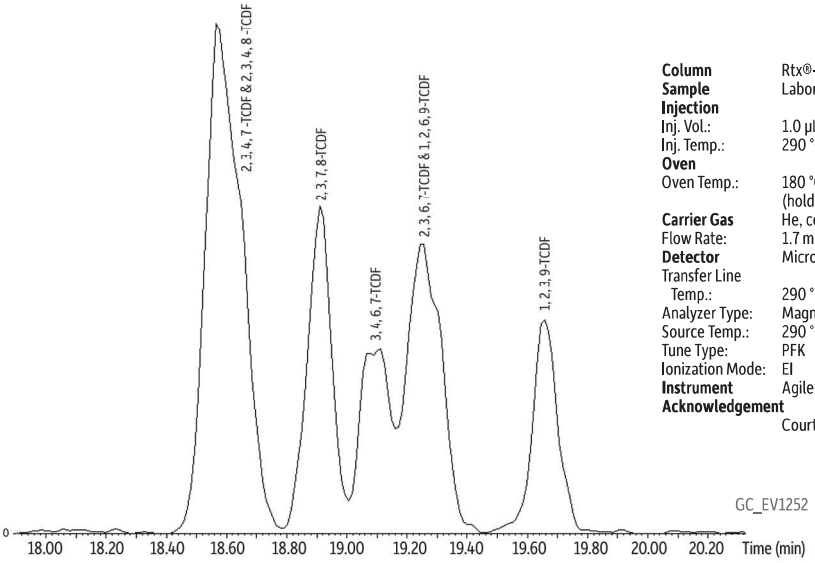
ID	df	temp. limits	40-Meter cat.#	60-Meter cat.#
0.18 mm	0.18 µm	20 to 320/340 °C	10759	
0.25 mm	0.25 µm	20 to 320/340 °C		10758

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: 1.5 mL/min
Detector
Transfer Line 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: 1.7 mL/min
Detector
Transfer Line 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).

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 cat.#
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

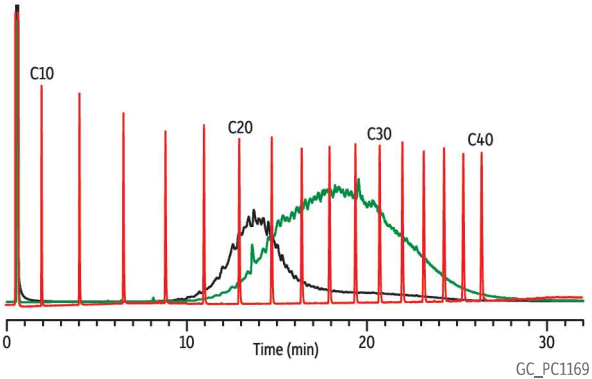
similar phases

Select Mineral Oil

Fused Silica Capillary & PLOT Column Ferrule Guide

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

Mineral Oil and Motor Oil on Rtx®-Mineral Oil



GC_PC1169

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	H_2, 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:	N_2
Data Rate:	20 Hz
Instrument	Agilent/HP6890 GC
Notes	Black trace = mineral oil Green trace = motor oil Red trace = C10-C40 standard



Restek's state-of-the-art facility and rigorous product testing programs ensure you get the quality you need for accurate, reliable results.

Restek innovation!



See **pages 193–202.**

PCB Congeners Analysis

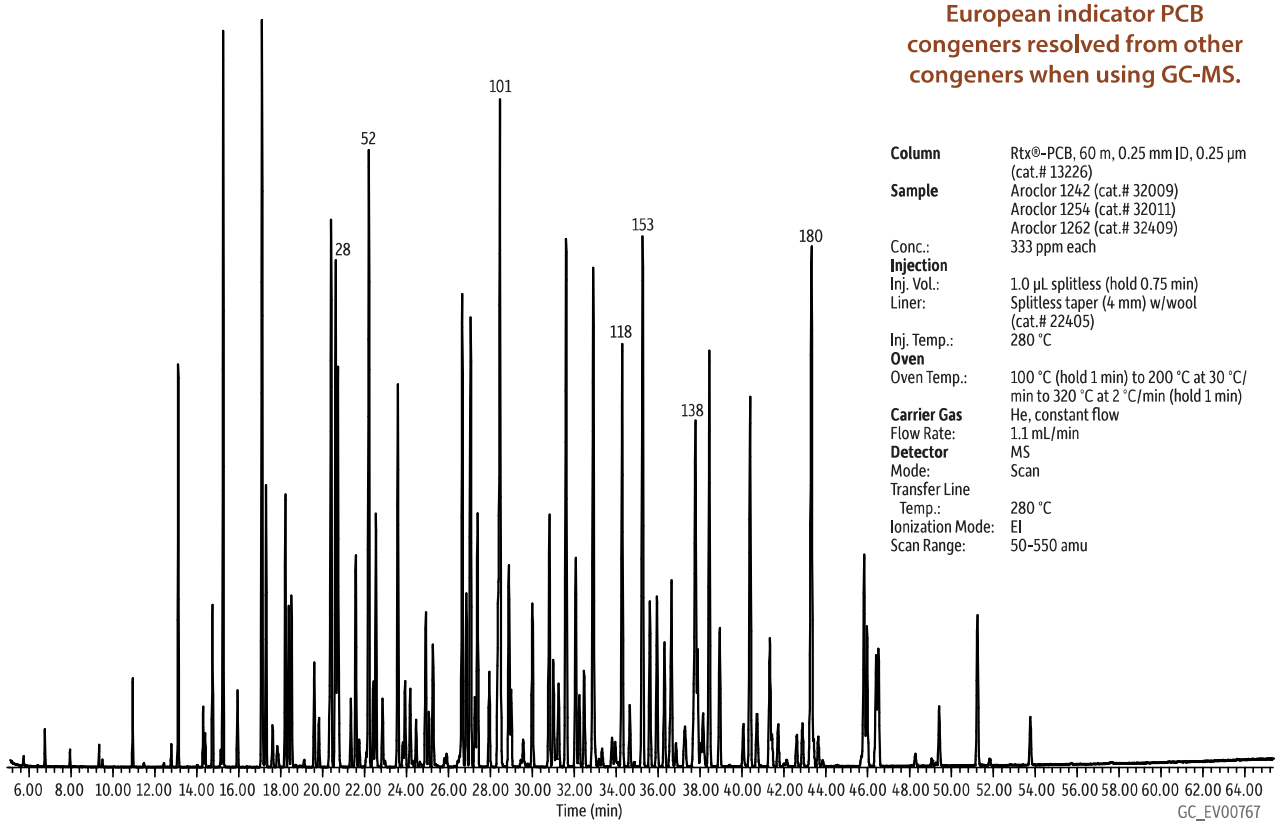
Rtx®-PCB Columns (fused silica)
(proprietary Crossbond® phase)

- 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 cat.#	30-Meter cat.#	40-Meter cat.#	60-Meter cat.#
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.

Aroclor PCBs on Rtx®-PCB



Peaks identified with PCB congener numbers.

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.

similar phases

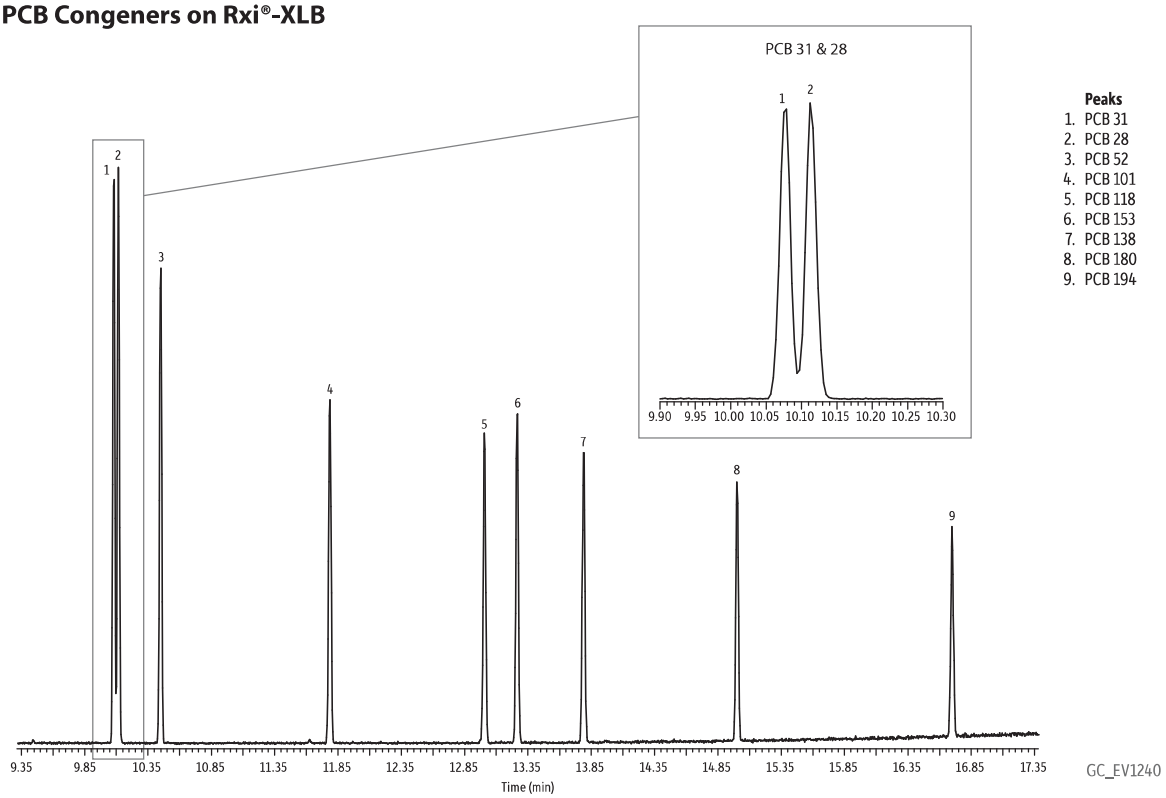
DB-XLB, VF-Xms, MR1, ZB-XLB

ID	df	temp. limits*	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#
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	

ID	df	temp. limits	20-Meter cat.#
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



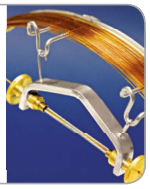
Peaks
1. PCB 31
2. PCB 28
3. PCB 52
4. PCB 101
5. PCB 118
6. PCB 153
7. PCB 138
8. PCB 180
9. PCB 194

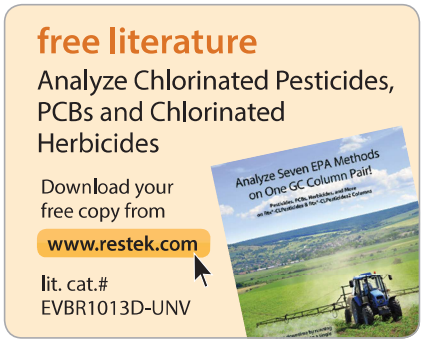
Column	Rxi®-XLB, 30 m, 0.25 mm ID, 0.25 µm (cat.# 13723)
Sample	PCB congener standard #2 (cat.# 32294)
	PCB 31 (cat.# custom)
Diluent:	Dichloromethane
Conc.:	3.5 ppm
Injection	
Inj. Vol.:	0.5 µL splitless (hold 1.75 min)
Liner:	2.0 mm ID straight inlet liner w/wool (cat.# 21718)
Inj. Temp.:	300 °C
Purge 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

Restek innovation!







Pesticides Analysis (Chlorinated)

Rtx®-CLPesticides/Rtx®-CLPesticides2

- Application-specific columns for organochlorine pesticides and herbicides.
- Low bleed—ideal for high sensitivity 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 changes.

Rtx®-CLPesticides Columns (fused silica)

(proprietary Crossbond® phases)

ID	df	temp. limits	15-Meter cat.#	20-Meter cat.#	30-Meter cat.#	60-Meter cat.#
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			11140	

Rtx®-CLPesticides2 Columns (fused silica)

(proprietary Crossbond® phases)

ID	df	temp. limits	10-Meter cat.#	15-Meter cat.#	20-Meter cat.#	30-Meter cat.#	60-Meter cat.#
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	

NOTE: Analyzing dirty or derivatized samples can contaminate your column. Restek does not recommend analyzing trace-level pesticide samples following derivatized samples (e.g., Methods 8151A and 552.2) without first performing inlet maintenance. Standard steps include trimming the guard column and changing the inlet liner, O-ring, seal, and septum.

kit

Rtx®-CLPesticides Column Kit (0.25 mm ID)

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

Description	qty.	cat.#
Rtx-CLPesticides Kit (0.25 mm ID)	kit	11199
Includes (each product also available separately)		
30m, 0.25mm ID, 0.25µm Rtx-CLPesticides Column Column	ea.	11123
30m, 0.25mm ID, 0.20µm Rtx-CLPesticides2 Column Column	ea.	11323
Universal Angled "Y" Press-Tight Connector, Deactivated	ea.	20403-261
5 m, 0.25 mm ID Siltek Guard Column	ea.	10026

Save money with our kits. Each includes recommended guard and analytical column combinations.

kit

Rtx®-CLPesticides Column Kit (0.32 mm ID)

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

Description	qty.	cat.#
Rtx-CLPesticides Kit (0.32 mm ID)	kit	11196
Includes (each product also available separately)		
30m, 0.32mm ID, 0.32µm Rtx-CLPesticides Column Column	ea.	11141
30m, 0.32mm ID, 0.25µm Rtx-CLPesticides2 Column Column	ea.	11324
Universal Angled "Y" Press-Tight Connector, Deactivated	ea.	20403-261
5 m, 0.32 mm ID Siltek Guard Column	ea.	10027

kit

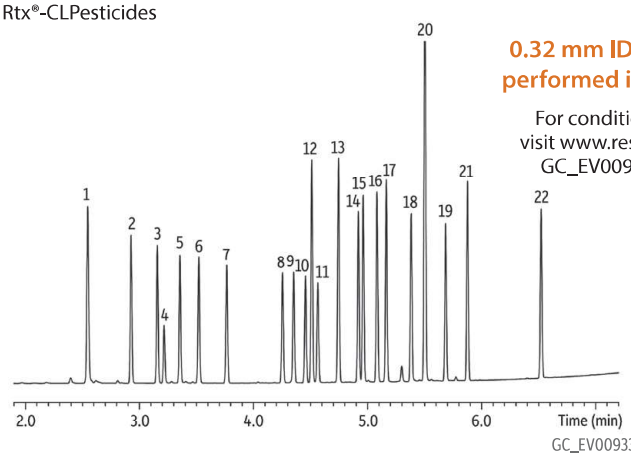
Rtx®-CLPesticides Column Kit (0.53 mm ID)

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

Description	qty.	cat.#
Rtx-CLPesticides Kit (0.53 mm ID)	kit	11197
Includes (each product also available separately)		
30m, 0.53mm ID, 0.50µm Rtx-CLPesticides Column Column	ea.	11140
30m, 0.53mm ID, 0.42µm Rtx-CLPesticides2 Column Column	ea.	11340
Universal Angled "Y" Press-Tight Connector, Deactivated	ea.	20403-261
5m, 0.53mm ID IP Deactivated Guard Column	ea.	10045

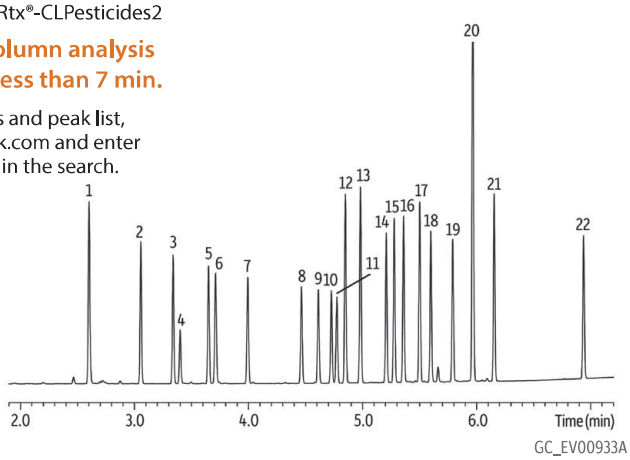
Organochlorine Pesticide Mix AB #2 on Rtx®-CLPesticides and Rtx®-CLPesticides2 (0.32 mm ID column set)

Rtx®-CLPesticides



GC_EV00933

Rtx®-CLPesticides2



GC_EV00933A

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

For conditions and peak list, visit www.restek.com and enter GC_EV00933 in the search.

Method Compound List	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.
	Competitor A set	7 / 8	0 / 1	
	Competitor B set	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 on at least one column.
	Competitor A set	27 / 29	0 / 3	
	Competitor B set	NDP / 16	NDP / 3	
8082A (Polychlorinated biphenyls [PCBs], Aroclors)	Rtx-CLPesticides / Rtx-CLPesticides2	7 / 7	n/a	• Fast PCB analysis times.
	Competitor A set	6 / 7	n/a	
	Competitor B set	24 / 21	n/a	
8151A (Chlorinated herbicides)	Rtx-CLPesticides / Rtx-CLPesticides2	13 / 13	1 / 0	• More elution order changes improve confidence in confirmational results.
	Competitor A set	13 / 13	0 / 0	
	Competitor B set	16 / 15	1 / 1	
504.1 (EDB, DBCP, TCP)	Rtx-CLPesticides / Rtx-CLPesticides2	6 / 6	0 / 0	• Reliably separate analytes from trihalomethane interferences.
	Competitor A set	6 / 6	0 / 0	
	Competitor B set	NDP	NDP	
505 (Organohalide pesticides)	Rtx-CLPesticides / Rtx-CLPesticides2	18 / 18.5	1 / 1	• All compounds resolved on at least one column.
	Competitor A set	14 / 14	0 / 1	
	Competitor B set	35 / 36	1 /2	
508.1 (Chlorinated pesticides, herbicides, organohalides)	Rtx-CLPesticides / Rtx-CLPesticides2	23.5 / 24	2 / 2	• Good balance of speed and resolution.
	Competitor A set	21 / 23	0 / 3	
	Competitor B set	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.
	Competitor A set	8 / 9	1 / 1	
	Competitor B set	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 (e.g., Methods 8151A and 552.2) without first performing inlet maintenance. Standard steps include trimming the guard column and changing the inlet liner, O-ring, seal, and septum.

For more information go to

www.restek.com/**CLP7**

Pesticides Analysis (Organophosphorus)

FAST efficient analysis of OPPs in EPA Method 8141

Rtx®-OPPesticides/Rtx®-OPPesticides2

- Application-specific columns for organophosphorus pesticides; best column combination for U.S. EPA Method 8141.
- 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 8141. Separation is improved and analysis time is significantly reduced, compared to other columns. The extended upper temperature limit of these phases (330 °C) allows analysts to bake out high molecular weight contamination typically associated with pesticide samples. The low-bleed columns are a perfect match for sensitive detection systems.

Restek innovation!
- Better separations
- Faster analyses

Rtx®-OPPesticides Columns (fused silica)

(proprietary Crossbond® phases)

ID	df	temp. limits	30-Meter cat.#
0.25 mm	0.25 µm	-20 to 310/330 °C	11223
0.32 mm	0.50 µm	-20 to 310/330 °C	11239
0.53 mm	0.83 µm	-20 to 310/330 °C	11240

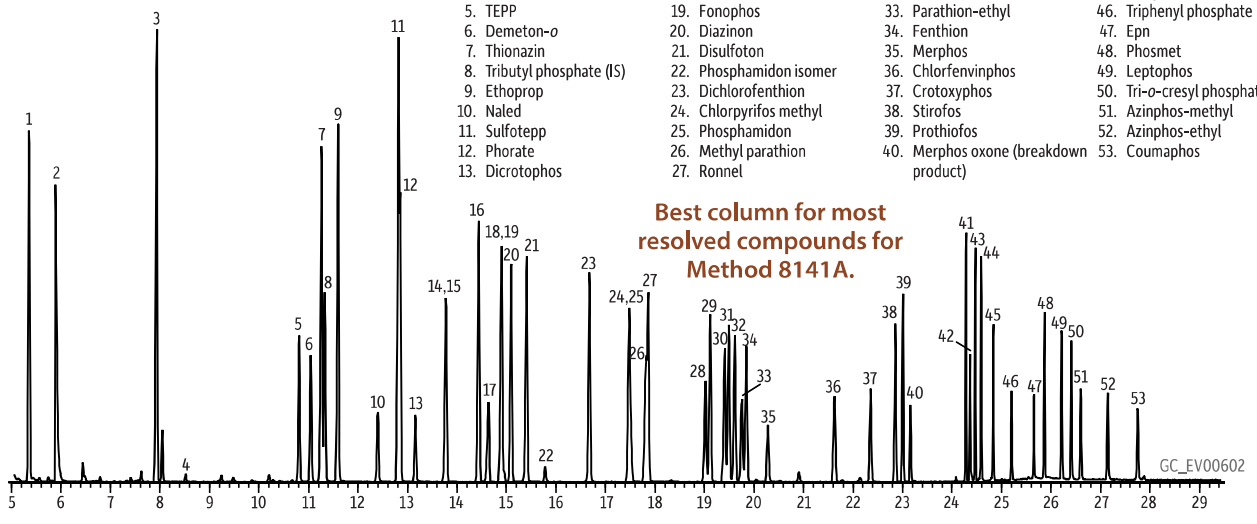
Rtx®-OPPesticides2 Columns (fused silica)

(proprietary Crossbond® phases)

ID	df	temp. limits	20-Meter cat.#	30-Meter cat.#
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

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

Peaks
1. Dichlorvos
2. Hexamethylphosphoramide
3. Mevinphos
4. Trichlorfon
5. TEPP
6. Demeton-*o*
7. Thionazin
8. Tributyl phosphate (IS)
9. Ethoprop
10. Naled
11. Sulfotepp
12. Phorate
13. Dicrotophos
14. Demeton-S
15. Monocrotophos
16. Terbufos
17. Dimethoate
18. Dioxathion
19. Fonophos
20. Diazinon
21. Disulfoton
22. Phosphamidon isomer
23. Dichlorofenthion
24. Chlorpyrifos methyl
25. Phosphamidon
26. Methyl parathion
27. Ronnel
28. Fenitrothion
29. Aspon
30. Malathion
31. Chlorpyrifos
32. Trichloronate
33. Parathion-ethyl
34. Fenthion
35. Merphos
36. Chlorfenvinphos
37. Crotoxyphos
38. Stirofos
39. Prothiofos
40. Merphos oxone (breakdown product)
41. Ethion
42. Fensulfothion
43. Sulprofos
44. Carbophenothion
45. Famphur
46. Triphenyl phosphate (SS)
47. Epn
48. Phosmet
49. Leptophos
50. Tri-*o*-cresyl phosphate
51. Azinphos-methyl
52. Azinphos-ethyl
53. Coumaphos



Column	Rtx®-OPPesticides2, 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.

Polycyclic Aromatic Hydrocarbons (PAHs) Analysis

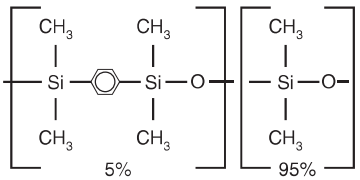
Rxi®-5Sil MS Columns (fused silica)
(low-polarity phase; Crossbond® 1,4-bis(dimethylsiloxy)phenylene dimethyl polysiloxane)

- 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 cat.#	30-Meter cat.#	60-Meter cat.#
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 cat.#	20-Meter cat.#	40-Meter cat.#	60-Meter cat.#
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

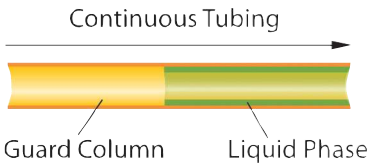


Similar to: (5%-phenyl)-methylpolysiloxane

similar phases

DB-5ms, DB-5msUI, VF-5ms, ZB-5ms, ZB-SemiVolatiles, Rtx-5Sil MS

Integra-Guard® Built-In Guard Column

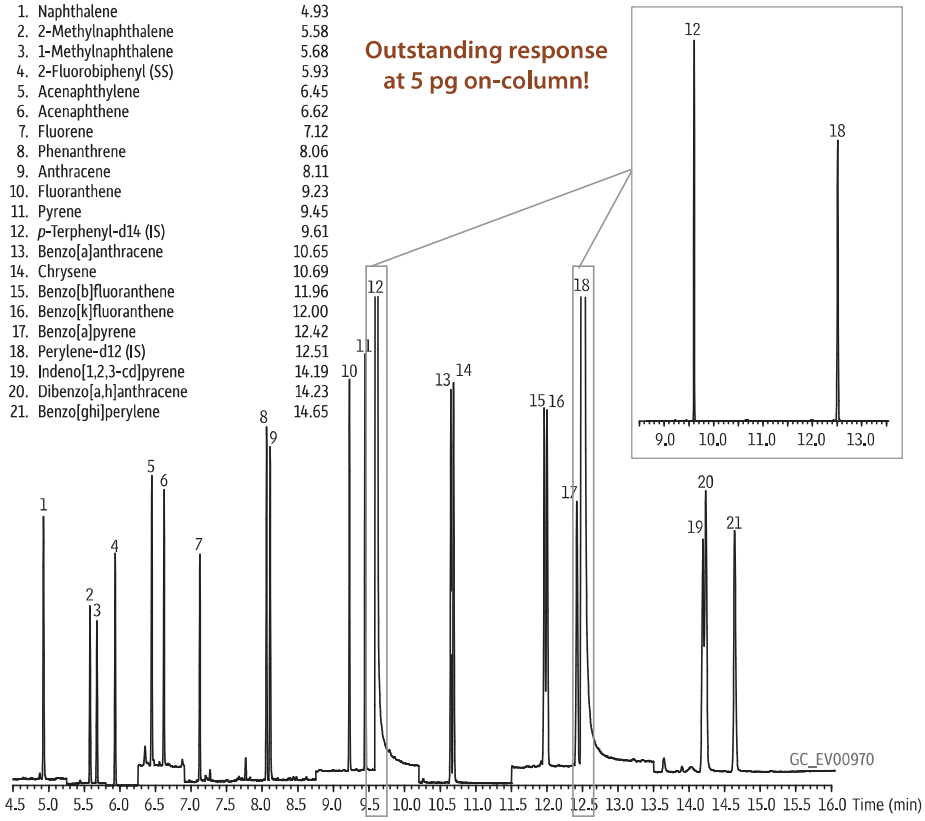


Get the protection without the connection!
See **page 23** for Rxi®-5Sil MS columns with built-in Integra-Guard® guard columns.

Polycyclic Aromatic Hydrocarbons on Rxi®-5Sil MS

Peaks		t_R (min)
1.	Naphthalene	4.93
2.	2-Methylnaphthalene	5.58
3.	1-Methylnaphthalene	5.68
4.	2-Fluorobiphenyl (SS)	5.93
5.	Acenaphthylene	6.45
6.	Acenaphthene	6.62
7.	Fluorene	7.12
8.	Phenanthrene	8.06
9.	Anthracene	8.11
10.	Fluoranthene	9.23
11.	Pyrene	9.45
12.	*p*-Terphenyl-d14 (IS)	9.61
13.	Benzo[a]anthracene	10.65
14.	Chrysene	10.69
15.	Benzo[b]fluoranthene	11.96
16.	Benzo[k]fluoranthene	12.00
17.	Benzo[a]pyrene	12.42
18.	Perylene-d12 (IS)	12.51
19.	Indeno[1,2,3-cd]pyrene	14.19
20.	Dibenzo[a,h]anthracene	14.23
21.	Benzo[ghi]perylene	14.65

Outstanding response at 5 pg on-column!



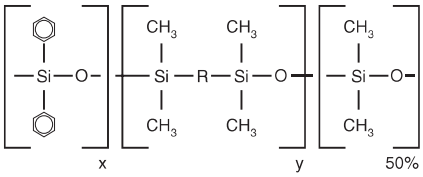
Column	Rxi®-5Sil MS, 30 m, 0.25 mm ID, 0.25 µm (cat.# 13623)
Sample	PAH mix, 1 µL of 0.005 µg/mL (IS 2 µg/mL) SV Calibration mix #5 / 610 PAH Mix (cat.# 31011) 1-Methylnaphthalene (cat.# 31283) 2-Methylnaphthalene (cat.# 31285) 2-Fluorobiphenyl (cat.# 31091)
Conc.:	5 pg on-column
Injection	
Inj. Vol.:	1.0 µL pulsed splitless (hold 0.15 min)
Liner:	Drilled Uniliner® (hole near top) w/wool (cat.# 21055-200.5)
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 Structure



Similar to: (50%-phenyl)-methylpolysiloxane

similar phases

DB-17ms, VF-17ms

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

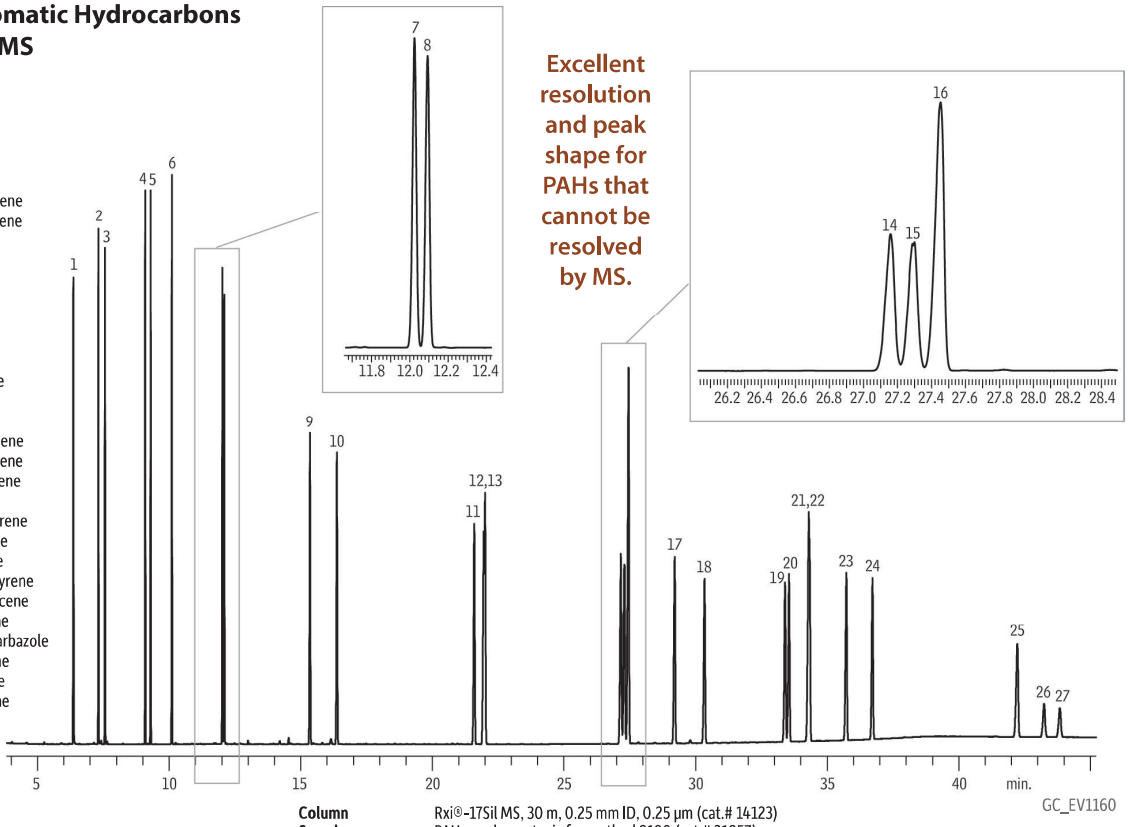
- 340/360 °C upper temperature limits.
- Excellent inertness and selectivity for active environmental compounds, such as PAHs.
- Equivalent to USP phase G3.
- Low bleed for use with sensitive detectors, such as MS.

ID	df	temp. limits*	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#
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 cat.#	20-Meter cat.#
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.

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	Rxi®-17Sil MS, 30 m, 0.25 mm ID, 0.25 µm (cat.# 14123)
Sample	PAH supplement mix for method 8100 (cat.# 31857) EPA Method 8310 PAH mixture (cat.# 31841) Triphenylene (custom)
Diluent:	Dichloromethane
Conc.:	10 ppm
Injection	
Inj. Vol.:	0.5 µL splitless (hold 1.75 min)
Liner:	Auto SYS XL PSS split/splitless w/wool (cat.# 21718)
Inj. Temp.:	320 °C
Purge Flow:	75 mL/min
Oven	
Oven Temp.:	65 °C (hold 0.5 min) to 220 °C at 15 °C/min to 330 °C at 4 °C/min (hold 15 min)
Carrier Gas	He, constant flow
Flow Rate:	2.0 mL/min
Detector	FID @ 320 °C
Instrument	PE Clarus 600 GC
Acknowledgement	Instrument provided by PerkinElmer

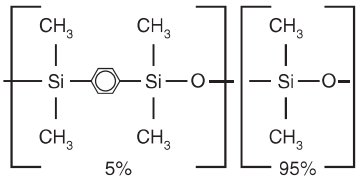
Semivolatiles Analysis

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.

Rxi®-5Sil MS Structure



Similar to: (5%-phenyl)-methylpolysiloxane

similar phases

DB-5ms, DB-5msUI, VF-5ms, ZB-5ms, ZB-SemiVolatiles, Rtx-5Sil MS

ID	df	temp. limits	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#
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	

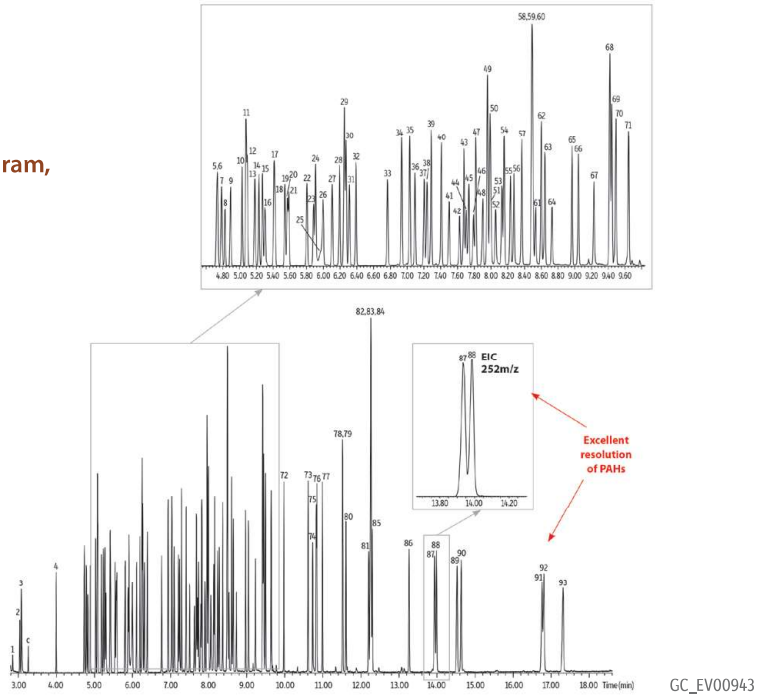
ID	df	temp. limits	10-Meter cat.#	20-Meter cat.#	40-Meter cat.#	60-Meter cat.#
0.15 mm	0.15 µm	-60 to 320/350 °C	43815	43816		
	2.0 µm	-60 to 320/350 °C		43817		
0.18 mm	0.10 µm	-60 to 320/350 °C				43607
	0.18 µm	-60 to 320/350 °C		43602	43605	
	0.36 µm	-60 to 320/350 °C		43604		

ordering note

Get the protection without the connection!
For Rxi®-5Sil MS columns with built-in Integra-Guard® guard columns, see **page 23**.

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

For complete chromatogram, see page 33.



GC_EV00943

free literature

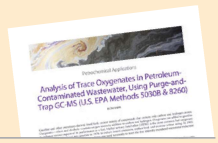
Whole Air Canister Sampling and Preconcentration GC-MS Analysis for pptv Levels of Trimethylsilanol in Semiconductor Cleanroom Air

lit. cat.# EVAN1788-UNV



Analysis of Trace Oxygenates in Petroleum-Contaminated Wastewater, Using Purge-and-Trap GC-MS (U.S. EPA Methods 5030B & 8260)

lit. cat.# EVAN1449-UNV



Download your free copies from

www.restek.com

Volatile Organics Analysis

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

- Application-specific columns for analyzing volatile organic pollutants by GC-MS including Methods TO-15, TMS, and EPA 8260.
- Complete separation of U.S. EPA Method 8260 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 cat.#	60-Meter cat.#	75-Meter cat.#
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

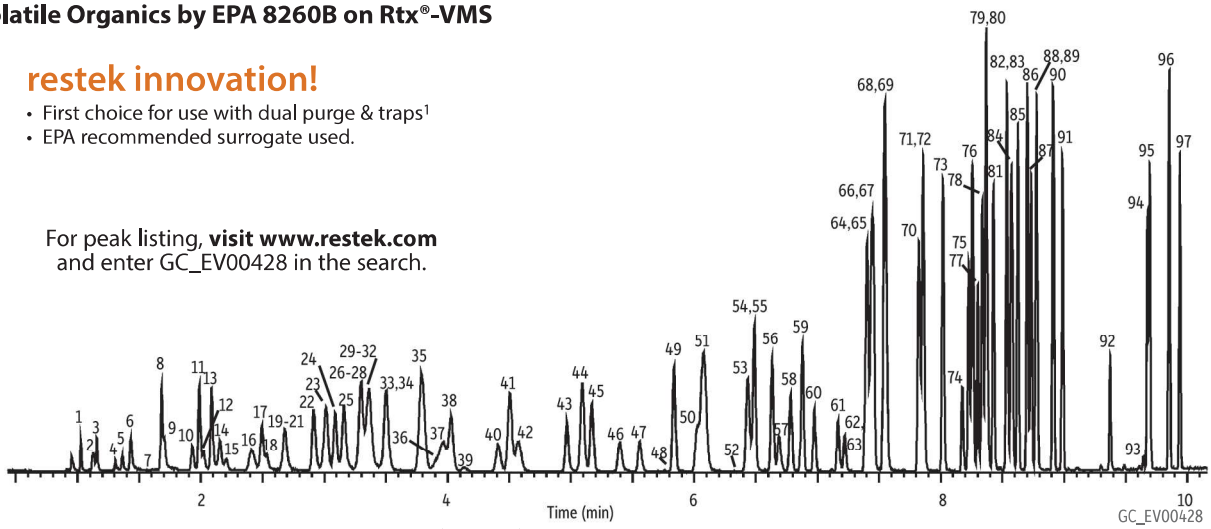
ID	df	temp. limits	20-Meter cat.#	40-Meter cat.#
0.18 mm	1.00 µm	-40 to 240/260 °C	49914	49915

Volatile Organics by EPA 8260B on Rtx®-VMS

restek innovation!

- First choice for use with dual purge & traps[1]
- EPA recommended surrogate used.

For peak listing, **visit www.restek.com** and enter GC_EV00428 in the search.



Column	Rtx®-VMS, 20 m, 0.18 mm ID, 1.00 µm (cat.# 49914)
Sample	
Diluent:	Water
Conc.:	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:	Vocarb® 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

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

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.

similar phases

DB-VRX

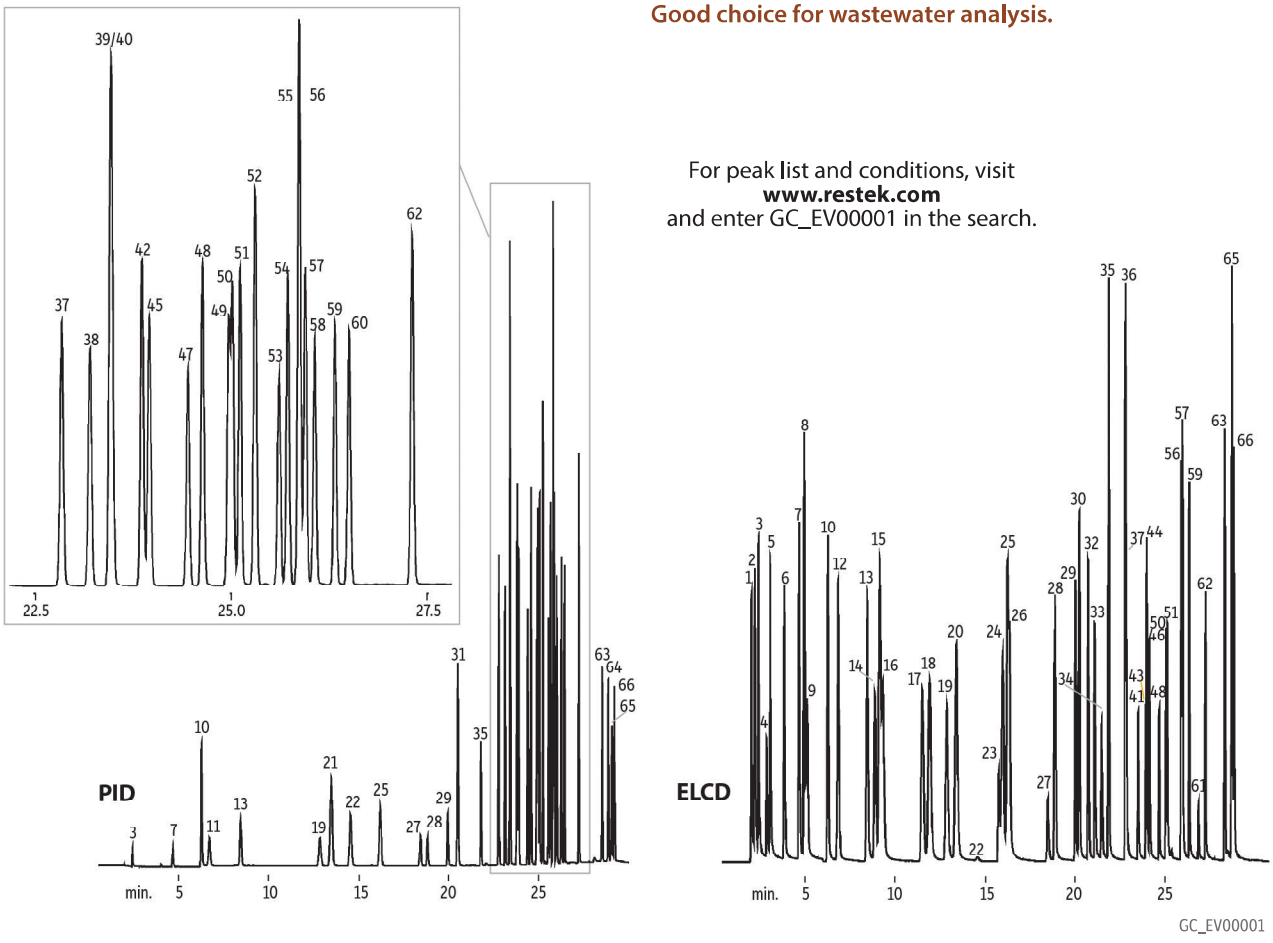
ID	df	temp. limits	30-Meter cat.#	60-Meter cat.#	75-Meter cat.#
0.25 mm	1.40 µm	-40 to 240/260 °C	19315	19316	
0.32 mm	1.80 µm	-40 to 240/260 °C	19319	19320	
0.45 mm	2.55 µm	-40 to 240/260 °C	19308		19309
0.53 mm	3.00 µm	-40 to 240/260 °C	19385	19388	

ID	df	temp. limits	20-Meter cat.#	40-Meter cat.#
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

similar phases
DB-502.2

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 cat.#	60-Meter cat.#	75-Meter cat.#	105-Meter cat.#
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 cat.#	40-Meter cat.#
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.

also available



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

MXT®-502.2 columns .....page 111
MXT®-Volatiles .....page 111

similar phases
VOCOL

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 cat.#	60-Meter cat.#	105-Meter cat.#
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.



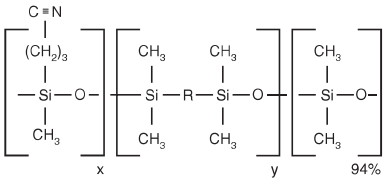
Volatile Organics Analysis

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—G43 phase 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 cat.#	30-Meter cat.#	60-Meter cat.#	75-Meter cat.#	105-Meter cat.#
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

Rxi®-624Sil MS (G43) Structure

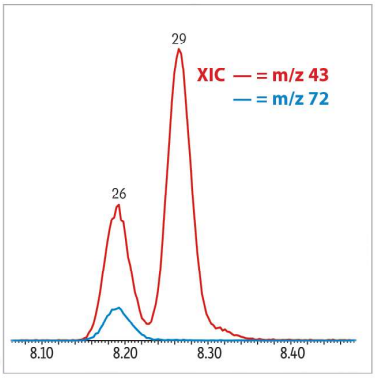


Similar to: (6%-cyanopropylphenyl)-methylpolysiloxane

similar phases

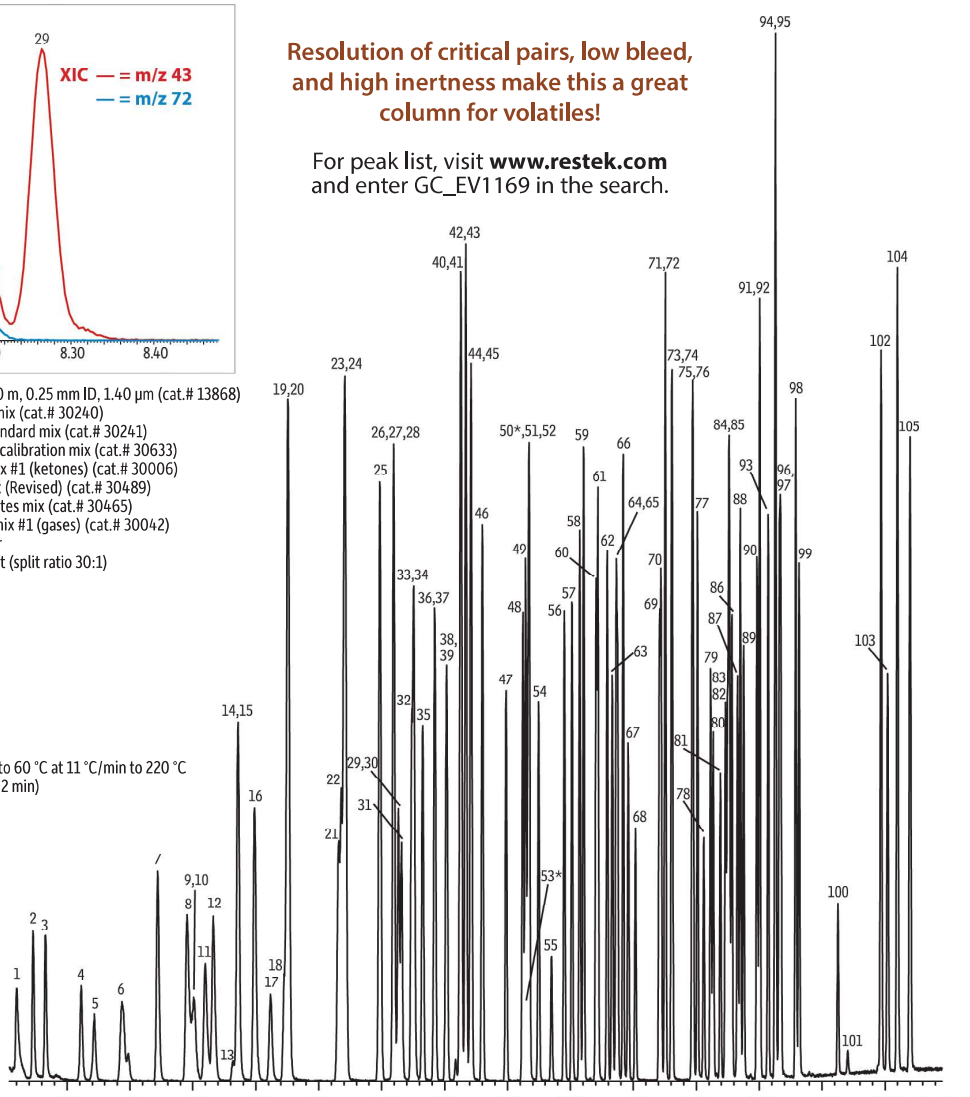
DB-624, VF-624ms, CP-Select 624 CB

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!

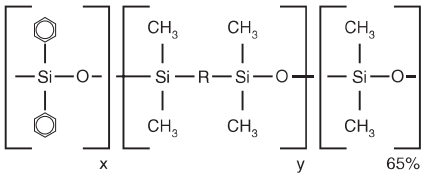
For peak list, visit **www.restek.com** and enter GC_EV1169 in the search.



Column	Rxi®-624Sil MS, 30 m, 0.25 mm ID, 1.40 µm (cat.# 13868)
Sample	8260A surrogate mix (cat.# 30240) 8260A internal standard mix (cat.# 30241) 8260B MegaMix® calibration mix (cat.# 30633) VOA calibration mix #1 (ketones) (cat.# 30006) 8260B acetate mix (Revised) (cat.# 30489) California oxygenates mix (cat.# 30465) 502.2 calibration mix #1 (gases) (cat.# 30042)
Conc.:	25 ppb in RO water
Injection	Purge and trap split (split ratio 30:1)
Inj. Temp.:	225 °C
Purge and Trap	
Instrument:	OI Analytical 4660
Trap Type:	10 Trap
Purge:	11 min @ 20 °C
Desorb Preheat Temp.:	180 °C
Desorb:	0.5 min @ 190 °C
Bake:	5 min @ 210 °C
Interface Connection:	Injection port
Oven	
Oven Temp.:	35 °C (hold 5 min) to 60 °C at 11 °C/min to 220 °C at 20 °C/min (hold 2 min)
Carrier Gas	He, constant flow
Flow Rate:	1.0 mL/min
Detector	MS
Mode:	Scan
Transfer Line Temp.:	230 °C
Analyzer Type:	Quadrupole
Source Temp.:	230 °C
Quad Temp.:	150 °C
Electron Energy:	70 eV
Solvent Delay Time:	1.5 min
Tune Type:	BFB
Ionization Mode:	EI
Scan Range:	36-260 amu
Instrument	Agilent 7890A GC & 5975C MSD
Notes	
Other Purge-and-Trap Conditions:	Sample Inlet: 40 °C Sample: 40 °C Water Management: Purge 110 °C, Desorb 0 °C, Bake, 240 °C
Acknowledgement	Eclipse 4660 purge-and-trap courtesy of O.I. Analytical, College Station, TX.

Cannabis Potency Analysis

Rxi®-35Sil MS Structure



similar phases

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

Rxi®-35Sil MS Columns (fused silica)

(midpolarity Crossbond® phase)

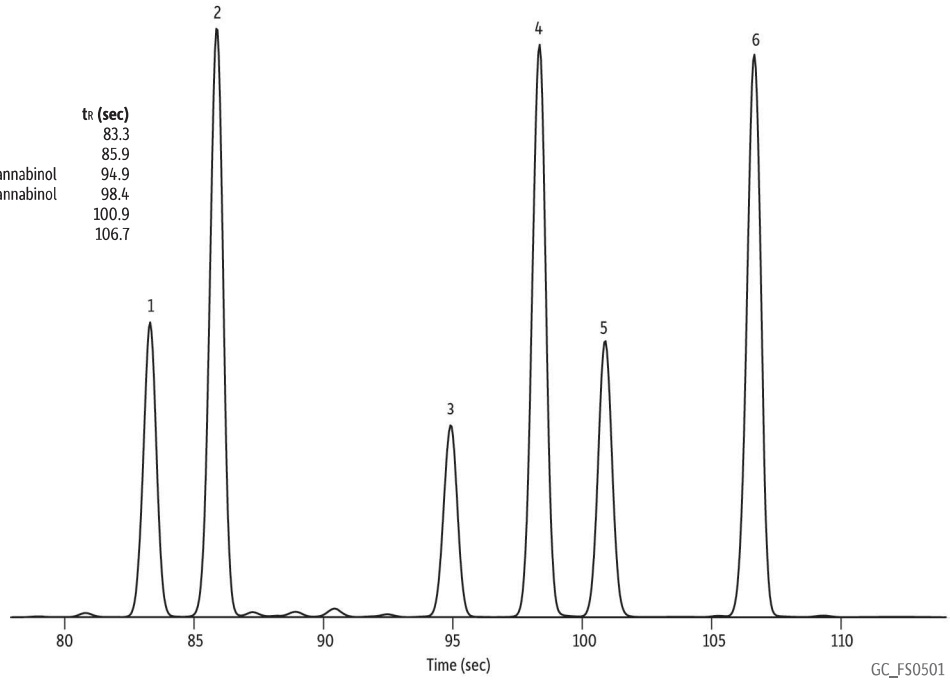
- Special selectivity and excellent inertness for substituted polar compounds, such as drugs, pesticides, herbicides, PCBs, phenols, etc.
- Provides superior separation for cannabinoids.
- Very low-bleed phase for GC-MS analysis.
- Extended temperature range: 50 °C to 340/360 °C.

The higher aromatic content of the Rxi®-35Sil MS column allows for superior separation of cannabinoids over traditional 5-type columns. Baseline separation can be achieved for a comprehensive list of cannabinoids by using a cost-effective 15 m column and readily available hydrogen carrier gas. The arylene content of the Rxi®-35Sil MS stationary phase ensures long column lifetime at the high elution temperatures required for cannabinoids analysis.

ID	df	temp. limits	15-Meter cat.#	30-Meter cat.#
0.25 mm	0.25 µm	50 to 340/360 °C	13820	13823

Cannabinoids on Rxi®-35Sil MS Using Hydrogen Carrier Gas by GC-FID

Peaks	t_R (sec)
1. Cannabichromene	83.3
2. Cannabidiol	85.9
3. Delta-8-Tetrahydrocannabinol	94.9
4. Delta-9-Tetrahydrocannabinol	98.4
5. Cannabigerol	100.9
6. Cannabinol	106.7



Column	Rxi®-35Sil MS, 15 m, 0.25 mm ID, 0.25 µm (cat.# 13820)
Sample	Cannabinoids standard (cat.# 34014) Cannabichromene (cat.# 34092) delta-8-Tetrahydrocannabinol (THC) (cat.# 34090) Cannabigerol (cat.# 34091)
Injection	
Inj. Vol.:	1 µL split (split ratio 50:1)
Liner:	Sky® 4 mm Precision® liner w/wool (cat.# 23305.5)
Inj. Temp.:	250 °C
Split Vent Flow Rate:	125 mL/min
Oven	
Oven Temp.:	225 °C (hold 0.1 min) to 330 °C at 35 °C/min (hold 0.9 min)
Carrier Gas	H_2, constant flow
Flow Rate:	2.5 mL/min
Detector	FID @ 350 °C
Constant Column + Constant Make-up:	50 mL/min
Make-up Gas Type:	N_2
Hydrogen flow:	40 mL/min
Air flow:	450 mL/min
Data Rate:	20 Hz
Instrument	Agilent/HP6890 GC

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.

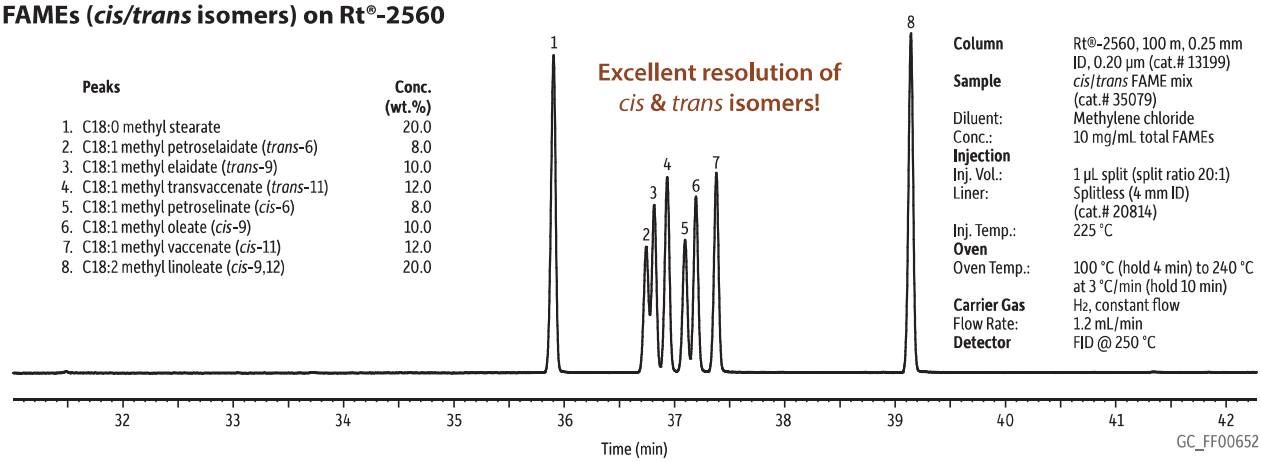
Because the Rt®-2560 stationary phase is not bonded, it should not be solvent rinsed.

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

similar phases
HP-88, CP-Sil 88, SPB-2560

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

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



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	
Flow Rate:	H_2, constant flow 1.2 mL/min
Detector	FID @ 250 °C

GC_FF00652

FAME Analysis (Polyunsaturated)

FAMEWAX Columns (USP G16) (fused silica)
(polar phase; Crossbond® polyethylene glycol)

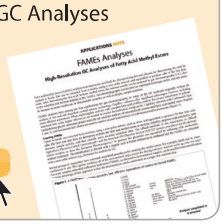
- Application-specific columns for FAMEs, specially tested with a FAME mixture.
- Temperature range: 20 °C to 250 °C.

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 cat.#
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 Analyses
High-Resolution GC Analyses of Fatty Acid Methyl Esters

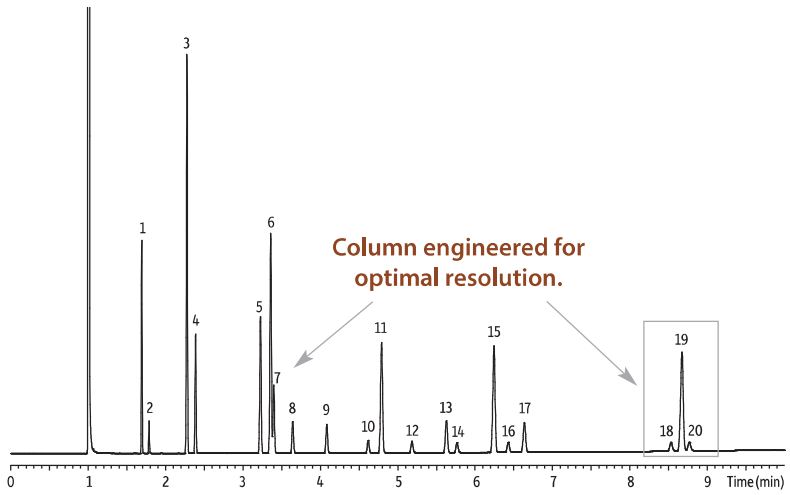
Download your free copy from
www.restek.com
lit. cat.# 59584B



similar phases
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:	Isooctane
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	
Flow Rate:	H_2, constant flow 3 mL/min
Detector	FID @ 275 °C

GC_FF00499

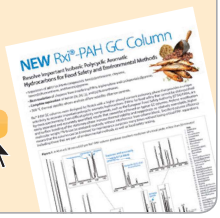
PAHs in Food Analysis

"The Rxi®-PAH column enabled us to separate important PAH derivative isomers, which we were experiencing trouble with for months. This column is excellent for PAH, NPAH, and OPAH separation and I would recommend anyone working in this field to try it out. Thank you Restek!"

Mohammed Salim Alam
Research Fellow
University of Birmingham, UK

Rxi®-PAH GC Column
Resolve Important Isobaric Polycyclic Aromatic Hydrocarbons for Food Safety and Environmental Methods

Download your free copy from
www.restek.com
lit. cat.#
GNTS1718-UNV



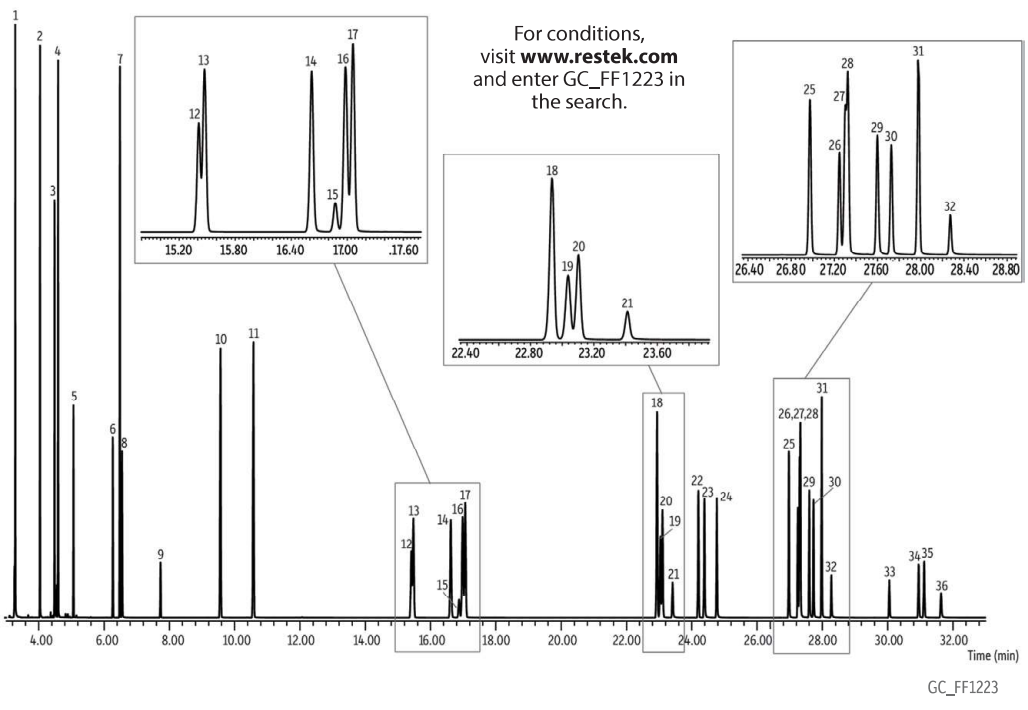
Rxi®-PAH Columns (fused silica)
(midpolarity proprietary phase)

- 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.

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 nonvolatile, 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 cat.#	40-Meter cat.#	60-Meter cat.#
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



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. Benz[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. Dibenzo[b,k]fluoranthene
34. Dibenzo[a,e]pyrene
35. Coronene
36. Dibenzo[a,h]pyrene

Pesticide Analysis in Cannabis

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.

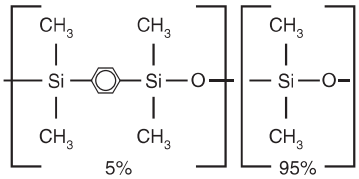
ID	df	temp. limits	30-Meter cat.#
0.25 mm	0.25 µm	-60 to 320/350 °C	13623
	0.50 µm	-60 to 320/350 °C	13638

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.#
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, 0.50 µm Rxi-5Sil MS w/5 m Integra-Guard Column	ea.	13638-124

Rxi®-5Sil MS Structure



Similar to: (5%-phenyl)-methylpolysiloxane

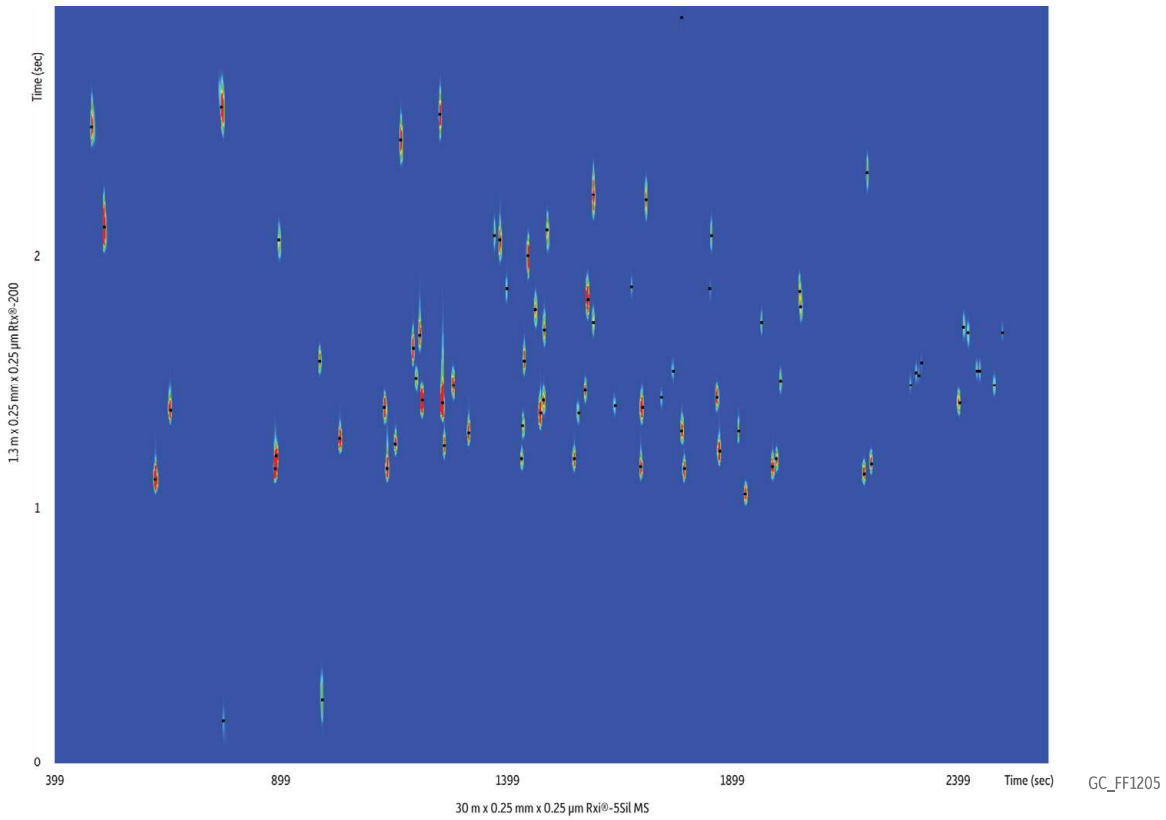
similar phases

DB-5ms, DB-5msUI, VF-5ms, ZB-5ms, ZB-SemiVolatiles, Rtx-5Sil MS

Growing Analytical Solutions for Medical Cannabis Labs

www.restek.com/**cannabis**

Marijuana Pesticides by GCxGC on Rxi®-5Sil MS and Rtx®-200

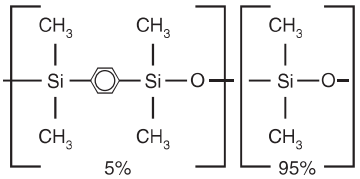


Column: Rxi®-5Sil MS 30 m, 0.25 mm ID, 0.25 µm (cat.# 13623); Rtx®-200 1.3 m, 0.25 mm ID, 0.25 µm (cat.# 15020); **Sample:** Diluent: Toluene; **Injection:** Inj. Vol.: 1 µL splitless (hold 1 min); Liner: Sky® 4 mm single taper w/wool (cat.# 23303.1); Inj. Temp.: 250 °C; Purge Flow: 40 mL/min; **Oven:** 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.

Pesticide Residues in Food Analysis

Rxi®-5Sil MS Structure



Similar to: (5%-phenyl)-methylpolysiloxane

similar phases

DB-5ms, DB-5msUI, VF-5ms, ZB-5ms, ZB-SemiVolatiles, Rtx-5Sil MS

also available

Comprehensive 203-compound GC multiresidue pesticide kit



See **page 568.**

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.

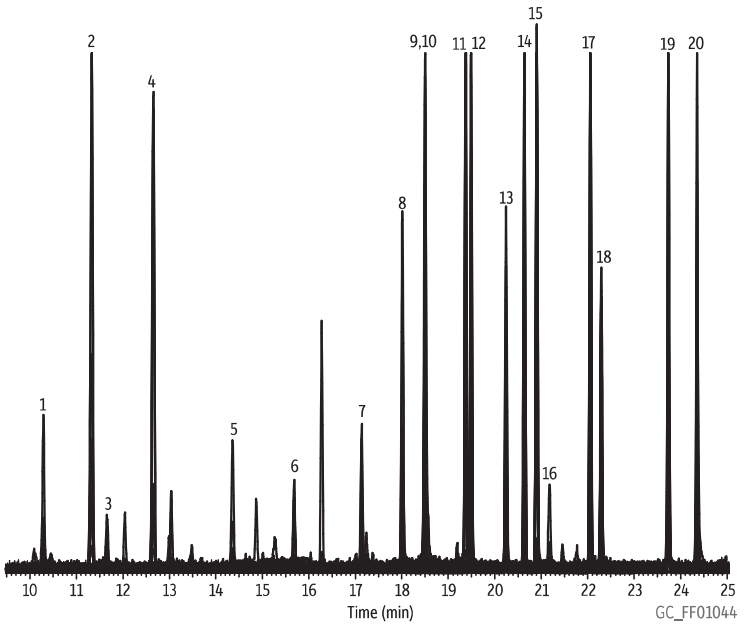
ID	df	temp. limits	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#
0.25 mm	0.10 µm	-60 to 320/350 °C	13605	13608	
	0.25 µm	-60 to 320/350 °C	13620	13623	13626
	0.50 µm	-60 to 320/350 °C	13635	13638	
	1.00 µm	-60 to 320/350 °C	13650	13653	13697
0.32 mm	0.25 µm	-60 to 320/350 °C	13621	13624	
	0.50 µm	-60 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 cat.#	20-Meter cat.#	40-Meter cat.#	60-Meter cat.#
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		

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.# 32415)
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 He, constant flow
Flow Rate: 1 mL/min
Detector MS
Mode: SIM
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.

1. Dilute with 1.5 mL hexane.
2. Add 6 mL of acetonitrile (ACN).
3. Mix for 30 minutes on a shaker.
4. Allow layers to separate (approximately 20 minutes), then collect the top (ACN) layer.
5. Repeat the liquid-liquid extraction (steps 2-4) and combine both ACN extract layers.
6. Place 1 mL of the combined ACN extract in a 1.5 mL tube containing 150 mg magnesium sulfate and 50 mg PSA.
7. Shake the tube for 2 minutes.
8. Centrifuge at 3,000 U/min for approximately 5 minutes.
9. 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

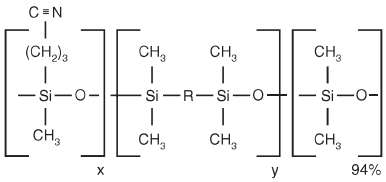
Residual Solvent Analysis for Cannabis Concentrates

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—G43 phase 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 cat.#	30-Meter cat.#	60-Meter cat.#	75-Meter cat.#	105-Meter cat.#
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

Rxi®-624Sil MS (G43) Structure



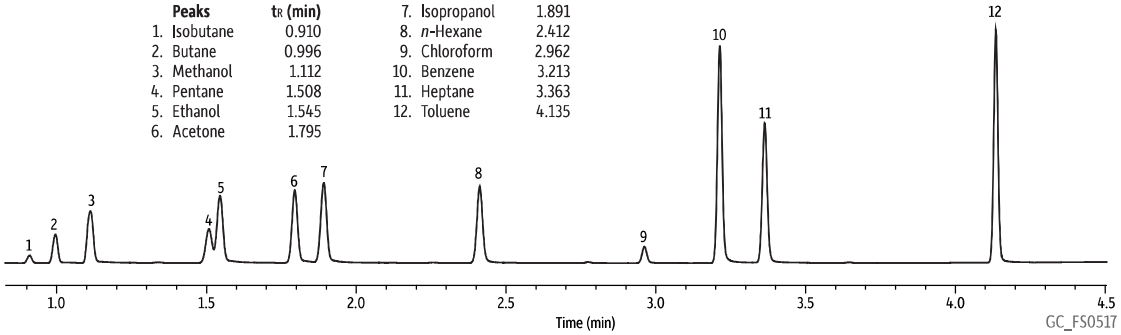
Similar to: (6%-cyanopropylphenyl)-methylpolysiloxane

similar phases

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

Residual Solvents in Cannabis Concentrates on Rxi®-624Sil MS by Headspace–Full Evaporation Technique (HS-FET)

Peaks	tR (min)				
1. Isobutane	0.910	7. Isopropanol	1.891
2. Butane	0.996	8. *n*-Hexane	2.412
3. Methanol	1.112	9. Chloroform	2.962
4. Pentane	1.508	10. Benzene	3.213
5. Ethanol	1.545	11. Heptane	3.363
6. Acetone	1.795	12. Toluene	4.135



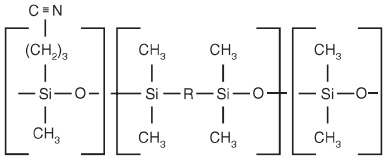
Column	Rxi®-624Sil MS, 30 m, 0.25 mm ID, 1.40 µm (cat.# 13868)
Sample	Residual solvent mix
Diluent:	Dimethyl sulfoxide (DMSO)
Conc.:	500 ppm (For the HS-FET technique, 10 µL of a 1,000 µg/mL standard was placed into a 20 mL headspace vial to represent a 500 ppm sample concentration, assuming a 20 mg sample.)
Injection	headspace-loop split (split ratio 10:1)
Liner:	Sky® 1.0 mm ID straight inlet liner (cat.# 23333.1)
Headspace-Loop	
Instrument:	Tekmar HT3
Inj. Time:	1.0 min
Transfer Line Temp.:	160 °C
Valve Oven Temp.:	160 °C
Needle Temp.:	140 °C
Sample Temp.:	140 °C
Platen temp equil. time:	1.0 min
Sample Equil. Time:	30.0 min
Vial Pressure:	20 psi
Pressurize Time:	5.0 min
Loop Pressure:	15 psi
Loop Fill Time:	2.0 min

Oven	
Oven Temp.:	35 °C (hold 1.5 min) to 300 °C at 30 °C/min (hold 2.0 min)
Carrier Gas	He, constant flow
Linear Velocity:	80 cm/sec
Detector	FID @ 250 °C
Make-up Gas Flow Rate:	45 mL/min
Make-up Gas Type:	N_2
Hydrogen flow:	40 mL/min
Air flow:	450 mL/min
Data Rate:	20 Hz
Instrument	Agilent/HP6890 GC
Notes	The butane used for standard preparation was a mixture of butane and isobutane in an unknown ratio. The concentrations of butane and isobutane should be considered approximate, but do not exceed 500 ppm for either component.

ChromaBLOGraphy
Check out the Restek blog for the most current topics in chromatography.
blog.restek.com

Terpenes Analysis for Cannabis and Hops

Rxi®-624Sil MS (G43) Structure



Similar to: (6%-cyanopropylphenyl)-methylpolysiloxane

similar phases

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

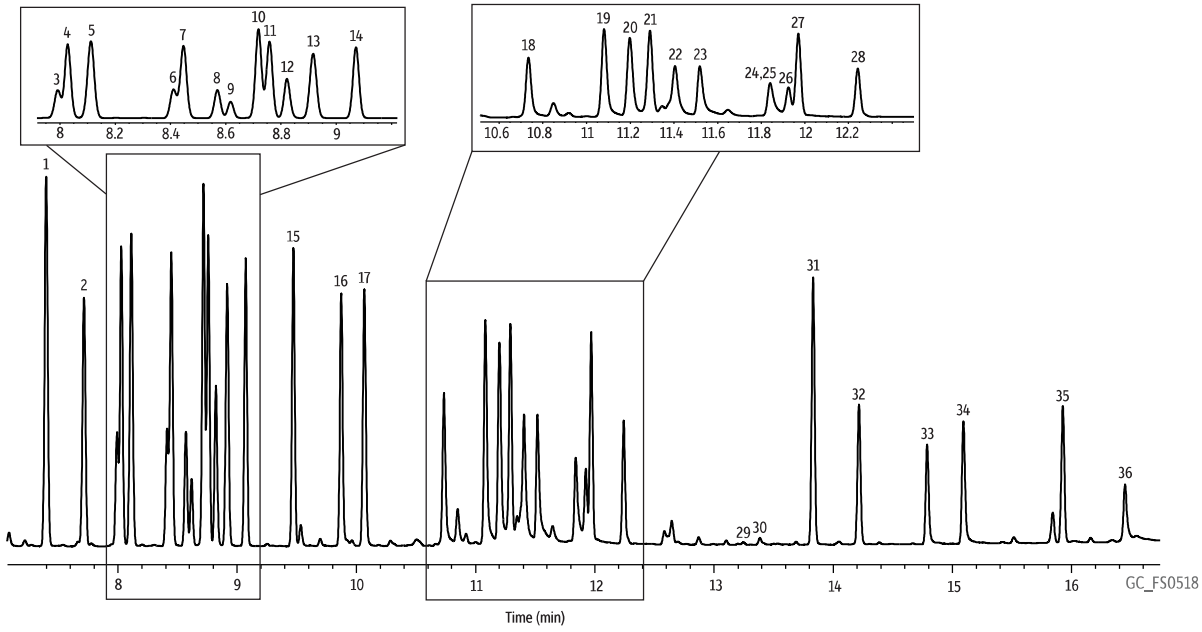
Rxi®-624Sil MS Columns (fused silica)

(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—G43 phase 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 cat.#	30-Meter cat.#	60-Meter cat.#	75-Meter cat.#	105-Meter cat.#
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

Medical Cannabis Terpenes on Rxi®-624Sil MS by FET-HS-GC



Peaks	tR (min)						
1. α-Pinene	7.39	10. Limonene	8.71	20. Borneol	11.19	30. Citral 4	13.43
2. Camphene	7.71	11. *p*-Cymene	8.75	21. α-Terpineol	11.29	31. β-caryophyllene	13.83
3. β-Myrcene	7.98	12. β-Ocimene	8.82	22. Dihydrocarveol	11.40	32. α-Humulene	14.21
4. Sabinene	8.02	13. Eucalyptol	8.91	23. Citronellol	11.51	33. Nerolidol 1	14.78
5. β-Pinene	8.11	14. γ-Terpinene	9.06	24. Geraniol	11.82	34. Nerolidol 2	15.08
6. α-Phellandrene	8.4	15. Terpinolene	9.47	25. 2-Piperidinone	11.88	35. Caryophyllene oxide	15.92
7. δ 3-Carene	8.44	16. Linalool	9.87	26. Citral 1	11.92	36. α-Bisabolol	16.43
8. α-Terpinene	8.57	17. Fenchone	10.06	27. Pulegone	11.97		
9. Ocimene	8.61	18. Isopulegol	10.73	28. Citral 2	12.24		
		19. dl-Menthol	11.08	29. Citral 3	13.19		

Column	Rxi® -624Sil MS, 30 m, 0.25 mm ID, 1.40 µm (cat.# 13868)	Vial Pressure:	20 psi
Sample	Terpenes mix	Loop Pressure:	15 psi
Diluent:	Isopropyl alcohol	**Oven**	
Conc.:	200 ng/µL (0.02% wt/vol). The sample was prepared by placing 10 µL into the headspace vial.	Oven Temp.:	60 °C (hold 0.10 min) to 300 °C at 12.50 °C/min (hold 3.0 min)
Injection	headspace-loop split (split ratio 10:1)	**Carrier Gas**	He, constant flow
Liner:	Sky® 1.0 mm ID straight inlet liner (cat.# 23333.1)	Linear Velocity:	33 cm/sec
Headspace-Loop		**Detector**	FID @ 320 °C
Inj. Port Temp.:	250 °C	Make-up Gas Flow Rate:	45 mL/min
Instrument:	Tekmar HT-3	Make-up Gas Type:	N_2
Inj. Time:	1.0 min	Hydrogen flow:	40 mL/min
Transfer Line Temp.:	160 °C	Air flow:	450 mL/min
Valve Oven Temp.:	160 °C	Data Rate:	20 Hz
Needle Temp.:	140 °C	**Instrument**	Agilent/HP6890 GC
Sample Temp.:	140 °C		
Sample Equil. Time:	30.0 min		

Triglycerides in Foods Analysis

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.

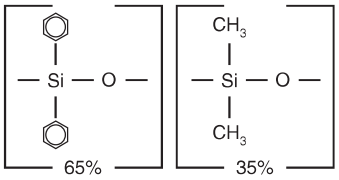
ID	df	temp. limits	15-Meter cat.#	30-Meter cat.#
0.25 mm	0.10 µm	40 to 370 °C	17005	17008
0.32 mm	0.10 µm	40 to 370 °C	17006	17009
0.53 mm	0.10 µm	40 to 370 °C	17007	17010

please note

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

• Vu2 Union® connectors (see page 229.)
• MXT®-Union connector kits for fused silica (see page 231.)

Rtx®-65TG Structure

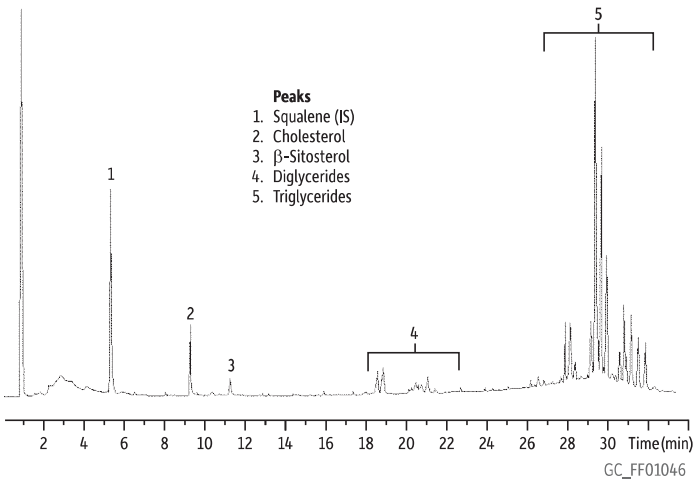


Similar to: (65%-phenyl)-methylpolysiloxane

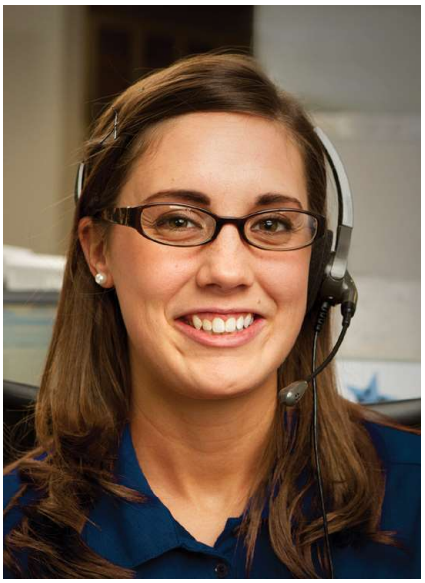
crossbond® technology

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

Egg Pasta Sterols & Glycerides on Rtx®-65TG



Column Rtx®-65TG, 30 m, 0.25 mm ID, 0.10 µm (cat.# 17008)
Sample Fat extract from egg pasta in diethyl ether solution with 3,000 ppm squalene (IS)
Conc.: 50 µg/mL
Injection
Inj. Vol.: 0.5 µL ptv split (split ratio 80:1)
Inlet Temp. Program: 70 °C (hold 12 min) to 370 °C at 99 °C/min (hold 5 min)
Oven
Oven Temp.: 220 °C (hold 2 min) to 360 °C at 5 °C/min (hold 5 min)
Carrier Gas H_2, constant flow
Flow Rate: 1.5 mL/min
Detector FID @ 370 °C
Acknowledgement
Daniele Naviglio, Fabiana Pizzolongo; Dipartimento di Scienza degli Alimenti – Università degli Studi di Napoli "Federico II" – Via Università, 100 - 80055 Portici (NA) – Italia



How can we help you today? Restek's Customer Service and Technical Service specialists are here to help you find the products and information you need quickly and efficiently.

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 cat.#	60-Meter cat.#
0.25 mm	0.40 µm	0 to 135 °C	10998	10999

similar phases

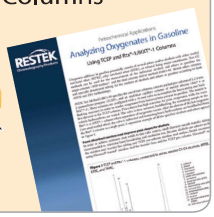
SPB-TCEP, CP-TCEP

free literature

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

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

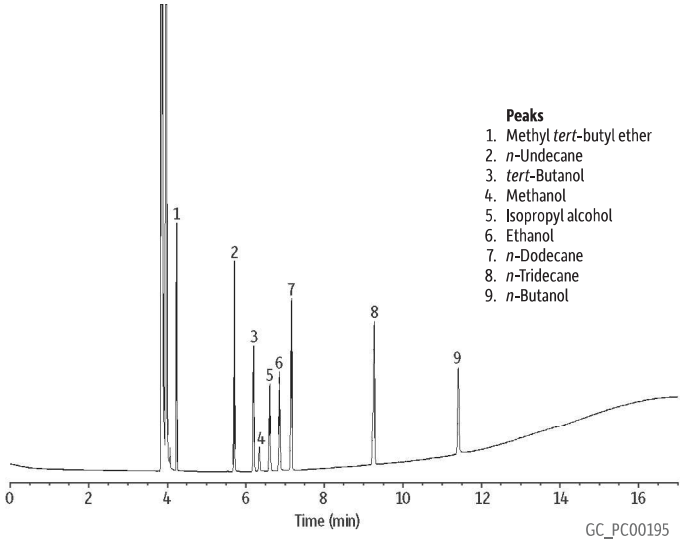
lit. cat.# 59587A



Save money!
Get six columns for the price of five.
Call 800-356-1688, ext. 3, or your Restek representative for details!



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

Biodiesel Fuels Analysis

Rtx®-Biodiesel TG Columns (fused silica)

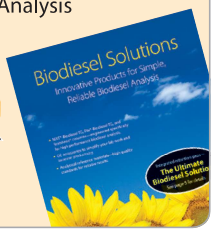
- Linearity for all reference compounds exceeds method requirements.
- Columns with retention gaps feature Alumaseal® connectors to prevent leaks and extend column life.
- Low column bleed at high temperatures.
- For glycerin and glycerides analysis, according to ASTM D6584 and EN 14105 methods.
- Stable to 350 °C.

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

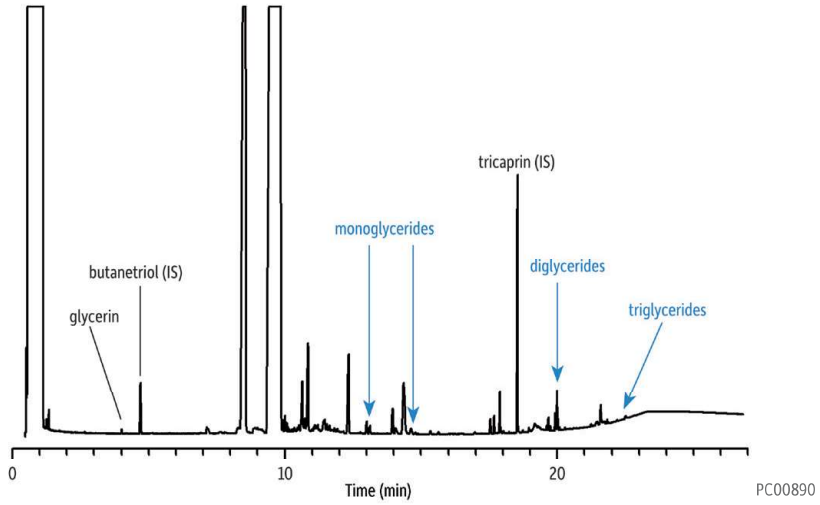
free literature
Biodiesel Solutions
Innovative Products for Simple, Reliable Biodiesel Analysis

Download your free copy from
www.restek.com

lit. cat.#
PCFL1409-UNV



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	Biodiesel (B100) plus monoolein, diolein, triolein, glycerin, butanetriol, tricaprin
Injection	
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	H_2, constant flow
Flow Rate:	4 mL/min
Detector	FID @ 380 °C

did you know?

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

similar phases

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

Method Recommended

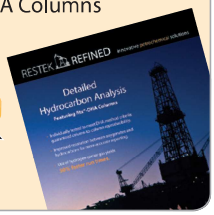
ASTM Method	Column	cat. #	Dimensions
D6729	Rtx-DHA-100	10148	100 m x 0.25 mm, 0.50 µm
D6730	Rtx-DHA-100 & Rtx-5 DHA Tuning Column	10148 & 10165	100 m x 0.25 mm, 0.50 µm w/ precolumn
D6733	Rtx-DHA-50	10147	50 m x 0.20 mm, 0.50 µm
D5501	Rtx-DHA-150	10149	150 m x 0.25 mm, 1.0 µm

free literature

Detailed Hydrocarbon Analysis
Featuring Rtx®-DHA Columns

Download your free copy from
www.restek.com

lit. cat.#
PCFL1007B-UNV



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.
- Stable to 340 °C.

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.

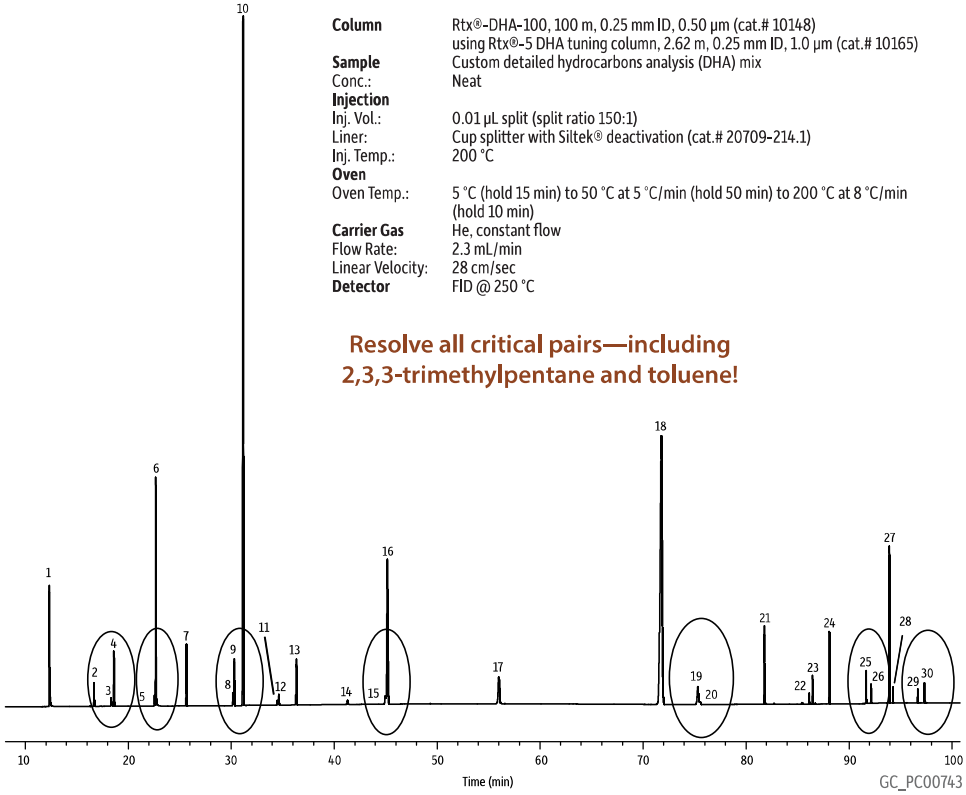
ID	df	temp. limits	50-Meter cat.#	100-Meter cat.#	150-Meter cat.#
0.20 mm	0.50 µm	-60 to 300/340 °C	10147		
0.25 mm	0.50 µm	-60 to 300/340 °C		10148	
	1.00 µm	-60 to 280/340 °C			10149

Rtx®-5 DHA Tuning Column (fused silica)

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

ID	df	temp. limits	5-Meter cat.#
0.25 mm	1.00 µm	-60 to 325/350 °C	10165

Detailed Hydrocarbons Analysis on Rtx®-DHA-100



Column Rtx®-DHA-100, 100 m, 0.25 mm ID, 0.50 µm (cat.# 10148)
using Rtx®-5 DHA tuning column, 2.62 m, 0.25 mm ID, 1.0 µm (cat.# 10165)
Sample Custom detailed hydrocarbons analysis (DHA) mix
Conc.: Neat
Injection
Inj. Vol.: 0.01 µL split (split ratio 150:1)
Liner: Cup splitter with Siltek® deactivation (cat.# 20709-214.1)
Inj. Temp.: 200 °C
Oven
Oven Temp.: 5 °C (hold 15 min) to 50 °C at 5 °C/min (hold 50 min) to 200 °C at 8 °C/min (hold 10 min)
Carrier Gas He, constant flow
Flow Rate: 2.3 mL/min
Linear Velocity: 28 cm/sec
Detector FID @ 250 °C

Resolve all critical pairs—including 2,3,3-trimethylpentane and toluene!

Peaks
1. Ethanol
2. C5
3. *tert*-Butanol
4. 2-Methylbutene-2
5. 2,3-Dimethylbutane
6. Methyl *tert*-butyl ether (MTBE)
7. C6
8. 1-Methylcyclopentene
9. Benzene
10. Cyclohexane
11. 3-Ethylpentane
12. 1-*tert*-2-Dimethylcyclopentane
13. C7
14. 2,2,3-Trimethylpentane
15. 2,3,3-Trimethylpentane
16. Toluene
17. C8
18. Ethylbenzene
19. *p*-Xylene
20. 2,3-Dimethylheptane
21. C9
22. 5-Methylnonane
23. 1,2-Methylethylbenzene
24. C10
25. C11 (undecane)
26. 1,2,3,5-Tetramethylbenzene
27. Naphthalene
28. C12 (dodecane)
29. 1-Methylnaphthalene
30. C13 (tridecane)

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 cat.#
0.53 mm	2.65 µm	-60 to 360 °C	10199

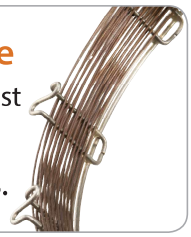
similar phases

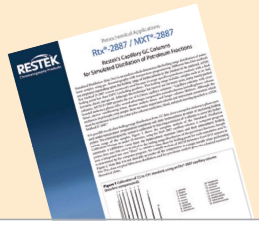
DB-2887, Petrocol 2887, Petrocol EX2887

also available

MXT®-1HT SimDist
and more simulated distillation products

See **pages 113–115.**





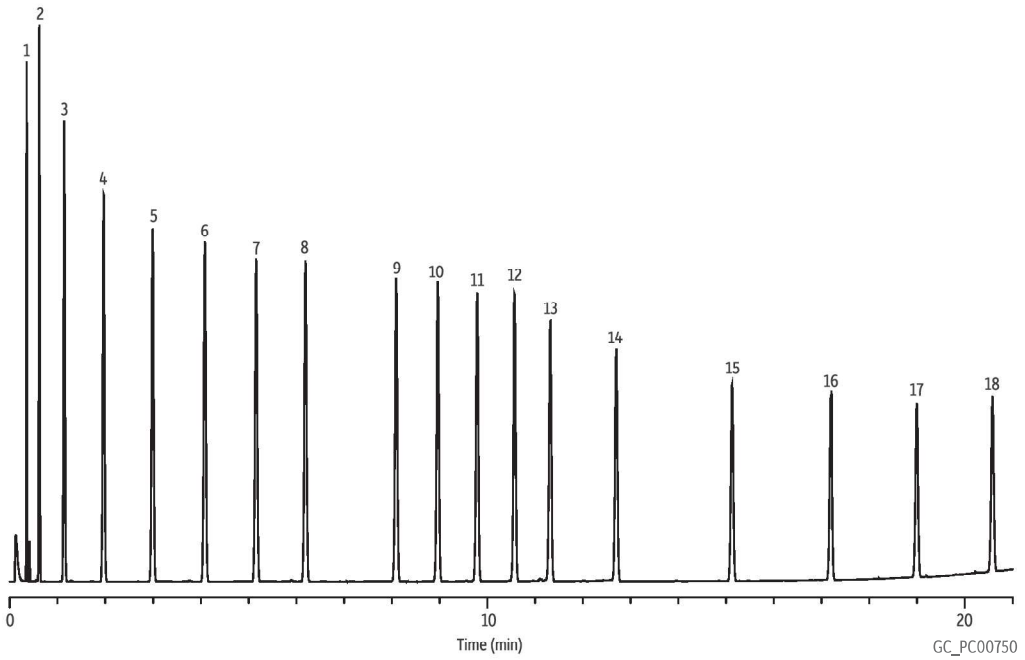
free literature

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

Simulated Distillation (C5-C44) on Rtx®-2887



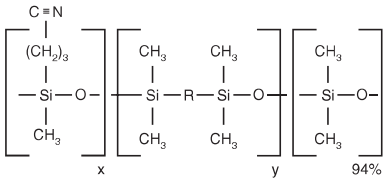
Peaks
1. C5
2. C6
3. C7
4. C8
5. C9
6. C10
7. C11
8. C12
9. C14
10. C16
11. C18
12. C20
13. C24
14. C28
15. C32
16. C36
17. C40
18. C44

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

G43 phase

Rxi®-624Sil MS Structure



Similar to: (6%-cyanopropylphenyl)-methylpolysiloxane

similar phases

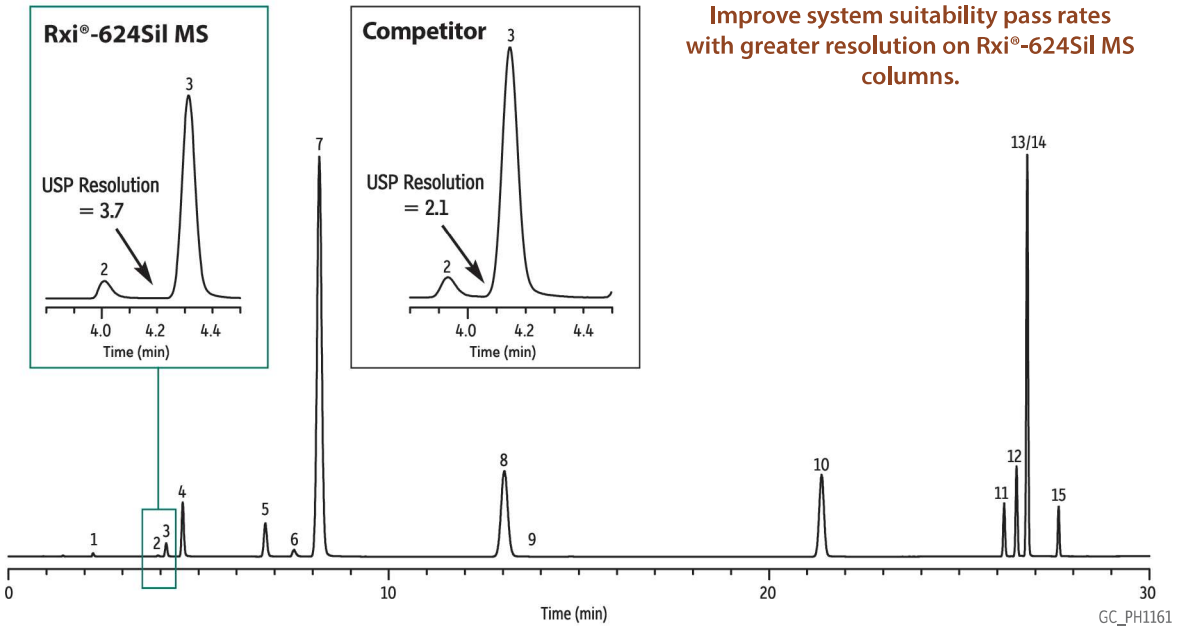
DB-624, VF-624ms, CP-Select 624 CB

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—G43 phase 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 cat.#	30-Meter cat.#	60-Meter cat.#	75-Meter cat.#	105-Meter cat.#
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. *trans*-1,2-Dichloroethene	4.798	7.83
5. *cis*-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. *m*-Xylene	27.147	10.85
14. *p*-Xylene	27.147	2.53
15. *o*-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.

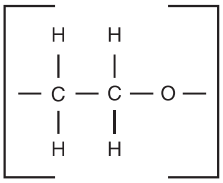
Restek's polar-deactivated surface tightly binds the Carbowax® polymer and increases thermal stability, relative to competitive columns. Because of the increased stability produced by the bonding process, Stabilwax® columns exhibit long column lifetimes, even when programming repeatedly up to 260 °C. 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.

ID	df	temp. limits	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#
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 cat.#	20-Meter cat.#
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 23**.

free literature

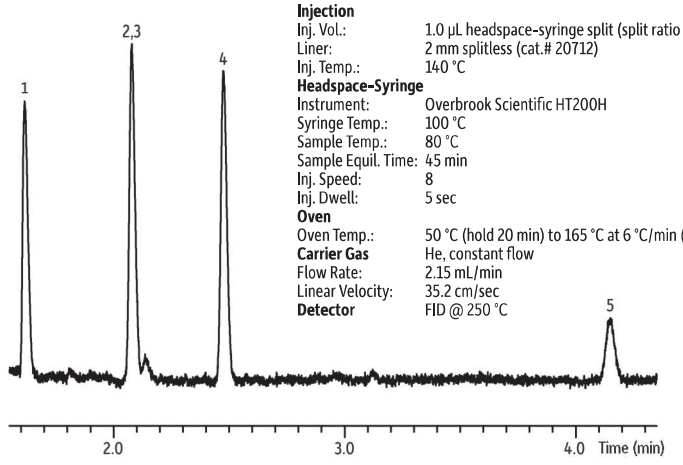
Custom Residual Solvent Mixes

Download your free copy from www.restek.com

lit. cat.# PHTS1212



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



GC_PH00951

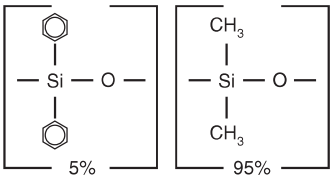
Column Stabilwax®, 30 m, 0.32 mm ID, 0.25 µm (cat.# 10624)
Sample Residual solvents - class 1 (cat.# 36279) in 20 mL headspace vial (cat.# 24685)
Diluent: Water
Injection
Inj. Vol.: 1.0 µL headspace-syringe split (split ratio 5:1)
Liner: 2 mm splitless (cat.# 20712)
Inj. Temp.: 140 °C
Headspace-Syringe
Instrument: Overbrook Scientific HT200H
Syringe Temp.: 100 °C
Sample Temp.: 80 °C
Sample Equil. Time: 45 min
Inj. Speed: 8
Inj. Dwell: 5 sec
Oven
Oven Temp.: 50 °C (hold 20 min) to 165 °C at 6 °C/min (hold 20 min)
Carrier Gas He, constant flow
Flow Rate: 2.15 mL/min
Linear Velocity: 35.2 cm/sec
Detector FID @ 250 °C

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

System suitability criteria met

G27 phase

Rtx®-5 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.

USP
Pharmaceutical Standards
See **pages 595–596**.



Organic Volatile Impurities (OVI) Analysis

Rtx®-5 (G27) 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.

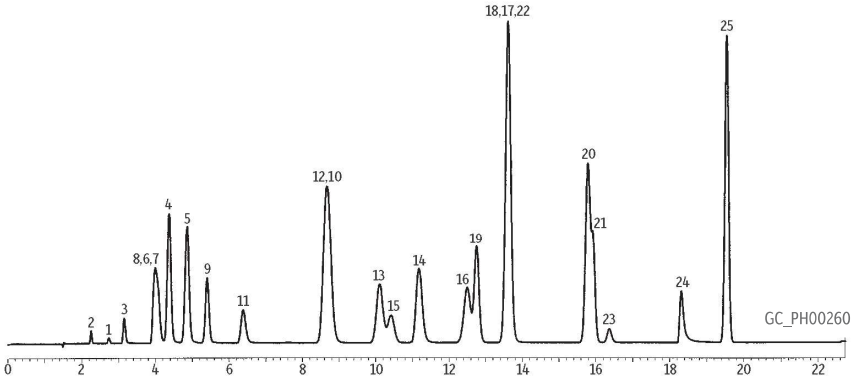
The diphenyl dimethyl polysiloxane stationary phase is the most popular GC stationary phase and is used in a wide variety of applications. All residual catalysts and low molecular weight fragments are removed from the Rtx®-5 polymer, providing a tight mono-modal distribution and extremely low bleed.

ID	df	temp. limits*	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#	105-Meter cat.#
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		
	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 cat.#	20-Meter cat.#	40-Meter cat.#
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.
- Analytical column with Integra-Guard® guard column eliminates connecting problems and leaks.
- Rtx®-G27 stable to 290 °C.

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

			30-Meter with 5-Meter, 0.53mm ID Integra-Guard Guard Column
ID	df	temp. limits	cat.#
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® cyanopropylmethyl phenylmethyl polysiloxane)

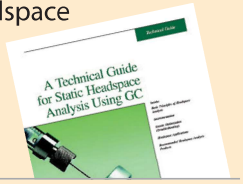
- Application-specific columns for residual solvents in pharmaceutical products. Meet all requirements of USP <467>.
- Analytical column with Integra-Guard® guard column eliminates connecting problems and leaks.
- Rtx®-G43 stable to 240 °C.

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

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

free literature

A Technical Guide for Static Headspace Analysis Using GC



lit. cat.#
59895B

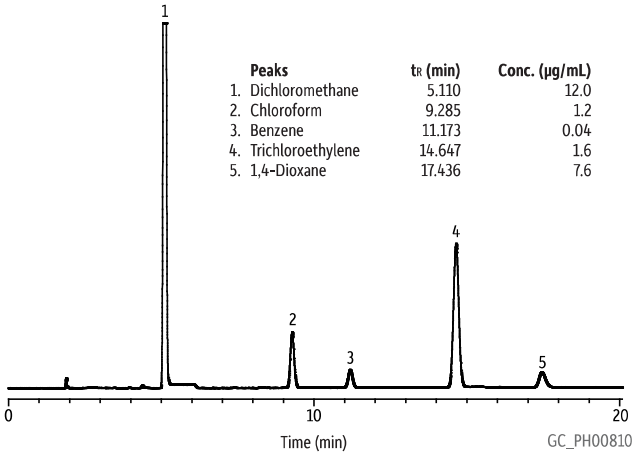
Custom Residual Solvents Mixes



lit. cat.#
PHTS1212

Download your free copies from
www.restek.com

USP <467> Residual Solvents on Rtx®-1301 (G43) by Static Headspace



Peaks	tR (min)	Conc. (µg/mL)
1. Dichloromethane	5.110	12.0
2. Chloroform	9.285	1.2
3. Benzene	11.173	0.04
4. Trichloroethylene	14.647	1.6
5. 1,4-Dioxane	17.436	7.6

Column	Rtx®-1301 w/5 m Integra-Guard®, 30 m, 0.53 mm ID, 3.00 µm (cat.# 16085-126)
Sample	USP <467> calibration mixture #5 (cat.# 36007)
Diluent:	DMSO
Conc.:	To each 22 mL headspace vial 5ml water, ~ 1.0 g of sodium sulfate and 100 µL of stock standard were added.
Injection	headspace-loop split (split ratio 2:1)
Headspace-Loop	
Inj. Port Temp.:	180 °C
Instrument:	Teledyne Tekmar HT3
Inj. Time:	1.0 min
Transfer Line Temp.:	150 °C
Valve Oven Temp.:	150 °C
Standby flow rate:	10 mL/min
Sample Temp.:	80 °C
Platen temp equil. time:	2.0 min
Sample Equil. Time:	15.0 min
Mixer time:	2.0 min
Mixing level:	5
Mixer stabilize time:	0.5 min
Vial Pressure:	15 psi
Pressurize Time:	2.0 min
Pressure Equilibration Time:	0.5 min
Loop Pressure:	5 psi
Loop Fill Time:	2.0 min
Loop fill equil. time:	0.5 min
Oven	
Oven Temp.:	40 °C (hold 20 min) to 240 °C at 25 °C/min (hold 10 min)
Carrier Gas	He, constant flow
Flow Rate:	5 mL/min
Detector	FID @ 250 °C
Make-up Gas Flow Rate:	45 mL/min
Notes	**FID conditions:** hydrogen flow: 40 mL/min air flow: 450 mL/min

similar phases

HP-FFAP, DB-FFAP, CP-WAX 58 FFAP CB, 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.

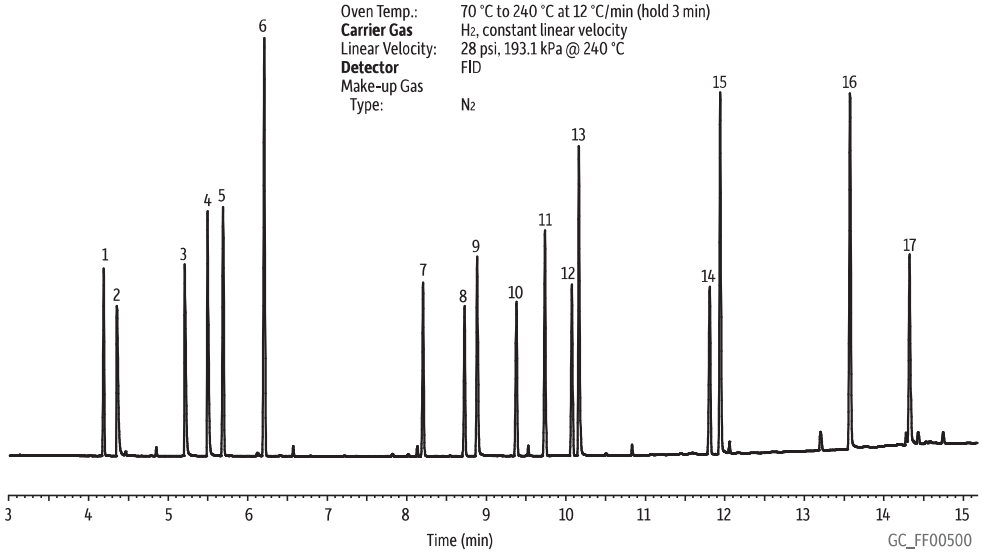
Stabilwax®-DA bonded polyethylene glycol has an acidic functionality incorporated into the polymer structure. This permits analysis of acidic compounds without derivatization, significantly reduces adsorption of acids, and increases sample capacity for volatile free acids. Stabilwax®-DA columns last 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 cat.#	30-Meter cat.#	60-Meter cat.#
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	
	0.50 µm	40 to 250/260 °C	11037	11040	
	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	
Diluent:	Ethyl acetate
Injection	
Inj. Vol.:	1 µL splitless (hold 0.5 min)
Liner:	Splitless (4 mm ID) w/glass wool (cat.# 20814-202.1)
Inj. Temp.:	240 °C
Oven	
Oven Temp.:	70 °C to 240 °C at 12 °C/min (hold 3 min)
Carrier Gas	
Linear Velocity:	H_2, constant linear velocity 28 psi, 193.1 kPa @ 240 °C
Detector	FID
Make-up Gas Type:	N_2



Peaks	Conc. (µg/mL)
1. Ethyl octanoate	100
2. Acetic acid	100
3. Propionic acid	100
4. Isobutyric acid	100
5. 3-Decanol	50
6. Ethyl decanoate	50
7. Ethyl laurate	50
8. *cis*-Lactone	100
9. 2-Phenylethanol	50
10. *trans*-Lactone	100
11. Methyl myristate	50
12. Ethyl myristate	50
13. Octanoic acid	100
14. Ethyl palmitate	50
15. Decanoic acid	100
16. Dodecanoic acid	100
17. Vanillin	100

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

similar phases

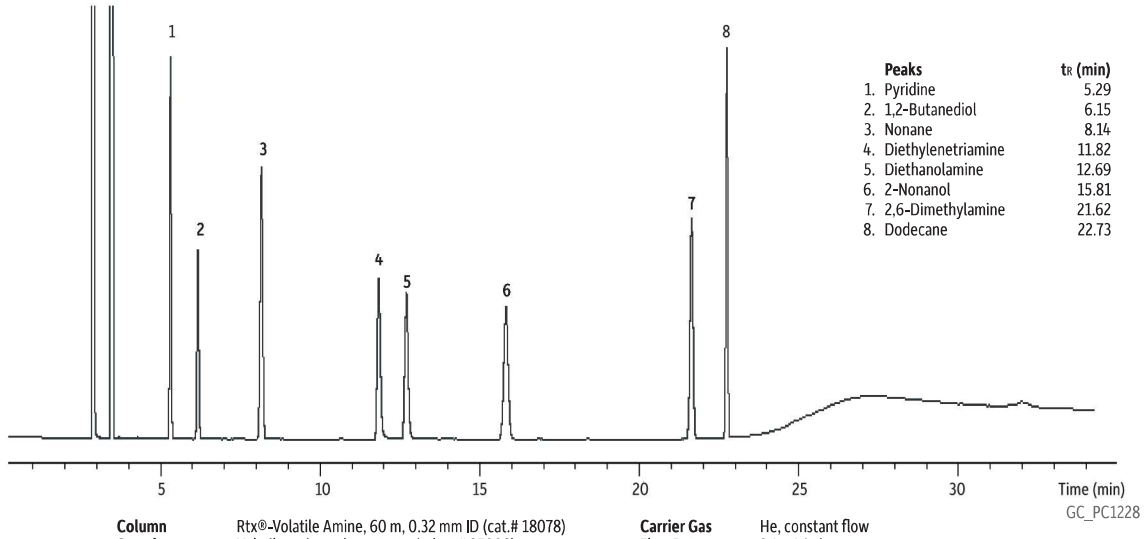
CP-Volamine

please note

We recommend using base-deactivated fused silica guard columns **(page 22)** and base-deactivated liners (**page 203**) with Rtx®-Volatile Amine columns.

ID	temp. limits	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#
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)



Peaks	t_R (min)
1. Pyridine	5.29
2. 1,2-Butanediol	6.15
3. Nonane	8.14
4. Diethylenetriamine	11.82
5. Diethanolamine	12.69
6. 2-Nonanol	15.81
7. 2,6-Dimethylamine	21.62
8. Dodecane	22.73

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:	N_2
Data Rate:	50 Hz
Instrument	Agilent/HP6890 GC

Restek innovation!

similar phases
Optima-5Amine

please note
We recommend using base-deactivated fused silica guard columns **(page 22)** and base-deactivated liners (**page 203**) with Rtx®-5 Amine columns.

Basic Compounds Analysis

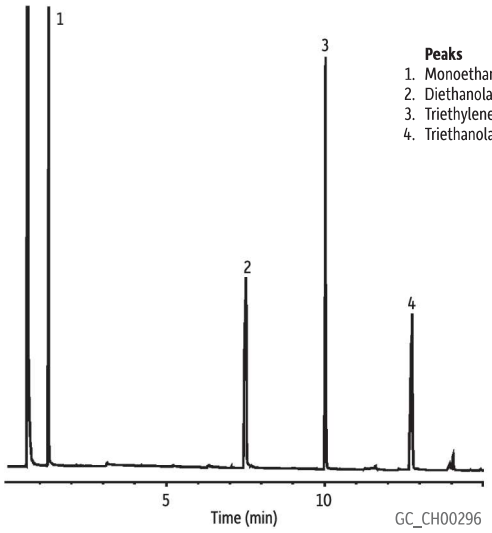
Rtx®-5 Amine Columns (fused silica)
(low-polarity phase; Crossbond® 5% diphenyl/95% dimethyl polysiloxane)

- 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 cat.#	30-Meter cat.#
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

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	H_2, 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.

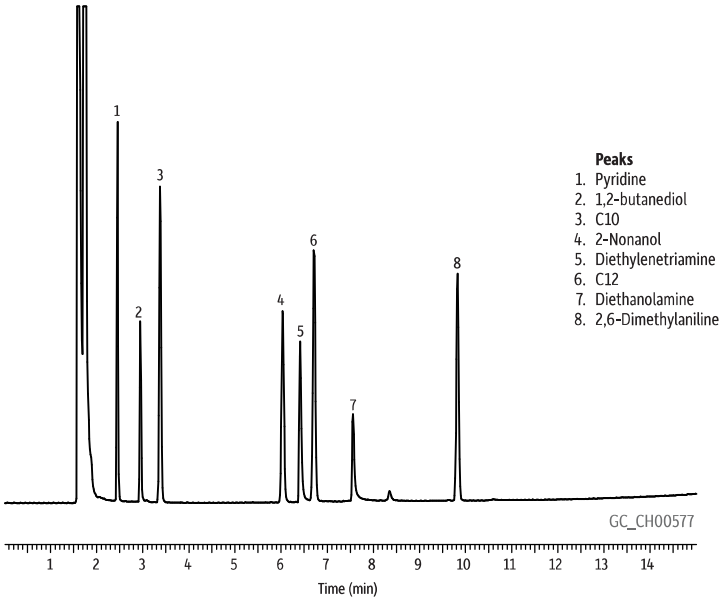
Restek innovation!

please note

We recommend using base-deactivated fused silica guard columns (**page 22**) and base-deactivated liners (**page 203**) with Rtx®-35 Amine columns.

ID	df	temp. limits	15-Meter cat.#	30-Meter cat.#
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

Amine Test Mix Rtx®-35 Amine



Peaks
1. Pyridine
2. 1,2-butanediol
3. C10
4. 2-Nonanol
5. Diethylenetriamine
6. C12
7. Diethanolamine
8. 2,6-Dimethylaniline

Column	Rtx®-35 Amine, 30 m, 0.53 mm ID, 1.00 µm (cat.# 11355)
Sample	Amine column test mix (cat.# 35002)
Diluent:	Methanol/methylene chloride
Conc.:	450-900 ppm
Injection	
Inj. Vol.:	1.0 µL split (split ratio 10:1)
Liner:	Splitless taper (4 mm), base deactivated (cat.# 20798-210.1)
Inj. Temp.:	250 °C
Oven	
Oven Temp.:	110 °C (hold 4 min) to 200 °C at 8 °C/min (hold 5 min)
Carrier Gas	He, constant pressure
Linear Velocity:	30 cm/sec
Detector	FID @ 300 °C



Because Restek is employee owned and independent, we are dedicated to providing the right solutions for all types of instruments.

similar phases

CAM, CP-WAX 51 for Amines, Carbowax® Amine



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.

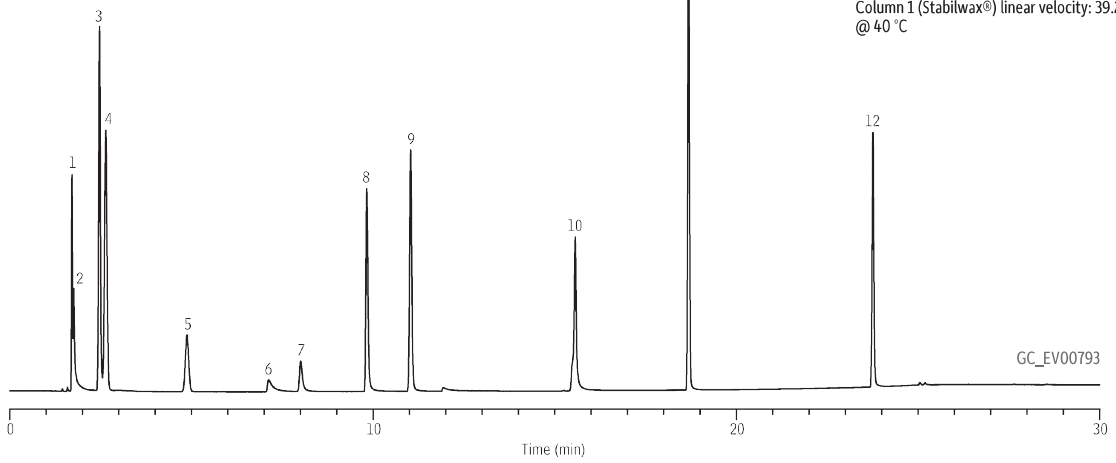
ID	df	temp. limits	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#
0.25 mm	0.25 µm	40 to 210/220 °C	10820	10823	
	0.50 µm	40 to 210/220 °C		10838	
0.32 mm	0.25 µm	40 to 210/220 °C	10821	10824	
	0.50 µm	40 to 210/220 °C		10839	
	1.00 µm	40 to 210/220 °C	10851	10854	10857
0.53 mm	0.50 µm	40 to 210/220 °C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

Volatile Organic Compounds by U.S. EPA Method 1671 on Stabilwax®-DB

Peaks	t_R (min)	Conc. (µg/mL)
1. Dimethylamine	1.71	200
2. Methylamine	1.76	200
3. Diethylamine	2.46	200
4. Triethylamine	2.64	200
5. Tetrahydrofuran (IS)	4.88	100
6. Methanol	7.12	40
7. Ethanol	8.01	40
8. Acetonitrile	9.82	200
9. *n*-Propanol	11.03	200
10. Methyl Cellosolve®	15.56	200
11. Formamide	18.68	500
12. Dimethyl sulfoxide	23.75	100
13. Ethylene glycol*		500

*Included in sample, but does not elute due to base deactivation in the DB phase.

Columns	Stabilwax®-DB 30 m, 0.32 mm ID, 1.00 µm (cat.# 10854) and Stabilwax® 30 m, 0.32 mm ID, 1.00 µm (cat.# 10654) using IP deactivated guard column 5 m, 0.53 mm ID (cat.# 10045) with SeCure® "Y" connector kit (cat.# 20278)
Sample	1671 Volatile organics mix
Diluent:	Deionized water
Injection	
Inj. Vol.:	1.0 µL split (split ratio 12:1)
Liner:	Gooseneck splitless (4 mm) (cat.# 20798)
Inj. Temp.:	200 °C
Oven	
Oven Temp.:	40 °C (hold 5 min) to 180 °C at 7 °C/min (hold 5 min)
Carrier Gas	He, constant pressure
Linear Velocity:	39.68 cm/sec @ 40 °C
Detector	FID @ 250 °C
Notes	"Y" Press-Tight® Connector (cat.# 20405) also used Column 1 (Stabilwax®) linear velocity: 39.25 cm/sec @ 40 °C



Chiral Analysis

Cyclodextrin Columns for Analyzing Many Chiral Compounds

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

Rt®-γDEXsa 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 cat.#
0.25 mm	0.25 µm	40 to 230 °C	13113
0.32 mm	0.25 µm	40 to 230 °C	13112

Rt®-βDEXm 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 cat.#
0.25 mm	0.25 µm	40 to 230 °C	13100
0.32 mm	0.25 µm	40 to 230 °C	13101

Rt®-βDEXsm 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 cat.#
0.25 mm	0.25 µm	40 to 230 °C	13105
0.32 mm	0.25 µm	40 to 230 °C	13104

Rt®-βDEXse 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-βDEXsm but provides better resolution for limonene, linalool, linalyl acetate, ethyl-2-methylbutyrate, 2,3-butane diol, and styrene oxides.

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

Rt®-βDEXsp 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-βDEXsm column, for complex enantiomeric separations.

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

Rt®-βDEXsa 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 cat.#
0.25 mm	0.25 µm	40 to 230 °C	13109
0.32 mm	0.25 µm	40 to 230 °C	13108

Rt®-βDEXcst 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 cat.#
0.25 mm	0.25 µm	40 to 230 °C	13103
0.32 mm	0.25 µm	40 to 230 °C	13102

free literature

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

lit. cat.# 59553



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

lit. cat.# 59546



Download your free copies from www.restek.com

tech tip

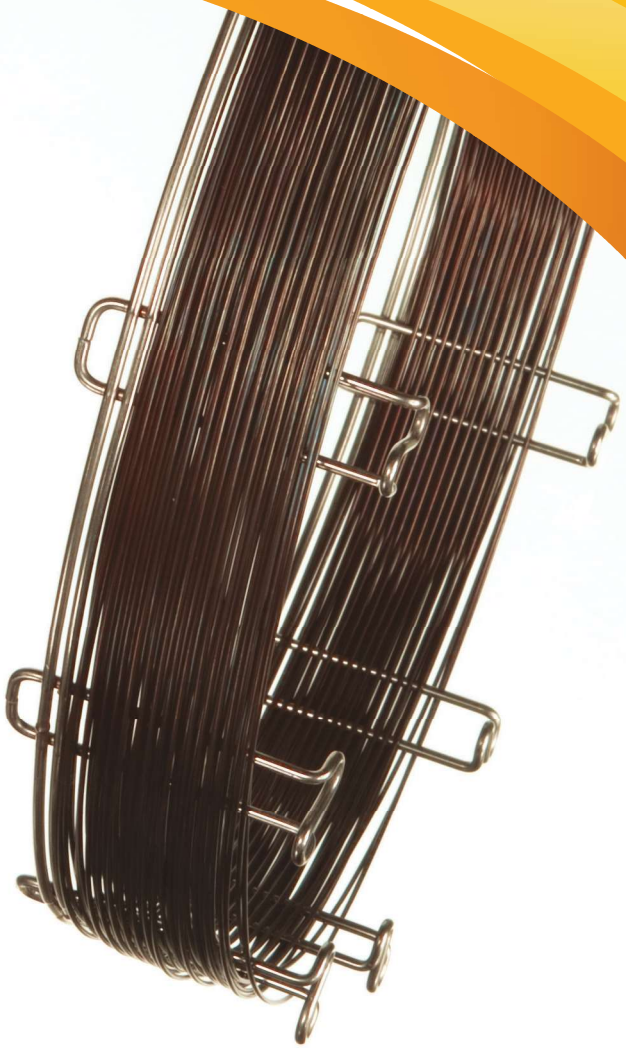
Lower elution temperatures significantly improve chiral selectivity.
This can be achieved the following ways:

- 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.

GC Columns

Metal MXT® Capillary Columns

MXT® Columns Overview 105
Guard/Retention Gap Columns 106
General-Purpose Columns 107–110
MXT®-1 ..... *107*
MXT®-5 ..... *108*
MXT®-50 ..... *109*
MXT®-1301 ..... *109*
MXT®-1701 ..... *109*
MXT®-200 ..... *110*
MXT®-WAX *110*
Application-Specific Columns 111–115
Environmental *111*
MXT®-502.2, MXT®-Volatiles, MXT®-624
Foods, Flavors, & Fragrances *112*
MXT®-65TG
Petroleum & Petrochemical *113–115*
MXT®-Biodiesel TG, MXT®-2887,
MXT®-1HT SimDist, MXT®-500 SimDist







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 an exclusive Siltek® treatment. This treatment makes the surface as inert as deactivated fused silica, and it allows us to treat the tubing with a wide variety of polymer phases. The unique Siltek® treatment also 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® treatment 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 most MXT® columns is 4.5", 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 the proper suffix number in the table to the column part number when you order!

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



Additional sizes and configurations may be available; call for details.
Note that 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.

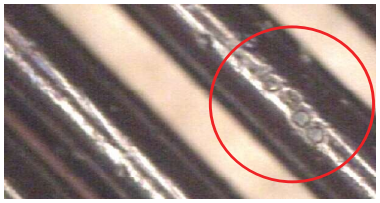
MXT® columns are your best choice for high temperature analyses and situations in which the potential for column breakage is high. Here's why:

- Metal tubing allows MXT® comlumns 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 or break.
- Inertness of MXT® columns and fused silica columns is similar, due to the unique properties of the Siltek® surface treatment.
- Metal columns can be coiled under 4.5 inches without breaking, making them 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, making them perfect for process GCs and field instruments.

MXT®-Biodiesel TG columns are undamaged by high thermal cycles compared to high-temperature (HT) 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.

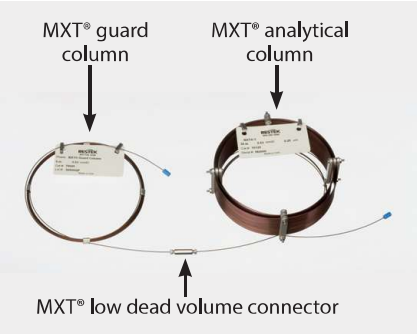
100 temperature cycles to 430 °C totaling 500 minutes at maximum temperature.

MXT ideal for high-temperature analyses

Custom MXT® columns are also available.

If you do not see the column you need listed in the following pages, contact Customer Service and we will be happy to help.

Connect MXT® columns using an MXT® low dead volume connector!



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 232 for more details.)

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 cat.#	5-Meter (6-pk.) cat.#	10-Meter cat.#
0.28 mm	0.56 ± 0.025 mm	70044	70044-600	70046
0.53 mm	0.74 ± 0.025 mm	70045	70045-600	70047

did you know?

Certificates of analysis for 5 m and 10 m Restek® guard columns are provided electronically. To view and download your 5 m or 10 m guard column certificate, simply visit **www.restek.com/documentation** then enter your catalog # and serial #.

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 cat.#	10-Meter cat.#	30-Meter* cat.#
0.28 mm	0.56 ± 0.025 mm	70080	70083	70086
0.53 mm	0.74 ± 0.025 mm	70081	70084	70087

*30-meter lengths are banded in 5-meter sections.
Diameters greater than 0.10 mm are tested with the Grob test mix to ensure high inertness.

also available
Column connector kits & ferrules
See **page 232.**



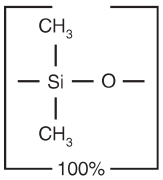
MXT®-1 Columns (Siltek®-treated stainless steel)

(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.
- 4.5" standard coil diameter.

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.

MXT®-1 Structure



Similar to: (100%-methyl)-polysiloxane

similar phases

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

ID	df	temp. limits*	6-Meter cat.#	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#	105-Meter cat.#
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		
	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 400 °C			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 cat.#	20-Meter cat.#	40-Meter cat.#
0.18 mm	0.20 µm	-60 to 330/430 °C	71811	71812	71813
	0.40 µm	-60 to 320/400 °C		71815	71816

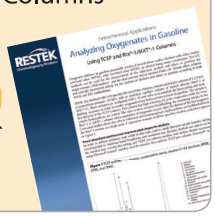
*Maximum temperatures listed are for shorter length columns. Longer columns may have a different maximum temperature.

free literature

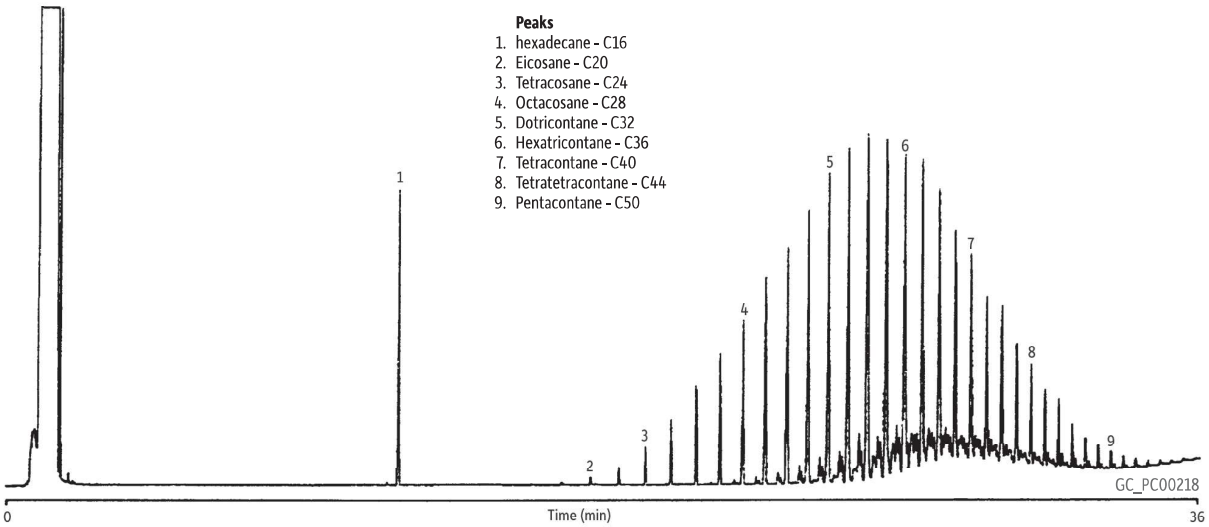
Analyzing Oxygenates in Gasoline Using TCEP and Rtx®-1/MXT®-1 Columns

Download your free copy from www.restek.com

lit. cat.# 59587A

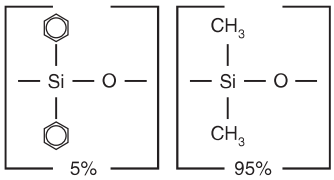


Petroleum Wax on MXT®-1



Column	MXT®-1, 30 m, 0.28 mm ID, 0.25 µm (cat.# 70124)
Sample	Petroleum wax
Diluent:	cyclohexane
Conc.:	0.1% w/w
Injection	
Inj. Vol.:	1.0 µL cold on-column
Oven	
Oven Temp.:	50 °C to 400 °C at 10 °C/min (hold 10 min)
Carrier Gas	H_2, constant flow
Linear Velocity:	60 cm/sec @ 50 °C
Detector	FID @ 400 °C
Notes	FID sensitivity: 64 x 10^{-11} AFS

MXT®-5 Structure



Similar to: (5%-phenyl)-methylpolysiloxane

similar phases

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

also available

Metal MXT® PLOT Columns

See **page 129.**



MXT® GC Column Ferrule Guide

GC Column ID	GC Column OD	Ferrule ID
0.18 mm	0.36 ± 0.001	0.4
0.25 mm	0.41 ± 0.001	0.5
0.28 mm	0.56 ± 0.001	0.6
0.32 mm	0.44 ± 0.0015	0.5
0.53 mm	0.74 ± 0.001	0.8

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.
- 4.5" standard coil diameter.

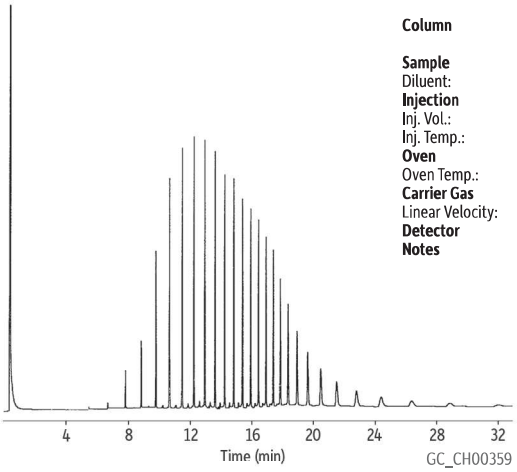
The diphenyl dimethyl polysiloxane stationary phase is the most popular GC stationary phase and is used in a wide variety of applications. All residual catalysts and low molecular weight fragments are removed from the MXT®-5 polymer, providing a tight monomodal distribution and extremely low bleed.

ID	df	temp. limits*	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#
0.25 mm	0.10 µm	-60 to 330/430 °C	70205	70208	
	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	
0.28 mm	0.25 µm	-60 to 340/430 °C	70221	70224	70227
	0.50 µm	-60 to 315/400 °C	70236	70239	
	1.00 µm	-60 to 310/360 °C	70251	70254	70257
	3.00 µm	-60 to 290/360 °C	70281	70284	
0.53 mm	0.25 µm	-60 to 340/430 °C	70222	70225	70228
	0.50 µm	-60 to 330/400 °C	70237	70240	
	1.00 µm	-60 to 310/360 °C	70252	70255	70258
	1.50 µm	-60 to 300/360 °C	70267	70270	
	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 cat.#	20-Meter cat.#	40-Meter cat.#
0.18 mm	0.20 µm	-60 to 325/430 °C	71821	71822	71823
	0.40 µm	-60 to 315/400 °C	71824	71825	

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

Siloxane (Polysiloxane 20) on MXT®-5



Column	MXT®-5, 15 m, 0.28 mm ID, 0.25 µm (cat.# 70221)
Sample	Polysiloxane 20
Diluent:	Pentane
Injection	
Inj. Vol.:	1.0 µL split (split ratio 100:1)
Inj. Temp.:	250 °C
Oven	
Oven Temp.:	75 °C to 340 °C at 15 °C/min
Carrier Gas	H_2, constant flow
Linear Velocity:	40 cm/sec
Detector	FID @ 340 °C
Notes	FID sensitivity: 16 x 10^{-11} AFS

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

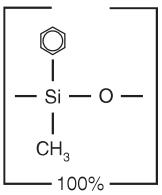
(midpolarity phase; Crossbond® phenyl methyl polysiloxane)

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

ID	df	temp. limits*	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#
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		70570	

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

MXT®-50 Structure



Similar to: (50%-phenyl)-methylpolysiloxane

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

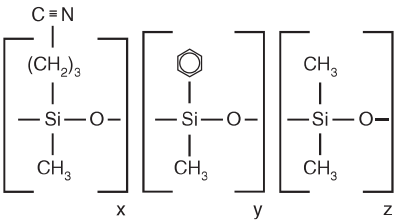
(low- to midpolarity phase)

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

ID	df	temp. limits*	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#
0.53 mm	1.00 µm	-20 to 260/280 °C		76055	
	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®-1301 Structure



Similar to: (6%-cyanopropylphenyl)-methylpolysiloxane

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

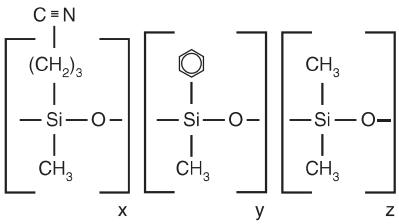
(midpolarity Crossbond® phase)

- 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.
- 4.5" standard coil diameter.

ID	df	temp. limits*	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#
0.25 mm	0.25 µm	-20 to 280 °C	72020	72023	
	1.00 µm	-20 to 260 °C		72053	
0.28 mm	1.00 µm	-20 to 260 °C	72051		
	1.50 µm	-20 to 250 °C	72066		
0.53 mm	0.50 µm	-20 to 270/280 °C		72040	
	1.00 µm	-20 to 260 °C	72052	72055	
	1.50 µm	-20 to 250 °C		72070	
	3.00 µm	-20 to 240 °C	72082	72085	72088

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

MXT®-1701 Structure



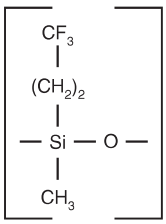
Similar to: (14%-cyanopropylphenyl)-methylpolysiloxane

similar phases

DB-PS1701

General-Purpose Columns

MXT®-200 Structure



Similar to: (trifluoropropyl)-methylpolysiloxane

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

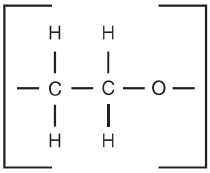
(midpolarity phase; Crossbond® trifluoropropylmethyl polysiloxane)

- 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.
- 4.5" standard coil diameter.

ID	df	temp. limits*	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#
0.25 mm	0.50 µm	-20 to 400 °C		75038	
	1.00 µm	-20 to 310/360 °C		75053	
0.53 mm	1.00 µm	-20 to 290/360 °C	75052	75055	75058
	1.50 µm	-20 to 280/360 °C		75070	75073
	3.00 µm	-20 to 260/360 °C	75082	75085	75088

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

MXT®-WAX Structure



similar phases

DB-PSWAX, UAC-CW

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

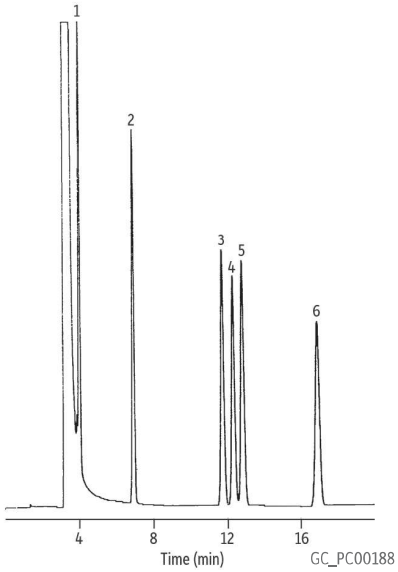
(polar phase; Crossbond® Carbowax® polyethylene glycol—provides oxidation resistance)

- 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.
- 4.5" standard coil diameter.

ID	df	temp. limits	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#
0.25 mm	0.25 µm	40 to 250/260 °C	70620	70623	
	0.50 µm	40 to 260 °C		70638	
0.28 mm	0.25 µm	40 to 250/260 °C		70624	
	0.50 µm	40 to 250/260 °C		70639	70642
	1.00 µm	40 to 240/250 °C	70651	70654	70657
0.53 mm	0.25 µm	40 to 250/260 °C	70622	70625	
	0.50 µm	40 to 250/260 °C	70637	70640	
	1.00 µm	40 to 240/250 °C	70652	70655	70658
	1.50 µm	40 to 230/250 °C	70666	70669	70672
	2.00 µm	40 to 220/250 °C	70667	70670	

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

Aromatics (Benzene/Toluene/Xylene) on MXT®-WAX



Peaks
1. Benzene
2. Toluene
3. Ethylbenzene
4. *p*-Xylene
5. *m*-Xylene
6. *o*-Xylene

Column	MXT®-WAX, 30 m, 0.28 mm ID, 1.00 µm (cat.# 70654)
Sample	BTEX Standard (cat.# 30051)
Injection	
Inj. Vol.:	1.0 µL split (split ratio 100:1)
Inj. Temp.:	260 °C
Oven	
Oven Temp.:	60 °C
Carrier Gas	H_2, constant flow
Linear Velocity:	38 cm/sec
Detector	FID @ 260 °C
Notes	FID sensitivity: 3.2 x 10^{-11} AFS

also available

Metal MXT® PLOT Columns

See **page 129.**



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.
- 4.5" standard coil diameter.

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 cat.#	60-Meter cat.#	105-Meter cat.#
0.25 mm	1.40 µm	-20 to 270/320 °C		70916	
0.28 mm	1.60 µm	-20 to 250/320 °C	70919		
0.53 mm	3.00 µm	-20 to 250/320 °C	70908	70909	70910

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

similar phases

DB-PS502.2

MXT® GC Column Ferrule Guide

GC Column ID	GC Column OD	Ferrule ID
0.18 mm	0.36 ± 0.001	0.4
0.25 mm	0.41 ± 0.001	0.5
0.28 mm	0.56 ± 0.001	0.6
0.32 mm	0.44 ± 0.0015	0.5
0.53 mm	0.74 ± 0.001	0.8

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.
- 4.5" standard coil diameter.

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 cat.#	60-Meter cat.#
0.28 mm	1.25 µm	-20 to 280/320 °C	70924	70926
0.53 mm	2.00 µm	-20 to 280/320 °C	70925	70927
	3.00 µm	-20 to 250/320 °C	70922	

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

also available

Column connector kits & ferrules

See **page 232.**



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

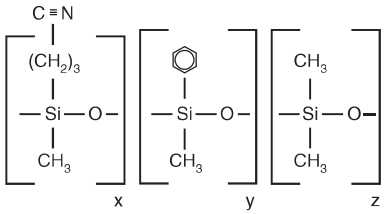
(low- to midpolarity phase)

- 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.
- 4.5" standard coil diameter.

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 cat.#	60-Meter cat.#
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

MXT®-624 Structure



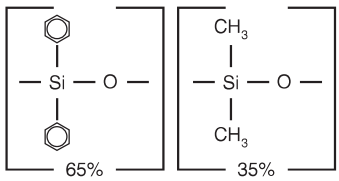
Similar to: (6%-cyanopropylphenyl)-methylpolysiloxane

similar phases

DB-PS624, UAC-624

Triglycerides in Foods Analysis

MXT®-65TG Structure



Similar to: (65%-phenyl)-methylpolysiloxane

similar phases

UAC-65HT

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.
- 4.5" standard coil diameter.

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 cat.#	30-Meter cat.#
0.25 mm	0.10 µm	20 to 370 °C	77005	77008
0.53 mm	0.10 µm	20 to 370 °C	77007	77010

free literature

MXT® Capillary Columns: Ideal for High Temperature GC Analysis

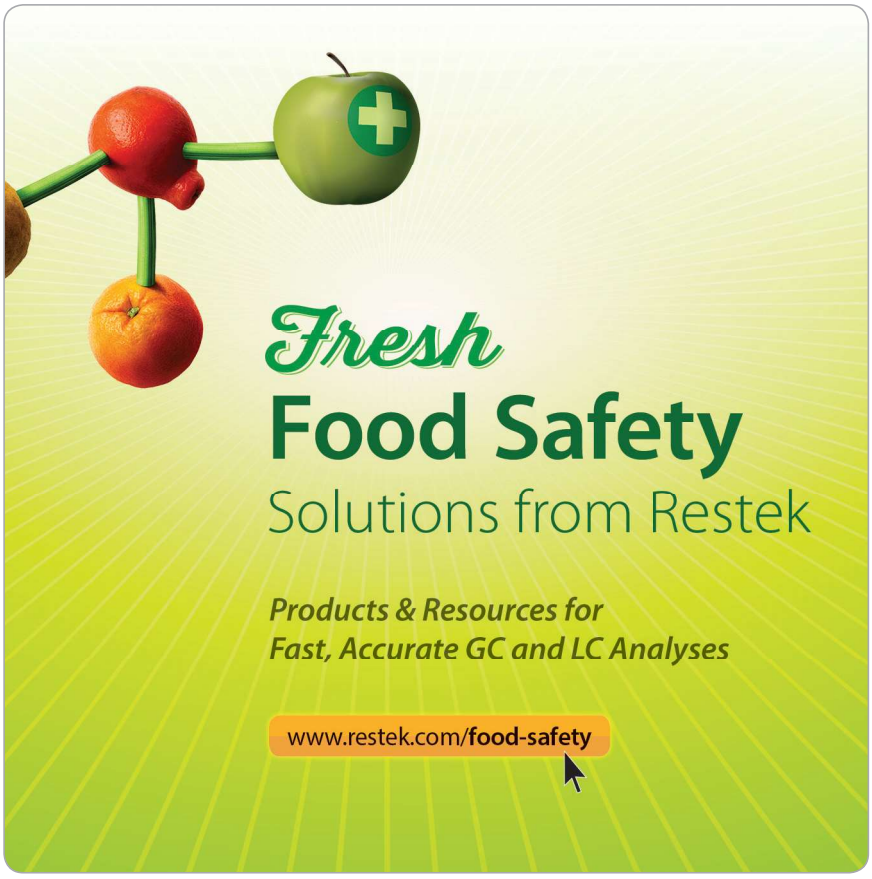
Download your free copy from www.restek.com

lit. cat.# GNTS1368A



MXT® GC Column Ferrule Guide

GC Column ID	GC Column OD	Ferrule ID
0.18 mm	0.36 ± 0.001	0.4
0.25 mm	0.41 ± 0.001	0.5
0.28 mm	0.56 ± 0.001	0.6
0.32 mm	0.44 ± 0.0015	0.5
0.53 mm	0.74 ± 0.001	0.8



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 cat.#	7" diameter 11-pin cage 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
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
2 m x 0.53 mm MXT Biodiesel TG Retention Gap	-60 to 430 °C	—	70294

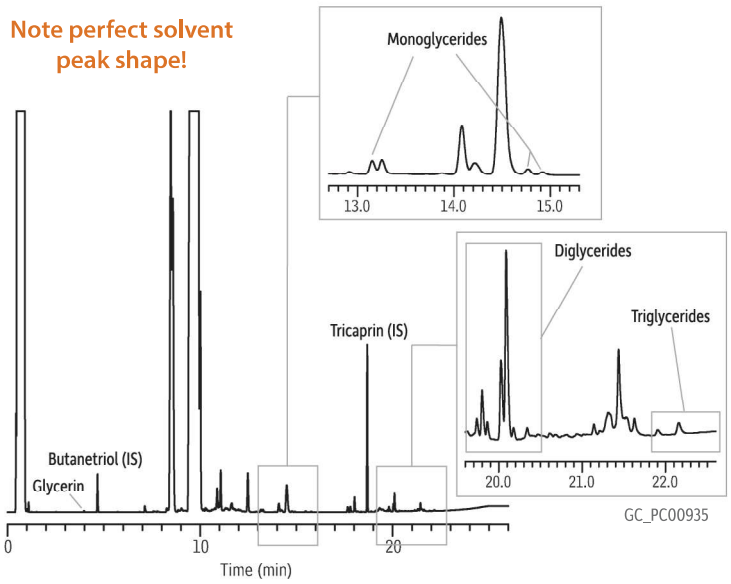
*Total column length = 16 meters.
**Connected with low dead volume MXT connector.

similar phases

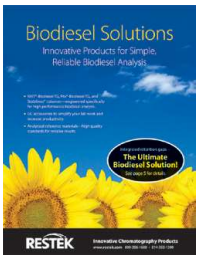
MET-Biodiesel

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	
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 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.
- 4.5" standard coil diameter.

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 cat.#
0.53 mm	2.65 µm	-60 to 360/400 °C	70199

similar phases

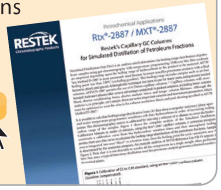
DB-PS2887

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



Simulated Distillation Analysis (C5-C110)

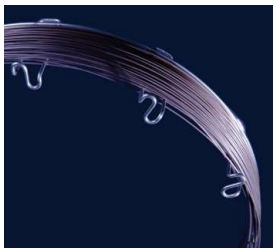
similar phases

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

Method Recommended Columns

ASTM Method	Hydrocarbon Range	cat. #	Configuration
D2887	C5–C44	70131	5 m x 0.53 mm, 0.88 µm
		70132	10 m x 0.53 mm, 2.65 µm
D7213 (D2887-ext)	C5–C60	70131	5 m x 0.53 mm, 0.88 µm
		70115	5 m x 0.53 mm, 0.20 µm
		70112	5 m x 0.53 mm, 0.10 µm
D5307	crude up to C42	70115	5 m x 0.53 mm, 0.20 µm
D6352	C10–C90	70112	5 m x 0.53 mm, 0.10 µm
		70115	5 m x 0.53 mm, 0.20 µm
D7096	gasoline up to C14	70132	10 m x 0.53 mm, 2.65 µm
		10177	15 m x 0.53 mm, 5 µm
D7500	C7–C110	70112	5 m x 0.53 mm, 0.10 µm
		70115	5 m x 0.53 mm, 0.20 µm
D7169	C5–C100	70112	5 m x 0.53 mm, 0.10 µm
		70115	5 m x 0.53 mm, 0.20 µm

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

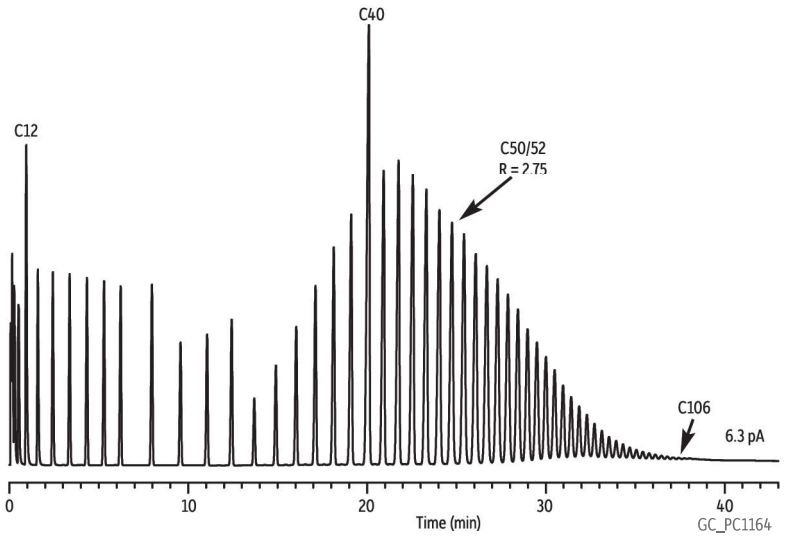


- Stable up to 450 °C—lowest bleed for longest column lifetime.
- Reliably meets all ASTM D6352, D7169, and D7500 specifications.
- 100% dimethyl polysiloxane phase allows easy comparisons to historical data.
- Individually tested for guaranteed performance.
- 7" coil diameter.

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.

ID	df	temp. limits	5-Meter cat.#	10-Meter cat.#
0.53 mm	0.10 µm	-60 to 430/450 °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

Hydrocarbons (C5-C106) on MXT®-1HT SimDist at 450 °C



Peaks	t_R (min)
1. C5	—
2. C6	—
3. C7	—
4. C8	—
5. C9	—
6. C10	—
7. C11	—
8. C12	0.938
9. C13	1.586
10. C14	2.425
11. C15	3.365
12. C16	4.332
13. C17	5.290
14. C18	6.217
15. C20	7.966
16. C22	9.566
17. C24	11.051
18. C26	12.426
19. C28	13.689
20. C30	14.897
21. C32	16.035
22. C34	17.110
23. C36	18.133
24. C38	19.108
25. C40	20.096
26. C42	20.923
27. C44	21.759
28. C46	22.556
29. C48	23.317
30. C50	24.051
31. C52	24.752
32. C54	25.422
33. C56	26.079
34. C58	26.701
35. C60	27.305
36. C62	27.878
37. C64	28.439
38. C66	28.975
39. C68	29.499
40. C70	30.002
41. C72	30.489
42. C74	30.906
43. C76	31.414
44. C78	31.862
45. C80	32.294
46. C82	32.719
47. C84	33.132
48. C86	33.529
49. C88	33.927
50. C90	34.310
51. C92	34.689
52. C94	35.059
53. C96	35.423
54. C98	35.773
55. C100	36.120
56. C102	36.463
57. C104	36.793
58. C106	37.118

Column	MXT®-1HT SimDist, 5 m, 0.53 mm ID, 0.10 µm (cat.# 70112)
Sample	Custom C5-C106 hydrocarbon standard
Diluent:	Carbon disulfide
Conc.:	1%
Injection	
Inj. Vol.:	0.5 µL cold on-column
Temp. Program:	53 °C to 450 °C at 10 °C/min (hold 5 min)
Oven	
Oven Temp.:	50 °C to 450 °C at 10 °C/min (hold 5 min)
Carrier Gas	He, constant flow
Flow Rate:	18 mL/min
Detector	FID @ 450 °C
Make-up Gas Flow Rate:	24 mL/min
Constant Column + Constant Make-up:	42 mL/min
Make-up Gas Type:	N_2
Data Rate:	20 Hz
Instrument	Shimadzu 2010 GC

Application-Specific Columns: Petroleum & Petrochemical

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

(nonpolar phase)

- Application-specific columns in unbreakable Siltek® treated stainless steel tubing meet all resolution criteria for high temperature simulated distillation.
- Stable to 430 °C.
- 4.5" standard coil diameter.

ID	df	temp. limits	6-Meter cat.#
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

similar phases

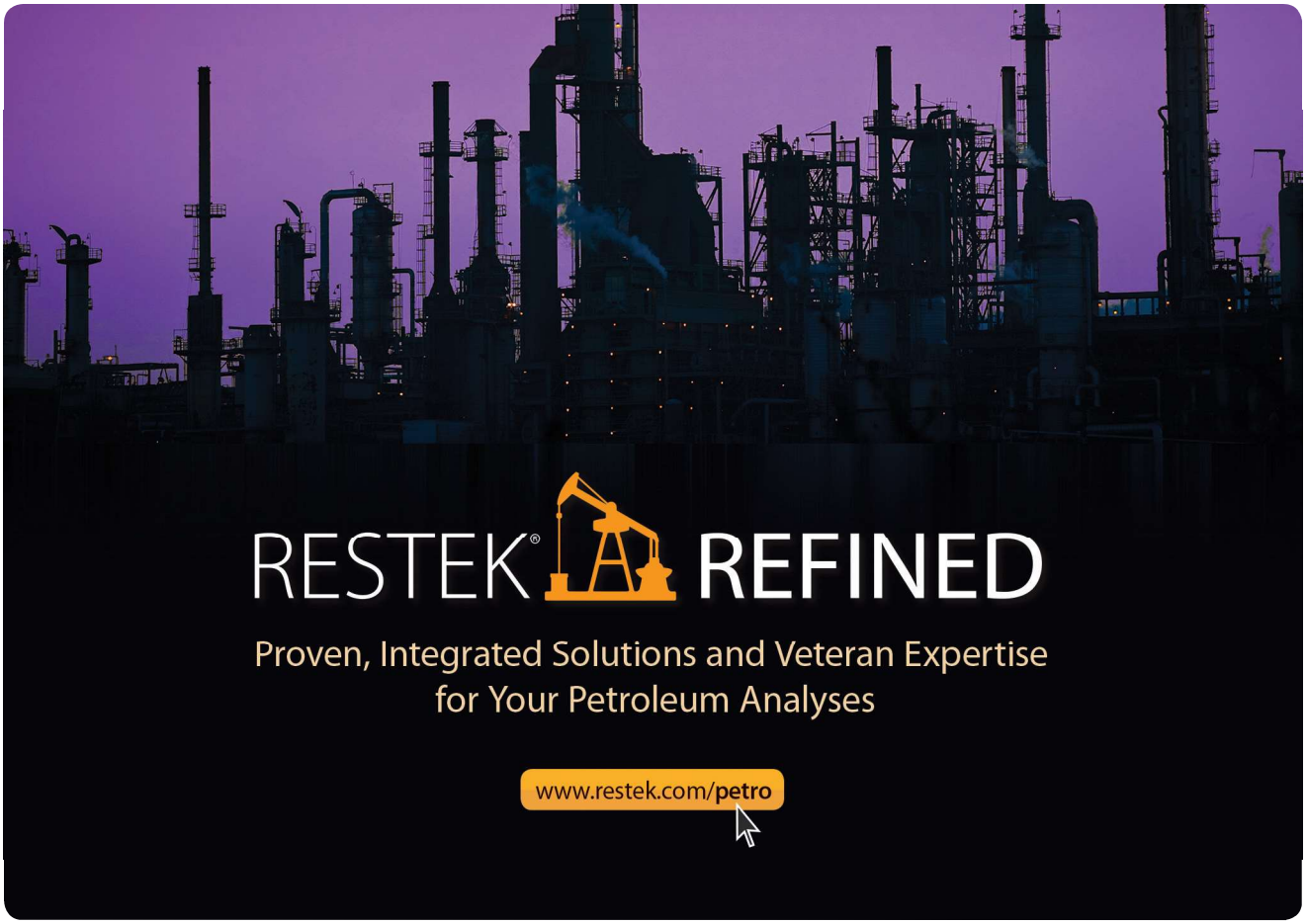
UAC-DX30

free literature

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

Download your free copy from www.restek.com

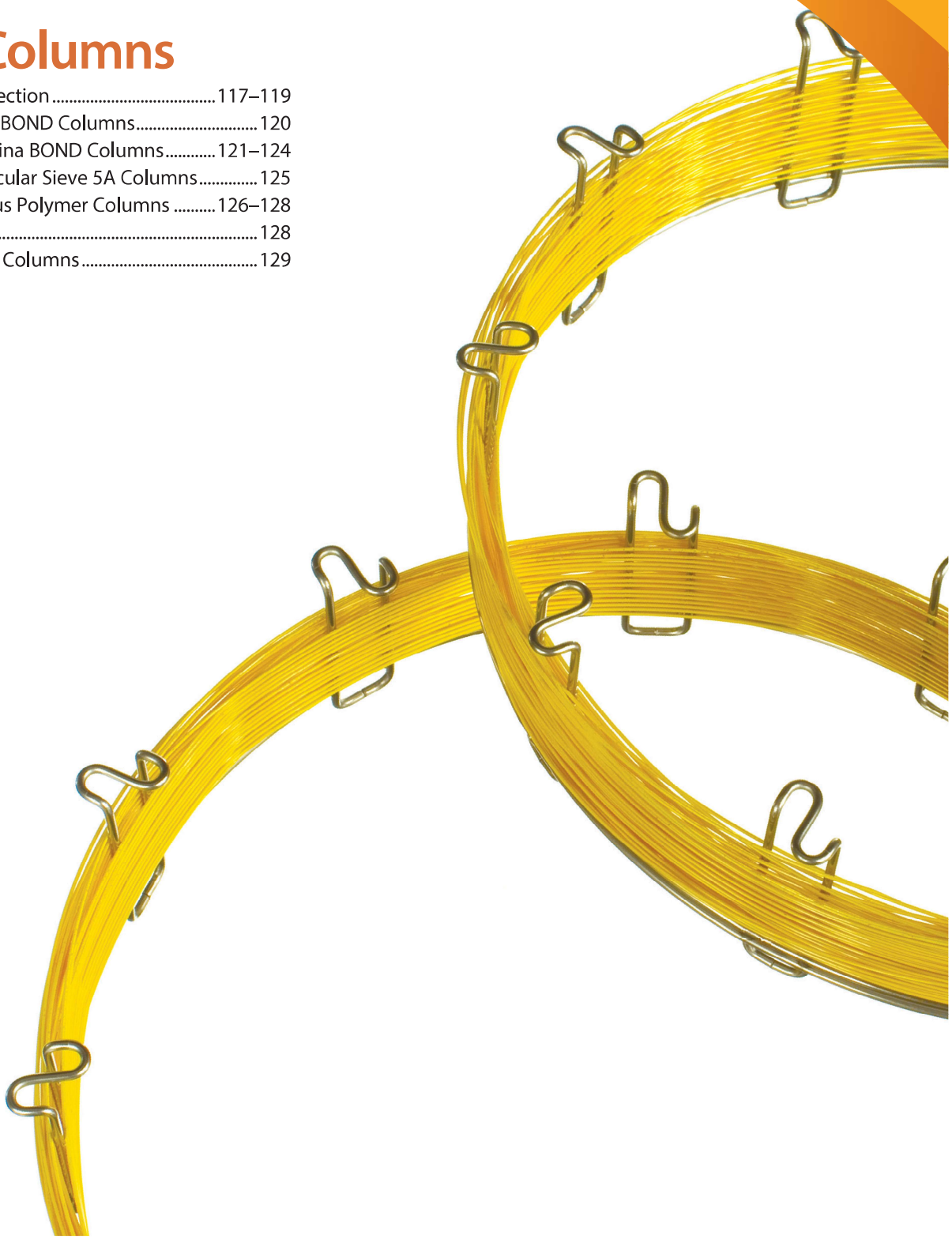
lit. cat.# 59551A



GC Columns

PLOT Columns

PLOT Column Selection 117–119
Fused Silica Silica BOND Columns 120
Fused Silica Alumina BOND Columns 121–124
Fused Silica Molecular Sieve 5A Columns 125
Fused Silica Porous Polymer Columns 126–128
Particle Trap 128
Metal MXT® PLOT Columns 129



Stable Bonded 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	Description/Application
Rt-Silica BOND (p. 120)	Bonded silica Light hydrocarbons, sulfur gases, carbon dioxide, and halocarbons
Rt-Alumina BOND/Na_2SO_4 (p. 121) MXT-Alumina BOND/Na_2SO_4 (p. 129)	C1–C5 hydrocarbons Purity analysis of ethylene, propylene, butenes, butadiene
Rt-Alumina BOND/KCl (p. 122)	C1-C10 hydrocarbons, C1-C5 isomers Purity analysis of ethylene, propylene, butene, butadiene.
Rt-Alumina BOND/CFC (p. 123)	Multi-halogenated alkanes, C1-C-5 range Chlorofluorocarbons (CFCs)
Rt-Alumina BOND/MAPD (p. 124) MXT-Alumina BOND MAPD (p. 129)	Trace analysis of methylacetylene, propadiene, acetylene
Rt-Msieve 5A (p. 125) MXT-Msieve 5A (p. 129)	Permanent gas analysis He, Ne, Ar, O_2, N_2, Xe, Rn, CH_4, and CO
Rt-Q-BOND (p. 126) MXT-Q-BOND (p. 129)	Nonpolar porous polymer High retention for solvents, alcohols, polar volatiles, CO_2, sulfur, and ppm water in solvents
Rt-QS-BOND (p. 127)	Intermediate polarity porous polymer (polarity between Q-BOND and S-BOND) Neutral solvents, ketones, esters, hydrocarbons, and baseline separation of ethane, ethene, acetylene
Rt-S-BOND (p. 127) MXT-S-BOND (p. 129)	Intermediate polarity porous polymer Light gases in ethylene and propylene, ketones, esters, hydrocarbons
Rt-U-BOND (p. 128)	Polar porous polymer More retention for polar compounds

PLOT Column Phase Cross-Reference: Similar Selectivity

Restek® Rt® and MXT® Columns	Porous Layer	Supelco	Alltech	Agilent (J&W, Varian, Chrompack)	Quadrex
Silica BOND	Bonded silica	———	———	CP Silica PLOT, GS-GasPro	———
Alumina BOND/Na_2SO_4	Aluminum oxide	Alumina-Sulfate	AT-Alumina	GS-Alumina ,CP-Al_2O_3/NA_2SO_4	———
Alumina BOND/KCl	Aluminum oxide	Alumina-Chloride	———	GS-Alumina KCl, HP PLOT Al_2O_3 . CP-Al_2O_3/KCl	———
Alumina BOND/CFC	Aluminum oxide	unique product			
Alumina BOND/MAPD	Aluminum oxide	———	———	Select Al_2O_3 MAPD	———
Msieve 5A	Molecular sieve 5A	Molsieve 5A	AT-Molesieve	HP PLOT Molesieve, CP-Molsieve 5A	PLT-5A
Q-BOND	100% Divinylbenzene	Supel-Q-PLOT	AT-Q	HP PLOT Q ,CP-PoraPLOT Q, CP-PoraBOND Q	———
QS-BOND	Intermediate polarity porous polymer	———	———	GS-Q	———
S-BOND	DVB vinylpyridine polymer	———	———	CP-PoraPLOT S	———
U-BOND	DVB ethylene glycol-dimethylacrylate polymer	———	———	HP PLOT U, CP-PoraPLOT U, CP-PoraBOND U	———

Stable Bonded Porous Layer Open Tubular (PLOT) Columns

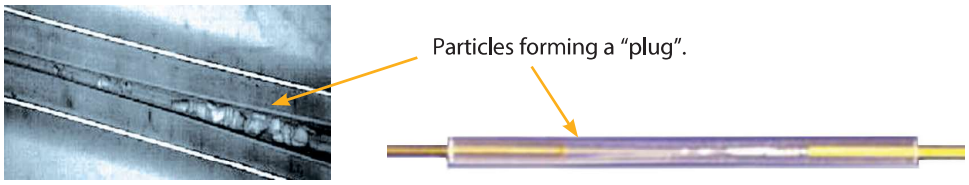
- Stabilized particle layers improve robustness and reproducibility of retention and flow.
- Fully compatible with valve switching and Deans switching systems.
- Highly efficient, reproducible analyses; ideal for permanent gases, solvents, and hydrocarbons.
- Innovative manufacturing procedure reduces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

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-fit connector.

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



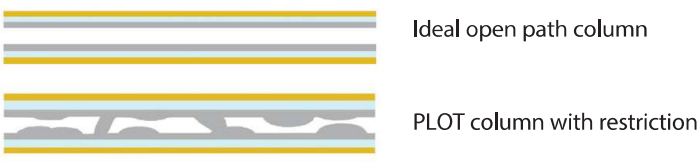
Restek® PLOT Columns Offer Improved Stability to Minimize Particle Release

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.

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.

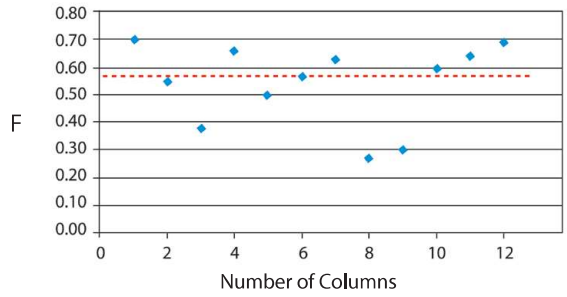
Figure 2: Inconsistent coating thicknesses result in restrictions that cause significant variation in flow.



In order to measure flow restriction reproducibility, Restek 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, Restek's 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. Flow restriction factors are specified on the certificate of analysis (CofA) included with every Restek® PLOT column, and the values are listed on the report.

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



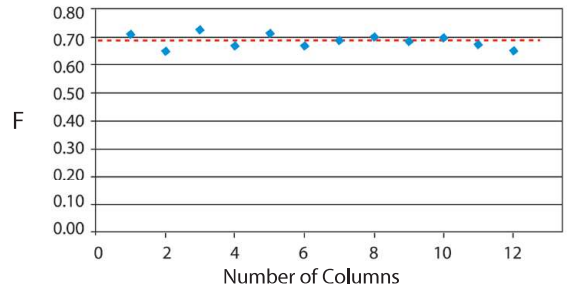
Equation 1: Flow restriction factor (F) is used to demonstrate coating consistency.

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

t_R = retention time

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

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



Equation 2: Percent flow restriction of coated column.

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

See what makes Restek's new **Rt®-Silica BOND** column the best on the market! .....**page 120**

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 Capillary & PLOT Column Ferrule Guide

GC Column ID	Ferrule ID
0.15 mm	0.4
0.18 mm	0.4
0.25 mm	0.4
0.32 mm	0.5
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.# PCBR1163D-UNV



similar phases

GS-GasPro, CP-SilicaPLOT

NEW!

Rt®-Silica BOND Columns (fused silica PLOT)

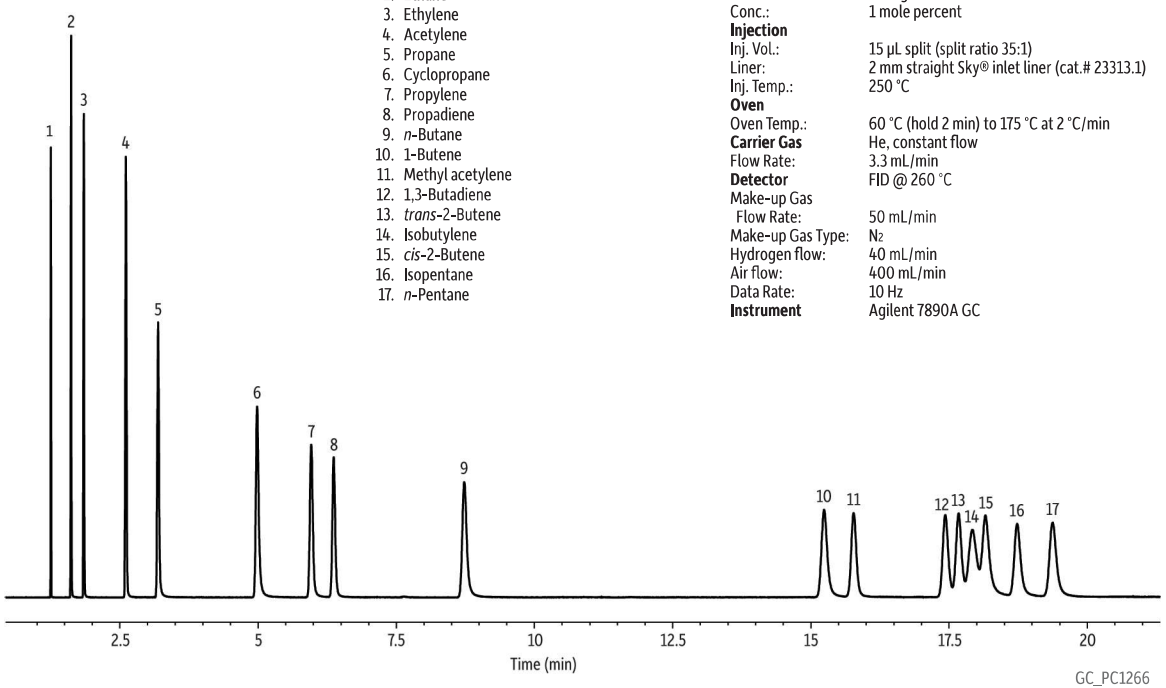
- Versatile column ideal for analysis of light hydrocarbons, sulfur gases, halocarbons, and carbon dioxide.
- Individually QC tested with sensitive C4 probes to ensure consistent selectivity.
- Proprietary manufacturing process practically eliminates particle release, reducing downtime due to obstructed FID jets.
- Bonded silica stationary phase minimizes impact of water, resulting in reproducible retention times for water-containing samples.
- Stable to 260 °C.

Restek's Rt®-Silica BOND columns are robust, versatile, selective PLOT columns that offer excellent performance for the analysis of light hydrocarbons, sulfur gases, and halocarbons above ambient temperature. In addition, carbon dioxide and other gases can be retained at ambient temperature on this silica-based column. High loadability, inertness, and consistent selectivity, as well as unmatched robustness at a maximum temperature of 260 °C, make the Rt®-Silica BOND column ideal for the analysis of active unsaturated hydrocarbons.

Rigorous C4 selectivity testing and additional testing to confirm efficiency and inertness ensure good separations are achieved with optimal peak shape and response for active analytes. As with all Restek® PLOT columns, our proprietary manufacturing process minimizes particle generation, which reduces the problems commonly associated with released particles (signal spikes, valve damage, and obstructed FID jets).

ID	temp. limits	15-Meter cat.#	30-Meter cat.#	60-Meter cat.#
0.32 mm	-80 to 260 °C	19784	19785	19786

Saturated and Unsaturated Hydrocarbons on Rt®-Silica BOND PLOT Column



Peaks
1. Methane
2. Ethane
3. Ethylene
4. Acetylene
5. Propane
6. Cyclopropane
7. Propylene
8. Propadiene
9. *n*-Butane
10. 1-Butene
11. Methyl acetylene
12. 1,3-Butadiene
13. *trans*-2-Butene
14. Isobutylene
15. *cis*-2-Butene
16. Isopentane
17. *n*-Pentane

Column	Rt®-Silica BOND, 30 m, 0.32 mm ID (cat.# 19785)
Sample	Custom DCG gas standard
Diluent:	Nitrogen
Conc.:	1 mole percent
Injection	
Inj. Vol.:	15 µL split (split ratio 35:1)
Liner:	2 mm straight Sky® inlet liner (cat.# 23313.1)
Inj. Temp.:	250 °C
Oven	
Oven Temp.:	60 °C (hold 2 min) to 175 °C at 2 °C/min
Carrier Gas	He, constant flow
Flow Rate:	3.3 mL/min
Detector	FID @ 260 °C
Make-up Gas Flow Rate:	50 mL/min
Make-up Gas Type:	N_2
Hydrogen flow:	40 mL/min
Air flow:	400 mL/min
Data Rate:	10 Hz
Instrument	Agilent 7890A GC

Rt®-Alumina BOND Columns

Restek® Rt®-Alumina BOND columns are highly selective for C1–C5 hydrocarbons and separate all saturated and 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.

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.

similar phases

GS-Alumina, CP-Al_2O_3/Na_2SO_4, Alumina-Sulfate

tech tip

Trace Water in the Carrier Gas

Traces of water in the carrier gas and samples 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 minutes at 200 °C under normal carrier gas flow. Periodic conditioning ensures excellent run-to-run retention time reproducibility.

Unless noted, the maximum programmable temperature for an Rt®-Alumina BOND column is 200 °C. Temperatures higher than the stated maximum temperature can cause irreversible changes to the porous layer adsorption properties.

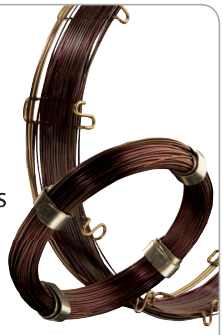
Rt®-Alumina BOND/Na_2SO_4 Columns (fused silica PLOT)

(Na_2SO_4 deactivation)

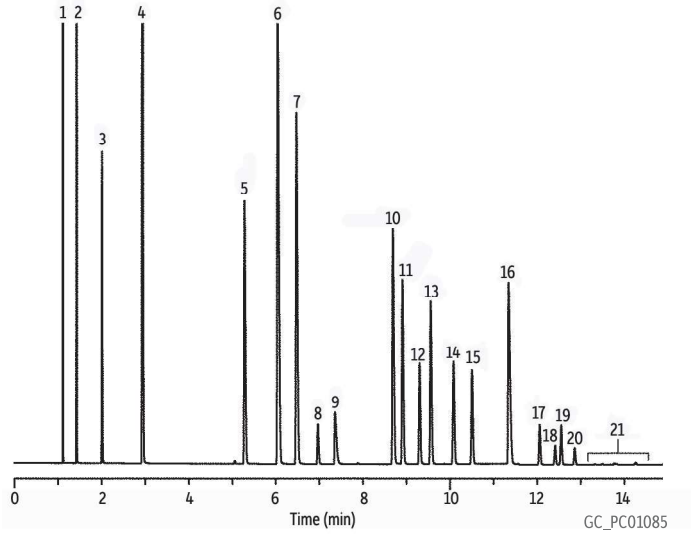
- Acetylene and propadiene elute after butanes.
- Best separation for butene isomers (impurities in butene streams).
- Methyl acetylene elutes after 1,3-butadiene.
- Cyclopropane (impurity in propylene) elutes well before propylene.
- Stable to 200 °C.

ID	df	temp. limits	30-Meter cat.#	50-Meter cat.#
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 129.



Refinery Gas on Rt®-Alumina BOND (Na_2SO_4)



Peaks

1. Methane
2. Ethane
3. Ethylene
4. Propane
5. Propylene
6. Isobutane
7. *n*-Butane
8. Propadiene
9. Acetylene
10. *trans*-2-Butene
11. 1-Butene
12. Isobutylene
13. *cis*-2-Butene
14. iso-Pentane
15. *n*-Pentane
16. 1,3-Butadiene
17. *trans*-2-Pentene
18. 2-Methyl-2-butene
19. 1-Pentene
20. *cis*-2-Pentene
21. Hexanes

Column	Rt®-Alumina BOND/Na_2SO_4, 50 m, 0.53 mm ID, 10 µm (cat.# 19756)
Sample	Refinery gas
Injection	
Inj. Vol.:	10 µL split
Liner:	Taper (2 mm) (cat.# 20795)
Inj. Temp.:	200 °C
Split Vent Flow Rate:	80 mL/min
Oven	
Oven Temp.:	45 °C (hold 1 min) to 200 °C at 10 °C/min (hold 3.5 min)
Carrier Gas	H_2, constant pressure (8.0 psi, 55.2 kPa)
Linear Velocity:	74 cm/sec @ 45 °C
Detector	FID @ 200 °C

Fused Silica Alumina BOND Columns

similar phases

GC-Alumina KCl, HP-PLOT Al_2O_3/KCl, CP-Al_2O_3/KCl, Alumina-Chloride

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.
- Stable to 200 °C.

ID	df	temp. limits	30-Meter cat.#	50-Meter cat.#
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

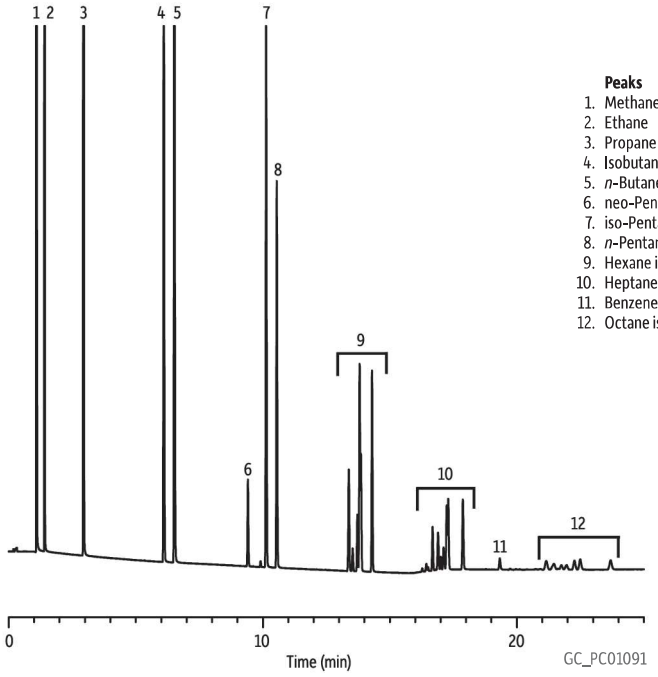
Fused Silica Capillary & PLOT Column Ferrule Guide

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



We pack Restek quality into each and every column we ship.

Natural Gas on Rt®-Alumina BOND/KCl



Column	Rt®-Alumina BOND/KCl, 50 m, 0.53 mm ID, 10 µm (cat.# 19760)
Sample	Natural gas
Injection	
Inj. Vol.:	500 µL split
Liner:	2.0 mm ID single taper (cat.# 20795)
Inj. Temp.:	200 °C
Split Vent Flow Rate:	50 mL/min
Oven	
Oven Temp.:	45 °C (hold 1 min) to 200 °C at 10 °C/min (hold 8.5 min)
Carrier Gas	H_2, constant pressure (8.0 psi, 55.2 kPa)
Linear Velocity:	45 cm/sec @ 45 °C
Detector	FID @ 200 °C
Make-up Gas Type:	N_2
Data Rate:	20 Hz
Instrument	HP5890 GC

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.
- Stable to 200 °C.

The Alumina BOND/CFC 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.

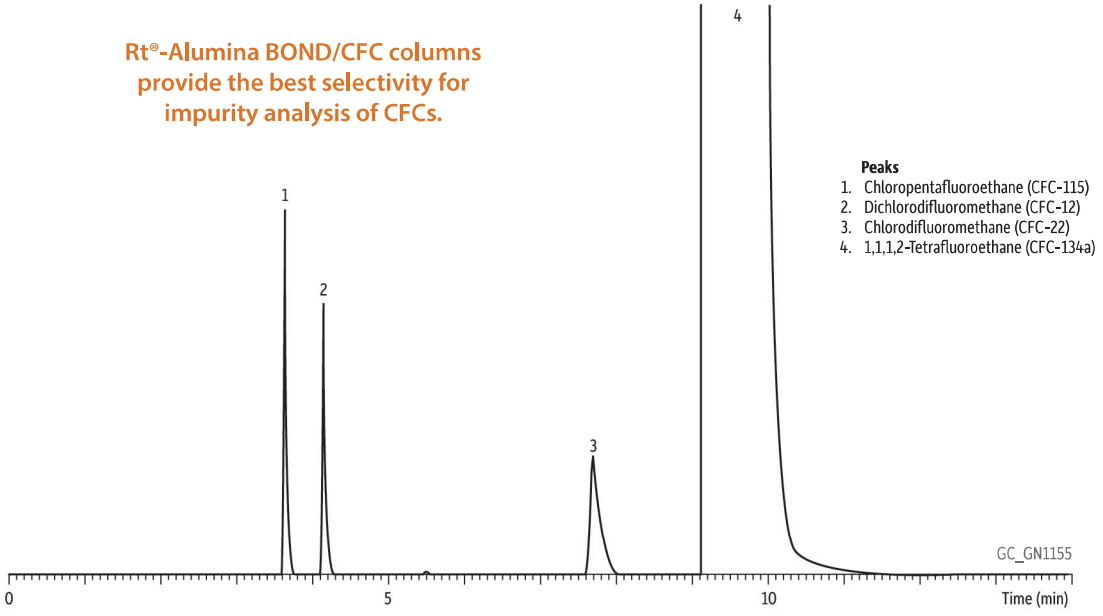
ID	df	temp. limits	30-Meter cat.#
0.53 mm	10 µm	to 200 °C	19763

did you know?

All Restek PLOT columns come standard on a 7"-diameter, 11-pin cage.

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.

Fused Silica Alumina BOND Columns

similar phases

Select Al_2O_3 MAPD

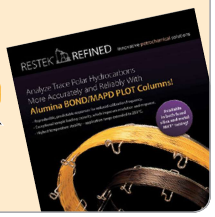
free literature

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.# PCBR1412A-UNV



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.
- Stable to 250 °C.

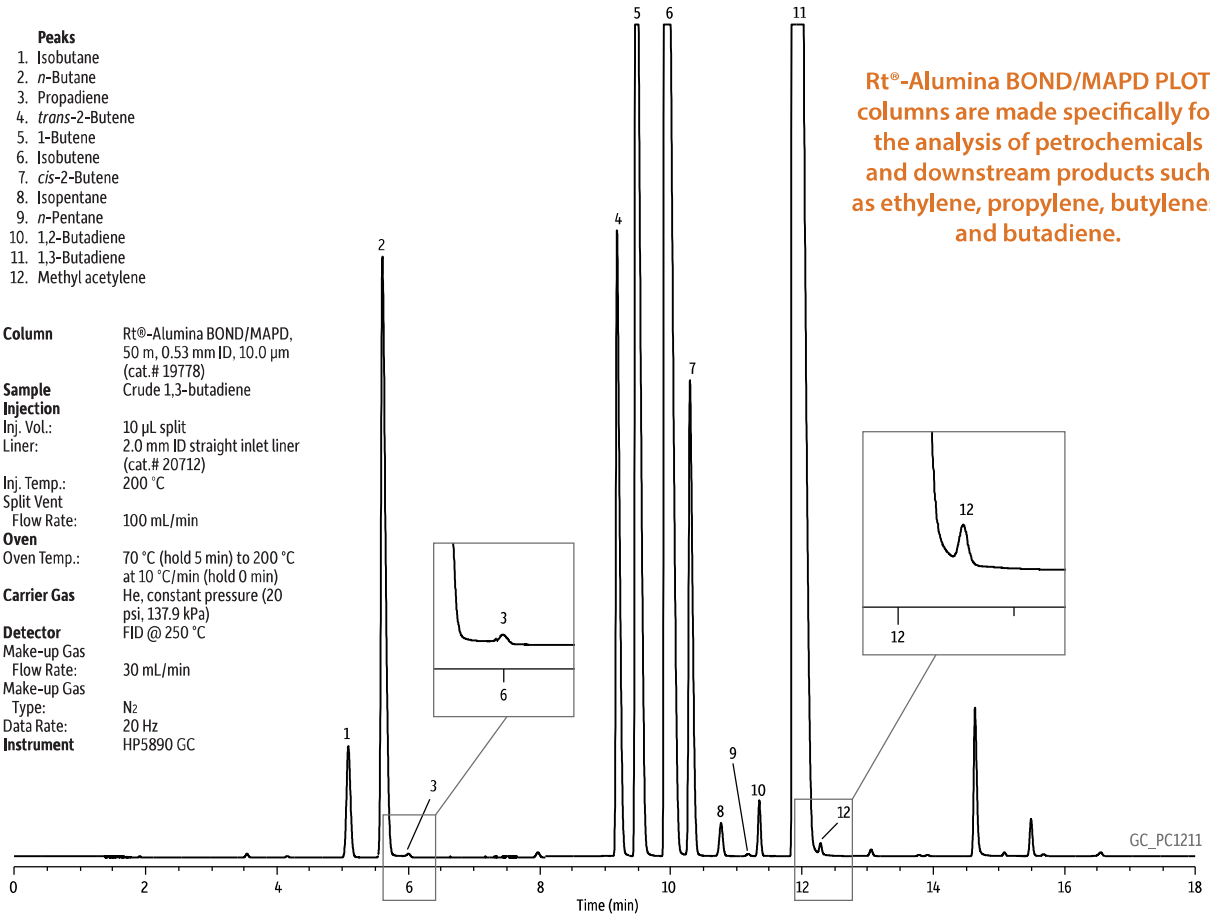
Restek's R&D chemists have optimized the deactivation technology applied to our Rt®-Alumina BOND/MAPD column for improved analysis of trace concentrations of polar hydrocarbons like acetylene, methyl acetylene, and propadiene in hydrocarbon streams containing higher levels of C1-C5 hydrocarbons. Our 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 cat.#	50-Meter cat.#
0.25 mm	4 µm	to 250 °C	19781	—
0.32 mm	5 µm	to 250 °C	19779	19780
0.53 mm	10 µm	to 250 °C	19777	19778

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

Peaks
1. Isobutane
2. *n*-Butane
3. Propadiene
4. *trans*-2-Butene
5. 1-Butene
6. Isobutene
7. *cis*-2-Butene
8. Isopentane
9. *n*-Pentane
10. 1,2-Butadiene
11. 1,3-Butadiene
12. Methyl acetylene

Column	Rt®-Alumina BOND/MAPD, 50 m, 0.53 mm ID, 10.0 µm (cat.# 19778)
Sample	Crude 1,3-butadiene
Injection	
Inj. Vol.:	10 µL split
Liner:	2.0 mm ID straight inlet liner (cat.# 20712)
Inj. Temp.:	200 °C
Split Vent Flow Rate:	100 mL/min
Oven	
Oven Temp.:	70 °C (hold 5 min) to 200 °C at 10 °C/min (hold 0 min)
Carrier Gas	He, constant pressure (20 psi, 137.9 kPa)
Detector	FID @ 250 °C
Make-up Gas Flow Rate:	30 mL/min
Make-up Gas Type:	N_2
Data Rate:	20 Hz
Instrument	HP5890 GC



Rt®-Alumina BOND/MAPD PLOT columns are made specifically for the analysis of petrochemicals and downstream products such as ethylene, propylene, butylenes, and butadiene.

Molecular Sieve 5A PLOT Columns

Restek's molecular sieve 5A PLOT columns are designed for efficient separation of argon/oxygen and other permanent gases, including carbon monoxide. 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 carbon monoxide 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.

Rt®-Msieve 5A Columns (fused silica PLOT)

- Improve accuracy with sharp, symmetrical peaks for argon, oxygen, and carbon monoxide.
- Easily separate permanent gases at temperatures above ambient.
- Restek® PLOT technology reduces particle release, improving flow reproducibility and reducing downtime for maintenance.
- Stable to 300 °C.

ID	df	temp. limits	15-Meter cat.#	30-Meter cat.#
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

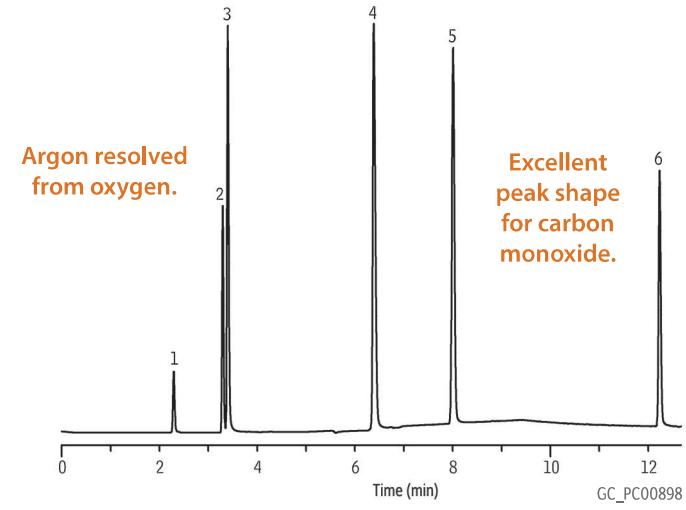
did you know?

Rt®-Msieve 5A PLOT columns are designed for efficient separation of Ar/O_2 and other permanent gases, including CO.

similar phases

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

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



Peaks	Conc. (µg/mL)
1. Hydrogen	40
2. Argon	30
3. Oxygen	50
4. Nitrogen	50
5. Methane	40
6. Carbon monoxide	50

Column	Rt®-Msieve 5A, 30 m, 0.53 mm ID, 50 µm (cat.# 19723)
Sample	Permanent gases
Injection	Sample valve
Sample Loop Vol.:	5 µL
Valve Name:	6-port Valco® valve
Inj. Temp.:	200 °C
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

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

also available

Metal MXT® PLOT Columns

See **page 129.**



Porous Polymer Columns

Porous polymers are unique, highly retentive stationary phases with a wide application range that are able to elute both polar and nonpolar compounds. They are very hydrophobic, so water has no impact on retention times and even elutes as a good chromatographic peak. The Q-BOND is our most nonpolar and widely used porous polymer column; functional groups can be added to increase polarity (i.e., QS-, S-, and U-BOND). 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.

similar phases

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.

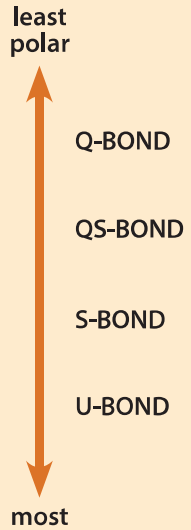
Rt®-Q-BOND Columns (fused silica PLOT)

100% divinylbenzene

- Nonpolar PLOT column incorporating 100% divinylbenzene.
- Excellent for analysis of C1 to C3 isomers and alkanes up to C12.
- High retention for CO_2 simplifies gas analysis; CO_2 and methane separated from $O_2/N_2/CO$. (Note: $O_2/N_2/CO$ not separated at room temperature.)
- Use for analysis of oxygenated compounds and solvents.
- Maximum temperature of 300 °C.

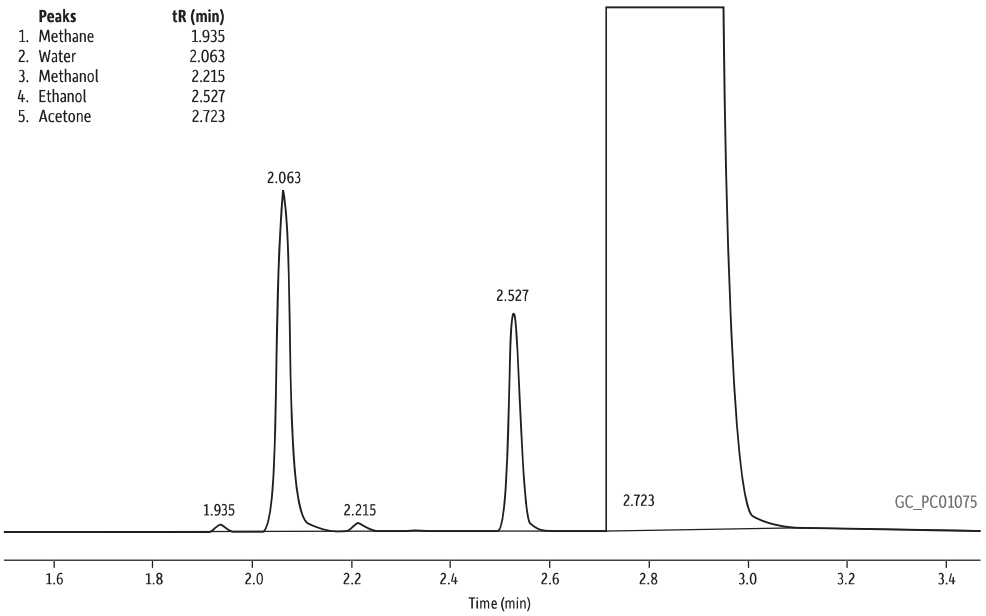
ID	df	temp. limits	15-Meter cat.#	30-Meter cat.#
0.25 mm	8 µm	to 280/300 °C	19764	19765
0.32 mm	10 µm	to 280/300 °C	19743	19744
0.53 mm	20 µm	to 280/300 °C	19741	19742

Restek porous polymer PLOT columns cover a wide range of polarities



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	
Diluent:	Acetone
Conc.:	0.5% Water and ethanol
Injection	
Inj. Vol.:	3 µL split (split ratio 11:1)
Liner:	Splitless taper (4 mm) w/wool (cat.# 22405)
Inj. Temp.:	250 °C
Oven	
Oven Temp.:	200 °C (hold 4 min)
Carrier Gas	He, constant linear velocity
Linear Velocity:	28.7 cm/sec @ 200 °C
Detector	TCD @ 260 °C

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

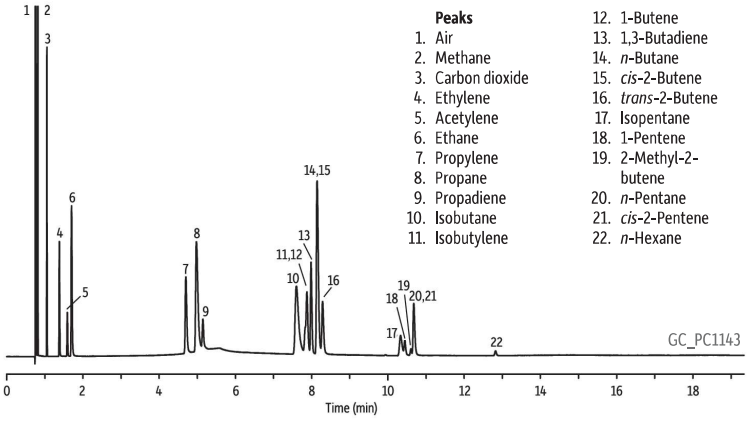
porous divinylbenzene homopolymer

- Intermediate polarity PLOT column incorporating low 4-vinylpyridine.
- Separates ethane, ethylene, and acetylene to baseline.
- Designed for the best possible separation between all C2 isomers.
- Stable to 250 °C.

similar phases
GS-Q

ID	df	temp. limits	15-Meter cat.#	30-Meter cat.#
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

Refinery Gas Mixture on Rt®-QS-BOND



Peaks
1. Air
2. Methane
3. Carbon dioxide
4. Ethylene
5. Acetylene
6. Ethane
7. Propylene
8. Propane
9. Propadiene
10. Isobutane
11. Isobutylene
12. 1-Butene
13. 1,3-Butadiene
14. *n*-Butane
15. *cis*-2-Butene
16. *trans*-2-Butene
17. Isopentane
18. 1-Pentene
19. 2-Methyl-2-butene
20. *n*-Pentane
21. *cis*-2-Pentene
22. *n*-Hexane

Column	Rt®-QS-BOND, 30 m, 0.53 mm ID, 20 µm (cat.# 19738)
Sample	Refinery gas standard
Injection	
Inj. Vol.:	20 µL split
Liner:	2 mm (cat.# 20712)
Inj. Temp.:	200 °C
Split Vent Flow Rate:	35 mL/min
Oven	
Oven Temp.:	40 °C (hold 2 min) to 225 °C at 15 °C/min (hold 5 min)
Carrier Gas	He, constant pressure (11.5 psi, 79.3 kPa)
Linear Velocity:	68 cm/sec @ 40 °C
Detector	TCD @ 225 °C
Make-up Gas Type:	He
Data Rate:	20 Hz
Sensitivity Mode:	He/H_2
Instrument	HP5890 GC

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

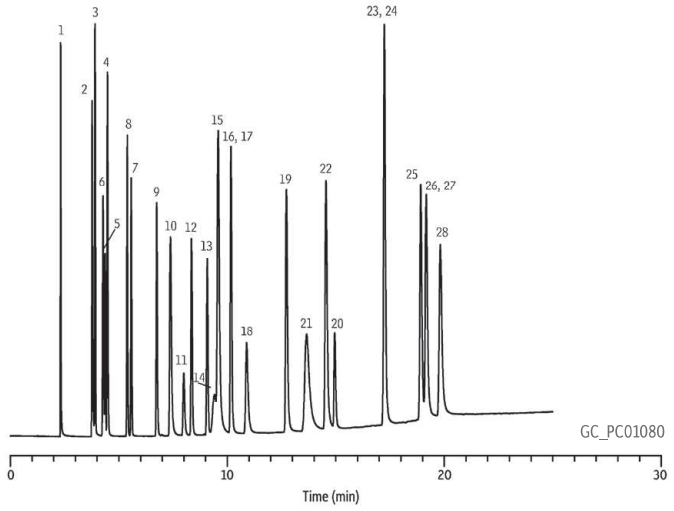
porous divinylbenzene homopolymer

- Midpolarity PLOT column, incorporating high 4-vinylpyridine.
- Use for the analysis of nonpolar and polar compounds.
- Stable to 250 °C.

similar phases
CP-PoraPLOT S

ID	df	temp. limits	15-Meter cat.#	30-Meter cat.#
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

Solvent Mixture on Rt®-S-BOND



Peaks
1. Methanol
2. Ethanol
3. Acetonitrile
4. Acetone
5. Dichloromethane
6. 1,1-Dichloroethene
7. Nitromethane
8. *trans*-1,2-Dichloroethylene
9. *cis*-1,2-Dichloroethylene
10. Tetrahydrofuran
11. Chloroform
12. Ethyl acetate
13. 1,2-Dichloroethane
14. 1,1,1-Trichloroethane
15. Benzene
16. 1,2-Dimethoxyethane
17. Trichloroethylene
18. 1,4-Dioxane
19. Pyridine
20. Dimethylformamide
21. Methylcyclohexane
22. Toluene
23. 2-Hexanone
24. Chlorobenzene
25. Ethylbenzene
26. *m*-Xylene
27. *p*-Xylene
28. *o*-Xylene

Column	Rt®-S-BOND, 30 m, 0.53 mm ID, 20 µm (cat.# 19746)
Sample	Solvent mixture
Injection	
Inj. Vol.:	1.0 µL split
Liner:	Taper (4 mm) (cat.# 20798)
Inj. Temp.:	200 °C
Split Vent Flow Rate:	100 mL/min
Oven	
Oven Temp.:	120 °C to 220 °C at 5 °C/min (hold 5.0 min)
Carrier Gas	H_2, constant pressure (4.2 psi, 29.0 kPa)
Linear Velocity:	40 cm/sec @ 120 °C
Detector	FID @ 220 °C

Fused Silica Porous Polymer Columns, Particle Trap

similar phases

HP-PLOT U, CP-PoraPLOT U, CP-PoraBOND U

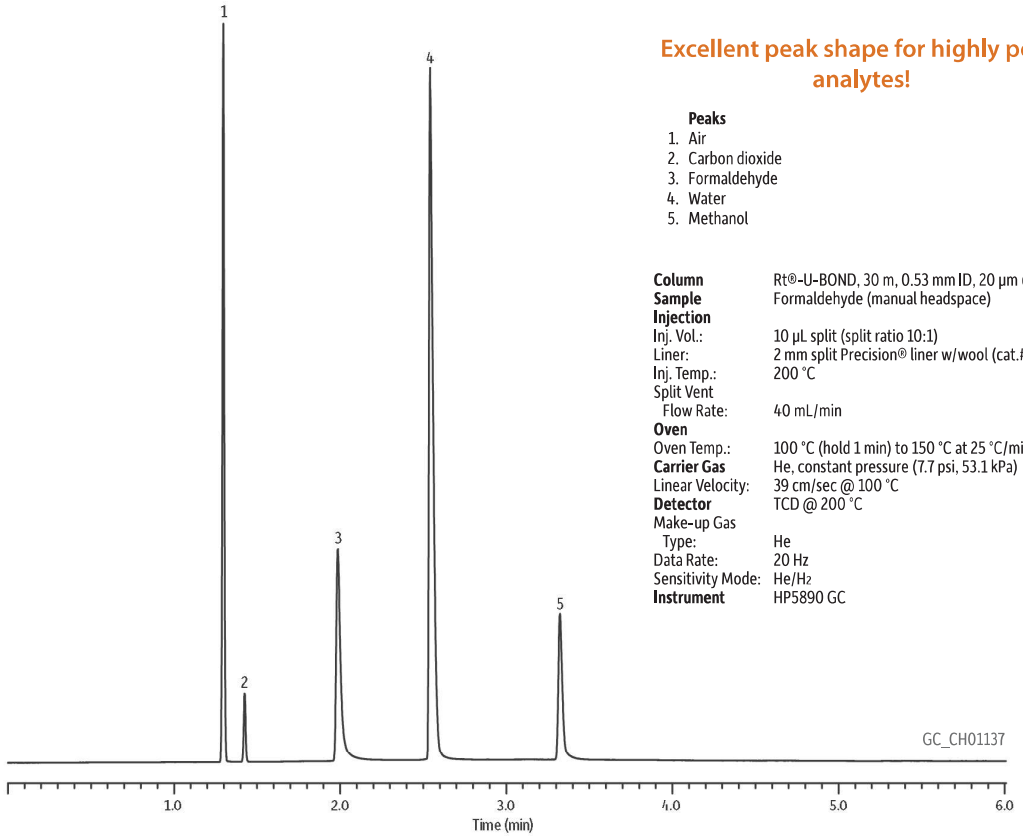
Rt®-U-BOND Columns (fused silica PLOT)

divinylbenzene ethylene glycol/dimethylacrylate

- Restek's highest polarity porous polymer column.
- Polar PLOT column, incorporating divinylbenzene ethylene glycol/dimethylacrylate.
- Highly inert for the analysis of polar and nonpolar compounds.
- Stable to 190 °C.

ID	df	temp. limits	15-Meter cat.#	30-Meter cat.#
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

Formaldehyde on Rt®-U-BOND



Excellent peak shape for highly polar analytes!

Peaks
1. Air
2. Carbon dioxide
3. Formaldehyde
4. Water
5. Methanol

Column	Rt®-U-BOND, 30 m, 0.53 mm ID, 20 µm (cat.# 19750)
Sample	Formaldehyde (manual headspace)
Injection	
Inj. Vol.:	10 µL split (split ratio 10:1)
Liner:	2 mm split Precision® liner w/wool (cat.# 20823)
Inj. Temp.:	200 °C
Split Vent Flow Rate:	40 mL/min
Oven	
Oven Temp.:	100 °C (hold 1 min) to 150 °C at 25 °C/min (hold 3 min)
Carrier Gas	He, constant pressure (7.7 psi, 53.1 kPa)
Linear Velocity:	39 cm/sec @ 100 °C
Detector	TCD @ 200 °C
Make-up Gas Type:	He
Data Rate:	20 Hz
Sensitivity Mode:	He/H2
Instrument	HP5890 GC



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, it is still possibile for particles to dislodge when extreme pressure shocks and gas flow changes occur. This sometimes happens when valve switching or backflushing 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 additional benefits for process GCs and field applications as they are virtually unbreakable and can be coiled into very small diameters.

ID	df	temp. limits	3.5" coil 15-Meter cat.#	7" diameter 11-pin cage 15-Meter cat.#	3.5" coil 30-Meter cat.#	7" diameter 11-pin cage 30-Meter cat.#
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/Na_2SO_4						
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



MXT® GC Column Ferrule Guide

GC Column ID	GC Column OD	Ferrule ID
0.18 mm	0.36 ± 0.001	0.4
0.25 mm	0.41 ± 0.001	0.5
0.28 mm	0.56 ± 0.001	0.6
0.32 mm	0.44 ± 0.0015	0.5
0.53 mm	0.74 ± 0.001	0.8

Speed Up and Simplify GC Method Development with
Restek's *EZGC*® Online Suite



Download these FREE web apps at www.restek.com/ezgc

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

Download your free copy from
www.restek.com

lit. cat.#
PCBR1163D-UNV



GC Columns

Packed/Micropacked Columns

Overview 131
Bonded Stationary Phases 132–133
Packed Column Tubing 134
Stock Packed Columns 135–136
Stock Micropacked Columns 137
Application-Specific
Packed/Micropacked Columns 138–141
Packed/Micropacked Column Installation Kits 142
Packed Column Packing Materials 143–145
Liquid Phases for Custom Columns 146
USP Liquid Phase & Solid Support
Cross-Reference 147
Custom Coated Packing Materials 148
Custom Packed/Micropacked Columns 149
Packed/Micropacked Column
Custom Order Form 150
Column Configurations 151



Packed Columns Overview

Put the power of Restek® packed columns to work for you.

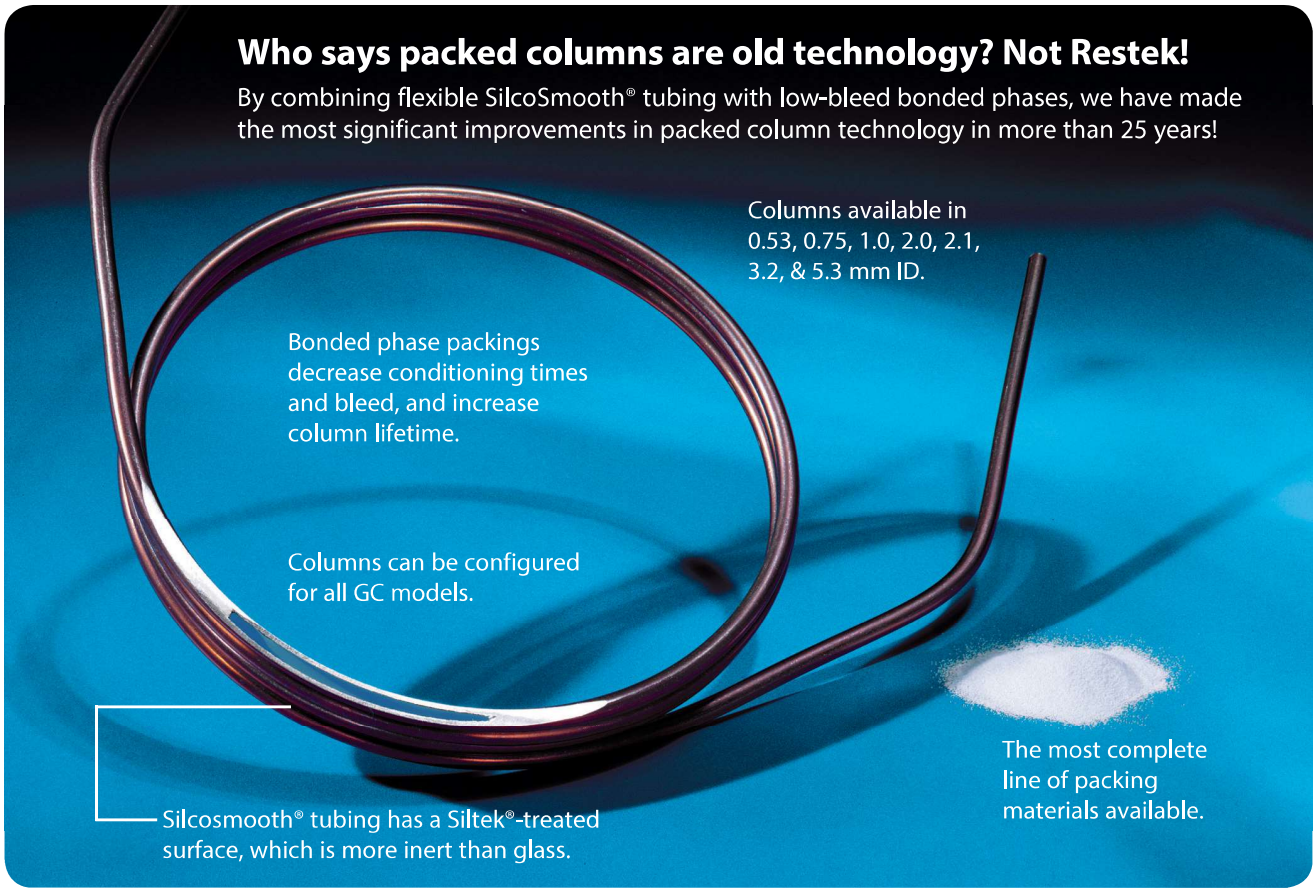
- SilcoSmooth® tubing provides the inertness of glass and the durability of stainless steel, so you get accurate results for a wide range of active compounds.
- Stable bonded stationary phases mean short conditioning times, low bleed, and long column lifetimes.
- Excellent retention time reproducibility delivers reliable, consistent results.

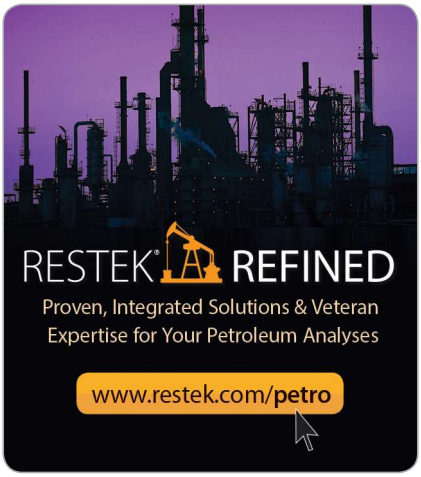
Packed columns offer large sample capacity and often can retain and separate compounds that cannot be analyzed by other techniques. While these advantages have resulted in their use in a wide range of GC applications, traditional packed columns are limited by unstable phases that break down easily, producing high column bleed and short column lifetimes. In addition, the tubing used for packed columns can present challenges; columns packed in glass tubing are inflexible and break easily, whereas columns made with metal tubing typically are not inert, meaning active compounds cannot be analyzed accurately as they react with metal tubing.

Restek® packed columns overcome these problems and are preferred over conventional packed columns, because they are exceptionally rugged and inert. You can generate accurate data quickly and reliably with less downtime for column changes with Restek® packed columns since they combine high-quality SilcoSmooth® tubing with stable bonded phase technology. SilcoSmooth® tubing is rugged, ultra-smooth seamless 304 stainless steel tubing that is deactivated with an innovative Siltek® treatment. This process results in packed columns that have both the inertness of glass and the strength and flexibility of stainless steel. In addition, our bonded phase technology features a coated support that is extremely stable and results in longer column lifetimes, lower bleed, and excellent reproducibility.

Put the power of Restek® packed columns to work in your lab today. We offer a broad range of common phases, as well as application-specific products developed for light hydrocarbon analysis, sulfurs, permanent gases, and ASTM Method D3606.

- Know which Restek® packed column you need? Find it on the following pages and order by web, phone, or fax today.
- Looking for an application-specific column? See what we recommend for your work on the following page.
- Need a custom column? Complete our custom product form on page 150 and we will send you a quote within two business days!





Bonded Stationary Phases

We combined our stationary phase synthesis experience with our unique Silcoport® packing deactivation process to create bonded phase packings that provide longer lifetimes, lower bleed, and shorter conditioning times.

Bonded methyl silicone phases (Rtx®-1 and Rtx®-5 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 nonbonded phases of comparable polarity; the bonded phases last longer than the equivalent nonbonded packing materials. Table I shows that retention times on an Rtx®-1 bonded packed column are highly repeatable after only 30 minutes of conditioning.

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

	Retention Time			
Hydrocarbon	**Min.**	**Max.**	**Mean**	**Stand. Dev.**
C5	0.241	0.243	0.242	0.001
C6	0.493	0.497	0.495	0.002
C10	5.746	5.765	5.752	0.005
C20	18.482	18.491	18.486	0.004
C28	25.093	25.103	25.098	0.004
C40	32.160	32.171	32.166	0.004
C44	34.316	34.328	34.326	0.007

n = 9 columns

Quick Reference Chart

For specific applications, Restek recommends using these optimized columns for better method performance.

Application	Column	Feature	Benefit
ASTM Method D3606	D3606 Application Column Set, p. 138 (Column 1: 6' (1.8 m), 1/8" OD, 2.0 mm ID, Rtx-1; Column 2: 16' (4.9 m), 1/8" OD, 2.0 mm ID, proprietary packing material)	Excellent separation of ethanol and benzene.	Reliably meets method requirements.
Refinery gases	2abc Refinery Gas Column Set , p. 139 Backflush Column	Optimized three-column set. (Backflush column sold separately.)	Elutes C5 hydrocarbons before C1-C4 hydrocarbons for optimized resolution.
Unsaturated light hydrocarbons	*n*-Octane on Res-Sil C Column, p. 139	Unique selectivity for unsaturated hydrocarbons.	Excellent resolution of unsaturated light hydrocarbons gives increased data accuracy.
cis-2-Butene and 1,3-butadiene	OPN on Res-Sil C Column, p. 139	Optimized selectivity for *cis*-2-butene and 1,3-butadiene resolution.	Increases data accuracy.
Permanent gases	Shincarbon ST Columns, p. 140 Packed or micropacked	Optimized selectivity for permanent gas resolution without cryogenic cooling. Preconditioned.	Increases productivity.
Low-level sulfurs	Rt-XLSulfur Columns, p. 141 Packed or micropacked	Highly inert for ppbv levels of sulfur. Eliminates need for PTFE tubing.	Increases data accuracy for low-level sulfur analysis. Eliminates need for a special GC setup.

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

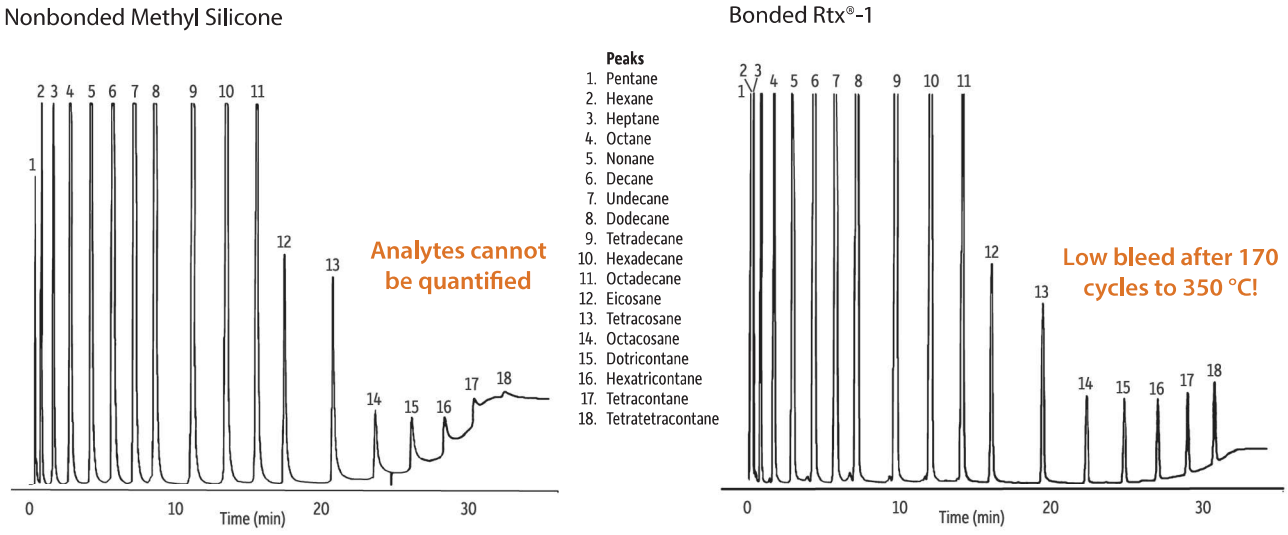
1-2-3 PUNCH!

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. Excellent retention time reproducibility for reliable, consistent results!

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, G2, G1
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, G27, G36
Stabilwax	BP-20, CP-Wax, CW-20, DB-Wax, HP-Innowax, PE-Wax, Supelcowax-10, G16

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



GC_PC00369

Column	Rtx®-1 Sim Dist 2887, SilcoSmooth® Tubing, 25 inches, 1/8 in. OD, 2 mm ID (cat.# 80000-800)
Sample	1–12% (w/w) each component ASTM D2887-01 calibration mix (1% each listed analyte in CS_2) (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

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

also available

For more information on micropacked columns, see **page 137.**

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 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® 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 welded and drawn tubing.

Hastelloy® Tubing

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

Nickel Tubing

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

Copper Tubing

Copper is a general-purpose tubing that is only recommended for inactive 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 and Micropacked Column Tubing Dimensions

	Packed				Micropacked		
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 1.0 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.

please note

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

Chromosorb® Diatomaceous Earth Packed Columns

Bonded Stationary Phase Packed Columns

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

	Stainless Steel Tubing				SilcoSmooth Tubing**			
Bonded Phase on 100/120 Silcoport W* **	**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-

Non-Bonded Stationary Phase Packed Columns

	Stainless Steel Tubing				SilcoSmooth Tubing**			
On 100/120 Silcoport W* **	**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-
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-

		Stainless Steel Tubing				SilcoSmooth Tubing**			
On Chromosorb PAW	**Mesh**	**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.
****Application-specific column.

Porous Polymer Packed Columns

Restek offers a full range of porous polymers, including HayeSep® and Porapak polymer packings for analyses of volatile compounds and light solvents.

	Stainless Steel Tubing				SilcoSmooth Tubing**			
Porous Polymers 80/100 Mesh	**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.

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.

please note

Temperature limits for stationary phases are listed on **page 146**.

Customized Solutions

Restek builds to your exact specifications.



Request columns at

www.restek.com/**packed**

also available

Porapak, HayeSep®, and Tenax® packing materials.

See **page 145.**

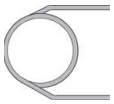
also available

CarboBlack packing materials. See **page 143**.

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 151 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.
Note: Standard micropacked columns fit all instruments. No special instrument configuration suffix is required.

CarboBlack Packed Columns

Graphitized carbon black offers unique selectivity and very little adsorption for alcohol analyses. Two types of CarboBlack supports are available, CarboBlack B and CarboBlack C. CarboBlack B support, with its higher surface area, can hold up to a 10% loading of a nonsilicone liquid phase. CarboBlack C support can hold up to a 1% loading of a nonsilicone liquid phase. Many Carbowax® 20M-loaded CarboBlack packings are available. CarboBlack packings are treated with KOH or picric acid for basic or acidic compounds, and special alcoholic beverage loadings are available. CarboBlack supports provide resolution and retention similar to Carbopack™ and Carbograph supports.

		Stainless Steel Tubing				SilcoSmooth Tubing**			
On CarboBlack B	Mesh	L (ft)	OD (in)	ID (mm)	cat.#*	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_3PO_4	60/80	6	1/8	2.1	80455-	1.8	1/8	2.0	80305-

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

		Stainless Steel Tubing				SilcoSmooth Tubing**			
On CarboBlack C	Mesh	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.
**Siltek-treated stainless steel.

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 results in excellent batch-to-batch reproducibility. In addition, our molecular sieves are preactivated and ready to use. Each column comes with metal end-fittings to prevent water or carbon dioxide from adsorbing into the packing during shipment.

		Stainless Steel Tubing				SilcoSmooth Tubing**			
Molecular Sieve	Mesh	L (ft)	OD (in)	ID (mm)	cat.#*	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.

Micropacked GC Columns

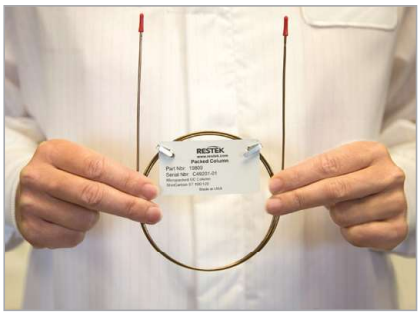
- Increased efficiency over traditional packed columns.
- Higher capacity than PLOT columns.
- Made from inert, flexible SilcoSmooth® tubing.
- Wide range of packings available.
- Standard coils fit all instruments. No special instrument configurations required.

Made with INERT SilcoSmooth® tubing!

All micropacked columns are made with inert SilcoSmooth® tubing, which is Siltek® treated for maximum inertness. See **page 134.**

Efficient, Inert, and Flexible

Micropacked columns are highly efficient and provide good sample capacity, resulting in 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*

Restek's packed column experts 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)*

	Mesh	ID	OD	Temp. Range	1-Meter cat.#	2-Meter cat.#
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 300 °C	19045	19043

Micropacked GC Columns (0.75 mm ID)

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

	Mesh	ID	OD	Temp. Range	1-Meter cat.#	2-Meter cat.#
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 cat.#	2-Meter cat.#
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

*Due to the small internal diameter of 0.53 mm ID columns, braided wire end plugs cannot be used; wool is inserted into the ends instead.

Customized Solutions

Restek builds to your exact specifications.



Request columns at

www.restek.com/packed



Aromatics Analysis

D3606 Application Column Set (2 column set)

- Complete resolution of benzene from ethanol—no compromising coelutions.
- 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 the current ASTM method D3606 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 chart on page 141.
**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

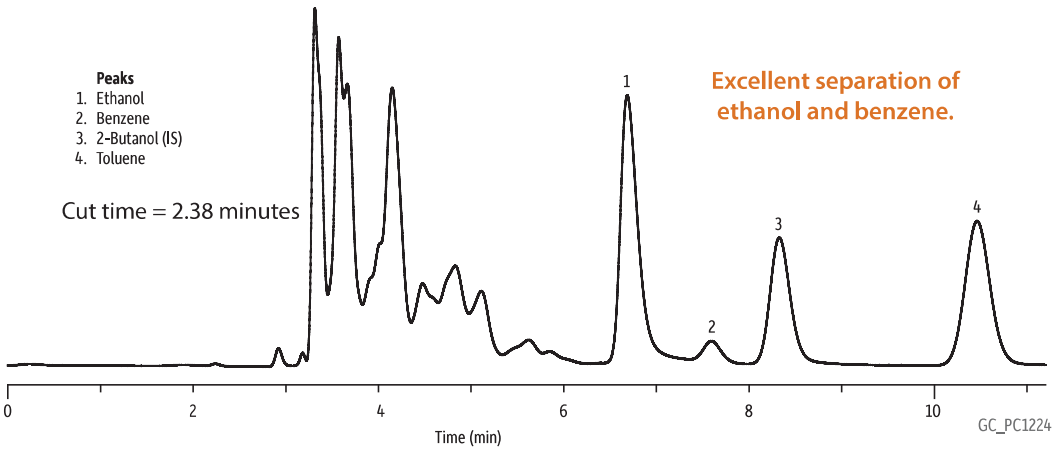
Resolve Benzene and Toluene in Spark Ignition Fuels Containing Ethanol

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).

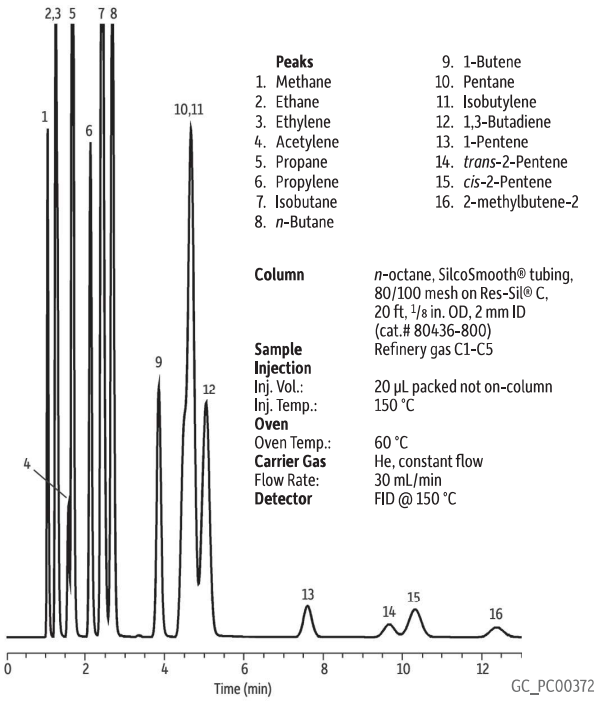
2abc Refinery Gas Column Set

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.#*
n-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 page 141.
**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.

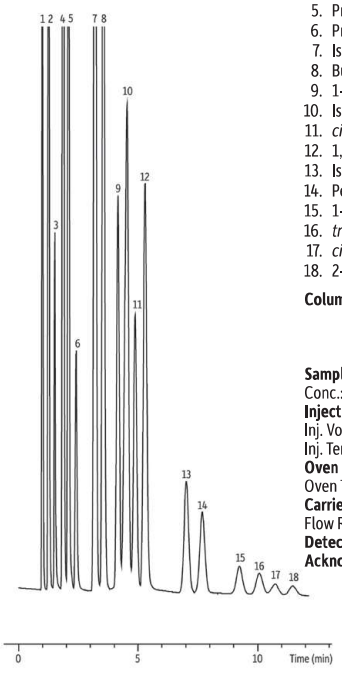
Figure 1: *n*-Octane on Res-Sil® C packing demonstrates unique selectivity for unsaturated light hydrocarbons.



Peaks	
1. Methane	9. 1-Butene
2. Ethane	10. Pentane
3. Ethylene	11. Isobutylene
4. Acetylene	12. 1,3-Butadiene
5. Propane	13. 1-Pentene
6. Propylene	14. *trans*-2-Pentene
7. Isobutane	15. *cis*-2-Pentene
8. *n*-Butane	16. 2-methylbutene-2

Column	*n*-octane, SilcoSmooth® tubing, 80/100 mesh on Res-Sil® C, 20 ft, 1/8 in. OD, 2 mm ID (cat.# 80436-800)
Sample	Refinery gas C1-C5
Injection	
Inj. Vol.:	20 µL packed not on-column
Inj. Temp.:	150 °C
Oven	
Oven Temp.:	60 °C
Carrier Gas	He, constant flow
Flow Rate:	30 mL/min
Detector	FID @ 150 °C

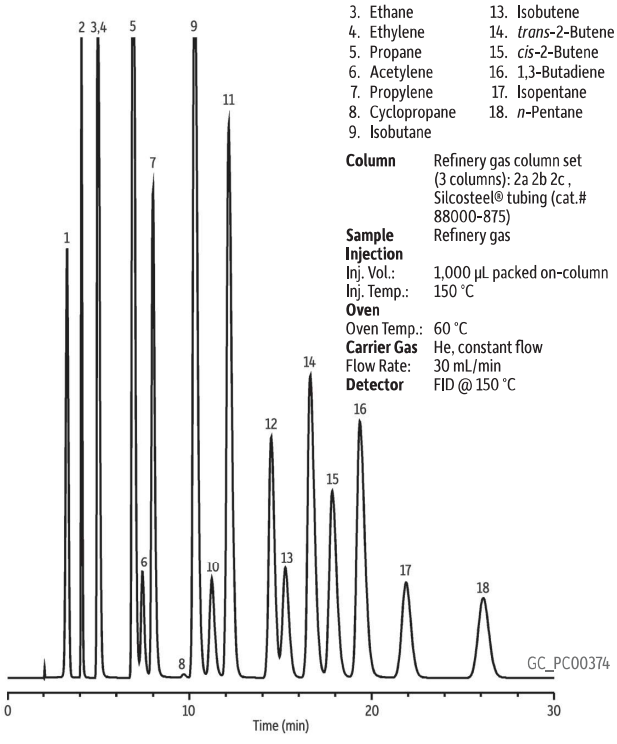
Figure 2: OPN on Res-Sil® C packing demonstrates unique selectivity for *cis*-2-butene and 1,3-butadiene.



Peaks	Retention Indices
1. Methane	100
2. Ethane/ethylene	200
3. Acetylene	260
4. Propane	300
5. Propylene	321
6. Propadiene	345
7. Isobutane	386
8. Butane	400
9. 1-Butene	422
10. Isobutylene/*trans*-2-butene	434
11. *cis*-2-Butene	443
12. 1,3-Butadiene	454
13. Isopentane	488
14. Pentane/3-methyl-1-butene	503
15. 1-Pentene	522
16. *trans*-2-Pentene	533
17. *cis*-2-Pentene	540
18. 2-Methyl-2-butene	549

Column	OPN, SilcoSmooth® Tubing, 80/100 mesh on Res-Sil® C packing, 12 ft, 1/8 in. OD, 2 mm ID (cat.# 80437-800)
Sample	Refinery gas
Conc.:	0.1-6 absolute mole %
Injection	
Inj. Vol.:	20 µL packed on-column
Inj. Temp.:	200 °C
Oven	
Oven Temp.:	50 °C
Carrier Gas	He, constant flow
Flow Rate:	30 mL/min
Detector	FID @ 200 °C
Acknowledgement	Standard courtesy of AC Analytical Controls

Figure 3: Refinery gas calibration standard on refinery gas packed column set.



Peaks	
1. C5-C6+	10. Propadiene
2. Methane	11. *n*-Butane
3. Ethane	12. 1-Butene
4. Ethylene	13. Isobutene
5. Propane	14. *trans*-2-Butene
6. Acetylene	15. *cis*-2-Butene
7. Propylene	16. 1,3-Butadiene
8. Cyclopropane	17. Isopentane
9. Isobutane	18. *n*-Pentane

Column	Refinery gas column set (3 columns): 2a 2b 2c , Silcosteel® tubing (cat.# 88000-875)
Sample	Refinery gas
Injection	
Inj. Vol.:	1,000 µL packed on-column
Inj. Temp.:	150 °C
Oven	
Oven Temp.:	60 °C
Carrier Gas	He, constant flow
Flow Rate:	30 mL/min
Detector	FID @ 150 °C

for more info

See **page 144** for more information on Res-Sil® packing materials.

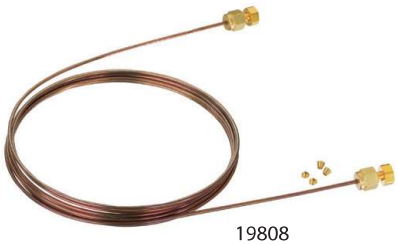
it's a fact

ShinCarbon ST is an ideal packing material for permanent gases, low molecular weight hydrocarbons, sulfur dioxide, and Freon® gases.

also available

Adapter kits for installing packed/micropacked columns.

See **page 142.**



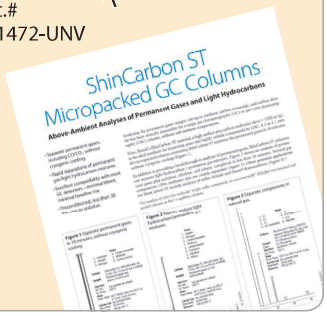
19808

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



Permanent Gases & Hydrocarbon Analysis

ShinCarbon ST Columns (packed & micropacked)
(SilcoSmooth® Stainless Steel)

- Separate permanent gases, including carbon monoxide and carbon dioxide, 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 at room temperature. ShinCarbon ST material, a high surface area carbon molecular sieve (~1,500 m^2/g), is the ideal medium for separating gases and highly volatile compounds by gas solid chromatography (GSC). The rapid, above-ambient analyses these columns provide is 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 for your convenience. This minimizes stabilization time (less than 30 minutes) when installing a new column which, in turn, reduces downtime.

ShinCarbon ST Columns (packed)*

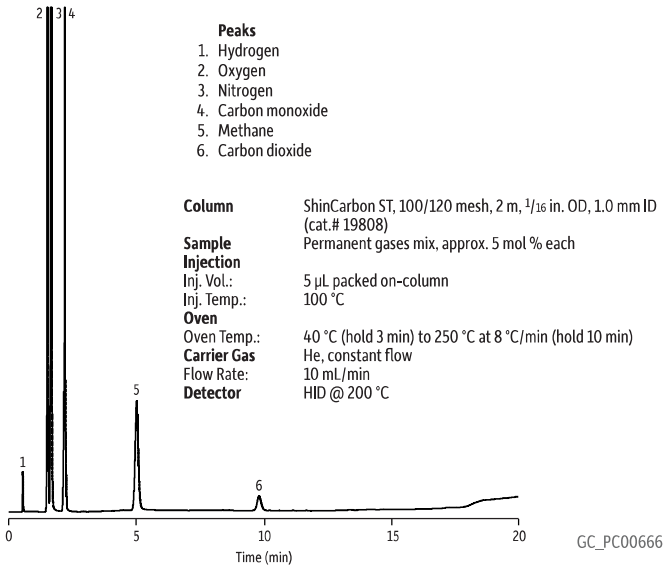
OD	ID	Mesh	2-Meter cat.#*
1/8" Silcosmooth	2.0 mm	80/100	80486-

ShinCarbon ST Columns (micropacked)

OD	ID	Mesh	1-Meter cat.#	2-Meter cat.#
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

*Please add column instrument configuration suffix number to cat.# when ordering. See chart on the next page.
Note: Columns do not include column nuts and ferrules. Optional installation kits can be ordered separately—see page 142.

Permanent Gases on ShinCarbon ST



Peaks
1. Hydrogen
2. Oxygen
3. Nitrogen
4. Carbon monoxide
5. Methane
6. Carbon dioxide

Column	ShinCarbon ST, 100/120 mesh, 2 m, 1/16 in. OD, 1.0 mm ID (cat.# 19808)
Sample	Permanent gases mix, approx. 5 mol % each
Injection	
Inj. Vol.:	5 µL packed on-column
Inj. Temp.:	100 °C
Oven	
Oven Temp.:	40 °C (hold 3 min) to 250 °C at 8 °C/min (hold 10 min)
Carrier Gas	He, constant flow
Flow Rate:	10 mL/min
Detector	HID @ 200 °C

GC_PC00666

Sulfur Analysis

Rt®-XLSulfur Columns (packed & micropacked)

- 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 Sulfinert® 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)*

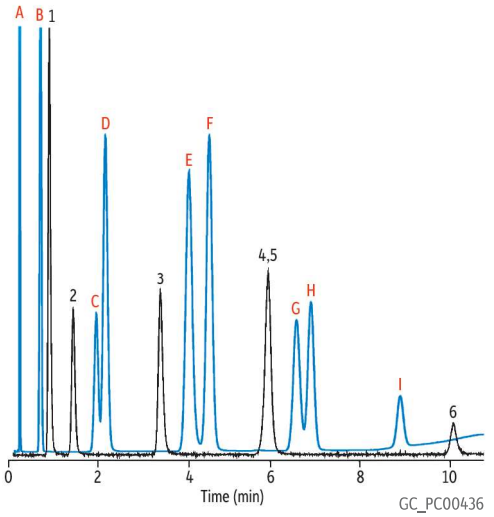
OD	ID	Mesh	1-Meter cat.#*	2-Meter cat.#*
1/8"	2.0 mm	100/120	80484-	80485-
3/16"	3.2 mm	100/120	80482-	80483-

Rt®-XLSulfur Columns (micropacked)

OD	ID	Mesh	1-Meter cat.#	2-Meter cat.#
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

*Please add column instrument configuration suffix number to cat.# when ordering. See chart on this page.
NOTE: Columns do not include column nuts and ferrules. Optional installation kits can be ordered separately—see page 142.

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	Rt®-XLSulfur, 1 m, 0.95 mm OD, 0.75 mm ID (cat.# 19806)
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.

did you know?

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

also available

Adapter kits for installing packed/micropacked columns.

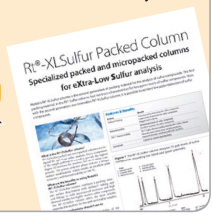
See **page 142.**

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.#
PCTS1500A-UNV



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

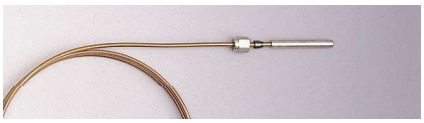


PE Auto System 8300, 8400, 8700
Suffix -840

See page 151 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.
Note: Standard micropacked columns fit all instruments. No special instrument configuration suffix is required.

Packed/Micropacked Column Installation Kits



Adaptor kit centers the packed column in the injection port, so the syringe will not scrape the sides of the column.

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 qty.	cat.#	For 3/16" Columns qty.	cat.#
Packed Column Inlet Adaptor Kit for 1/4" Injection Ports	kit	21651	kit	21650



21065

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



21067

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



22429
Large-Bore Dual Vespel® Ring Inlet Seals

Micropacked Inlet Conversion Kits

- Convert a capillary GC split/splitless inlet for use with 1/16" OD micropacked columns.
- For use with Agilent 5890, 6890, and 7890 GCs.
- Sample pathways deactivated for ultimate inertness.



1/4" SS Nut
23152



Large-Bore
FID Adaptor



1/4" Vespel®/Graphite
Ferrule
20221



1/16" SS Nuts
23150



Large-Bore
Reducing Nut



1/16" Vespel®/
Graphite Ferrules
20218



22430



20772

Description	qty.	cat.#
Micropacked Column Adaptor Kit for Split/Splitless Injection* *Complete kit with FID and injection port adaptors* 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* *Complete kit with FID and injection port adaptors* 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 *Injection Port Adaptor Kit* Kit includes: dual Vespel ring inlet seal, large bore; reducing nut, large bore; 1/16" ferrule, Vespel/graphite; 1/16" nut, stainless steel; 4 mm splitless liner, intermediate polarity deactivated	kit	22426
Micropacked Column Adaptor Kit for On-Column Injection *Injection Port Adaptor Kit* Kit includes: dual Vespel ring inlet seal, large bore; reducing nut, large bore; 1/16" ferrule, Vespel/graphite; Siltek treated metal liner installation guide; 1/16" nut, stainless steel	kit	22427
Micropacked Column Adaptor Kit for FID* *FID Adaptor Kit* 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.

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.

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.

did you know?

CarboBlack supports replace
- Carbopack™
- Carbograph

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.



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 • 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 International Technical Service at intltechsupp@restek.com or find a local distributor at **www.restek.com/distributor**

Packed Column Packing Materials

also available

Custom packing materials are also available.

See **page 148**.



Put our decades of experience to work for you.

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 Durapak and Porasil 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 139). 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 QC 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.

did you know?

Res-Sil® replaces
- Porasil B
- Porasil C
- Durapak

Description	temp. limits	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
n-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.

[1]N.C. Saha, S.K. Jain, and R.K. Dua. J. Chromat. Sci 1978, 323-328.

Customized Solutions

Restek builds to your exact specifications.



Request columns at

www.restek.com/packed

Porapak Packing Materials

Description	temp. limits	g/btl.	Mesh 50/80 cat.#	Mesh 80/100 cat.#	Mesh 100/120 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 148**.

HayeSep® Packing Materials

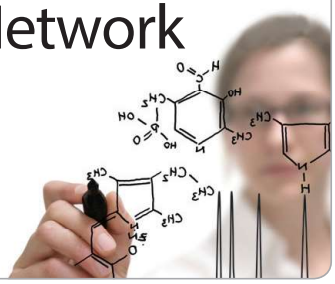
Description	temp. limits	g/btl.	Mesh 60/80 cat.#	Mesh 80/100 cat.#	Mesh 100/120 cat.#
HayeSep A	165 °C	24 g	22560	25032	25033
HayeSep B	190 °C	24 g	25561	25034	25035
HayeSep C	250 °C	24 g	25562	25036	25037
HayeSep D	290 °C	24 g	25563	25038	25039
HayeSep DIP	290 °C	24 g	25564	25565	25566
HayeSep DB	290 °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® Packing Materials

Description	temp. limits	Min. Qty.	Mesh 60/80 cat.#	Mesh 80/100 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)
Apiezon L	50/300
p,p'-Azoxydiphenetole	132/140
BC-120	0/125
Bentone-34	0/180
bis (2-ethoxyethyl) adipate	0/150
bis (2-ethylhexyl) phthalate	150 max.
bis (2-methoxyethyl) adipate	20/100
n,n'-Bis(*p*-methoxylbenzylidene)-α,α'-bi-*p*-toluidine (BMBT)	189/225
Carbowax 1000	40/150
Carbowax 20M	60/225
Carbowax 20M-terephthalic acid	60/225
Carbowax 400	10/100
Carbowax 600	30/125
Cyclohexanedimethanol succinate	100/250
DC-11	0/300
DC-200	0/200
DC-550	20/250
DEGS-PS	20/200
Di(2-ethylhexyl)sebacate	0/125
Diethylene glycol succinate (DEGS)	20/200
Diethylene glycol adipate (DEGA)	0/200
Diisodecyl phthalate	0/175
2,4-Dimethylsulfolane	0/50
Di-*n*-decyl phthalate	10/175
Dinonyl phthalate	20/150
Ethylene glycol adipate	100/225
Ethylene glycol phthalate	100/200
Ethylene glycol succinate	100/200
FFAP	50/250
Fluorad FC-431, 50% solution in ethyl acetate	40/200
Hallcomid M-18-OL	8/150
Halocarbon 10-25	20/100
Halocarbon K-352	0/250
Halocarbon wax	50/150
Igepal® CO-880 (Nonoxynol)	100/200
Igepal CO-890	100/200
Krytox	-30/260
Neopentyl glycol adipate	50/225
Neopentyl glycol sebacate	50/225
Neopentyl glycol succinate	50/225
Nonoxynol (Igepal CO-880)	100/200
β,β-Oxydipropionitrile	0/75
OV-1, dimethyl (gum)	100/350
OV-1, vinyl	100/350
OV-3, phenyl methyl	0/350
OV-7, phenyl methyl dimethyl, 20% phenyl	0/350
OV-11, phenyl methyl dimethyl, 35% phenyl	0/350
OV-17, phenyl methyl, 50% phenyl	0/375

Phase	min./max. temp. (°C)
OV-22, phenyl methyl diphenyl, 65% phenyl	0/350
OV-25, phenyl methyl diphenyl, 75% phenyl	0/350
OV-61, diphenyl, 33% phenyl	0/350
OV-73, 5.5% diphenyl	0/325
OV-101, dimethyl (fluid)	0/350
OV-105, cyanopropyl methyl	0/275
OV-202, trifluoropropyl (fluid)	0/275
OV-210, trifluoropropyl (fluid)	0/275
OV-215, trifluoropropyl (gum)	0/275
OV-225, cyanopropyl methylphenyl methyl	0/265
OV-275, dicyanoallyl	25/250
OV-330, silicone - Carbowax	0/250
OV-351	50/270
OV-1701, vinyl	0/250
Phenyldiethanolamine succinate	0/230
Polethylene glycol adipate (EGA)	100/225
Polyphenyl ether (5 rings) OS-124	0/200
Polypropylene glycol	0/150
Rtx-1 (Rt-101)	0/350
Rt-1000	50/250
Rt-1200	25/200
Rt-1220	50/200
Rt-1500, Rt-1510	50/230
Rt-2100	0/350
Rt-2300	20/275
Rt-2330, Rt-2340	25/275
Rt-608Pkd	0/275
Rt-Sebaconitrile	25/110
Rt-XLSulfur	250 max.
SE-30, SE-52, SE-54	50/300
Silar 5 CP, Silar 10 CP	0/250
Sorbitol	150 max.
Squalane	20/100
Squalene	0/100
Stabilwax	40/240
Tetracyanoethylated pentaerythritol	30/175
THEED (Tetrahydroxyethlenediamine)	0/125
β,β-Thiodipropionitrile (TDPN)	100
Tricresyl phosphate	20/125
1,2,3-Tris (2-cyanoethoxy) propane (TCEP)	0/175
Triton X-100, Triton X-305	0/200
UC W982	0/300
UCON 50-HB-2000	0/200
UCON 50-HB-280-X	0/200
UCON 50-HB-5100	0/200
UCON HB-1800-X	200 max.
UCON LB-550-X	0/200
Versamid 900	190/275

Advantages of Using Restek® Packed Columns

- Reasonably priced.
- Low-bleed, long-lifetime bonded phases.
- Wide variety of supports and packings.
- Produced by experienced packed column chromatographers.



USP Liquid Phase & Solid Support Cross-Reference

Restek can meet all of your packed column needs for 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	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
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, ethylene 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	XE 60
G27	5% Phenyl-95% methylpolysiloxane	SE-52, Rtx-5
G28	25% Phenyl-75% methylpolysiloxane	DC 550
G29	3,3'-Thiodipropionitrile	TDPN
G30	Tetraethylene glycol dimethyl ether	Tetraethylene glycol dimethyl ether
G31	Nonylphenoxypoly(ethyleneoxy)ethanol (average ethyleneoxy chain length is 30): nonoxynol 30	Igepal CO 880
G32	20% Phenylmethyl-80% dimethylpolysiloxane	OV-7
G33	20% Carborane®-80% methylsilicone	Dexsil 300
G34	Diethylene glycol succinate polyester stabilized with phosphoric acid	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
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	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
S1D	Crushed firebrick, calcined or burned with a clay binder >900 °C, not acid-washed, may be silanized	Chromosorb PNAW
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 HayeSep P
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 acrylonitrite 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

Custom Coated Packing Materials



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 146 and the coating ranges are listed in the chart. Coated packings are available in minimum orders of 20 grams.

To order, please call your Restek representative for pricing and specify the following:

1) Stationary phase and stationary phase concentration.

2) Support and support mesh size.

3) Amount of packing needed.

Ordering Example: (1%) (XE-60) (CarboBlack B (80/120) (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

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, OV®-1701, and XE-60. Call your Restek representative for pricing.

Customized Solutions

Restek builds to your exact specifications.

Request columns at

www.restek.com/**packed**



Custom Packed/Micropacked Columns

Custom Packed Columns

To order, specify the following:

1) Column dimensions (length, ID) and tubing material.
2) Packing description (percent coating and phase, support mesh size, and treatment).
3) Column configuration (instrument manufacturer, model number, on-column injection or not) and with or without nuts and ferrules.

Ordering Example: (6' x 1/8") (stainless steel) (1%) (XE-60) (CarboBlack B 80/120) (Agilent 6890) (on-column injection) (fittings kit)

Please use the custom order form on page 150 or visit **www.restek.com/packed**

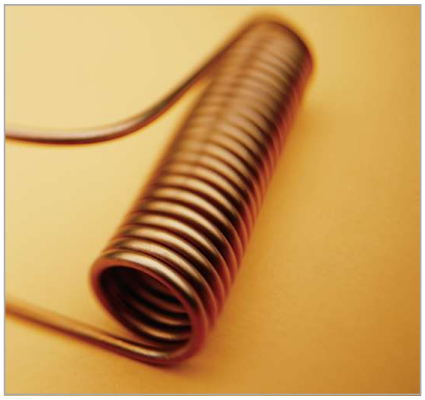
Custom Micropacked Columns

To order, contact your Restek representative and specify the following:

1) Physical dimensions (length, OD, ID, and tubing material).
2) Packing description (percent coating and phase, support mesh size).
3) Installation kit (see page 142), 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 150 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.

ordering note

For international pricing on custom packed or micropacked columns, please contact your Restek representative.

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 • 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 International Technical Service at intltechsupp@restek.com or find a local distributor at **www.restek.com/distributor**

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_____" void
   Do 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**
1/4" brass nuts
1/4" to 1/8" V/G reducing ferrules
No additional charge

❍ **KIT 2S**
1/4" brass nuts
1/4" to 3/16" V/G reducing ferrules
No additional charge

❍ **KIT A**
1/8" brass nuts
1/8" V/G ferrules
No additional charge

❍ **KIT B**
1/8" brass nuts
1/8" brass front & back ferrules
No additional charge
V/G = Vespel®/graphite

❍ **KIT C**
1/8" stainless steel nuts
1/8" stainless steel front & back ferrules
Additional charge

❍ **KIT D**
1/8" stainless steel nuts
1/8" V/G ferrules
Additional charge

❍ **KIT E**
1/4" stainless steel nuts
1/4" to 1/8" V/G reducing ferrules
Additional charge

❍ **KIT F**
1/4" stainless steel nuts
1/4" to 3/16" V/G reducing ferrules
Additional charge

❍ **KIT V**
1/8" VCR fitting
check appropriate circle:
❍ Stainless Steel (additional charge)
❍ Nickel (additional charge)

for a quote:

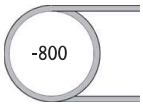
Complete this form and fax to Restek at 814-353-1309, or to your Restek representative.

This form is also available online at:

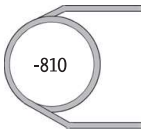
www.restek.com/**packed**

Standard Configurations (choose one)

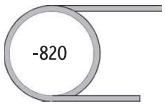
General Configuration



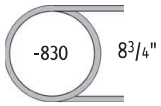
Agilent 5880, 5890, 5987, 6890, 7890



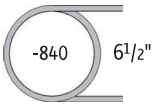
Bruker 430, 450 (Varian 3700, Vista Series, FID)



PE 900-3920, Sigma 1,2,3



PE Auto System 8300, 8400, 8700



-810	Agilent 5880, 5890, 5987, 6890, 7890	-851	Shimadzu 8A	-885	Pye Unicam 4500
-811	Agilent 6850	-852	Shimadzu 9A	-890	Gow Mac 590
-820	Scion (Bruker 430, 450) (Varian 3700,Vista Series, FID)	-853	Shimadzu 17A, 2010	-891	Gow Mac 550
-821	Scion (Bruker 430, 450) (Varian 3800)	-854	Shimadzu Mini 2	-892	Gow Mac 750
-830	PerkinElmer 900-3920, Sigma 1,2,3	-860	Thermo Scientific - TRACE 2000	-893	Gow Mac 816 (3" coil, 3" spread on the arms, and a total height of 5")
-840	PerkinElmer Auto System 8300, 8400, 8700, Clarus 500 (C500)	-865	Carlo Erba	-894	Gow Mac 580
-841	PerkinElmer Auto Sys XL	-870	Tremetrics/Tracor	-895	SRI 8610C
-845	ABB 3100, AAI (4" coil)	-874	HNU 310 & 311 (4.5" coil)	-895R	SRI 8610C Dual GC Right Side
-850	Shimadzu 14A, 2014	-875	Analytical Controls Configuration	-895L	SRI 8610C Dual GC Left Side
		-880	Carle 40030	-896	SRI 9300
		-881	Hitachi 263		

Custom Configurations (Please provide dimensions on order form, page 150, or at **www.restek.com/packed**)

Figure 1

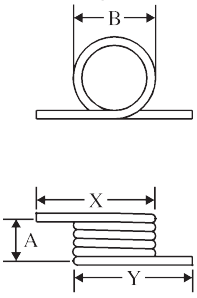


Figure 2

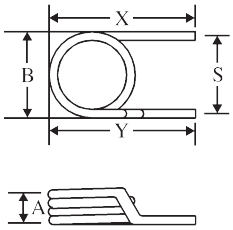


Figure 3

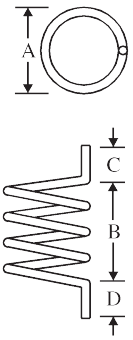


Figure 4

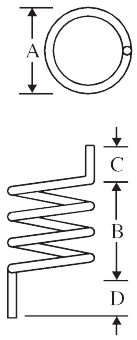


Figure 5

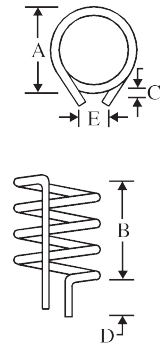


Figure 6

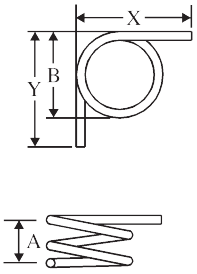


Figure 7

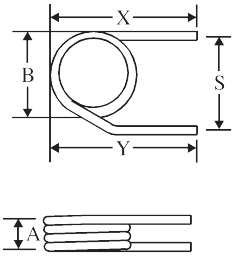


Figure 8

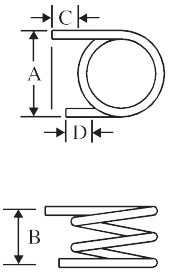


Figure 9

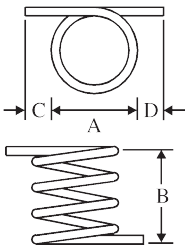


Figure 10

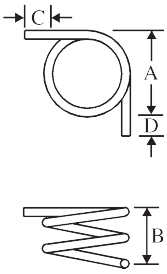


Figure 11

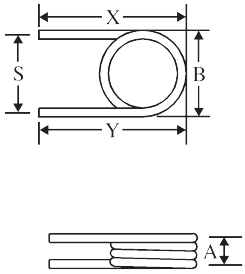


Figure 12

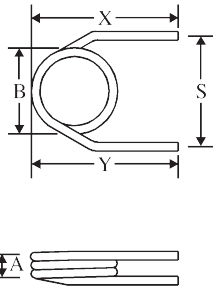


Figure 13

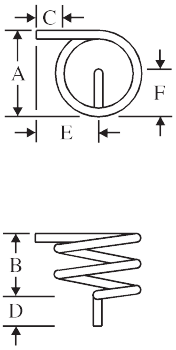


Figure 14

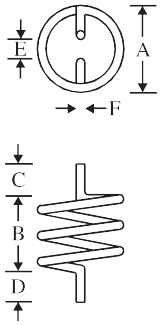


Figure 15

