

GC Columns

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GC COLUMNS

CAPILLARY COLUMNS

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Top: Henry Knepp and Tim Wilson, Manufacturing Technicians
Bottom: Trisha Houser, Quality Assurance



Selecting a GC Column

Several simple principles can be used to simplify the selection process and find the correct column for the analytical task at hand. When selecting the proper capillary column, the chromatographer is faced with choices that require informed decisions when optimizing analysis speed, retention or capacity, and resolution. These three analysis goals are affected by several factors or variables that are contained in the resolution equation:

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

↑ Efficiency
 ↑ Retention
 ↑ Selectivity

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

The resolution equation is divided roughly into three sections consisting of variables affecting selectivity, efficiency, and capacity or retention. Looking at how each section of the resolution equation influences the analytical separation will make column selection less difficult.



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 pictured: Steve Allison, Lisa Pantzar, Jarl Snider, Mike Wittrig,
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Selectivity, α

The selectivity of the capillary column is directly related to how the analyte molecule interacts with the stationary phase being considered. If the analyte strongly interacts with the stationary phase, it can be said that strong “intermolecular” forces exist. These intermolecular forces of attraction of the analyte for the stationary phase are a function of the structure of both the analyte molecule and the stationary phase. If these two structures are similar, then these attractive forces for one another are strong. If they are weak, then analyte to stationary phase attraction is weak, and retention is less. Therefore, when selecting a stationary phase, knowledge of the structure of the analytes of interest and the stationary phase is crucial. Table II provides the chemical structure of Restek’s most common stationary phases.

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

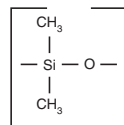
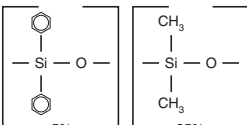
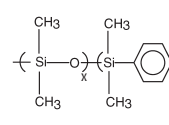
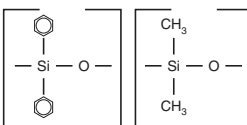
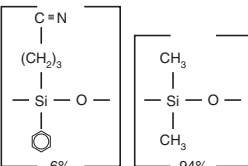
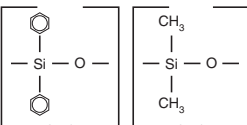
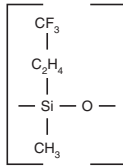
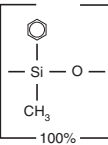
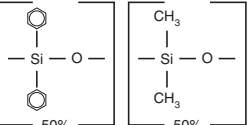
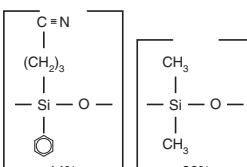
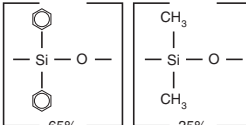
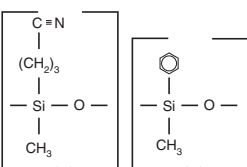
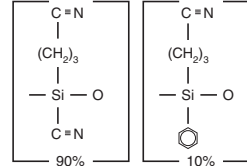
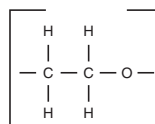
As methyl groups are replaced by different functionalities such as phenyl or cyanopropyl pendant groups, the selectivity of the column shifts towards compounds that will have a better solubility in the stationary phase. For example the Rtx®-200 stationary phase provides high selectivity for analytes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

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

Table I Retention indices for Restek phases

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

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

| | | | |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Rxi®-1ms, Rtx®-1 100% dimethyl polysiloxane</p>  <p>100%</p> <p>Polarity: nonpolar Uses: solvents, petroleum products, pharmaceutical samples, waxes [G1]</p> | <p>Rxi®-5ms, Rtx®-5, Rtx®-5MS 5% diphenyl 95% dimethyl polysiloxane</p>  <p>5% 95%</p> <p>Polarity: slightly polar Uses: flavors, environmental, aromatic hydrocarbons [G27]</p> | <p>Rxi®-5Sil MS, Rtx®-5Sil MS proprietary</p>  <p>Polarity: slightly polar Uses: flavors, environmental, pesticides, PCBs, aromatic hydrocarbons</p> | <p>Rtx®-20 20% diphenyl 80% dimethyl polysiloxane</p>  <p>20% 80%</p> <p>Polarity: slightly polar Uses: volatile compounds, alcohols [G32]</p> |
| <p>Rtx®-1301, Rtx®-624, Rtx®-G43 6% cyanopropylphenyl 94% dimethyl polysiloxane</p>  <p>6% 94%</p> <p>Polarity: slightly polar Uses: volatile compounds, insecticides, residue solvents in pharmaceutical products [G43]</p> | <p>Rtx®-35 35% diphenyl 65% dimethyl polysiloxane</p>  <p>35% 65%</p> <p>Polarity: intermediately polar Uses: pesticides, Aroclor PCBs, amines, nitrogen-containing herbicides [G42]</p> | <p>Rtx®-200 trifluoropropylmethyl polysiloxane</p>  <p>Polarity: selective for lone pair electrons Uses: environmental, solvents, Freon® gases, drugs, ketones, alcohols [G6]</p> | <p>Rtx®-50 100% methylphenyl polysiloxane</p>  <p>100%</p> <p>Polarity: intermediately polar Uses: FAMES, carbohydrates [G3]</p> |
| <p>Rxi®-17 50% diphenyl 50% dimethyl polysiloxane</p>  <p>50% 50%</p> <p>Polarity: intermediately polar Uses: triglycerides, phthalate esters, steroids, phenols [G3]</p> | <p>Rtx®-1701 14% cyanopropylphenyl 86% dimethyl polysiloxane</p>  <p>14% 86%</p> <p>Polarity: intermediately polar Uses: pesticides, Aroclor PCBs, alcohols, oxygenates [G46]</p> | <p>Rtx®-65TG 65% diphenyl 35% dimethyl polysiloxane</p>  <p>65% 35%</p> <p>Polarity: intermediately polar Uses: triglycerides, rosin acids, free fatty acids</p> | <p>Rtx®-225 50% cyanopropylmethyl 50% phenylmethyl polysiloxane</p>  <p>50% 50%</p> <p>Polarity: polar Uses: FAMES, carbohydrates [G7]</p> |
| <p>Rt®-2330 90% biscyanopropyl 10% cyanopropylphenyl polysiloxane</p>  <p>90% 10%</p> <p>Polarity: polar Uses: cis/trans FAMES, dioxin isomers, rosin acids [G48]</p> | <p>Stabilwax®, Rtx®-Wax Carbowax® PEG</p>  <p>Polarity: polar Uses: FAMES, flavors, acids, amines, solvents, xylene isomers [G16]</p> | | |

ordering note

Designations in [brackets] are USP codes. We recommend this phase when your application calls for this code.



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Retention, k

The capacity of the column relates to how much material a column can chromatograph without adversely affecting peak shape. If the amount of a compound (mass) exceeds the capacity of a wall coated open tubular column (WCOT), the peak will front, i.e., the column will exhibit peak symmetry of less than 1, a characteristic "shark fin" shaped peak. The goal is to select a column with sufficient capacity such that peak shape will not suffer.

There are two primary column-related dimensions that affect capacity, assuming the proper column phase was selected: column internal diameter (ID) and phase film thickness (μ).

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

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

Table III Typical column characteristics

| Characteristic | Column ID | | | | |
|---------------------------------------------|-------------|------------|------------|------------|-------------|
| | 0.10mm | 0.18mm | 0.25mm | 0.32mm | 0.53mm |
| Helium Flow (@ 20cm/sec.) | 0.05mL/min. | 0.3mL/min. | 0.7mL/min. | 1.2mL/min. | 2.6mL/min. |
| Hydrogen Flow (@ 40cm/sec.) | 0.09mL/min. | 0.6mL/min. | 1.4mL/min. | 2.4mL/min. | 5.2mL/min. |
| Sample Capacity (max load per component) | <10ng | <50ng | 50–100ng | 400–500ng | 1000–2000ng |
| Theoretical Plates/Meter | 8000 | 3700 | 2700 | 2100 | 1300 |

Efficiency, N

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

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

What Are the Operating Temperatures for My Column?

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

Rtx®-VMS (fused silica)

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

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

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

Selection of Capillary Column Summary

Selecting a capillary column for an analysis can be done by utilizing the resources available. This includes the following steps:

1) Choose the proper phase for the compounds being chromatographed

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

2) Select column ID, film thickness, and length

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

3) Set optimum parameters for your analysis

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



need **more** help?

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

Columns by Phase

| Restek | Phase Composition | USP | | | | | | | | |
|-----------------------------------------|-----------------------------------------------------------|----------------------------|-----------------------------------------|-----------------------------------------------|--------------------|----------------------|----------------------------|---------------------------------|-------------|-----------------------|
| | | Nomenclature* | Agilent | Varian | SGE | Phenomenex | Macherey-Nagel | Supelco | Alltech | Quadrex |
| Rtx-1 (p. 47) | 100% dimethyl polysiloxane | G1, G2, G38 | HP-1 / DB-1 | CP Sil 5 CB | BP-1 | ZB-1 | Optima-1 | SPB-1 | AT-1 | 007-1 |
| Rxi-1ms (p. 40) | 100% dimethyl polysiloxane (low bleed) | | HP-1/ HP-1ms DB-1/ DB-1ms Ultra-1 | VF-1ms / CP-Sil 5 CB Low Bleed/MS | | ZB-1ms | Optima-1/ Optima-1ms | SPB-1, Equity-1 | AT-1 | 007-1 |
| Rtx-5 (p. 48, 76) | 5% diphenyl 95% dimethyl polysiloxane | G27, G36 | HP-5/ DB-5 | CP-Sil 8 / CP Sil 8 CB | BP-5 | ZB-5 | Optima-5 | SPB-5 | AT-5 | 007-2 |
| Rxi-5HT (p. 44) | 5% phenyl 95% dimethyl polysiloxane | | DB-5HT | VF-5HT | | ZB-5HT | | | | |
| Rxi-5ms (p. 41) | 5% diphenyl 95% dimethyl polysiloxane (low bleed) | G27, G36 | HP-5/ HP-5ms DB-5, Ultra-2 | | | | | SPB-5, Equity-5 | AT-5ms | 007-2 |
| Rxi-5Sil MS (p. 42, 78, 88) | 5% phenyl arylene 95% dimethyl polysiloxane | | DB-5ms | VF-5ms / CP-Sil 8 CB Low Bleed/MS | BPX-5 | ZB-5ms | Optima-5ms | SLB-5 | | |
| Rxi-XLB (p. 44, 85) | Arylene/methyl modified polysiloxane | | DB-XLB | VF-XMS | | MR1 | | | | |
| Rtx-20 (p. 49) | 20% diphenyl 80% dimethyl polysiloxane | G28, G32 | | | | | | SPB-20 | AT-20 | 007-7 |
| Rtx-35 (p. 49) | 35% diphenyl 65% dimethyl polysiloxane | G42 | HP-35, DB-35 | VF-35ms | BPX-35, BPX-608 | ZB-35 | | SPB-35, SPB-608 | AT-35 | 007-11 |
| Rxi-35Sil MS (p. 44) | 35% phenyl arylene polysiloxane | | DB-35ms | | | MR2 | | | | |
| Rtx-50 (p. 50) | 100% phenyl methyl polysiloxane (50% phenyl) | G3 | HP-50 | | AT-50 | | Optima-17 | SPB-50 | AT-50 | 007-17 |
| Rxi-17 (p. 45) | 50% diphenyl 50% dimethyl polysiloxane | | HP-17, DB-17 | CP-Sil 24 CB / VF-17ms | | ZB-50 | | | | |
| Rtx-65 (p. 50) | 65% diphenyl 35% dimethyl polysiloxane | G17 | | | | | | | | 400-65HT, 007-65HT |
| Rtx-1301 (p. 53, 74) Rtx-624 (p. 74) | 6% cyanopropyl phenyl 94% dimethyl polysiloxane | G43 | HP-1301, HP-624, DB-1301, DB-624 | CP-1301, VF-1301ms, VF-624ms | BP-624 | ZB-624 | Optima-1301, Optima-624 | SPB-1301 | AT-624 | 007-1301 |
| Rtx-1701 (p. 54) | 14% cyanopropyl phenyl 86% dimethyl polysiloxane | G46 | HP-1701, PAS-1701, DB-1701 | CP Sil 19 CB, VF-1701ms | BP-10 | ZB-1701, ZB-1701P | Optima-1701 | SPB-1701 | AT-1701 | 007-1701 |
| Rtx-200 (p. 52) | trifluoropropyl methyl polysiloxane | G6 | DB-210, DB-200 | VF-200ms | | | Optima-210 | | AT-210 | 007-210 |
| Rtx-200ms (p. 52) | trifluoropropyl methyl polysiloxane (low bleed) | | | VF-200ms | | | | | | |
| Rtx-225 (p. 53) | 50% cyanopropyl 50% phenylmethyl polysiloxane | G7, G19 | HP-225, DB-225 | CP Sil 43 CB | BP-225 | | Optima-225 | | AT-225 | 007-225 |
| Rtx-440 (p. 51) | modified polysiloxane (unique phase) | | unique column | | | | | | | |
| Rt-2330 (p. 55) | 90% biscyanopropyl 10% cyanopropyl phenyl polysiloxane | G48 | | | BPX-70 | | | SP-2330, SP-2331, SP-2380 | AT-Silar | |
| Rt-2560 (p. 55) | bicyanopropyl polysiloxane | | HP-88 | CP Sil 88 | | | | SP-2560 | | |
| Rtx-Wax (p. 56) | polyethylene glycol | G14, G15, G16, G20, G39 | HP-Wax, DB-Wax | CP Wax 52 CB | BP-20 | ZB-Wax | Optima Wax | | AT-Wax | |
| Stabilwax (p. 57, 75) | polyethylene glycol | G14, G15, G16, G20, G39 | Innowax | CP Wax 52 CB | | | | Supelcowax-10 | | |
| Restek | Phase Composition | USP Nomenclature | Agilent | Varian | SGE | Phenomenex | Macherey-Nagel | Supelco | Alltech | Quadrex |
| Rt-Alumina BOND (p. 98) | Na ₂ SO ₄ deactivation | | GS-Alumina, HP PLOT S | CP-AL203 / Na ₂ SO ₄ | | | | Alumina-PLOT | AT-Alumina | |
| Rt-Msieve 5A (p. 99) | | | GS-Msieve, HP PLOT Molsieve | CP-Molsieve 5A | | | | Molsieve 5A | AT-Molsieve | PLT-5A |
| Rt-Q-BOND (p. 100) | 100% divinylbenzene | | | CP-PoraPLOT Q, CP-PoraBond Q | | | | Supel-Q-PLOT | AT-Q | |
| Rt-QS-BOND (p. 100) | porous divinyl benzene homopolymer | | GS-Q | | | | | | | |
| Rt-S-BOND (p. 100) | divinylbenzene 4-vinylpyridine | | | CP-PoraPLOT S | | | | Supel-G45 | | |
| Rt-U-BOND (p. 100) | divinylbenzene ethylene glycol/dimethylacrylate | | HP-PLOT U | CP-PoraPLOT U, CP-PoraBond U | | | | Supel-N PLOT | | |

*See page 129 for our USP Liquid Phase and Solid Support Cross-Reference.

Columns by Application

| Restek | Applications | Agilent | Supelco | Macherey-Nagel | SGE | Varian | Phenomenex |
|--------------------------------------------------|-------------------------------------------------------------------|----------------------------------|--------------------------------|-----------------------------|----------|----------------------------|------------|
| Specially deactivated phases | | | | | | | |
| Rtx-5Amine (p. 59) | Amines | | | | | CP-Sil 8 CB | |
| Rtx-35Amine (p. 60) | Amines | unique column | | | | | |
| Stabilwax-DB (p. 61) | Amines | CAM | Carbowax Amine | | | CP WAX 51 | |
| Stabilwax-DA (p. 62) | Free acids | HP-FFAP, DB-FFAP | Nukol | PermaBond FFAP, Optima FFAP | BP-21 | CP WAX 58 CB | |
| Chiral Columns | | | | | | | |
| Rt-βDEXm (p. 63) | Chiral | | | | | | |
| Rt-βDEXsm (p. 63) | Chiral | | | | | | |
| Rt-βDEXse (p. 63) | Chiral | | | | | | |
| Rt-βDEXsp (p. 63) | Chiral | | | | | | |
| Rt-βDEXsa (p. 63) | Chiral | | | | | | |
| Rt-βDEXcst (p. 63) | Chiral | | | | | | |
| Rt-γDEXsa (p. 63) | Chiral | | | | | | |
| Foods, Flavors, & Fragrances | | | | | | | |
| Rt-2560 (p. 64) | cis/trans FAMES | HP-88 | SPB-2560 | | | | |
| FAMEWAX (p. 65) | Marine oils | | Omegawax | | | | |
| Rt-CW20M F&F (p. 66) | Flavors & fragrance | HP-20m, CarboWax 20 | | | BP-20M | 007-CW | |
| Rtx-1 F&F (p. 66) | Flavors & fragrance | | | | | | |
| Rtx-65 TG (p. 67) | Triglycerides | unique column | | | | | |
| Petrochemical | | | | | | | |
| Rtx-1PONA (p. 68) | Detailed hydrocarbon analysis | HP-PONA, DB-Petro | Petrocol DH | | BP1-PONA | CP Sil PONA CB | |
| Rtx-2887 (p. 69) | Hydrocarbons - ASTM 2887 | DB-2887 | Petrocol 2887, Petrocol EX2887 | | | | |
| MXT-2887 (p. 69,106) | Hydrocarbons - ASTM 2887 | | | | | | |
| D3606 (p. 118) | Ethanol - ASTM 3606 | unique column | | | | | |
| Rt-TCEP (p. 71) | | | TCEP | | | CP-TCEP | |
| MXT-1 Sim Dist (p. 70,107) | Simulated distillation | DBHT-SMD | | | | CP-SIMDIST | |
| MXT-500 Sim Dist (p. 70,107) | Simulated distillation | unique column | | | | | |
| Rtx-Biodiesel TG (p. 72) | Triglycerides in biodiesel | unique column | | | | | |
| MXT-Biodiesel TG (p. 72,107) | | unique column | | | | | |
| Clinical/Forensic - Blood Alcohol Testing | | | | | | | |
| Rtx-BAC1 (p. 73) | Blood alcohol testing | DB-ALC1 | | | | | |
| Rtx-BAC2 (p. 73) | Blood alcohol testing | DB-ALC2 | | | | | |
| Pharmaceutical | | | | | | | |
| Rtx-G27 w/IntegraGuard (p. 77) | Organic volatile impurities (OVI) - USP 467 | | | | | | |
| Rtx-G43 w/IntegraGuard (p. 77) | Organic volatile impurities (OVI) - USP 467 | | OVI-G43 | | | | |
| Rtx-1301 (p. 53, 74) | Organic volatile impurities (OVI) - USP 467 | HP-1301, HP-624, DB-1301, DB-624 | SPB-1301 | | BP-624 | CP-1301, VF-1301ms, VF-624 | ZB-624 |
| Rtx-624 (p. 74, 93) (G43) | | | | | | | |
| Rtx-5 (p. 48, 76) (G27) | Organic volatile impurities (OVI) - USP 467 | HP-5/ DB-5 | SPB-5, Equity-5 | Optima-1301, Optima-624 | BP-5 | CP-Sil 8, CP Sil 8 CB | ZB-5 |
| Stabilwax (p. 57, 75) (G16) | Organic volatile impurities (OVI) - USP 467 | Innowax | Supelcowax-10 | | BP-624 | CP Wax 52 CB | |
| Environmental | | | | | | | |
| Rxi-5Sil MS (p. 42, 78, 88) | Semivolatiles - EPA Methods 8270, 625, 525 | DB-5ms | SLB-5 | Optima-5ms | | VF-5ms | |
| Rtx-VMS (p. 90) | Volatiles - EPA Methods 8260, 624, 524 | unique column | | | | | |
| Rtx-624 (p. 74, 93) | Volatiles - EPA Method 624 | HP-624, DB-624 | SPB-1301 | Optima-624 | | VF-1301ms | ZB-624 |
| Rtx-502.2 (p. 92) | Volatiles - EPA Methods 8010, 8020, 502.2, 601, 602 | DB-502.2 | VOCOL | | | | |
| Rtx-VRX (p. 91) | Volatiles - EPA Methods 8010, 8020, 502.2, 601, 602 | DB-VRX | | | | | |
| Rtx-CLPesticides (p. 80) | Organochlorine pesticides - EPA Methods 8081, 8082, 608, 505, 508 | unique column | | | | | |
| Rtx-CLPesticides2 (p. 80) | Organochlorine pesticides - EPA Methods 8081, 8082, 608, 505, 508 | unique column | | | | | |
| Stx-CLPesticides (p. 82) | Organochlorine pesticides - EPA Methods 8081, 8082, 608, 505, 508 | unique column | | | | | |
| Stx-CLPesticides2 (p. 82) | Organochlorine pesticides - EPA Methods 8081, 8082, 608, 505, 508 | unique column | | | | | |
| Rtx-1614 (p. 83) | Brominated flame retardants | unique column | | | | | |
| Rtx-PCB (p. 84) | Polychlorinated biphenyl - EPA Methods 8082, 608, PCB congeners | unique column | | | | | |
| Rxi-XLB (p. 44, 85) | Polychlorinated biphenyl - EPA Methods 8082, 608, PCB congeners | DB-XLB | | | | VF-XMS | |
| Rtx-OPPesticides (p. 79) | Organophosphorus pesticides - EPA Method 8141 | unique column | | | | | |
| Rtx-OPPesticides2 (p. 79) | Organophosphorus pesticides - EPA Method 8141 | unique column | | | | | |
| Rtx-Dioxin2 (p. 87) | Dioxin & Furans - EPA Methods | unique column | | | | | |
| Rtx-Dioxin (p. 86) | Dioxin & Furans - EPA Methods | unique column | | | | | |
| Rt-PAH (p. 89) | Polycyclic aromatic hydrocarbons | unique column | | | | | |
| Rtx-TNT & Rtx-TNT2 (p. 93) | Explosives - EPA Method 8095 | unique column | | | | | |



Trisha Houser, Quality Assurance



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

GC Column Installation Checklist

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

Instrument Preparation & Column Installation

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

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

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

Standby Conditions

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

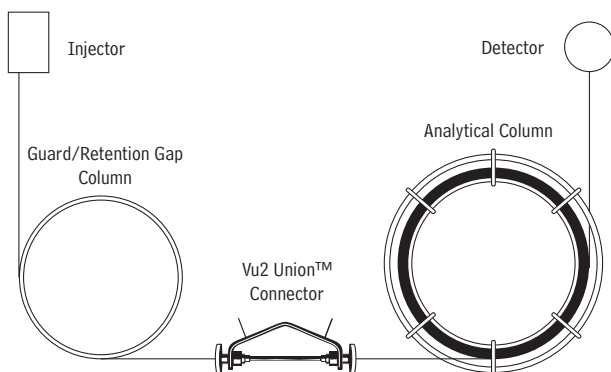
Long-Term: remove the column from the GC and seal the ends by gently and carefully pushing each end into the curved edge of a septum. Store the column in the original box away from strong lighting.

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

Guard Columns and Retention Gaps

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

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



please note

For superior inertness, try our Siltek® guard columns!
See [page 31](#) for details.

Having trouble making a leak-free connection?
Try our “built in” Integra-Guard™ columns!
See [page 33](#) for details.

Analyte Focusing

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

For cool on-column injection, the purpose of a retention gap is to help focus the sample components when introducing a liquid sample directly into the retention gap. The cool on-column injection is performed by inserting the syringe needle into the retention gap (this can be accomplished with a 0.53mm ID retention gap and a 26s gauge syringe) and transferring the liquid sample directly into the retention gap. The injection is made with the injector and column oven set below the boiling point of the solvent. As the solvent is evaporated, the volatile target analytes migrate in the solvent towards the analytical column, and the heavier analytes will be distributed over the retention gap. As the oven temperature increases, the target analytes vaporize and move unretained down the retention gap column until the compounds reach the liquid stationary phase of the analytical column. At this juncture, the target analytes are trapped/focused by the liquid phase and form 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, next page). As the oven temperature is increased, the solvent and target compounds are vaporized and move unretained through the retention gap (Figure 2b, next page). When the target compounds come in contact with the stationary phase, they are refocused in a narrow band (Figure 2c, next page), improving the chromatography.

did you know?

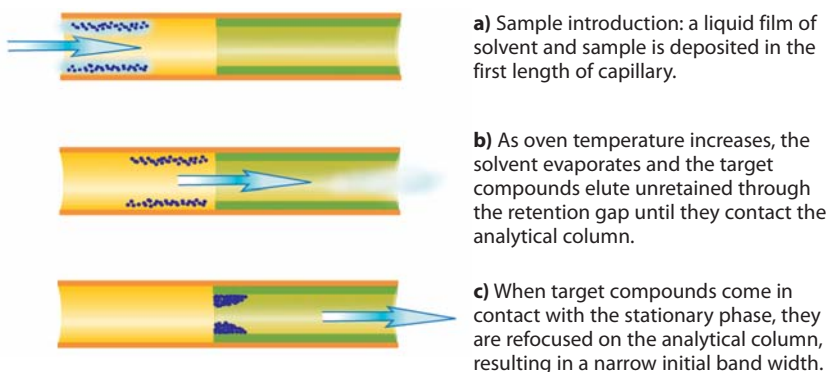
We test our guard columns/ transfer lines with the Grob test mix to ensure high inertness.



it's a **fact**

To eliminate connections, use our unique Integra-Guard™ Column. See [page 33](#).

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



Protecting the Analytical Column

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

Contamination can cause active sites as well as change the conditions of the focusing zone of the analytical column. Both conditions will adversely affect the chromatography. Another advantage of the guard column is when a section is removed for maintenance the resolution of closely eluting compounds will not be affected because the guard column is not a contributor to the resolving power of the analytical column. This allows for a longer lifetime of the analytical column, and replacing only the guard column when it becomes too short.

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

What type of guard column should be used?

When using a guard column, it is important to match the polarity of the solvent and the polarity of the surface deactivation. Rxi® Guard tubing is good for a wide variety of applications and allows most common solvents (methylene chloride, hexane, isooctane, toluene) to easily wet and create a uniform film on the tubing surface. If more polar solvents such as methanol or water are used, a polar-deactivated guard column is recommended to allow the solvent to wet the tubing surface. Polar-deactivated guard columns are not resistant to harsh “water vaporization” that 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 beading of the solvent if the oven temperature is 20°C below the solvent boiling point.

Siltek® deactivation creates a highly inert surface for very active compounds such as chlorinated and organophosphorus pesticides. Base-deactivated guard columns reduce adsorption and tailing for amines and other basic compounds.

How is a guard column connected to the analytical column?

To connect the guard column to the analytical column, Vu2-Union™, Press-Tight®, and other connectors are available. MXT™ unions, typically used for connecting metal columns together, are now available for fused silica columns. See pages 215 to 219 for information about these connectors.

Connectors for Fused Silica Columns



Vu2 Union™ Connector



Press-Tight® Connector



MXT™ Union Connector Kit for Fused Silica

Rxi® Guard/Retention Gap Columns (Fused Silica)

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

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

Intermediate-Polarity Deactivated Guard/Retention Gap Columns/Transfer Lines (Fused Silica)

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

- Useful for a wide range of applications.
- Use with most common solvents.
- Maximum temperature: 325°C

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

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

Siltek®-Deactivated Guard/Retention Gap Columns/Transfer Lines (Fused Silica)

Tested with the Grob test mix, to ensure high inertness.

- Revolutionary deactivation process for superior inertness.
- Analyze active samples accurately; ideal for chlorinated pesticide analysis (reduces endrin breakdown to less than 1%).
- Maximum temperature: 380°C.

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

Polar-Deactivated Guard/Retention Gap Columns (Fused Silica)

Tested with the Grob test mix, to ensure high inertness.

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

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

*Not tested with the Grob test mix because of a large pressure drop.

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

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

it's a **fact**

To eliminate connections, use an Integra-Guard™ Column. See **page 33**.

also **available**

MXT® Guard/Retention Gap Columns

Rugged, flexible, Siltek® treated stainless steel tubing; inertness comparable to fused silica tubing. See **page 104** for our Intermediate-Polarity Deactivated MXT® Guard/ Retention Gap Columns/ Transfer Lines.

it's a **fact**

Use guard columns to:

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



did you **know?**

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



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, and Stabilwax®-DB capillary columns.
- Batch test chromatogram included.
- Maximum temperature: 315°C.

Chemists using guard columns in 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 for completely inert sample pathways.

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

did you know?

We test our guard columns/ transfer lines with the Grob test mix to ensure high inertness.

Hydroguard™ Water-Resistant Guard/Retention Gap Columns/Transfer Lines (Fused Silica)

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

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

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

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

also available

MXT® Guard Columns

Rugged, flexible, Siltek® treated stainless steel tubing; inertness comparable to fused silica tubing. See [page 104](#) for our Hydroguard™ MXT® Guard Tubing/Transfer Lines.

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

*Not tested with the Grob test mix because of a large pressure drop.

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

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

best choice

Siltek® treated tubing (cat.# 22505, [page 244](#)) is recommended for purge and trap transfer lines.

Innovative Integra-Guard™ Columns

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

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

| Description | qty. | cat.# | price |
|---------------------------------------------------------------------|------|-----------|---------|
| Rtx-1 | | | |
| 30m, 0.25mm ID, 0.25µm Rtx-1 w/5m Integra-Guard Column | ea. | 10123-124 | |
| 30m, 0.53mm ID, 1.00µm Rtx-1 w/5m Integra-Guard Column | ea. | 10155-126 | |
| 30m, 0.53mm ID, 5.00µm Rtx-1 w/5m Integra-Guard Column | ea. | 10179-126 | |
| Rtx-5 | | | |
| 30m, 0.25mm ID, 0.25µm Rtx-5 w/5m Integra-Guard Column | ea. | 10223-124 | |
| 30m, 0.25mm ID, 0.25µm Rtx-5 w/10m Integra-Guard Column | ea. | 10223-127 | |
| 30m, 0.25mm ID, 1.00µm Rtx-5 w/5m Integra-Guard Column | ea. | 10253-124 | |
| 30m, 0.32mm ID, 0.25µm Rtx-5 w/5m Integra-Guard Column | ea. | 10224-125 | |
| 30m, 0.32mm ID, 1.00µm Rtx-5 w/5m Integra-Guard Column | ea. | 10254-125 | |
| 30m, 0.53mm ID, 5.00µm Rtx-5 w/5m Integra-Guard Column (Rtx-G27) | ea. | 10279-126 | |
| 60m, 0.32mm ID, 0.25µm Rtx-5 w/5m Integra-Guard Column | ea. | 10227-125 | |
| Rtx-5MS | | | |
| 15m, 0.25mm ID, 0.25µm Rtx-5MS w/5m Integra-Guard Column | ea. | 12620-124 | |
| 15m, 0.25mm ID, 0.50µm Rtx-5MS w/10m Integra-Guard Column | ea. | 12635-127 | |
| 30m, 0.25mm ID, 0.10µm Rtx-5MS w/5m Integra-Guard Column | ea. | 12608-124 | |
| 30m, 0.25mm ID, 0.25µm Rtx-5MS w/5m Integra-Guard Column | ea. | 12623-124 | |
| 30m, 0.25mm ID, 0.25µm Rtx-5MS w/10m Integra-Guard Column | ea. | 12623-127 | |
| 30m, 0.25mm ID, 0.50µm Rtx-5MS w/5m Integra-Guard Column | ea. | 12638-124 | |
| 30m, 0.25mm ID, 0.50µm Rtx-5MS w/10m Integra-Guard Column | ea. | 12638-127 | |
| 30m, 0.32mm ID, 0.25µm Rtx-5MS w/5m Integra-Guard Column | ea. | 12624-125 | |
| 30m, 0.32mm ID, 1.00µm Rtx-5MS w/5m Integra-Guard Column | ea. | 12654-125 | |
| Rxi-5Sil MS | | | |
| 15m, 0.25mm ID, 0.25µm Rxi-5Sil MS w/10m Integra-Guard Column | ea. | 13620-127 | enquire |
| 30m, 0.25mm ID, 0.25µm Rxi-5Sil MS w/5m Integra-Guard Column | ea. | 13623-124 | |
| 30m, 0.25mm ID, 0.25µm Rxi-5Sil MS w/10m Integra-Guard Column | ea. | 13623-127 | |
| 30m, 0.25mm ID, 0.50µm Rxi-5Sil MS w/5m Integra-Guard Column | ea. | 13638-124 | |
| 30m, 0.25mm ID, 0.50µm Rxi-5Sil MS w/10m Integra-Guard Column | ea. | 13638-127 | |
| 30m, 0.32mm ID, 0.50µm Rxi-5Sil MS w/5m Integra-Guard Column | ea. | 13639-125 | enquire |
| Rtx-624 | | | |
| 30m, 0.25mm ID, 1.40µm Rtx-624 w/5m Integra-Guard Column | ea. | 10968-124 | |
| 30m, 0.32mm ID, 1.80µm Rtx-624 w/5m Integra-Guard Column | ea. | 10970-125 | |
| 30m, 0.53mm ID, 3.00µm Rtx-624 w/5m Integra-Guard Column | ea. | 10971-126 | |
| Rtx-1301 | | | |
| 30m, 0.53mm ID, 3.00µm Rtx-1301 w/5m Integra-Guard Column (Rtx-G43) | ea. | 16085-126 | |
| Rtx-1701 | | | |
| 30m, 0.25mm ID, 0.25µm Rtx-1701 w/5m Integra-Guard Column | ea. | 12023-124 | |
| Stabilwax | | | |
| 30m, 0.25mm ID, 0.25µm Stabilwax w/5m Integra-Guard Column | ea. | 10623-124 | |
| 30m, 0.32mm ID, 1.00µm Stabilwax w/5m Integra-Guard Column | ea. | 10654-125 | |
| 30m, 0.53mm ID, 1.00µm Stabilwax w/5m Integra-Guard Column | ea. | 10655-126 | |
| Rtx-BAC1 & Rtx-BAC2 | | | |
| 30-Meter, 0.32mm ID, 1.80µm Rtx-BAC1 w/5m Integra-Guard | ea. | 18003-125 | |
| 30-Meter, 0.32mm ID, 1.20µm Rtx-BAC2 w/5m Integra-Guard | ea. | 18002-125 | |
| 30-Meter, 0.53mm ID, 3.00µm Rtx-BAC1 w/5m Integra-Guard | ea. | 18001-126 | |
| 30-Meter, 0.53mm ID, 2.00µm Rtx-BAC2 w/5m Integra-Guard | ea. | 18000-126 | |

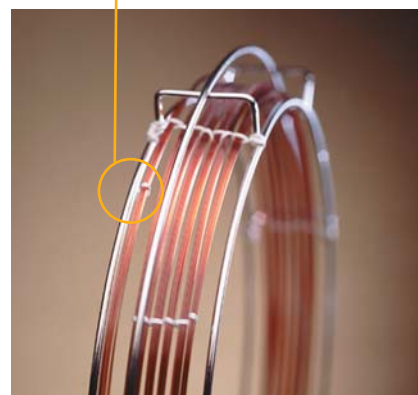
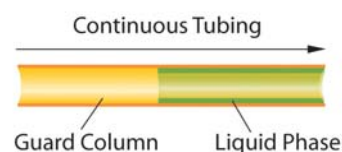
restek innovation!

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

similar products

DuraGuard, EZ-Guard, Guardian

Integra-Guard™ built-in guard column



Phases currently available as Integra-Guard™ columns

| | |
|--------------|----------------|
| Rtx®-1 | Rtx®-1701 |
| Rtx®-5 | Rtx®-Volatiles |
| Rtx®-5MS | Rtx®-20 |
| Rxi®-5Sil MS | Rtx®-35 |
| Rtx®-1301 | Rtx®-BAC 1 & 2 |
| Rtx®-624 | Stabilwax® |

Integra-Guard™ columns are available for all phases listed, for columns with 0.25, 0.32 or 0.53mm ID.

If you don't see what you need here, contact us.

Fast GC Using 0.10mm and 0.18mm ID Capillary Columns and Comprehensive GC

- Significantly reduces analysis time without sacrificing resolution.
- Highest column efficiencies, great for GC/MS.
- Excellent for comprehensive GC (GCxGC) as second dimension column.

Narrow bore (0.10mm ID) columns are attractive alternatives to conventional-diameter capillary columns because they provide faster analysis times and higher resolving power. As column ID decreases, column efficiency (plates/meter) greatly increases. For instance, a 0.18mm ID column (5,150 plates/meter) is much more efficient than a 0.25mm ID column (2,500 plates/meter). Therefore, resolution can be achieved with a shorter column, which decreases the analysis time. When switching from a 0.25mm ID column to a 0.10mm ID column (8,500 plates/meter), the improvement in column efficiency is even more dramatic.

Typically, 0.18mm ID columns are used for fast GC analysis, and methods are easily converted. The 0.10mm ID columns require more research to switch methods to the smaller ID due to higher back pressures and lower column capacity.

The outer diameter of the 0.10mm and 0.18mm ID tubing is the same as 0.25mm ID tubing, which makes connections less complicated.

Rxi®-1ms Columns (fused silica)

(Crossbond® 100% dimethyl polysiloxane)

| ID | df (µm) | temp. limits | 10-Meter | 20-Meter |
|--------|---------|------------------|----------|----------|
| 0.10mm | 0.10 | -60 to 330/350°C | 13301 | |
| 0.18mm | 0.18 | -60 to 330/350°C | | 13302 |

Stabilwax® Columns (fused silica)

(Crossbond® Carbowax® polyethylene glycol)

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

Rxi®-5ms Columns (fused silica)

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

| ID | df (µm) | temp. limits | 10-Meter | 20-Meter |
|--------|---------|------------------|----------|----------|
| 0.10mm | 0.10 | -60 to 330/350°C | 13401 | |
| 0.18mm | 0.18 | -60 to 330/350°C | | 13402 |
| | 0.30 | -60 to 330/350°C | | 13409 |
| | 0.36 | -60 to 330/350°C | | 13411 |

Rt®-LC50 Columns (fused silica)

| ID | df (µm) | temp. limits | 10-Meter |
|--------|---------|----------------|----------|
| 0.10mm | 0.10 | 100°C to 270°C | 19736 |
| 0.18mm | 0.10 | 100°C to 270°C | 19735 |

Rxi®-5Sil MS Columns (fused silica)

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

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

Rtx®-CLPesticides (fused silica)

| ID | df (µm) | temp. limits | 10-Meter | 20-Meter |
|--------|---------|------------------|----------|----------|
| 0.10mm | 0.10 | -60 to 310/330°C | 43101 | |
| 0.18mm | 0.18 | -60 to 310/330°C | 42101 | 42102 |

Rtx®-CLPesticides2 (fused silica)

| ID | df (µm) | temp. limits | 10-Meter | 20-Meter |
|--------|---------|------------------|----------|----------|
| 0.10mm | 0.10 | -60 to 310/330°C | 43301 | 43302 |
| 0.18mm | 0.14 | -60 to 310/330°C | 42301 | 42302 |

Rxi®-17 Columns (fused silica)

(Crossbond® 50% diphenyl/50% dimethyl polysiloxane)

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



Operating considerations for 0.10mm ID columns

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

GCxGC Selectivity Kit A

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

- Rxi®-17, 1.1m (±3cm), 0.10mm ID, 0.10µm, 50% diphenyl dimethylpolysiloxane
- Rtx®-CLPesticides, 1.1m (±3cm), 0.10mm ID, 0.10µm, trifluoropropyl containing polymer
- Stabilwax®, 1.1m (±3cm), 0.10mm ID, 0.10µm, polar polyethylene glycol
- Rt®-LC350, 1.1m (±3cm), 0.15mm ID, 0.10µm, liquid crystalline phase selective for aromatic compounds



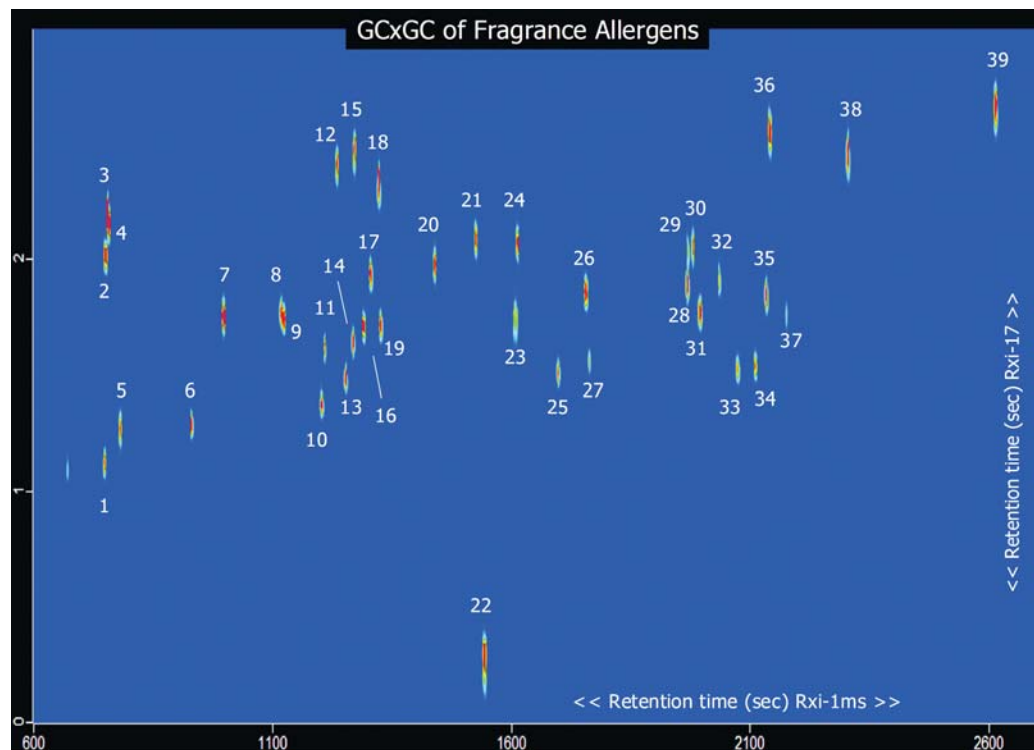
| Description | qty. | cat.# | price |
|-------------------------|------|-------|-------|
| GCxGC Selectivity Kit A | kit | 15105 | |

Columns can also be purchased individually.

| | | | |
|--------------------------------------------------|-----|-------|--|
| Rxi-17, 1.1m (±3cm), 0.10mm ID, 0.10µm | ea. | 15104 | |
| Rtx-CLPesticides, 1.1m (±3cm), 0.10mm ID, 0.10µm | ea. | 15103 | |
| Stabilwax, 1.1m (±3cm), 0.10mm ID, 0.10µm | ea. | 15102 | |
| Rt-LC350, 1.1m (±3cm), 0.15mm ID, 0.10µm | ea. | 15101 | |

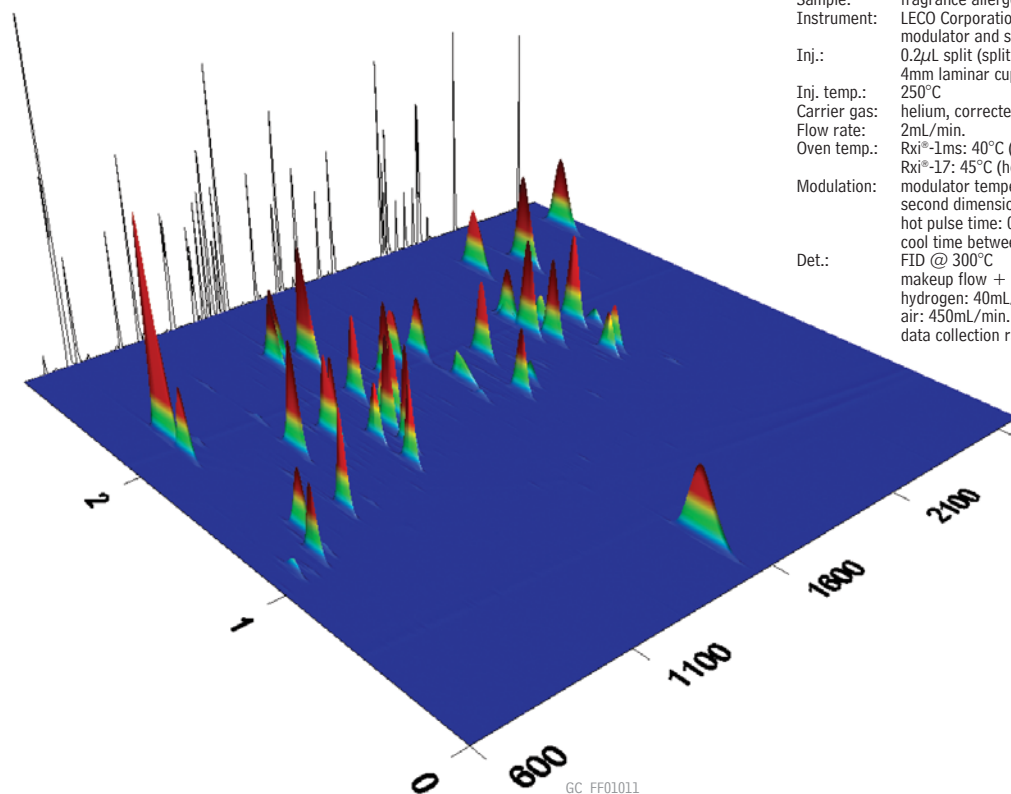


Fragrance Allergens on Rxi®-1ms & Rxi®-17 (GC x GC)



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

GC_FF01010

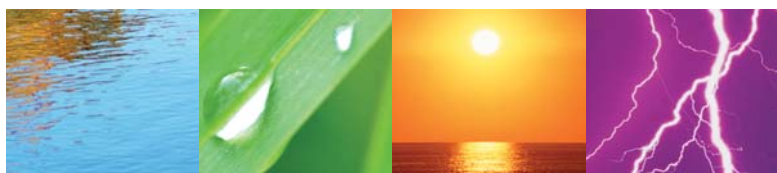


GC_FF01011

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

High-Performance Rxi[®] Columns

Exceptionally Inert Capillary Columns



Unsurpassed inertness

An Rxi[®] column's inertness allows analysis of active compounds at levels not attainable with other manufacturers' columns. Basic and acidic compounds can be analyzed on the same column, often under the same conditions.

Ultra-low bleed

Save time and money through faster baseline stabilization. With the lowest column bleed in the industry, Rxi[®] columns improve detection for trace level GC/MS analysis. Ultra-low bleed also reduces conditioning time after instrument maintenance.

Guaranteed reproducibility

Consistency is everything. With Rxi[®] column technology, we guarantee it: every new column will perform exactly as the column it replaces.

Unmatched performance

Every Rxi[®] column is held to stringent performance specifications for coating efficiency, selectivity, film thickness, inertness, and bleed. This guarantees you the most reliable columns available anywhere.



Restek's Exceptionally Inert Rxi® Capillary GC Columns

As GC detectors become more sensitive, accurately quantifying low concentrations of target compounds becomes much more challenging. We developed the Rxi® column line specifically to improve low-level quantification. Our goal was to develop a superior column that had the highest inertness, lowest bleed, and greatest reproducibility of any column available.

The exceptionally low bleed levels of Rxi® columns improve low-level analysis by reducing detector noise. This improves signal-to-noise ratios for low-level compounds leading to more accurate and reproducible results. A highly inert column improves results for active compounds by preventing adsorption of target analytes in the system. The inertness of Rxi® columns allows analysis of acidic and basic compounds on the same column—often under the same conditions—without the peak tailing, that can skew results for low-level analytes.

Finally, consistent column performance is critical to low-level analysis. In developing the Rxi® columns we wanted to guarantee reproducibility, so customers would always receive a column that worked as well as their previous column. To guarantee column-to-column reproducibility we redesigned the entire manufacturing process and used strict quality specifications. Every Rxi® column is individually tested for coating efficiency, selectivity, film thickness, inertness, and bleed level. As a result, Rxi® columns offer the most consistent retention times and highest level of inertness on the market. The data presented here demonstrate the unmatched performance of the Rxi® columns; we guarantee these columns, engineered to improve low-level analyses, are the most reliable columns available.

Low Bleed

Our bleed test is performed using a flame ionization detector with a compound marker to ensure the accuracy of the comparison. Column bleed was evaluated at 330°C and also at 350°C. As shown in Figure 1, the Rxi®-5ms column exhibits the lowest bleed of any column at both 330°C and 350°C. Note that at 350°C the variation in the bleed levels of the columns tested increases significantly. This increase is due to the difference in how the stationary phases are cross-linked by different manufacturers. As shown, the Rxi® technology used for Restek columns results in a very stable stationary phase that does not degrade, or bleed, compared to other columns on the market.

Highly Inert

We used pyridine (a basic compound) and 2,4-dinitrophenol (an acidic compound) to evaluate the activity level of our Rxi® columns. In this test, if the column was too acidic the pyridine peak would tail, where-

as if the column was too basic the 2,4-dinitrophenol peak would tail and exhibit a low response factor. The excellent peak symmetry shown in Figure 2 demonstrates the neutrality of the Rxi®-5ms column for both acidic and basic compounds. Additionally, while many other commercially available columns are not able to detect 2,4-dinitrophenol at 0.5ng on-column, the Rxi®-5ms column produces a response factor of 0.14.

Figure 1 Rxi®-5ms columns have the lowest bleed among all major column brands.

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

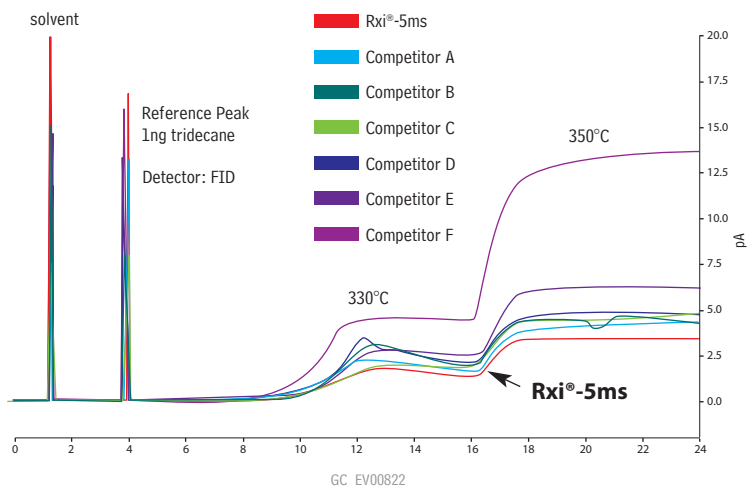
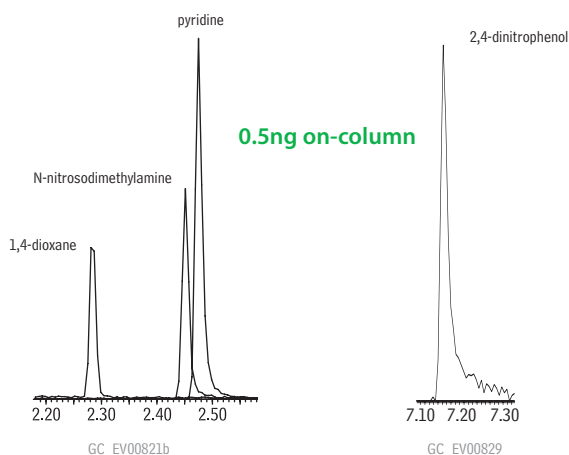
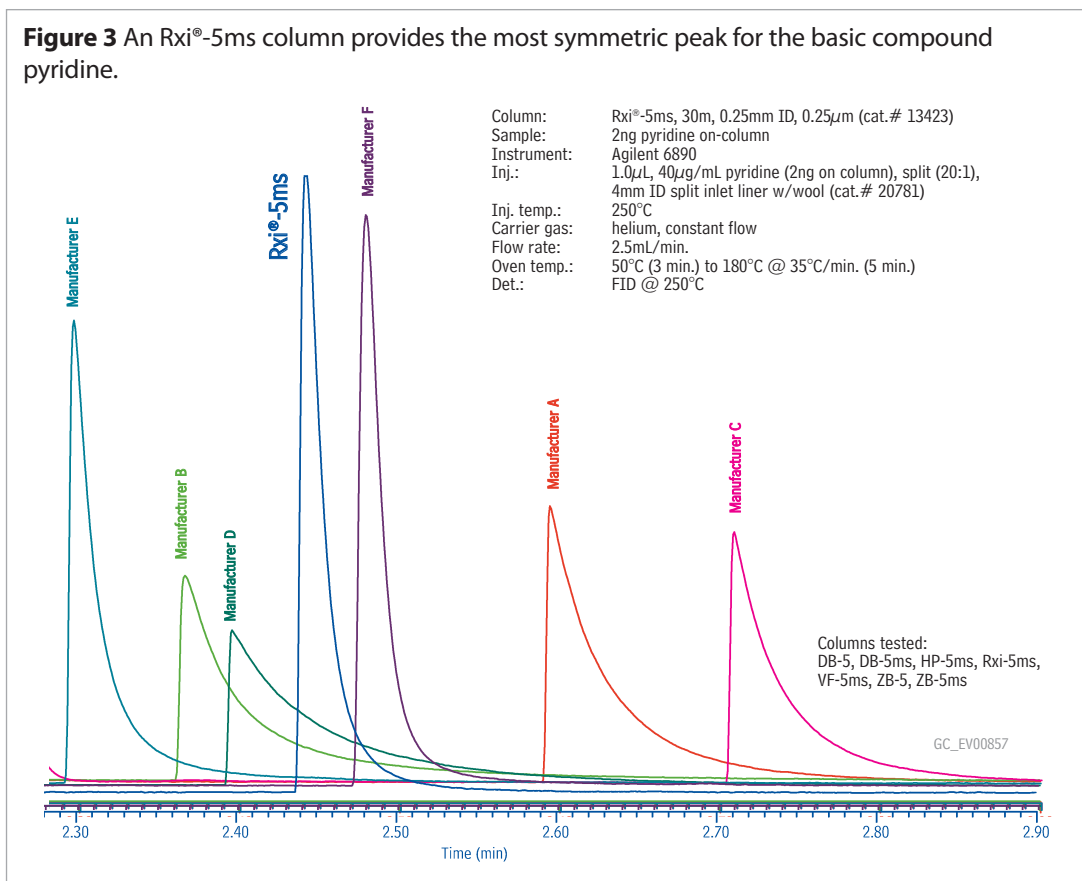


Figure 2 Peak symmetry for pyridine or 2,4-dinitrophenol is excellent from an Rxi®-5ms column, even with 0.5ng on-column!



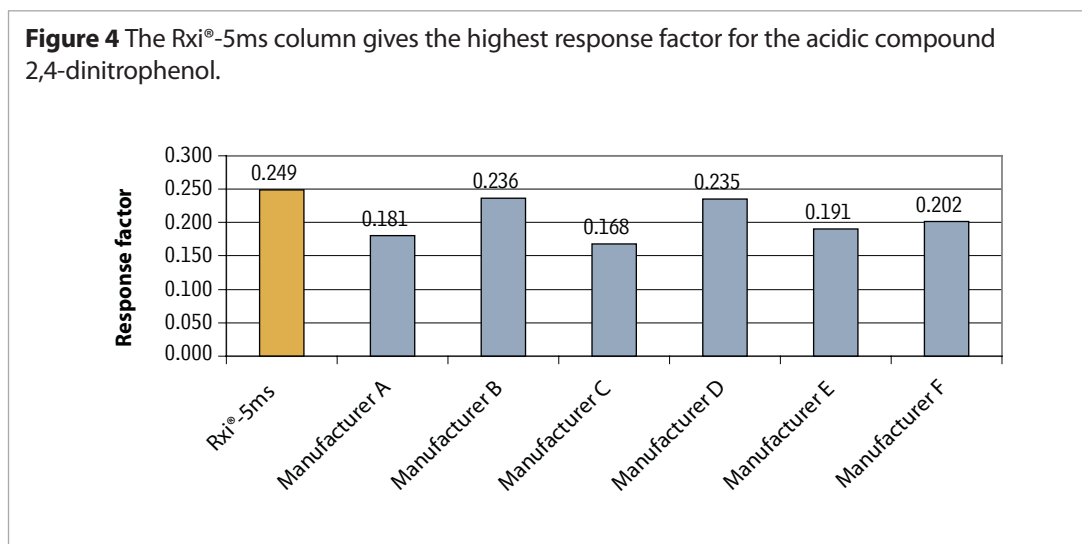
To further compare the inertness of the Rxi®-5ms column toward basic compounds to other columns on the market, 2ng of pyridine was used as a test probe. As shown in Figure 3, the tailing of pyridine is a very sensitive marker for inertness, and the excellent peak symmetry on the Rxi®-5ms column demonstrates its inertness for basic compounds.

Figure 3 An Rxi®-5ms column provides the most symmetric peak for the basic compound pyridine.



Another comparison of column inertness to acidic compounds was made with 2ng of 2,4-dinitrophenol. Figure 4 compares the mean response factors obtained on several columns and demonstrates that the Rxi®-5ms column is the most sensitive and gives the highest response factor for 2,4-dinitrophenol. In summary, Rxi®-5ms is the most inert column available for both basic and acidic compounds.

Figure 4 The Rxi®-5ms column gives the highest response factor for the acidic compound 2,4-dinitrophenol.



Column-to-Column Reproducibility

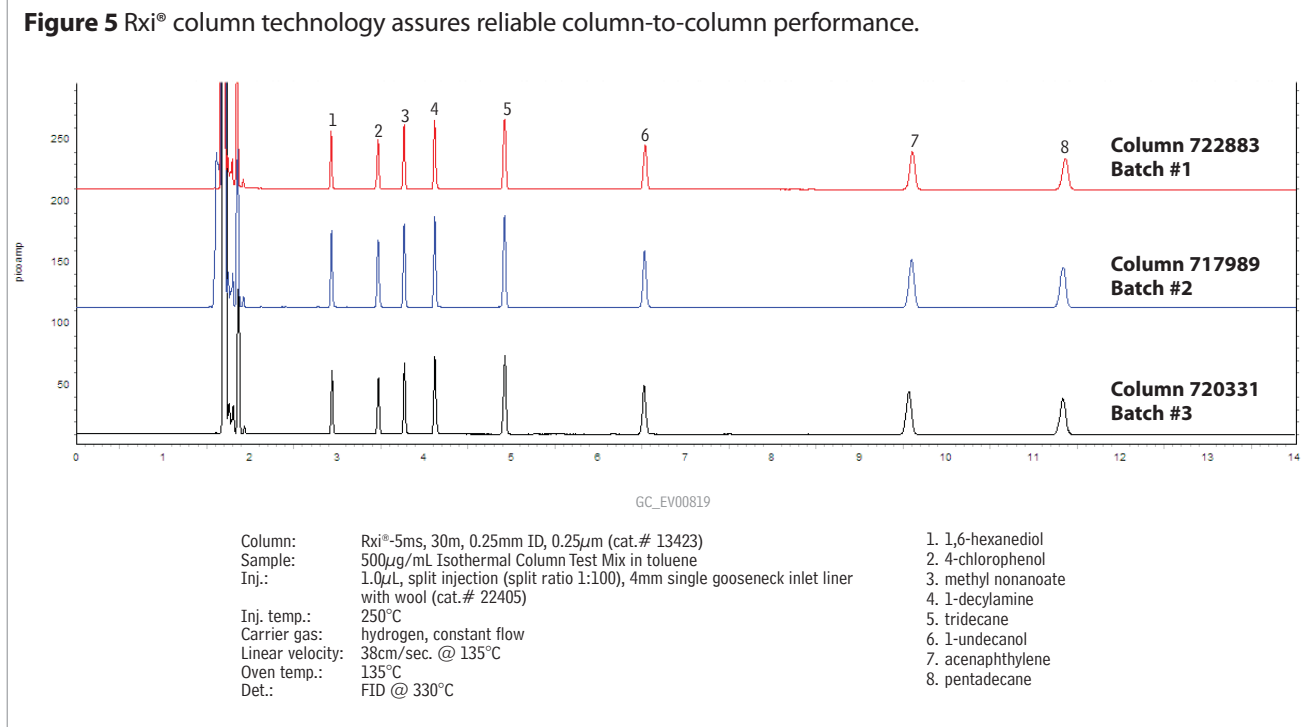
Column-to-column reproducibility is critical to obtaining consistent, reliable results for low-level analytes. We re-engineered our column manufacturing process to guarantee column-to-column reproducibility. The data in Figure 5 compare column performance from three separate production lots that were manufactured independently over a three-month period. The inertness and retention time of the probes match exactly across all three column batches. This means the responses and peak characteristics of active compounds will not vary from column-to-column, or lot-to-lot.

Summary

Rxi® columns offer unmatched performance in the three areas most critical to the accurate analysis of low-level analytes: bleed, inertness and reproducibility. Whether you are pursuing lower detection limits or simply looking for greater column-to-column consistency, Rxi® columns will outperform any column in the industry. Try these columns for yourself. We are sure you will be 100% satisfied, guaranteed.



Restek's Research & Development Group
pictured: Roy Lautamo, Bill Bromps, Ryan Smith, Shawn Reese





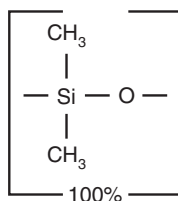
Rxi® Guard/Retention Gap Columns

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

Fused Silica

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

Rxi®-1ms Structure



Rxi®-1ms (nonpolar phase, Crossbond® 100% dimethyl polysiloxane)

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

Rxi®-1ms Columns (fused silica)

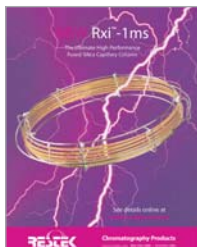
(Crossbond® 100% dimethyl polysiloxane)

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

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

similar phases

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



free literature

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

Download your free copy from www.restek.com.

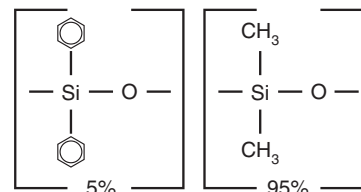
Flyer
lit. cat.# 580075B



Searching for a chromatogram?
www.restek.com

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

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

Rxi®-5ms Structure**Rxi®-5ms Columns** (fused silica)

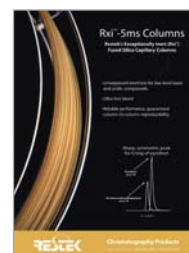
(Crossbond® 5% diphenyl/95% dimethyl polysiloxane)

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

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

similar phases

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

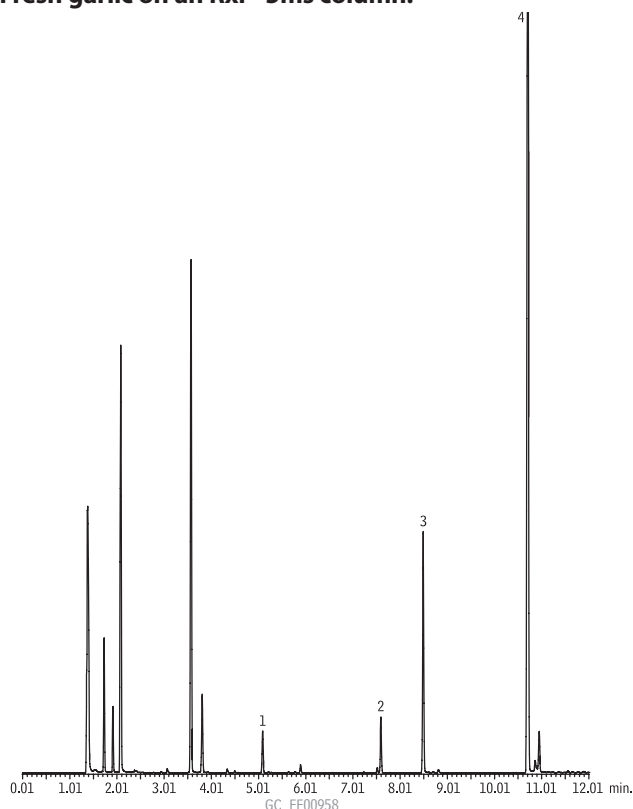


free literature

Rxi®-5ms ColumnsDownload your free copy from www.restek.com.

Flyer

lit. cat.# 580046A

Fresh garlic on an Rxi®-5ms column.

1. allyl methylsulfide
2. 3,3'-thiobis-1-propene
3. allyl mercaptan
4. diallyl disulphide

Column: Rxi®-5ms, 30m, 0.25mm ID, 1.0µm (cat.# 13453)
with a 5m, 0.32mm ID IP deactivated guard column (cat.# 10044)

Sample: fresh garlic

Inj.: split (10:1)

Inj. temp.: 220°C

Flow rate: 1.5mL/min.

Oven temp.: 35°C (hold 1 min.) to 220°C @ 15°C/min. to 300°C @ 45°C/min.

Det: MS

Scan range: 35-350amu

Ionization: EI

Mode: scan

Headspace Conditions

Instrument: PerkinElmer TurboMatrix 40 Trap Headspace Sampler

Column pressure: 15psi (103kPa)

Inj. pressure: 30psi (207kPa)

Thermostat time: 15 min.

Vial pressurize time: 1 min.

Withdraw time: 0.2 min.

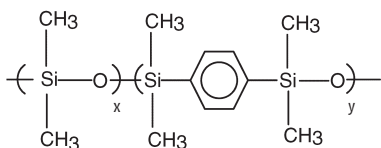
Injection time: 0.02 min.

Oven temp.: 80°C

Needle temp.: 90°C

Transfer temp.: 110°C

Rxi®-5Sil MS Structure



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

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

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

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

similar phases

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

free literature

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

Download your free copy
from www.restek.com.

Flyer

lit. cat.# GNFL1061



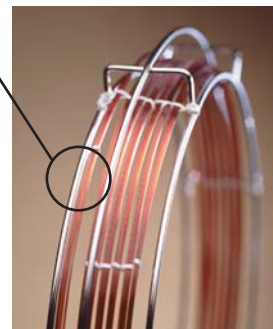
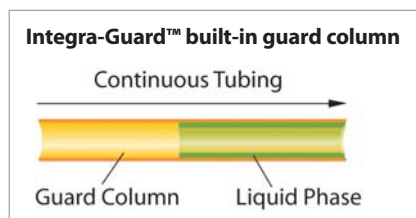
Rxi®-5Sil MS with Integra-Guard™

Get the protection without the connection!

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

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

Phases currently available as Integra-Guard™ columns

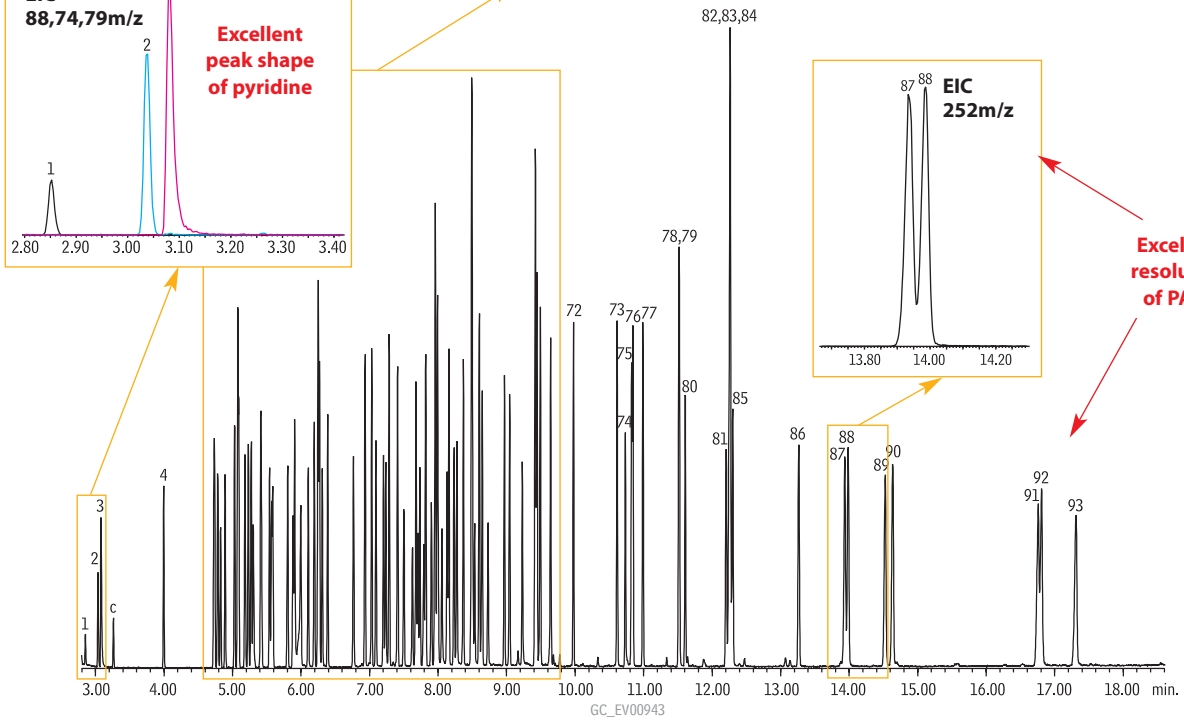
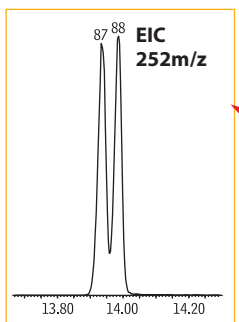
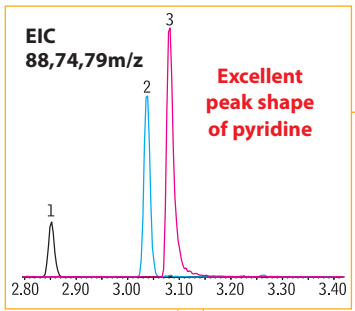
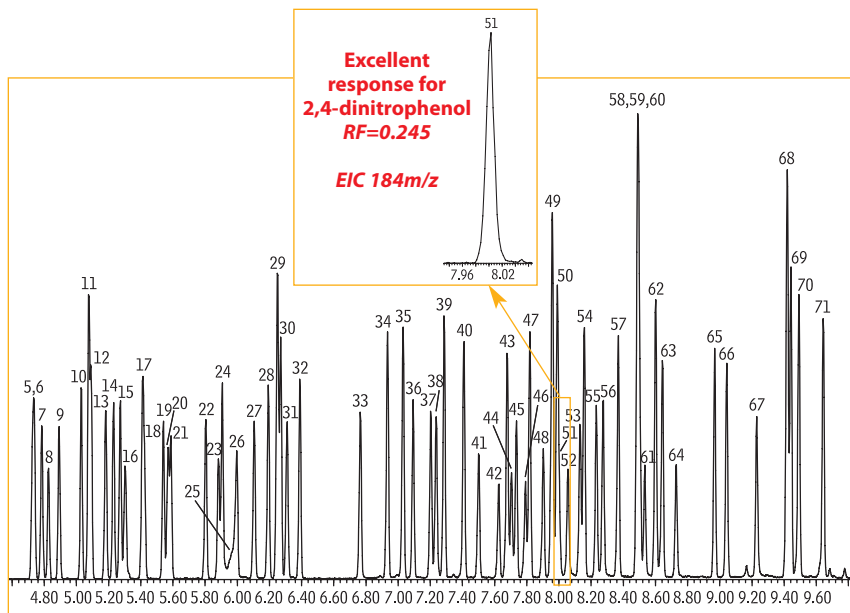


Rtx®-1
Rtx®-5
Rtx®-5MS
Rxi®-5Sil MS
Rtx®-1301
Rtx®-624
Rtx®-1701
Rtx®-Volatiles
Rtx®-20
Rtx®-35
Rtx®-BAC 1 & 2
Stabilwax®

Integra-Guard™ columns are available for all phases listed, for columns with 0.25, 0.32 or 0.53mm ID and lengths to 75 meters.

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

Column: Rxi®-5Si1 MS, 30m, 0.25mm ID, 0.25µm (cat.# 13623)
 Sample: US EPA Method 8270D Mix, 1µL of 10µg/mL (IS 40µg/mL) 8270 MegaMix® (cat.# 31850) Benzoic Acid (cat.# 31879) 8270 Benzidines Mix (cat.# 31852) Acid Surrogate Mix (4/89 SOW) (cat.# 31025) Revised B/N Surrogate Mix (cat.# 31887) 1,4-Dioxane (cat.# 31853) SV Internal Standard Mix (cat.# 31206)
 Inj.: 1.0µL (10ng on-column concentration), 4mm Drilled Uniliner® (hole near bottom) inlet liner (cat.# 20756), pulsed splitless: pulse 25psi @ 0.2 min., 60mL/min. @ 0.15 min.
 Inj. temp.: 250°C
 Carrier gas: helium, constant flow
 Flow rate: 1.2mL/min.
 Oven temp.: 40°C (hold 1.0 min.) to 280°C @ 25°C/min. to 320°C @ 5°C/min. (hold 1 min.)
 Det.: MS
 Transfer line temp: 280°C
 Scan range: 35-550amu
 Ionization: EI
 Mode: scan



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

c = contaminant



similar phases

DB-XLB, VF-Xms

tech tip

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

- By eliminating contact between the sample and the hot metal surfaces in the injection port, a Drilled Uniliner® inlet liner prevents analytes from degrading in the injection port.
- A pulsed injection (30psi/0.4 min.) reduces the time the analytes spend in the injection port, and helps to minimize breakdown.

similar phases

DB-35ms, MR2



Lowest bleed, most inert high-temperature column available!

similar phases

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

Rxi®-XLB (low polarity proprietary phase)

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

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

Rxi®-XLB Columns (fused silica)

(low polarity proprietary phase)

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

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

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



Rxi®-35Si1 MS (midpolarity phase; equivalent to 35% phenyl methylpolysiloxane)

- Excellent inertness for active compounds.
- Very low bleed phase for GC/MS analysis.
- Extended temperature range: 50°C to 340/360°C.

Rxi®-35Si1 MS Columns (fused silica)

(midpolarity phase; equivalent to 35% phenyl methylpolysiloxane)

| ID | df (μm) | temp. limits | 30-Meter |
|--------|---------|-----------------|----------|
| 0.25mm | 0.25 | 50 to 340/360°C | 13823 |
| 0.32mm | 0.25 | 50 to 340/360°C | 13824 |
| 0.53mm | 0.50 | 50 to 320/340°C | 13840 |

Rxi®-5HT (nonpolar phase; 5% diphenyl/95% dimethylpolysiloxane)

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

Rxi®-5HT Columns (fused silica)

(nonpolar phase; 5% diphenyl/95% dimethylpolysiloxane)

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

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

Rxi®-17 (midpolarity phase; Crossbond® 50% diphenyl/50% dimethyl polysiloxane)

- General purpose columns for pesticides, herbicides, rosin acids, phthalate esters, triglycerides, sterols.
- Temperature range: 0°C to 320°C.

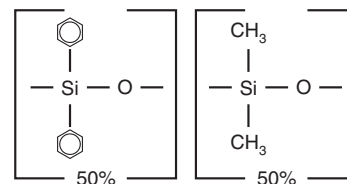
Rxi®-17 Columns (fused silica)

(Crossbond® 50% diphenyl/50% dimethyl polysiloxane)

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

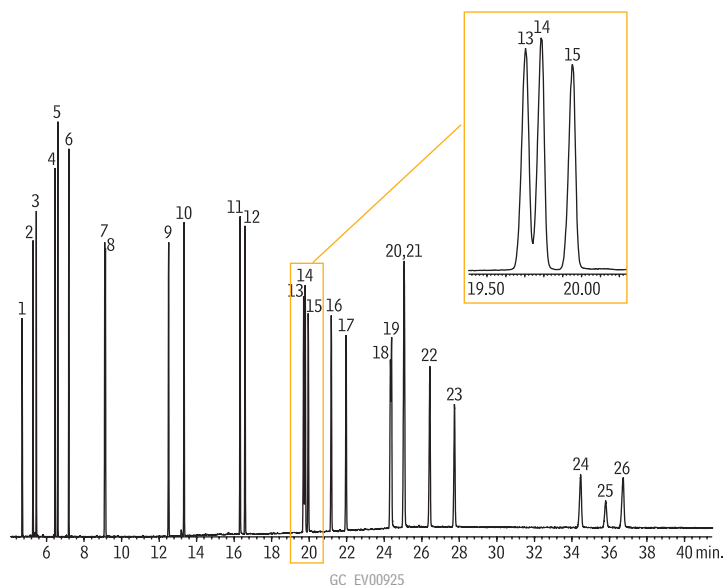
| ID | df (µm) | temp. limits | 10-Meter | 20-Meter |
|--------|---------|-----------------|----------|----------|
| 0.10mm | 0.10 | 40 to 280/320°C | 13501 | |
| 0.18mm | 0.18 | 40 to 280/320°C | | 13502 |

NEW!

Rxi®-17 Structure

similar phases

DB-17, DB-608, VF-17ms, CP-Sil 24 CB

Polycyclic aromatic hydrocarbons on an Rxi®-17 column.

Completely resolve benzo(j)fluoranthene.

| Peak List | Ret. Time (min.) |
|------------------------------|------------------|
| 1. naphthalene | 4.70 |
| 2. 1-methylnaphthalene | 5.28 |
| 3. 2-methylnaphthalene | 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. benzo(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. dibenzo(a,h)acridine | 24.33 |
| 19. dibenzo(a,j)acridine | 24.39 |
| 20. indeno(1,2,3-cd)pyrene | 25.04 |
| 21. dibenzo(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 |

Column: Rxi®-17, 30m, 0.25mm ID, 0.25µm (cat.# 13523)
 Sample: PAH mix, 20µg/mL each component:
 EPA Method 610 Mix (cat.# 31011), PAH Supplement Mix (cat.# 31857)
 1-methylnaphthalene (cat.# 31283), 2-methylnaphthalene (cat.# 31285)
 Inj.: 1.0µL pulsed splitless injection (20ng each component on column),
 4mm Drilled Uniliner® inlet liner with hole near top (cat.# 21055);
 pulse: 20psi @ 0.3 min., 40mL/min. @ 0.2 min.
 Inj. temp.: 300°C
 Carrier gas: helium, constant flow
 Flow rate: 1.2mL/min.
 Oven temp.: 90°C (hold 1.0 min.) to 215°C @ 25°C/min. (hold 0.5 min.) to
 235°C @ 4°C/min., to 280°C @ 15°C/min., to 320°C @ 4°C/min. (hold 20 min.)
 Det.: Agilent 5973 GC/MS
 Scan range: 50-550amu
 Solvent delay: 4.0 min.
 Tune: DFTPP
 Ionization: EI

General Purpose Columns



Chemically bonded capillary columns

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

Comprehensive GC column selection

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

Broad range of stationary phases

- Columns based on polysiloxane backbone; functional groups added to the polymers to vary selectivity.
- Polyethylene glycol (PEG) phases.



Rtx[®]-1 (nonpolar phase; Crossbond[®] 100% dimethyl polysiloxane)

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

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

Rtx[®]-1 Columns (fused silica)(Crossbond[®] 100% dimethyl polysiloxane)

| ID | df (μm) | temp. limits* | 15-Meter | 30-Meter | 60-Meter | 105-Meter |
|--------|---------|------------------|----------|----------|----------|-----------|
| 0.25mm | 0.10 | -60 to 330/350°C | 10105 | 10108 | 10111 | |
| | 0.25 | -60 to 330/350°C | 10120 | 10123 | 10126 | 10129 |
| | 0.50 | -60 to 330/350°C | 10135 | 10138 | 10141 | 10144 |
| | 1.00 | -60 to 320/340°C | 10150 | 10153 | 10156 | 10159 |
| 0.32mm | 0.10 | -60 to 330/350°C | 10106 | 10109 | 10112 | |
| | 0.25 | -60 to 330/350°C | 10121 | 10124 | 10127 | 10130 |
| | 0.50 | -60 to 330/350°C | 10136 | 10139 | 10142 | |
| | 1.00 | -60 to 320/340°C | 10151 | 10154 | 10157 | 10160 |
| | 1.50 | -60 to 310/330°C | 10166 | 10169 | 10172 | 10175 |
| | 3.00 | -60 to 280/300°C | 10181 | 10184 | 10187 | 10190 |
| | 4.00 | -60 to 280/300°C | | 10198 | | |
| | 5.00 | -60 to 260/280°C | 10176 | 10178 | 10180 | |
| 0.45mm | 2.55 | -60 to 270/290°C | | | | |
| 0.53mm | 0.10 | -60 to 320/340°C | 10107 | 10110 | | |
| | 0.25 | -60 to 320/340°C | 10122 | 10125 | 10128 | |
| | 0.50 | -60 to 310/330°C | 10137 | 10140 | 10143 | |
| | 1.00 | -60 to 310/330°C | 10152 | 10155 | 10158 | |
| | 1.50 | -60 to 310/330°C | 10167 | 10170 | 10173 | |
| | 3.00 | -60 to 270/290°C | 10182 | 10185 | 10188 | 10189 |
| | 5.00 | -60 to 270/290°C | 10177 | 10179 | 10183 | 10194 |
| | 7.00 | -60 to 240/260°C | 10191 | 10192 | 10193 | |

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

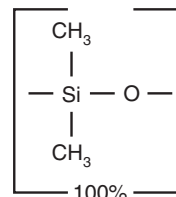
*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

Rtx[®]-1 with Integra-Guard™ Column

Get the protection without the connection!

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

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

Rtx[®]-1 Structuresimilar **phases**

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

also **available****MXT[®] Columns**

Rugged, flexible, Siltek[®] treated stainless steel tubing; inertness comparable to fused silica tubing. See **page 105** for our MXT[®]-1 columns.

it's a **fact**

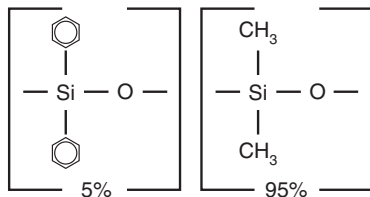
For exceptional inertness, ultra-low bleed, and unsurpassed performance, choose Rxi[®]-1ms columns! See **pages 36-40**.

crossbond[®] **technology**

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

**Catch the Buzz**

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

Rtx[®]-5/Rtx[®]-5MS StructureRtx[®]-5/Rtx[®]-5 MS (low polarity phase; Crossbond[®] 5% diphenyl/95% dimethyl polysiloxane)

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

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

Rtx[®]-5 Columns (fused silica)(Crossbond[®] 5% diphenyl/95% dimethyl polysiloxane)

| ID | df (μm) | temp. limits* | 15-Meter | 30-Meter | 60-Meter | 105-Meter |
|--------|------------------|------------------|----------|----------|----------|-----------|
| 0.25mm | 0.10 | -60 to 330/350°C | 10205 | 10208 | 10211 | 10214 |
| | 0.25 | -60 to 330/350°C | 10220 | 10223 | 10226 | 10229 |
| | 0.50 | -60 to 330/350°C | 10235 | 10238 | 10241 | 10244 |
| | 1.00 | -60 to 320/340°C | 10250 | 10253 | 10256 | 10259 |
| 0.32mm | 0.10 | -60 to 330/350°C | 10206 | 10209 | 10212 | 10215 |
| | 0.25 | -60 to 330/350°C | 10221 | 10224 | 10227 | 10230 |
| | 0.50 | -60 to 330/350°C | 10236 | 10239 | 10242 | 10245 |
| | 1.00 | -60 to 330/350°C | 10251 | 10254 | 10257 | 10260 |
| | 1.50 | -60 to 310/330°C | 10266 | 10269 | 10272 | 10275 |
| 0.53mm | 0.10 | -60 to 320/340°C | 10207 | 10210 | 10213 | 10216 |
| | 0.25 | -60 to 320/340°C | 10222 | 10225 | 10228 | 10231 |
| | 0.50 | -60 to 310/330°C | 10237 | 10240 | 10243 | 10246 |
| | 1.00 | -60 to 310/330°C | 10252 | 10255 | 10258 | 10261 |
| | 1.50 | -60 to 310/330°C | 10267 | 10270 | 10273 | 10276 |
| | 3.00 | -60 to 270/290°C | 10282 | 10285 | 10288 | 10291 |
| 5.00 | -60 to 270/290°C | 10277 | 10279 | 10283 | | |

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

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

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

Rtx[®]-5MS—Low-bleed GC/MS Columns (fused silica)(Crossbond[®] 5% diphenyl/95% dimethyl polysiloxane)

Column specifically tested for low bleed performance.

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

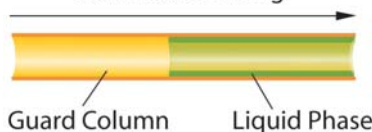
similar phases

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

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

Integra-Guard™ built-in guard column

Continuous Tubing



Get the protection without the connection!

For Rtx[®]-5 and Rtx[®]-5MS columns with built-in Integra-Guard™ guard columns, see page 33.

also available

MXT[®] ColumnsRugged, flexible, Siltek[®] treated stainless steel tubing; inertness comparable to fused silica tubing. See page 106 for our MXT[®]-5 columns.Rtx[®]-5 Amine Columns

See page 59.

it's a fact

For exceptional inertness, ultra-low bleed, and unsurpassed performance, choose Rxi[®]-5ms columns! See pages 36-39, 41.

Six columns for the price of five!

Other phases and configurations available on request.

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

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

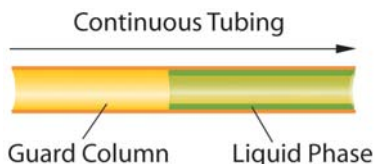
Rtx[®]-20 polymer is synthesized to exacting standards. All residual catalysts and low molecular weight fragments are removed from the polymer, providing a tight monomodal distribution and extremely low bleed.

Rtx[®]-20 Columns (fused silica)(Crossbond[®] 20% diphenyl/80% dimethyl polysiloxane)

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

Integra-Guard™ built-in guard column**Get the protection without the connection!**

For Rtx[®]-20 and Rtx[®]-35 columns with built-in Integra-Guard™ guard columns, see [page 33](#).

**Rtx[®]-35** (midpolarity phase; Crossbond[®] 35% diphenyl/65% dimethyl polysiloxane)

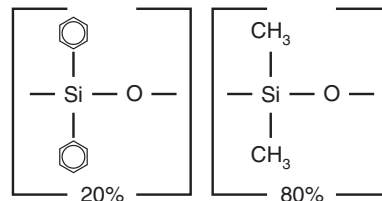
- General purpose columns for organochlorine pesticides, PCB congeners or (e.g.) Aroclor mixes, herbicides, pharmaceuticals, sterols, rosin acids, phthalate esters.
- Temperature range: 40°C to 320°C.
- Equivalent to USP G42 phase.

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

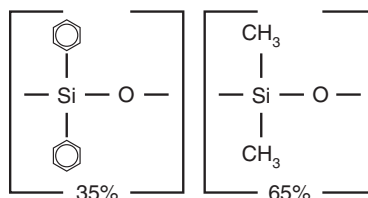
Rtx[®]-35 Columns (fused silica)(Crossbond[®] 35% diphenyl/65% dimethyl polysiloxane)

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

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

Rtx[®]-20 Structuresimilar **phase**

SPB-20

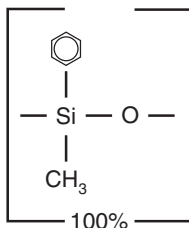
Rtx[®]-35 Structuresimilar **phases**

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

also **available****MXT[®] Columns**

Rugged, flexible, Siltek[®] treated stainless steel tubing; inertness comparable to fused silica tubing. See [page 108](#) for our MXT[®]-20 columns and [page 108](#) for our MXT[®]-35 columns.

Rtx[®]-35 Amine ColumnsSee [page 60](#).

Rtx[®]-50 Structure

similar phases

HP-50, SPB-50, SP-2250

also available

MXT[®] Columns

Rugged, flexible, Siltek[®] treated stainless steel tubing; inertness comparable to fused silica tubing. See [page 108](#) for our MXT[®]-50 columns.

Rtx[®]-50 (midpolarity phase; Crossbond[®] 100% methylphenyl polysiloxane)

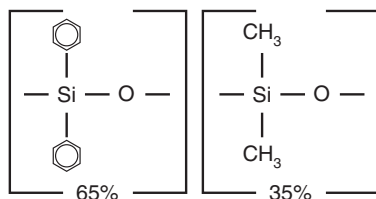
- General purpose columns for pesticides, herbicides, rosin acids, phthalate esters, triglycerides, sterols.
- Temperature range: 40°C to 320°C.
- Equivalent to USP G3 phase.

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

Rtx[®]-50 Columns (fused silica)(Crossbond[®] 100% methylphenyl polysiloxane)

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

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

Rtx[®]-65 StructureRtx[®]-65 (mid to high polarity phase; Crossbond[®] 65% diphenyl/35% dimethyl polysiloxane)

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

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

Rtx[®]-65 Columns (fused silica)(Crossbond[®] 65% diphenyl/35% dimethyl polysiloxane)

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

similar phases

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

also available

MXT[®] Columns

Rugged, flexible, Siltek[®] treated stainless steel tubing; inertness comparable to fused silica tubing. See [page 109](#) for our MXT[®]-65 columns.

also available

Rtx[®]-65TG ColumnsSee [page 67](#).crossbond[®] technology

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

Rtx[®]-440 (intermediate polarity proprietary Crossbond[®] phase)

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

restek **innovation!****Rtx[®]-440 Columns** (fused silica)(intermediate polarity proprietary Crossbond[®] phase)

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

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

Organochlorine Pesticides (US EPA Method 8081A) on an Rtx[®]-440 column.Column: Rtx[®]-440 30m, 0.25mm ID, 0.50μm (cat.# 12939)

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

Inj.: 1.0μL splitless (hold 0.75 min.), 2mm Siletek[®]
treated single gooseneck inlet liner (cat.# 20961-214.1)
275°C

Inj. temp.: 275°C

Carrier gas: hydrogen, constant pressure

Linear velocity: 51 cm/sec. @ 140°C

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

(hold 2 min.) to 330°C @ 30°C/min.

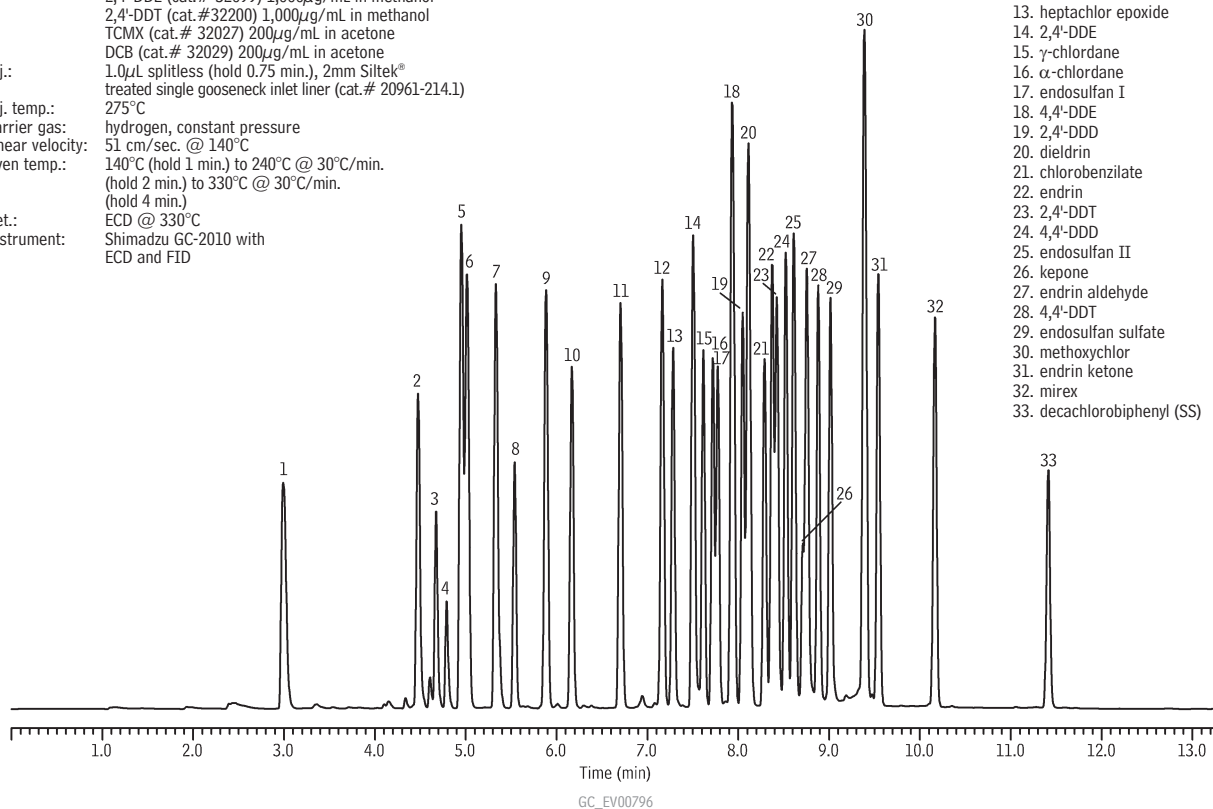
(hold 4 min.)

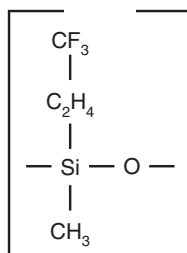
Det.: ECD @ 330°C

Instrument: Shimadzu GC-2010 with

ECD and FID

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



Rtx[®]-200 Structure**Rtx[®]-200** (midpolarity phase; Crossbond[®] trifluoropropylmethyl polysiloxane)

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

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

Rtx[®]-200 Columns (fused silica)(Crossbond[®] trifluoropropylmethyl polysiloxane)

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

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

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

similar phases

DB-200, DB-210

also available

MXT[®] Columns

Rugged, flexible, Siltek[®] treated stainless steel tubing; inertness comparable to fused silica tubing. See page 110 for our MXT[®]-200 columns.

Rtx[®]-200MS—Low-bleed GC/MS Columns (fused silica)(Crossbond[®] trifluoropropylmethyl polysiloxane)

Column specifically tested for low bleed performance.

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

Rtx®-1301 (low to midpolarity phase; Crossbond® 6% cyanopropylphenyl/94% dimethyl polysiloxane)

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

Many analysts feel the Rtx®-1301 column has the best cyanosilicone 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.

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

(Crossbond® 6% cyanopropylphenyl/94% dimethyl polysiloxane)

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

Rtx®-225 (polar phase; Crossbond® 50% cyanopropylmethyl/50% phenylmethyl polysiloxane)

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

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

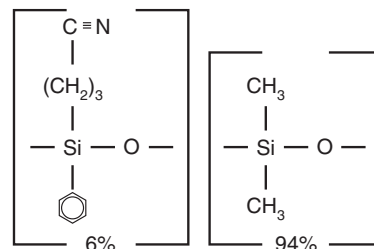
Improvements to the Rtx®-225 polymer have increased thermal stability, reduced bleed, and improved inertness. The Rtx®-225 column provides a 20°C thermal stability advantage over other “225” columns because of our unique polymer synthesis technology and proprietary siloxane deactivation. In most similar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

Rtx®-225 Columns (fused silica)

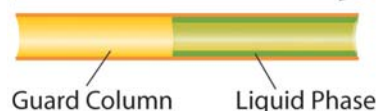
(Crossbond® 50% cyanopropylmethyl/50% phenylmethyl polysiloxane)

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

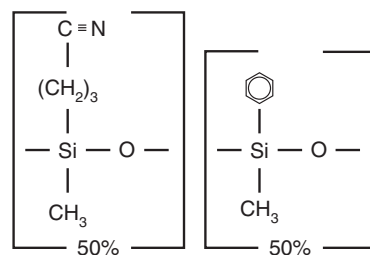
*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

Rtx®-1301 Structuresimilar **phases**

DB-1301, DB-624, HP-1301, HP-624, SPB-1301, SPB-624, VF-1301, VF-624ms, CP-1301, CP-Select 624 CB
See Rtx-624, pages 74 and 93.

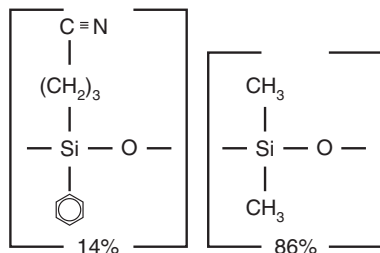
Integra-Guard™ built-in guard column
Continuous Tubing**Get the protection without the connection!**

For Rtx®-1301 columns with built-in Integra-Guard™ guard columns, see **page 33**.

Rtx®-225 Structuresimilar **phases**

DB-225, HP-225, SPB-225

Rtx®-1701 Structure



Rtx®-1701 (midpolarity phase; Crossbond® 14% cyanopropylphenyl/86% dimethyl polysiloxane)

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

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

Rtx®-1701 Columns (fused silica)

(Crossbond® 14% cyanopropylphenyl/86% dimethyl polysiloxane)

| ID | df (µm) | temp. limits* | 15-Meter | 30-Meter | 60-Meter |
|--------|---------|------------------|----------|----------|----------|
| 0.25mm | 0.10 | -20 to 280°C | | | 12011 |
| | 0.25 | -20 to 280°C | 12020 | 12023 | 12026 |
| | 0.50 | -20 to 270/280°C | 12035 | 12038 | 12041 |
| | 1.00 | -20 to 260/280°C | 12050 | 12053 | 12056 |
| 0.32mm | 0.10 | -20 to 280°C | | | 12009 |
| | 0.25 | -20 to 280°C | 12021 | 12024 | 12027 |
| | 0.50 | -20 to 270/280°C | 12036 | 12039 | 12042 |
| | 1.00 | -20 to 260/280°C | 12051 | 12054 | 12057 |
| 0.53mm | 0.10 | -20 to 280°C | | | 12066 |
| | 0.25 | -20 to 270/280°C | 12022 | 12025 | 12028 |
| | 0.50 | -20 to 260/270°C | 12037 | 12040 | 12043 |
| | 1.00 | -20 to 250/270°C | 12052 | 12055 | 12058 |
| 0.18mm | 0.20 | -20 to 280°C | | | 12067 |
| | 0.40 | -20 to 270/280°C | 12067 | 12070 | 12073 |
| | 3.00 | -20 to 230/250°C | 12082 | 12085 | 12088 |

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

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

similar phases

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

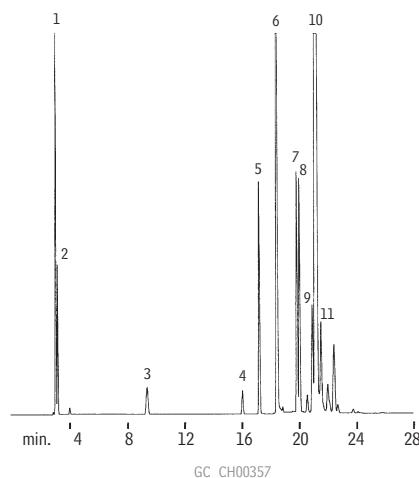
Integra-Guard™ built-in guard column
Continuous Tubing

Get the protection without the connection!
For Rtx®-1701 columns with built-in Integra-Guard™ guard columns, see [page 33](#).

also available

MXT® Columns

Rugged, flexible, Siltek® treated stainless steel tubing; inertness comparable to fused silica tubing. See [page 110](#) for our MXT®-1701 columns.

Styrene impurities on an Rtx®-1701 column.

- 1,3-butadiene
- butene
- acrylonitrile
- diethylhydroxylamine
- toluene
- vinylcyclohexene
- ethylbenzene
- m*-xylene
- o*-xylene
- styrene
- cumene

Column: Rtx®-1701, 30m, 0.53mm ID, 3.0µm (cat.# 12085)
 Inj.: 0.5mL split injection of a 95% pure styrene
 Oven temp.: 40°C (hold 10 min.) to 150°C @ 12°C/min. (hold 15 min.)
 Inj./det. temp.: 150°C
 Carrier gas: helium
 Linear velocity: 20cm/sec. set @ 40°C
 FID sensitivity: 16 x 10⁻¹¹ AFS
 Split vent: 40cc/min.

Permission to publish this chromatogram granted by Copolymer Rubber and Chemical Corp.

Rt[®]-2330 (highly polar phase; 90% biscyanopropyl/10% phenylcyanopropyl polysiloxane—not bonded)

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

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

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

Rt[®]-2330 Columns (fused silica)

(90% biscyanopropyl/10% phenylcyanopropyl polysiloxane)

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

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

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

Rt[®]-2560 (highly polar phase; biscyanopropyl polysiloxane—not bonded)

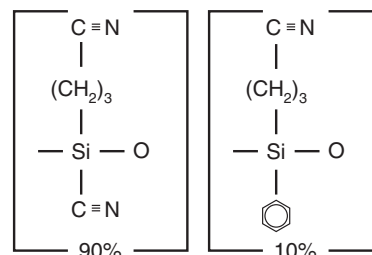
- Application-specific column for *cis/trans* FAMES.
- Stable to 250°C.

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

Rt[®]-2560 Column (fused silica)

(biscyanopropyl polysiloxane)

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

Rt[®]-2330 Structure

similar phases

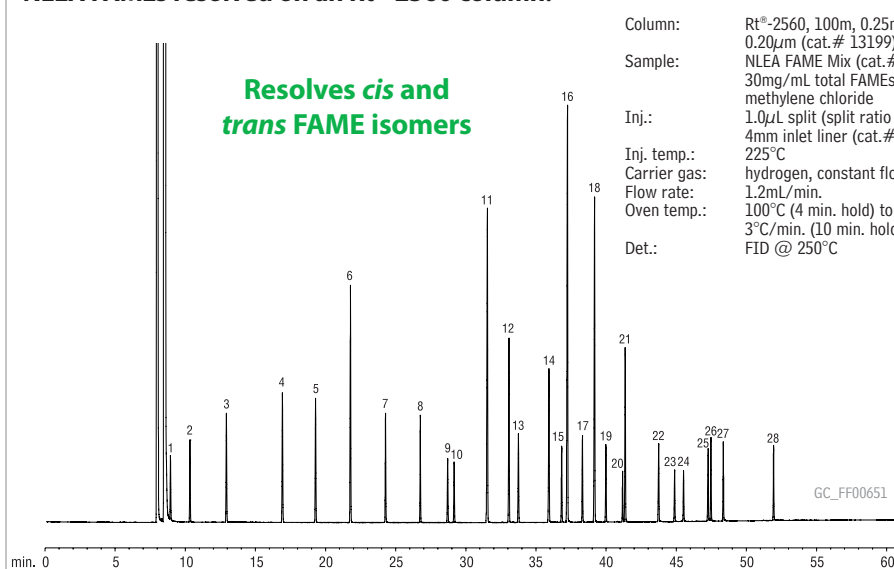
DB-23, HP-23, SP-2330, SP-2380

Doing Dioxin Analysis?

Rtx[®]-Dioxin and Rtx[®]-Dioxin2 columns provide better resolution and higher maximum temperatures than conventional columns. See [pages 86 and 87](#).

similar phases

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

NLEA FAMES resolved on an Rt[®]-2560 column.

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

1. C4:0 methyl butyrate
2. C6:0 methyl hexanoate
3. C8:0 methyl octanoate
4. C10:0 methyl decanoate
5. C11:0 methyl undecanoate
6. C12:0 methyl laurate
7. C13:0 methyl tridecanoate
8. C14:0 methyl myristate
9. C14:1 methyl myristoleate (*cis*-9)
10. C15:0 methyl pentadecanoate
11. C16:0 methyl palmitate
12. C16:1 methyl palmitoleate (*cis*-9)
13. C17:0 methyl heptadecanoate
14. C18:0 methyl stearate
15. C18:1 methyl elaidate (*trans*-9)
16. C18:1 methyl oleate (*cis*-9)
17. C18:2 methyl linoleaidate (*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 methyltricosanoate
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)

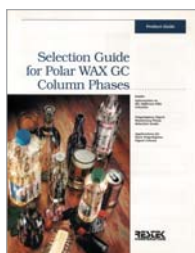
a plus 1 story

"For many years, I have searched the market place for a bonded polar GC phase that delivered the chemical inertness, long-term phase stability and practical robustness necessary to meet my operational requirements. Only after an extensive nine month in-house testing programme, can I say that I have finally found that phase in Rtx®-Wax."

Steve Rowlands, Quest International (Kent UK)

similar phases

DB-WAX, HP-Wax



free literature

Selection Guide for Polar Wax GC Column Phases

Download your free copy from www.restek.com.

Technical Guide
lit. cat.# 59890

Rtx®-Wax (polar phase; Crossbond® Carbowax® polyethylene glycol)

- General purpose columns for FAMES, solvents, BTEX aromatics, flavor compounds, alcohols.
- Temperature range: 20°C to 250°C.
- Equivalent to USP G14, G15, G16, G20, G39 phases.

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

Rtx®-Wax Columns (fused silica)

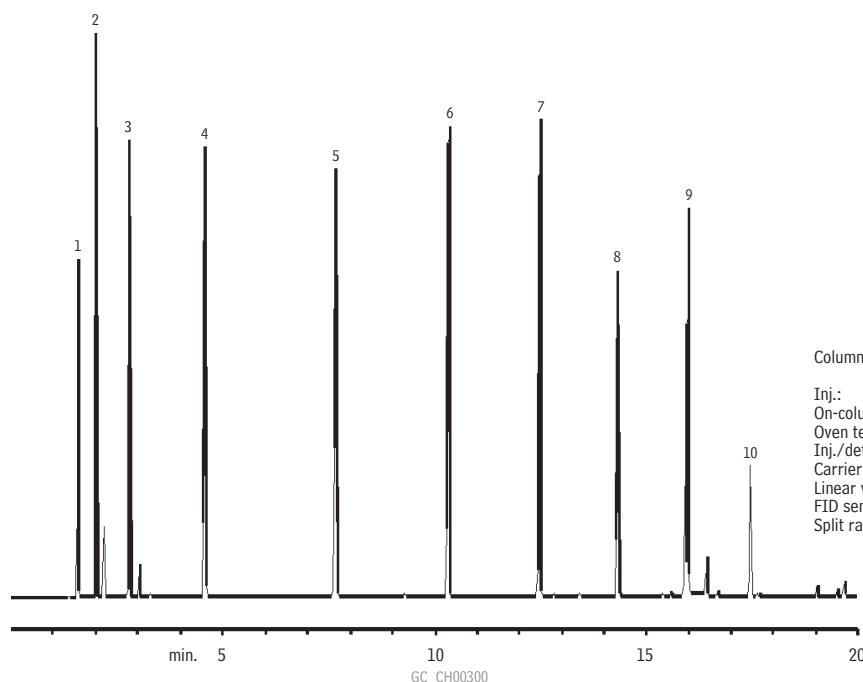
(Crossbond® Carbowax® polyethylene glycol)

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

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

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

Sharp, well-resolved peaks for aldehydes, using an Rtx®-Wax column.



1. ethanal
2. propanal
3. butenal
4. pentanal
5. hexanal
6. heptanal
7. octanal
8. nonanal
9. decanal
10. undecanal

Column: Rtx®-Wax, 30m, 0.25mm ID, 0.50µm (cat.# 12438)
 Inj.: split injection of C2-C11 aldehydes mixture
 On-column conc.: 250ng
 Oven temp.: 40°C (hold 5 min.) to 200°C @ 10°C/min.
 Inj./det. temp.: 200°C
 Carrier gas: hydrogen
 Linear velocity: 35cm/sec. set @ 40°C
 FID sensitivity: 82 x 10⁻¹¹ AFS
 Split ratio: 100:1

Stabilwax® (polar phase; Crossbond® Carbowax® polyethylene glycol)

- General purpose columns for FAMES, flavor compounds, essential oils, solvents, xylene isomers, and US EPA Method 603 (acrolein/acrylonitrile).
- Resistant to oxidative damage.
- Temperature range: 40°C to 260°C.
- Equivalent to USP G14, G15, G16, G20, and G39 phases.

Our polar-deactivated surface tightly binds the Carbowax® polymer and increases thermal stability, relative to competitive columns. The bonding mechanisms produce a column that can be rejuvenated by solvent washing. Compared to silicone stationary phases, PEG phases are more resistant to damage from strongly acidic or basic volatile compounds.

Stabilwax® Columns (fused silica)

(Crossbond® Carbowax® polyethylene glycol)

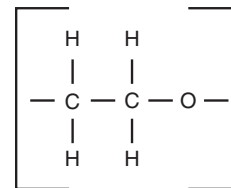
| ID | df (µm) | temp. limits | 15-Meter | 30-Meter | 60-Meter |
|--------|---------|-----------------|----------|----------|----------|
| 0.25mm | 0.10 | 40 to 250/260°C | 10605 | 10608 | 10611 |
| | 0.25 | 40 to 250/260°C | 10620 | 10623 | 10626 |
| | 0.50 | 40 to 250/260°C | 10635 | 10638 | 10641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

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

also available

MXT® Columns

Rugged, flexible, Silcosteel® treated stainless steel tubing; inertness comparable to fused silica tubing. See page 110 for our MXT®-WAX columns.

Stabilwax® Structure

manufacturing procedure

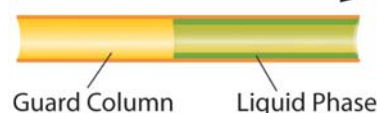
Better column-to-column reproducibility

similar phases

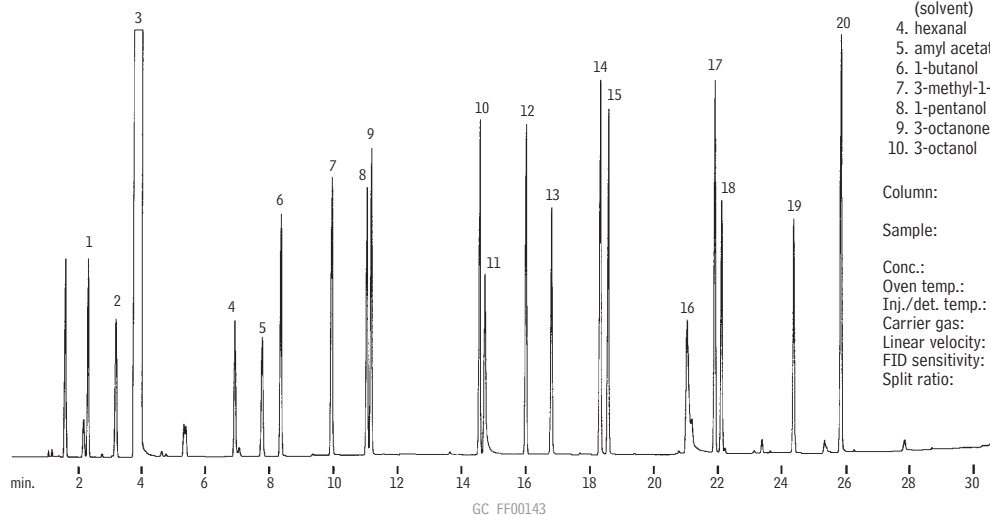
DB-WAX, DB-WAXetr, HP-Wax, HP-Innowax, Supelcowax 10, CP-Wax 52 CB

Integra-Guard™ built-in guard column

Continuous Tubing

**Get the protection without the connection!**

For Stabilwax® columns with built-in Integra-Guard™ guard columns, see page 33.

Synthetic mushroom aroma on a Stabilwax® column.

- | | |
|---------------------------------|------------------------|
| 1. acetone | 11. nonanal |
| 2. ethyl acetate | 12. 1-octen-3-ol |
| 3. methylene chloride (solvent) | 13. furfural |
| 4. hexanal | 14. benzaldehyde |
| 5. amyl acetate | 15. octyl alcohol |
| 6. 1-butanol | 16. phenylacetaldehyde |
| 7. 3-methyl-1-butanol | 17. α-terpineol |
| 8. 1-pentanol | 18. 2,4-nonadienal |
| 9. 3-octanone | 19. 2,4-decadienal |
| 10. 3-octanol | 20. benzyl alcohol |

Column: Stabilwax®, 30m, 0.32mm ID, 1.0µm (cat.# 10654)
 Sample: 1.0µL split injection of a synthetic mushroom aroma
 Conc.: 10ng per component
 Oven temp.: 40°C to 220°C @ 6°C/min.
 Inj./det. temp.: 260°C
 Carrier gas: hydrogen
 Linear velocity: 40cm/sec.
 FID sensitivity: 4 x 10⁻¹¹ AFS
 Split ratio: 100:1

Application-Specific Columns



Application-specific columns

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

Many chromatography markets and applications represented

- Foods, Flavors, & Fragrances.
- Petrochemical.
- Clinical/Forensic.
- Pharmaceutical.
- Environmental.

Unique stationary phases and applications

- Designed to help solve chromatographic challenges.



Basic Compounds Analysis

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

- Application-specific columns for amines and other basic compounds, including alkylamines, diamines, triamines, ethanalamines, 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.

Rtx®-5 Amine Columns (fused silica)

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

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

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similar **phase**

PTA-5

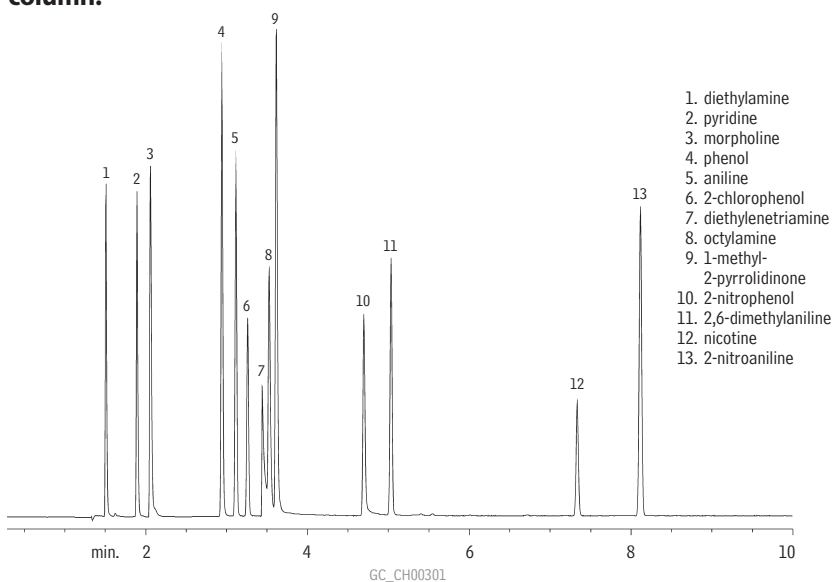
also **available**

See **page 60** for Rtx®-35 Amine columns.

please **note**

We recommend using base-deactivated fused silica guard columns (**page 32**) and base-deactivated liners (www.restek.com) with Rtx®-5 Amine columns.

Excellent peak shapes for amines & phenols on an Rtx®-5 Amine column.



Column: Rtx®-5 Amine, 30m, 0.32mm ID, 1.0µm (cat.# 12354)
 Sample: 1.0µL split injection of amines and phenols in water
 On-column conc.: 22ng
 Oven temp.: 120°C to 220°C @ 10°C/min.
 Inj./det. temp.: 305°C
 Carrier gas: hydrogen
 Linear velocity: 38cm/sec. set @ 120°C
 FID sensitivity: 6.4 x 10¹¹ AFS
 Split ratio: 25:1

Table of Contents for
Applications

see **page 489**





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Basic Compounds Analysis

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

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

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

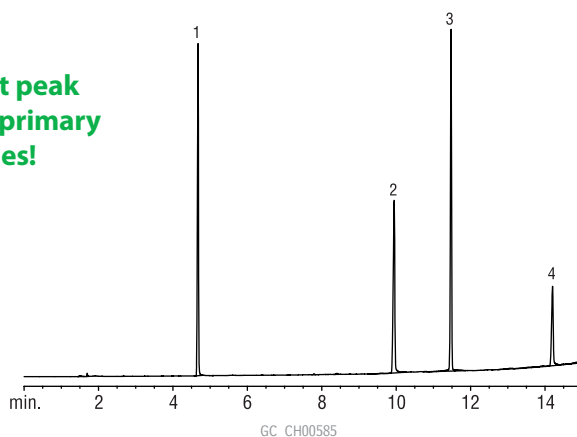
Rtx®-35 Amine Columns (fused silica)

(Crossbond® 35% diphenyl/65% dimethyl polysiloxane)

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

Sharp ethanolamine peaks, low bleed: Rtx®-35 Amine column.

Excellent peak shape for primary amines!



1. monoethanolamine
2. diethanolamine
3. triethyleneglycol monomethylether
4. triethanolamine

Column: Rtx®-35 Amine, 30m, 0.32mm ID, 1.0μm (cat.# 11354)
 Sample: 500μg/mL ethanolamine standard in water
 Inj.: 1.0μL split (split ratio 10:1), cup splitter inlet liner (cat.# 20709)
 Inj. temp.: 300°C
 Carrier gas: helium, constant pressure
 Linear velocity: 40cm/sec. @ 50°C
 Oven temp.: 50°C (hold 0.50 min.) to 280°C @15°C/min.
 Det.: FID @ 300°C

Basic Compounds Analysis

Stabilwax®-DB (polar phase; Crossbond® base-deactivated Carbowax® polyethylene glycol)

- 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.

Stabilwax®-DB Columns (fused silica)

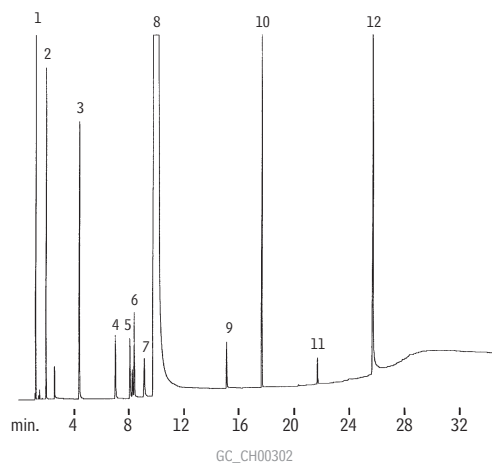
(Crossbond® Carbowax® polyethylene glycol for amines and basic compounds)

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

similar phases

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

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



Excellent resolution and peak shape for impurities in HMD!

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

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

Acidic Compounds Analysis

Stabilwax®-DA (polar phase; Crossbond® acid-deactivated Carbowax® polyethylene glycol)

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

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

Stabilwax®-DA Columns (fused silica)

(Crossbond® Carbowax® polyethylene glycol for acidic compounds)

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

similar phases

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

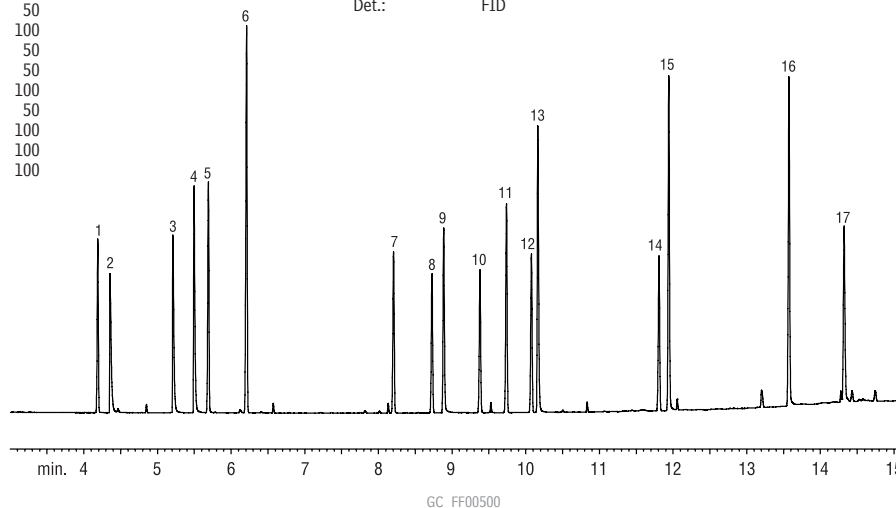
crossbond® technology

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

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

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

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



Enantiomers Analysis

Cyclodextrin Columns for Analyzing Many Chiral Compounds

By adding β or γ cyclodextrin to our bonded Rtx®-1701 stationary phase, we greatly enhance overall utility and column lifetime for our chiral columns, compared to columns that have pure cyclodextrin stationary phases. Separations of more than one hundred chiral compounds have been achieved using our unique DEX columns, and our columns continue to demonstrate stability after hundreds of temperature program cycles. Refer to the applications section of this catalog for examples, or call our Technical Service chemists or your Restek representative for assistance in matching a column to your chiral analysis.

Rt®- β DEXm Columns (fused silica)

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

| ID | df (μ m) | temp. limits | 30-Meter |
|--------|---------------|--------------|----------|
| 0.25mm | 0.25 | 40 to 230°C | 13100 |
| 0.32mm | 0.25 | 40 to 230°C | 13101 |

Uses: General purpose chiral phase with many published applications.

Rt®- β DEXsm Columns (fused silica)

(2,3-di-O-methyl-6-O-*tert*-butyl dimethylsilyl beta cyclodextrin doped into 14% cyanopropylphenyl/86% dimethyl polysiloxane)

| ID | df (μ m) | temp. limits | 30-Meter |
|--------|---------------|--------------|----------|
| 0.25mm | 0.25 | 40 to 230°C | 13105 |
| 0.32mm | 0.25 | 40 to 230°C | 13104 |

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

Rt®- β DEXse Columns (fused silica)

(2,3-di-O-ethyl-6-O-*tert*-butyl dimethylsilyl beta cyclodextrin doped into 14% cyanopropylphenyl/86% dimethyl polysiloxane)

| ID | df (μ m) | temp. limits | 30-Meter |
|--------|---------------|--------------|----------|
| 0.25mm | 0.25 | 40 to 230°C | 13107 |
| 0.32mm | 0.25 | 40 to 230°C | 13106 |

Uses: Similar in performance to Rt- β DEXsm but provides better resolution for limonene, linalool, linalyl acetate, ethyl-2-methylbutyrate, 2,3-butane diol, and styrene oxides.

Rt®- β DEXsp Columns (fused silica)

(2,3-di-O-propyl-6-O-*tert*-butyl dimethylsilyl beta cyclodextrin doped into 14% cyanopropylphenyl/86% dimethyl polysiloxane)

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

Uses: Often useful in dual-column configurations, with the Rt- β DEXsm column, for complex enantiomeric separations.

Rt®- β DEXsa Columns (fused silica)

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

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

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

Rt®- β DEXcst Columns (fused silica)

(Proprietary cyclodextrin material doped into 14% cyanopropylphenyl/86% dimethyl polysiloxane)

| ID | df (μ m) | temp. limits | 30-Meter |
|--------|---------------|--------------|----------|
| 0.25mm | 0.25 | 40 to 230°C | 13103 |
| 0.32mm | 0.25 | 40 to 230°C | 13102 |

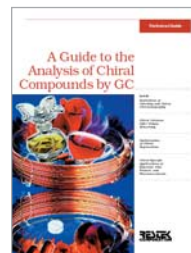
Uses: Proprietary stationary phase, developed specifically for the fragrance industry. Also used for pharmaceutical applications.

Rt®- γ DEXsa Columns (fused silica)

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

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

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



free
literature

A Guide to the Analysis of
Chiral Compounds by GC

Download your free copy
from www.restek.com.

Technical Guide
lit. cat.# 59889

please note

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

i tech tip

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

- Faster linear velocities (80cm/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 50ng or less.



free
literature

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

Applications Note
lit. cat.# 59553



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

Applications Note
lit. cat.# 59546

Download your free
copies from
www.restek.com.

cis/trans FAMES

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

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

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

similar phases

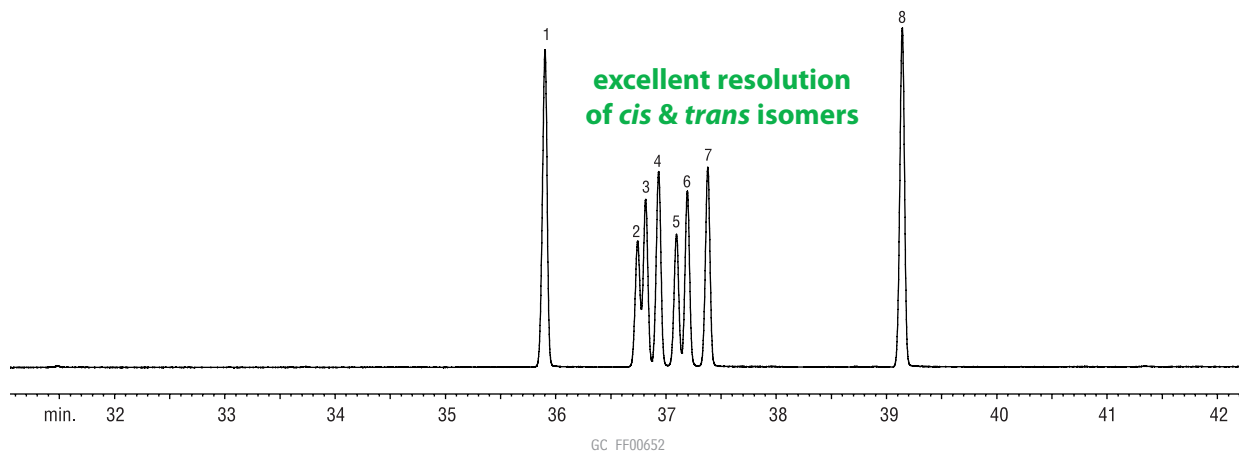
SPB-2560, HP-88, Silar 10C, CP-Sil 88 FAME,
 CP-Sil 88

Rt®-2560 Column (fused silica)

(biscyanopropyl polysiloxane)

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

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



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

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



Catch the Buzz

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

Polyunsaturated FAME Analysis

FAMEWAX (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.

FAMEWAX Columns (fused silica)

(Crossbond® polyethylene glycol)

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

similar phase

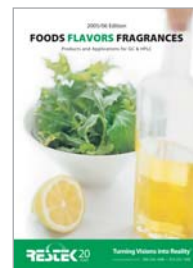
Omegawax

free literature

Foods, Flavors, and Fragrances

Includes important analysis tips and chromatograms for analysis of fats and oils, carbohydrates, vitamins, amino acids, organic acids, preservatives, flavors and fragrances, essential oils, and chiral separations. Retention time indices and complete product listings for all relevant GC and HPLC products also are included.

Minicatalog
lit. cat.# 59260A



Monitoring Volatile Compounds in Food Contact Packaging, Using Purge and Trap GC/MS and an Rtx®-5MS Capillary Column

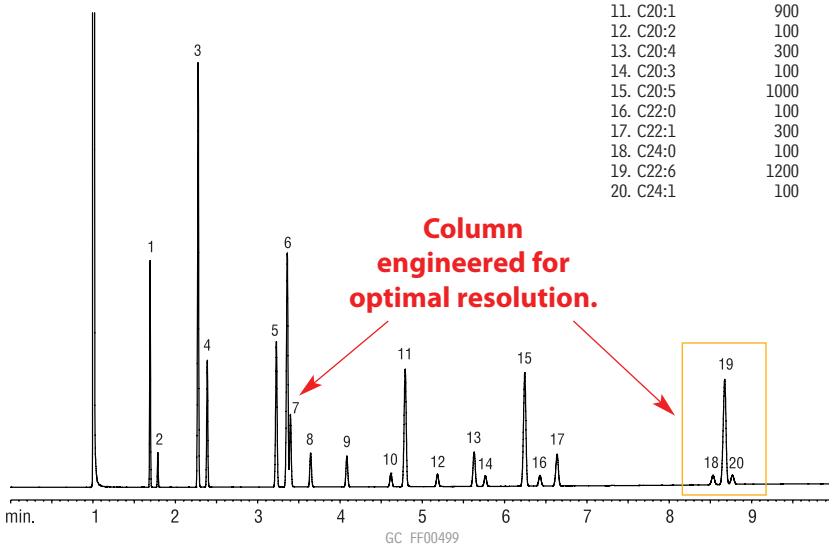
Applications Note
lit. cat.# 59348

Download your free copies from www.restek.com.

FAMEs (marine oil standard) on a FAMEWAX column.

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

| Peak List | Conc. (µg/mL) |
|----------------------|---------------|
| 1. C14:0 | 600 |
| 2. C14:1 | 100 |
| 3. C16:0 | 1600 |
| 4. C16:1 | 500 |
| 5. C18:0 | 800 |
| 6. C18:1 (oleate) | 1300 |
| 7. C18:1 (vaccenate) | 400 |
| 8. C18:2 | 200 |
| 9. C18:3 | 200 |
| 10. C20:0 | 100 |
| 11. C20:1 | 900 |
| 12. C20:2 | 100 |
| 13. C20:4 | 300 |
| 14. C20:3 | 100 |
| 15. C20:5 | 1000 |
| 16. C22:0 | 100 |
| 17. C22:1 | 300 |
| 18. C24:0 | 100 |
| 19. C22:6 | 1200 |
| 20. C24:1 | 100 |



Perfect confirmation column for F&F analysis!



Flavor & Fragrance Compounds Analysis

- Rt®-CW20M F&F** (polar phase; Carbowax® polyethylene glycol—not bonded)
- Application-specific columns for flavor and fragrance compounds, specially tested.
 - True nonbonded Carbowax® 20M polarity.
 - Temperature range: 60°C to 220°C.

Rt®-CW20M F&F Columns (fused silica)
(Carbowax® polyethylene glycol)

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

similar phases

HP-20M, Carbowax® 20M

- Rtx®-1 F&F** (nonpolar phase; Crossbond® 100% dimethyl polysiloxane)
- Application-specific columns for flavor and fragrance compounds.
 - Stable to 350°C.

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

Rtx®-1 F&F Columns (fused silica)
(Crossbond® 100% dimethyl polysiloxane)

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

similar phase

HP-1



“Our Innovations chemists come from industry and regularly collaborate with government and industry leaders in order to continually develop new methods and optimize market-specific applications. When you work with Restek, you work with experienced chromatographers who practice in your field.”

Restek’s Innovations Group

pictured: Silvia Martinez, Kristi Sellers, Julie Kowalski, Chris English, Barry Burger, Amanda Rigdon, Jason Thomas, Scott Grossman, Michelle Misselwitz (not pictured: Ty Kahler, Rick Morehead)

Triglycerides in Foods Analysis

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

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

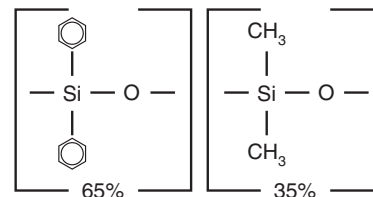
The Rtx®-65TG phase resolves triglycerides by degree of unsaturation as well as by carbon number. Because of the chemistry required to achieve 370°C thermal stability, an Rtx®-65TG column should not be used for analyses of polar compounds.

Rtx®-65TG Columns (fused silica)

(Crossbond® 65% diphenyl/35% dimethyl polysiloxane)

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

Rtx®-65TG Structure



save **money!**

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

crossbond® **technology**

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

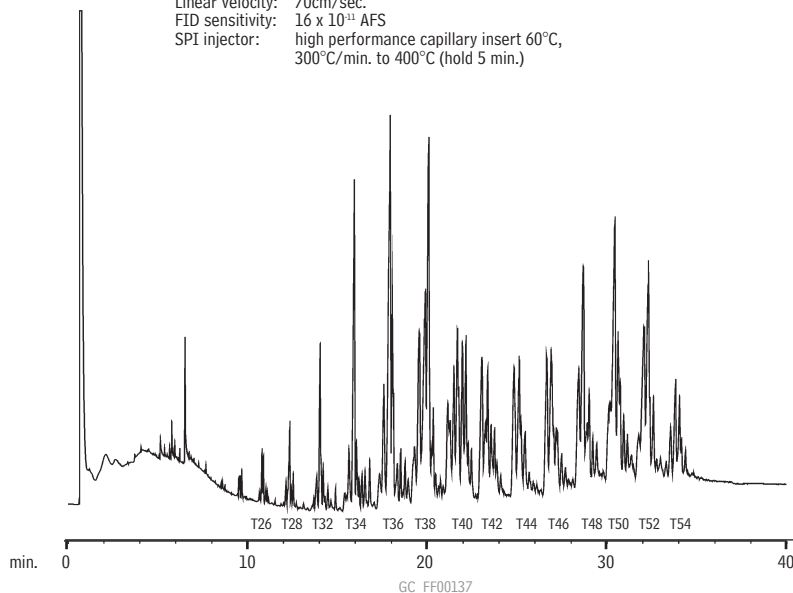
please **note**

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

- Vu2 Union® (see page 215)
- MXT™-Union Connector Kits for Fused Silica (see page 218)

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

Column: Rtx®-65TG, 30m, 0.25mm ID, 0.10µm (cat.# 17008)
 Sample: 0.2µL cold on-column injection of 1% butterfat in isoctane
 Oven temp.: 80°C (hold 1 min.) to 240°C @ 30°C/min. to 360°C @ 4°C/min. (hold 5 min.)
 Det. temp.: 380°C
 Carrier gas: hydrogen
 Linear velocity: 70cm/sec.
 FID sensitivity: 16 x 10¹¹ AFS
 SPI injector: high performance capillary insert 60°C, 300°C/min. to 400°C (hold 5 min.)



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Rtx®-1PONA column now available in 50 and 150 meter lengths.

Detailed Hydrocarbon Analysis (DHA)

Rtx®-1PONA (nonpolar phase; Crossbond® 100% dimethyl polysiloxane)

- Application-specific columns meet ASTM and CGSB requirements for detailed hydrocarbon analysis.
- Stable to 340°C.

The Rtx®-1PONA polymer was designed to offer the exact polarity necessary to resolve hydrocarbons in the specific order requested by petrochemical companies. In order to meet the demanding resolution and retention criteria of the American Society for Testing and Materials (ASTM) and the Canadian General Standards Board (CGSB), Restek has developed unique quality control tests and specifications for the Rtx®-1PONA column. The measured values for retention (k), efficiency (n), and stationary phase selectivity (RI) are controlled so that each column exceeds the requirements of the ASTM and CGSB methods.

similar phases

Petrocol DH, DB-Petro, HP-PONA

Rtx®-1PONA Column (fused silica)

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

| ID | df (μm) | temp. limits | 50-Meter | 100-Meter | 150-Meter |
|--------|---------|------------------|----------|-----------|-----------|
| 0.25mm | 0.50 | -60 to 300/340°C | 10186 | 10195 | 10197 |

please note

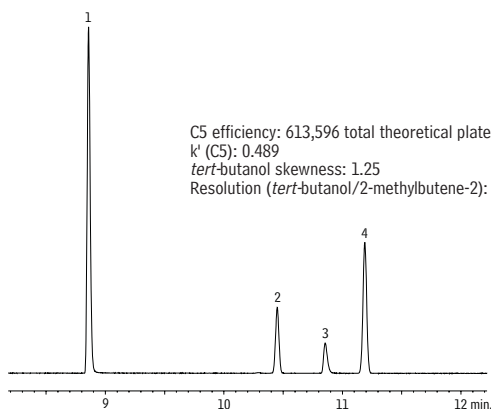
To achieve critical resolutions, a 5-meter tuning column is connected to the analytical column and adjusted to the needed length through a series of trial analyses.

Rtx®-5PONA Tuning Column (fused silica)

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

| ID | df (μm) | temp. limits | 5-Meter |
|--------|---------|--------------|---------|
| 0.25mm | 1.0 | -60 to 325°C | 10196 |

Sharp, symmetric peak for ethanol (gasoline oxygenate), using an Rtx®-1PONA column.**

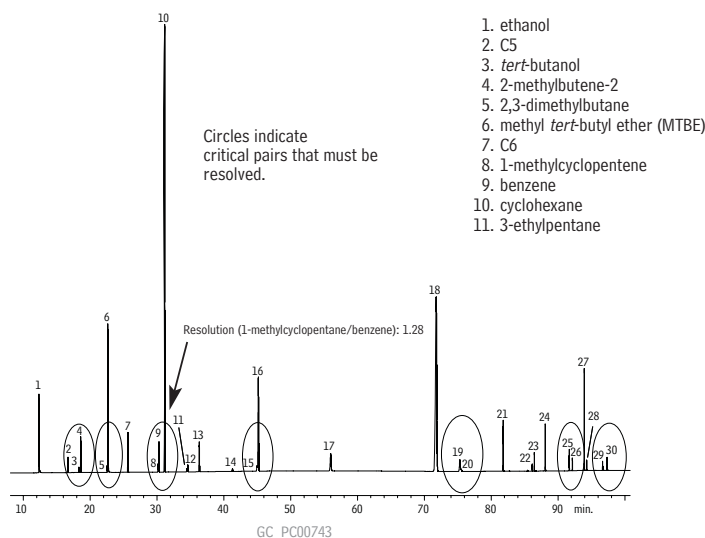


1. ethanol
2. C5
3. tert-butanol
4. 2-methylbutene-2

Rtx®-1PONA column produces symmetrical alcohol peaks!

**P=paraffins; O=olefins; N=naphthenes; A=aromatics.
In alternate terminology: paraffins & isoparaffins = alkanes; naphthenes = cyclic alkanes; olefins = alkenes.

Critical pairs of gasoline components resolved per ASTM specifications, using an Rtx®-1PONA column.



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

Column: Rtx®-1PONA, 100m, 0.25mm ID, 0.5μm (cat.# 10195) plus Rtx®-5PONA tuning column, 2.62m, 0.25mm ID, 1.0μm, connected via Press-Tight® connector (cat.# 20446)
Sample: custom detailed hydrocarbon analysis (DHA) mix, neat
Inj.: 0.01μL, split (split ratio 150:1), 4mm cup inlet liner (cat.# 20709)
Inj. temp.: 200°C
Carrier gas: helium, constant flow
Linear velocity: 28cm/sec. (2.3mL/min.)
Oven temp.: 5°C (hold 15 min.) to 50°C @ 5°C/min. (hold 50 min.) to 200°C @ 8°C/min. (hold 10 min.)
Det.: FID @ 250°C

Simulated Distillation (C5-C44) Analysis

Rtx®-2887 (nonpolar phase; Crossbond® 100% dimethyl polysiloxane)

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

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

Rtx®-2887 Column (fused silica)

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

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

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

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

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

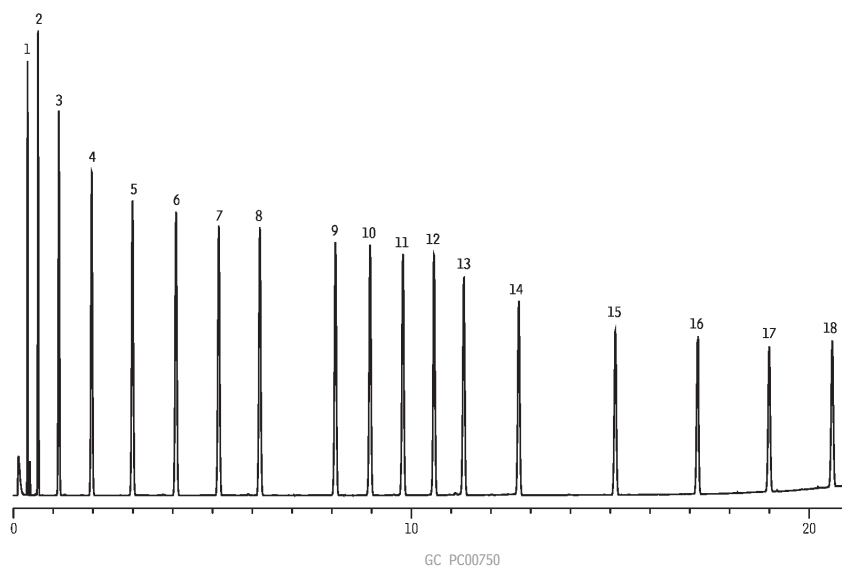
also available

Rtx®-1 SimDist 2887—a packed column for process instrumentation. See [page 116](#).

similar phases

DB-2887, Petrocol EX2887

Negligible baseline rise for C5 to C44 hydrocarbons on an Rtx®-2887 column.



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, 10m, 0.53mm ID, 2.65μm (cat.# 10199)
 Sample: 1μL direct injection of 0.01-0.1 wt. % C5 to C44 hydrocarbon standard in carbon disulfide
 Inj. temp.: 360°C
 Det. temp.: 360°C
 Carrier gas: helium (constant flow)
 Linear velocity: 15mL/min. (112cm/sec.)
 Oven temp.: 35°C to 360°C @ 15°C/min. (hold 5 min.)

Simulated Distillation (C44-C100) Analysis

MXT®-1HT Sim Dist/MXT®-1 Sim Dist/MXT®-500 Sim Dist (nonpolar phases)

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

Manufactured from Siltek® treated stainless steel tubing, MXT® columns are the most durable high temperature GC columns available. As outlined in ASTM Method D6352, high temperature simulated distillation requires a column that can withstand temperatures to 430°C. MXT®-1HT Sim Dist and MXT®-500 Sim Dist columns exhibit excellent peak shape and low bleed, even at 430°C! The unique MXT®-1HT Sim Dist methyl silicone polymer gives the correct retention time/boiling point curve. The MXT®-500 Sim Dist carborane siloxane polymer offers a slight shift in the calculated boiling range distribution for petroleum samples containing aromatic hydrocarbons.

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

| ID | df (μm) | temp. limits | 5-Meter |
|--------|---------|------------------|---------|
| 0.53mm | 0.10 | -60 to 430°C | 70100 |
| | 0.20 | -60 to 400/430°C | 70103 |

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

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

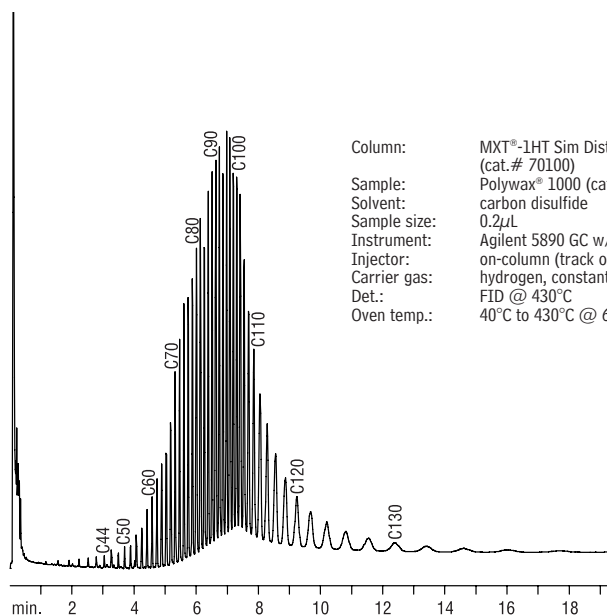
MXT®-500 Sim Dist Column (Siltek® treated stainless steel)

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

Polywax® Calibration Materials

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

C44-C130 hydrocarbons on an MXT®-1HT Sim Dist column.



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

GC_PC00543



MXT®-1HT Sim Dist column now available in 0.20μm film thickness.

similar phases

DB-1HT, CP-HT-Simdist CB

Aromatics & Oxygenates in Gasoline Analysis

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

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

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

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

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

Rt®-TCEP Columns (fused silica)

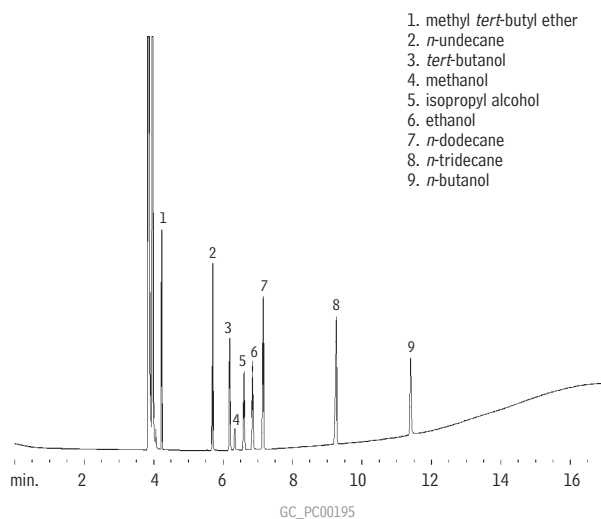
(1,2,3-tris[2-cyanoethoxy]propane)

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

similar phases

SPB-TCEP, CP-TCEP

Petroleum oxygenates on an Rt®-TCEP column.



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

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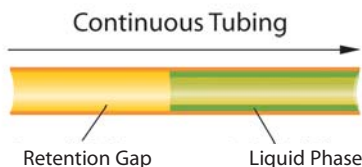




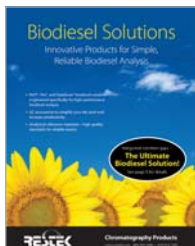
Rtx®-Biodiesel TG and MXT®-Biodiesel TG columns now available in more dimensions.

Integra-Gap™ technology

- Built-in retention gap
- Eliminates connector



free literature



Biodiesel Solutions:
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lit. cat.# 580207

Biodiesel Fuels Analysis

Rtx®-Biodiesel TG

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

Rtx®-Biodiesel TG Columns (fused silica)

| Description | temp. limits | cat.# | price |
|----------------------------------------------------|--------------|-------|-------|
| 10m, 0.32mm ID, 0.10 | to 330/380°C | 10292 | |
| 10m, 0.32mm ID, 0.10 w/2m x 0.53mm retention gap** | to 330/380°C | 10291 | |
| 15m, 0.32mm ID, 0.10 | to 330/380°C | 10294 | |
| 15m, 0.32mm ID, 0.10 w/2m x 0.53mm retention gap** | to 330/380°C | 10293 | |

MXT®-Biodiesel TG

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

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

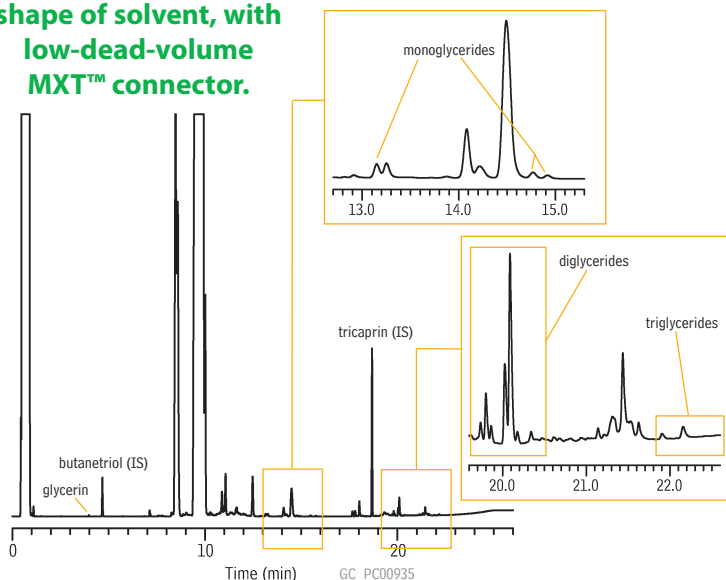
| Description | temp. limits | cat.# | price |
|----------------------------------------------------|------------------|-------|-------|
| 14m, 0.53mm ID, 0.16 w/2m Integra-Gap* | -60 to 380/430°C | 70289 | |
| 10m, 0.32mm ID, 0.10 | -60 to 380/430°C | 70292 | |
| 10m, 0.32mm ID, 0.10 w/2m x 0.53mm Retention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

*Total column length=16 meters.

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

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

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



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

Blood Alcohol Analysis

Rtx®-BAC1/Rtx®-BAC2 (proprietary Crossbond® phase)

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

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

Rtx®-BAC1 Columns (fused silica)

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

Rtx®-BAC2 Columns (fused silica)

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

restek **innovation!**

Baseline resolution in less than 3 minutes.

similar phases

DB-ALC1, DB-ALC2

ordering note

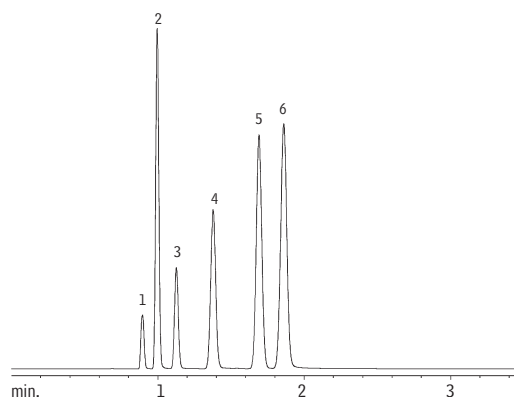
Get the protection without the connection!

For Rtx®-BAC1 and Rtx®-BAC2 columns with built-in Integra-Guard™ guard columns, see **page 33**.

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

Rtx®-BAC1

30m, 0.53mm ID, 3.0 μ m (cat.# 18001)

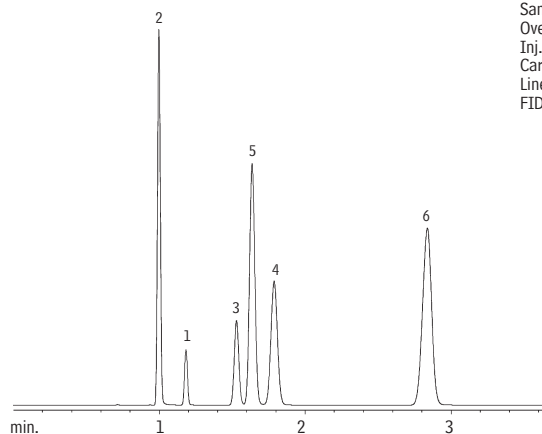


Blood alcohol analysis in less than 3 minutes!

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

Rtx®-BAC2

30m, 0.53mm ID, 2.0 μ m (cat.# 18000)



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

GC_PH00239

Get More!

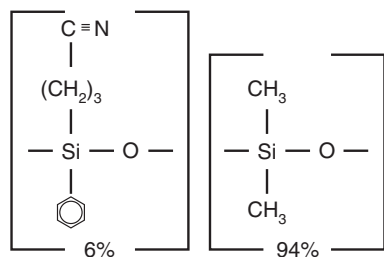
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G43 phase

Rtx®-1301/Rtx®-624 Structure



Organic Volatile Impurities (OVI) Analysis

- Rtx®-1301/Rtx®-624** (low to midpolarity phase; Crossbond® 6% cyanopropylphenyl/94% dimethyl polysiloxane)
- General purpose columns for residual solvents, alcohols, oxygenates, and volatile organic compounds.
 - Temperature range: -20°C to 240°C.
 - Equivalent to USP G43 phase.



Many analysts feel the Rtx®-1301 and Rtx®-624 columns have the best cyanosilicone 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.

similar phases

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

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

(Crossbond® 6% cyanopropylphenyl/94% dimethyl polysiloxane)

| ID | df (μm) | temp. limits* | 30-Meter | 60-Meter |
|--------|---------|---------------|----------|----------|
| 0.32mm | 1.80 | -20 to 240°C | 16092 | 16093 |
| 0.53mm | 3.00 | -20 to 240°C | 16085 | 16088 |

Rtx®-624 Columns (fused silica)

(Crossbond® 6% cyanopropylphenyl/94% dimethyl polysiloxane)

| ID | df (μm) | temp. limits | 30-Meter |
|--------|---------|--------------|----------|
| 0.32mm | 1.80 | -20 to 240°C | 10970 |

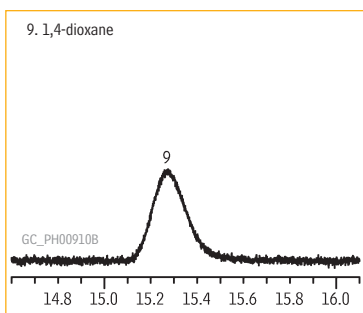
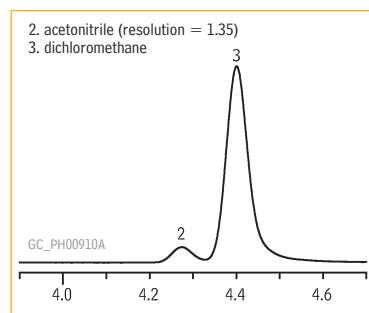
*Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

ordering note

Get the protection without the connection!

For Rtx®-1301 and Rtx®-624 columns with built-in Integra-Guard™ guard columns, see [page 33](#).

USP Residual Solvent Class 2 Mixture A standard solution on an Rtx®-624 (G43) column.

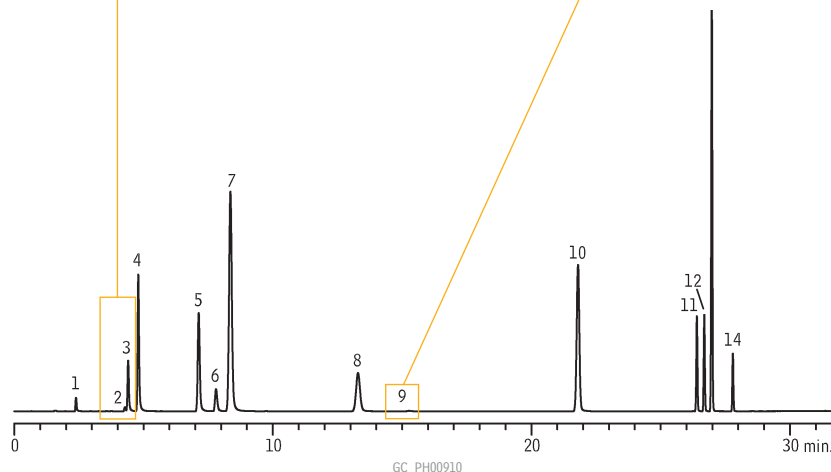


1. methanol
2. acetonitrile (resolution = 1.35)
3. dichloromethane
4. *trans*-1,2-dichloroethene
5. *cis*-1,2-dichloroethene
6. tetrahydrofuran
7. cyclohexane
8. methylcyclohexane
9. 1,4-dioxane
10. toluene
11. chlorobenzene
12. ethyl benzene
13. *m*-xylene/*p*-xylene
14. *o*-xylene

Column: Rtx®-624, 30m, 0.32 ID, 1.8μm (cat.# 10970)
 Sample: USP <467> Class 2 Mixture A standard solution (cat.# 36271) in 20mL headspace vial
 Inj.: headspace injection (split ratio 1:5), 1mm split liner, Siltek® deactivated (cat.# 20972-214.1)
 Inj. temp.: 140°C
 Carrier gas: helium, constant flow
 Flow rate: 2.16mL/min., 35.3cm/sec.
 Oven temp.: 40°C for 20 min. to 240°C @ 10°C/min. (hold for 20 min.)
 Det.: FID @ 240°C

Headspace Conditions

Instrument: Tekmar HT3
 Transfer line temp.: 105°C
 Valve oven temp.: 105°C
 Sample temp.: 80°C
 Sample equil. time: 45 min.
 Vial pressure: 10psi
 Pressurize time: 0.5 min.
 Loop fill pressure: 5psi
 Loop fill time: 2.00 min.
 Inject time: 1.00 min.



Organic Volatile Impurities (OVI) Analysis

Stabilwax® (polar phase; Crossbond® Carbowax® polyethylene glycol)

- General purpose columns for FAMES, flavor compounds, essential oils, solvents, xylene isomers, and US EPA Method 603 (acrolein/acrylonitrile).
- Resistant to oxidative damage.
- Temperature range: 40°C to 260°C.
- Equivalent to USP G14, G15, G16, G20, and G39 phases.

Our polar-deactivated surface tightly binds the Carbowax® polymer and increases thermal stability, relative to competitive columns. The bonding mechanisms produce a column that can be rejuvenated by solvent washing. Compared to silicone stationary phases, PEG phases are more resistant to damage from strongly acidic or basic volatile compounds.

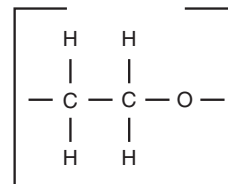
Stabilwax® Columns (fused silica)

(Crossbond® Carbowax® polyethylene glycol)

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

G16 phase

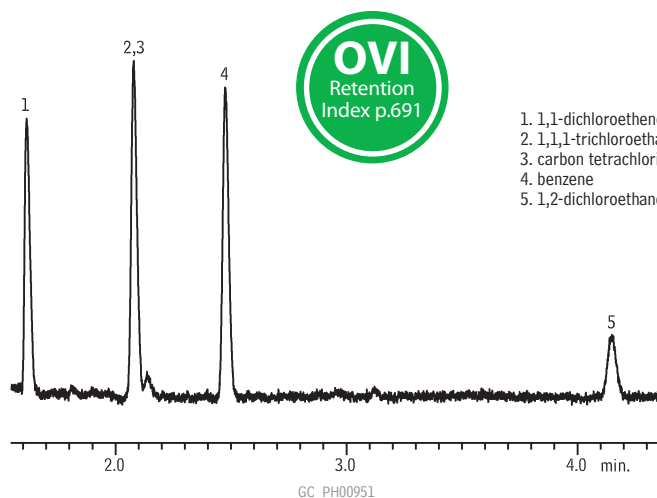
Stabilwax® Structure



similar phases

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

Residual solvents class 1 on a Stabilwax® (G16) column.



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

ordering note

Get the protection without the connection!

For Stabilwax® columns with built-in Integra-Guard™ guard columns, see [page 33](#).

also available

Other Dimensions!

For our complete listing of Stabilwax® columns, see [page 57](#).

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

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

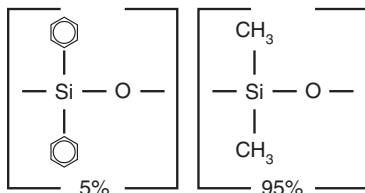


Searching for a chromatogram?

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G27 phase

Rtx®-5 Structure



Organic Volatile Impurities (OVI) Analysis

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

- General purpose columns for drugs, solvent impurities, pesticides, hydrocarbons, PCB congeners or (e.g.) Aroclor mixes, essential oils, semivolatiles.
- Temperature range: -60°C to 290°C.
- Equivalent to USP G27 and G36 phases.

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

Rtx®-5 Columns (fused silica)

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

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

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

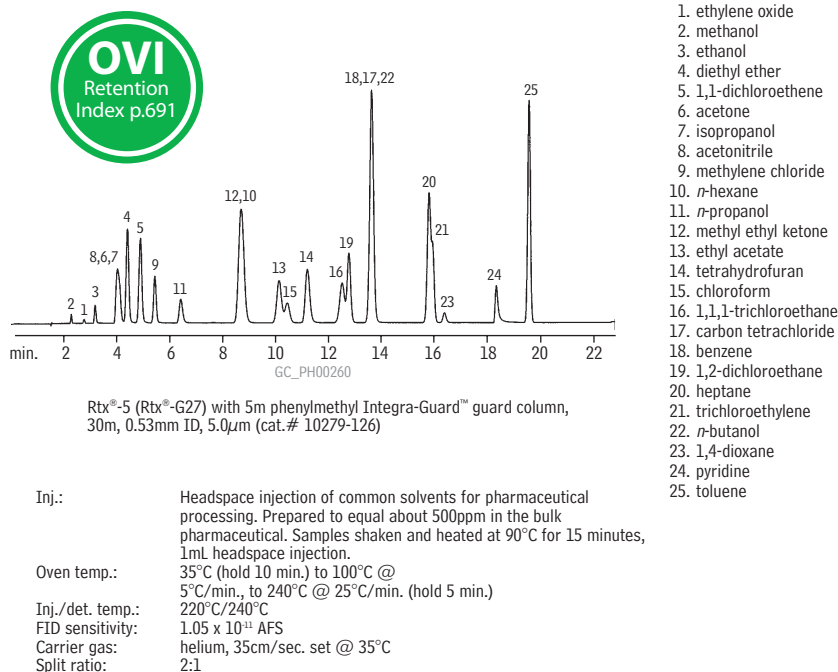
similar phases

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

super performer

For exceptional inertness, ultra-low bleed, and unsurpassed performance, choose Rxi®-5ms columns! See [pages 36-39, 41](#).

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



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Organic Volatile Impurities (OVI) Analysis

Rtx®-G27 (Crossbond® 5% diphenyl/95% dimethyl polysiloxane)

with Integra-Guard™ Guard Column

Rtx®-G43 (Crossbond® 6% cyanopropylphenyl/94% dimethyl polysiloxane)

with Integra-Guard™ Guard Column

- Analytical column with Integra-Guard™ guard column eliminates connecting problems and leaks.
- Rtx®-G27 stable to 290°C; Rtx®-G43 stable to 240°C.

Rtx®-G27 Column (fused silica with 5-meter Integra-Guard™ guard column)

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

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

Rtx®-G43 Column (fused silica with 5-meter Integra-Guard™ guard column)

(Crossbond® 6% cyanopropylphenyl/94% dimethyl polysiloxane)

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

please **note**

Analytical Reference Materials for USP <467> are available. See **pages 479-480**.

free
literature

**A Technical Guide for
Static Headspace
Analysis Using GC**

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Technical Guide
lit. cat.# 59895A



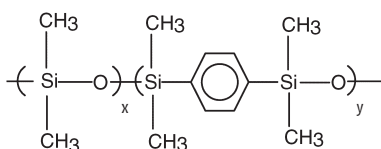
“We work hard to ensure the products you receive are of the highest quality. We are ISO 9001 certified and take pride in making the best columns on the market.”

Restek’s GC Columns Manufacturing Group

pictured: (top row) Linda Holden, David Rhodes, Sheldon McMurtrie, Kelsea Miller, Tom Barone, Ken Kline, Aaron Decker, Carolyn Williams, Raymond Ciampichini, Pete Rose, Dale Lucas, (bottom row) Tom Gurecki, Jack Haesler, Jackie Glasgow, Tim Wilson, David W. Rhodes, Henry Knepp, Russ Stewart, Jessica Andrus, Kim Shaffer, Santina Newlen (not pictured: Paul Kline, Robert Mattus, Russ Myers, Jessie Sproul, Ron Stricek, Tina Walters, Pat Reed, Shawn Giffin)

Semivolatiles Analysis

Rxi®-5Sil MS Structure



Rxi®-5Sil MS (low polarity Crossbond® silarylene phase; selectivity close to 5% diphenyl/95% 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 polycyclic aromatic compounds, chlorinated hydrocarbons, phthalates, phenols, amines, organochlorine pesticides, organophosphorus pesticides, drugs, solvent impurities, and hydrocarbons.
- Temperature range: -60°C to 350°C.

similar phases

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

ordering note

Get the protection without the connection!

For Rxi®-5Sil MS columns with built-in Integra-Guard™ guard columns, see [page 33](#).

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



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 Columns (fused silica)

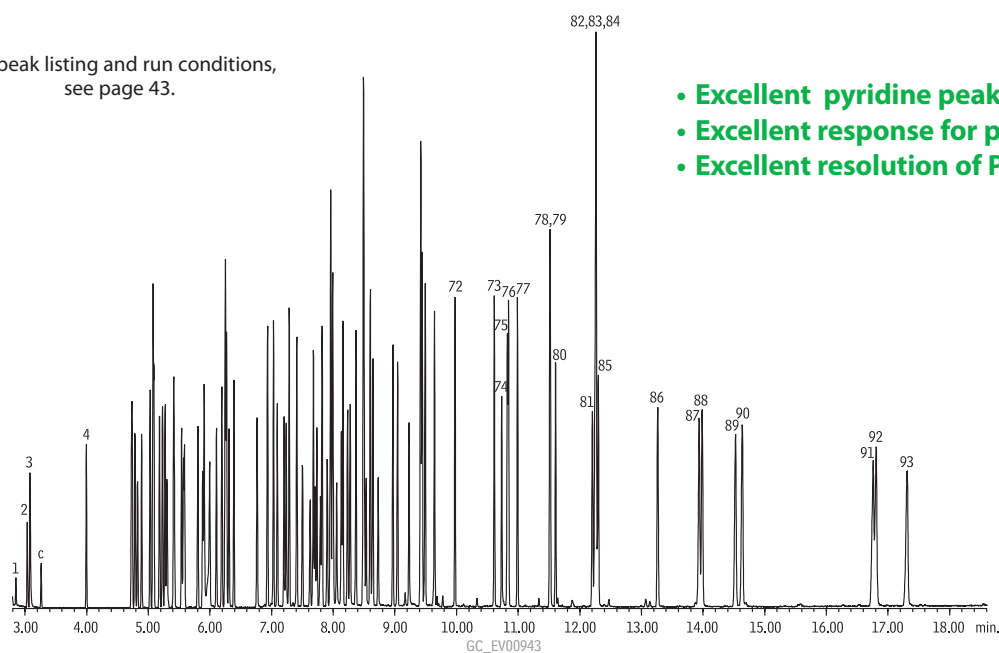
(Crossbond®, selectivity close to 5% diphenyl/95% dimethyl polysiloxane)

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

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

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

For peak listing and run conditions, see page 43.



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

Organophosphorus Pesticides Analysis

Rtx®-OPPesticides/Rtx®-OPPesticides2 (proprietary Crossbond® phases)

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



Using sophisticated computer modeling software, we created two stationary phases for separating the 55 organophosphorus pesticides (OPP) listed in EPA Method 8141A. Separation is improved, and analysis time is significantly reduced, compared to other columns. The extended upper temperature limit of these phases (330°C) allows analysts to bake out high molecular weight contamination typically associated with pesticide samples. The low bleed columns are a perfect match for sensitive detection systems.

Rtx®-OPPesticides Columns (fused silica)

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

restek innovation!

- Better separations
- Faster analysis

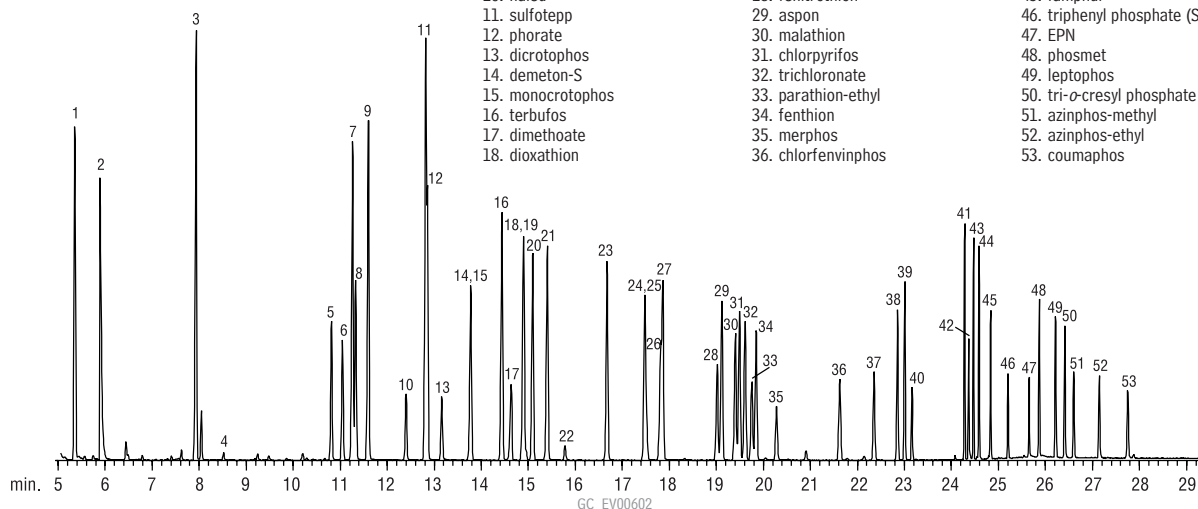
Rtx®-OPPesticides2 Columns (fused silica)

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

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

Best column choice to resolve Method 8141A compounds!

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



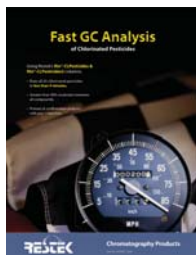
Column: Rtx®-OPPesticides2, 30m, 0.25mm ID, 0.25μm (cat.# 11243)
 Sample: US EPA Method 8141A Custom Standard Mix 1μL 100ppm (100ng on column)
 Triphenylphosphate Standard (cat.# 32281)
 Tributylphosphate Standard (cat.# 32280)
 8140/8141 OP Pesticides Calibration Mix A (cat.# 32277)
 8141 OP Pesticides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

Inj. temp.: 250°C
 Carrier gas: helium, constant flow
 Flow rate: 1.0mL/min.
 Oven temp.: 80°C (hold 0.5 min.) to 140°C @ 20°C/min. to 210°C @ 4°C/min. (hold 1 min.) to 280°C @ 30°C (hold 5 min.)
 Det: MS
 Transfer line temp.: 280°C
 Scan range: 35-400amu
 Ionization: EI



restek **innovation!**

- Very low bleed
- Faster analysis



free literature

Fast GC Analysis of Chlorinated Pesticides

Download your free copy from www.restek.com

Flyer
lit. cat.# 59547A

also **available**

For a wide variety of column connectors, see **pages 213-219**.

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

ordering **note**

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

Chlorinated Pesticides Analysis

Rtx®-CLPesticides/Rtx®-CLPesticides2 (proprietary Crossbond® phases)

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

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

Rtx®-CLPesticides Columns (fused silica)

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

Rtx®-CLPesticides2 Columns (fused silica)

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

Rtx®-CLPesticides Column Kits

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

0.25mm ID Rtx-CLPesticides Kit cat.# 11199 (kit), 1081.10

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

0.32mm ID Rtx-CLPesticides Kit cat.# 11196 (kit), 1112.00

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

0.53mm ID Rtx-CLPesticides Kit cat.# 11197 (kit), 1189.20

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

Add a reference mix to your kit order and save!

| Description | list price | price with/kit | suffix # |
|--------------------------------------------------|------------|----------------|----------|
| Organochlorine Pesticide Mix AB #1 (cat.# 32291) | enquire | | -530 |
| Organochlorine Pesticide Mix AB #2 (cat.# 32292) | enquire | | -535 |

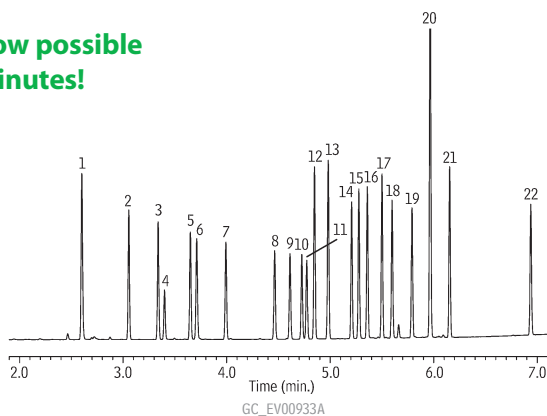
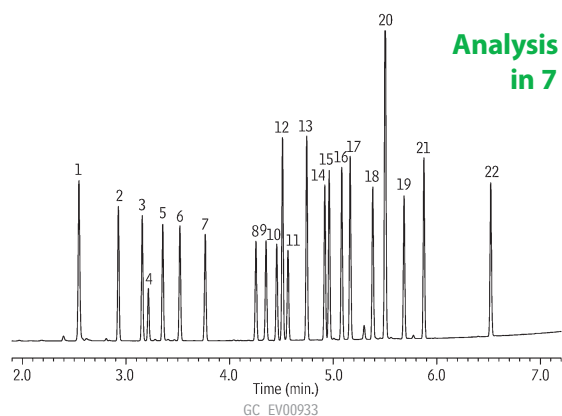
Chlorinated Pesticides Analysis

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

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

Rtx®-CLPesticides

Rtx®-CLPesticides2

Analysis now possible
in 7 minutes!

Columns: Rtx®-CLPesticides, 30m, 0.32mm ID, 0.32 μ m (cat.# 11141) and Rtx®-CLPesticides2, 30m, 0.32mm ID, 0.25 μ m (cat.# 11324) with 5m x 0.32mm ID Rxi® deactivated guard tubing (cat.# 10039), connected using Deactivated Universal "Y" Press-Tight® connector (cat.# 20405-261)

Sample: Organochlorine Pesticide Mix AB #2, 8-80 μ g/mL each component in hexane/toluene (cat.# 32292), Pesticide Surrogate Mix, 200 μ g/mL each component in acetone (cat.# 32000)

Inj.: 1.0 μ L splitless (hold 0.3 min.), 4mm single gooseneck inlet liner (cat.# 20799)

Inj. temp.: 250°C

Carrier gas: helium, constant flow

Linear velocity: 60cm/sec. @ 120°C

Oven temp.: 120°C to 200°C @ 45°C/min. to 230°C @ 15°C/min. to 330°C (hold 2 min.) @ 30°C/min.

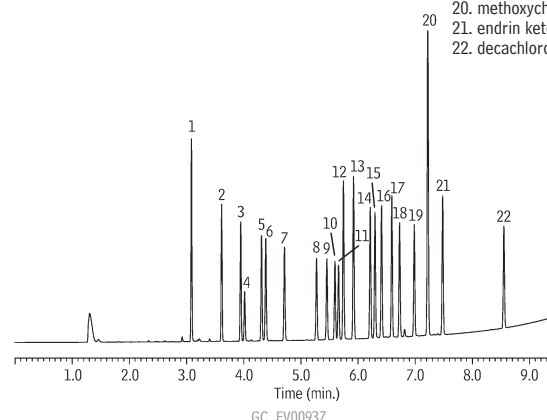
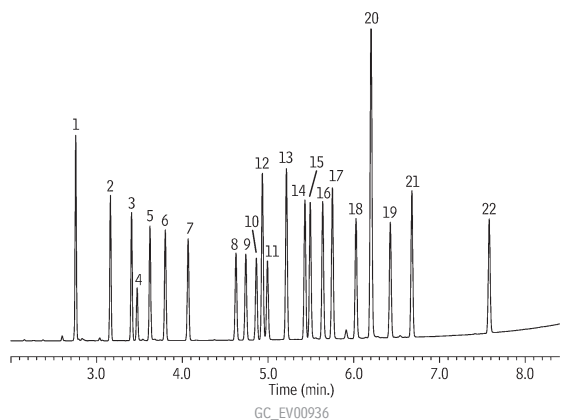
Det.: ECD @ 330°C

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

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

Rtx®-CLPesticides

Rtx®-CLPesticides2



Columns: Rtx®-CLPesticides, 30m, 0.53mm ID, 0.50 μ m (cat.# 11140) and Rtx®-CLPesticides2, 30m, 0.53mm ID, 0.42 μ m (cat.# 11340) with 5m x 0.53mm ID Rxi® deactivated guard tubing (cat.# 10054), connected using Siltek® Treated Universal "Y" Press-Tight® connector (cat.# 20486)

Sample: Organochlorine Pesticide Mix AB #2, 8-80 μ g/mL each component in hexane/toluene (cat.# 32292), Pesticide Surrogate Mix, 200 μ g/mL each component in acetone (cat.# 32000)

Inj.: 1.0 μ L splitless (hold 0.3 min.), 4mm single gooseneck inlet liner (cat.# 20799)

Inj. temp.: 250°C

Carrier gas: helium, constant flow

Linear velocity: 45cm/sec. @ 120°C

Oven temp.: 120°C to 200°C @ 45°C/min. to 230°C @ 12.5°C/min. to 325°C (hold 2 min.) @ 30°C/min.

Det.: ECD @ 330°C



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Chlorinated Pesticides Analysis

Stx™-CLPesticides/Stx™-CLPesticides2 (proprietary Crossbond® phases)

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

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

it's a **fact**

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

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

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

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

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

Stx™-CLPesticides Kits

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



0.25mm ID Stx-CLPesticides Kit cat.# 11190 (kit), 1081.10

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



0.32mm ID Stx-CLPesticides Kit cat.# 11193 (kit), 1112.00

| Includes: | cat.# | price |
|-------------------------------------------------|-------|-------|
| 30m, 0.32mm ID, 0.32μm Stx-CLPesticides Column | 11546 | |
| 30m, 0.32mm ID, 0.25μm Stx-CLPesticides2 Column | 11444 | |
| Universal Angled "Y" Press-Tight Connector | 20403 | |
| 5m, 0.32mm ID Siltek Guard Column | 10027 | |

ordering **note**

Kits include Siltek® deactivated guard column.

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Environmental
Related Articles Online

www.restek.com/environmental

Brominated Flame Retardants Analysis

Rtx®-1614 (5% phenyl methyl)

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



Rtx®-1614 Columns (fused silica)

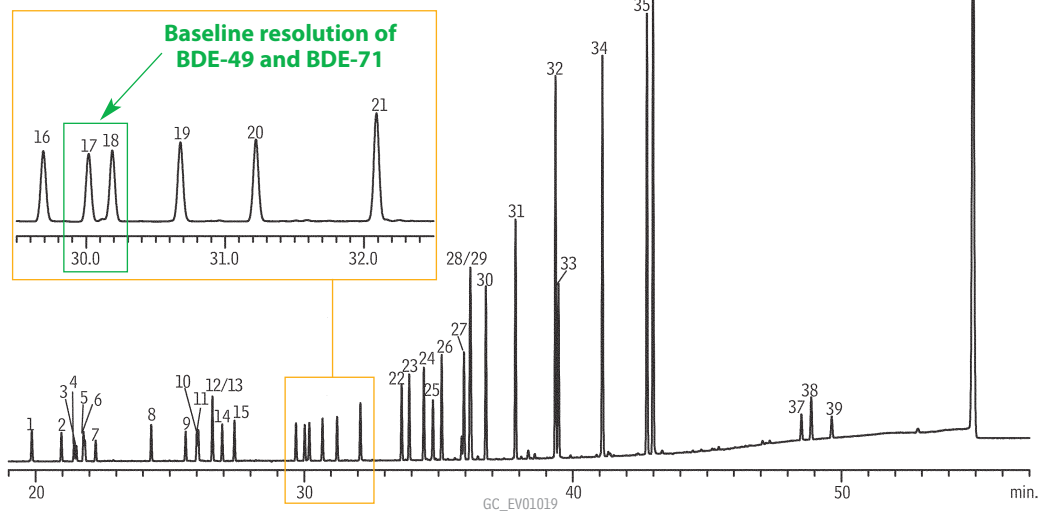
(5% phenyl methyl)

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

Separate PBDEs accurately and reliably on an Rtx®-1614 column.

Column: Rtx®-1614, 30m, 0.25mm ID, 0.10μm (cat.# 10295)
 Sample: 100-300ppb PBDE PAR Solution (cat.# E0-5113, Cambridge Isotope Laboratories Inc.), 500ppb decabromodiphenyl ether (cat.# BDE-209, Wellington Laboratories)
 Inj.: 1μL splitless (hold 1 min.), 4mm cyclo double gooseneck liner (cat.# 20896)
 Inj. temp.: 300°C
 Carrier gas: helium, constant flow
 Linear velocity: 20cm/sec. @ 100°C
 Oven temp.: 100°C (hold 3 min.) to 320°C @ 5°C/min. (hold 15 min.)
 Detector temp.: μ-ECD @ 340°C

Greater response and higher inertness for BDE-209!



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

Table of Contents for
Applications

see page 489





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PCB Congeners Analysis

Rtx®-PCB (proprietary Crossbond® phase)

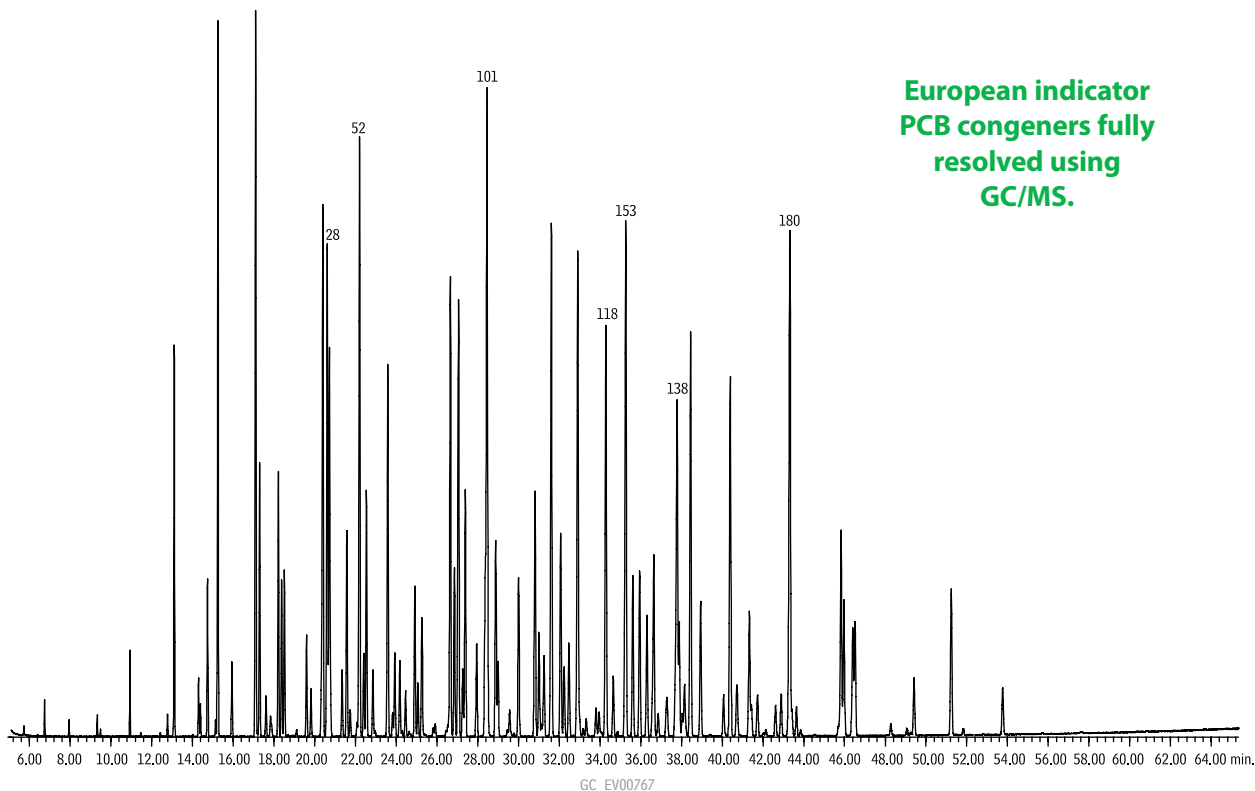
- Unique polymer for PCBs analysis by GC/ECD or GC/MS.
- Good results for other semivolatiles.
- Low polarity; inert to active compounds.
- Stable to 340°C.

Rtx®-PCB Columns (fused silica)

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

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

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



European indicator
PCB congeners fully
resolved using
GC/MS.

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

PCB Congeners Analysis

Rxi®-XLB (low polarity proprietary phase)

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

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

Rxi®-XLB Columns (fused silica)

(low polarity proprietary phase)

| ID | df (μm) | temp. limits* | 15-Meter | 30-Meter | 60-Meter |
|--------|---------|-----------------|----------|----------|----------|
| 0.25mm | 0.10 | 30 to 340/360°C | 13705 | 13708 | |
| | 0.25 | 30 to 340/360°C | 13720 | 13723 | 13726 |
| | 0.50 | 30 to 340/360°C | | 13738 | |
| | 1.00 | 30 to 340/360°C | 13750 | 13753 | |

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

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

also available

Other Dimensions!

See [page 44](#) for our complete listing of Rxi®-XLB columns.

similar phases

DB-XLB, VF-Xms

Get More!

Environmental
Related Articles Online

www.restek.com/environmental



Dioxin & Furan Congeners Analysis

restek **innovation!**

Rtx®-Dioxin (proprietary Crossbond® phase)

- Replacement column for 5% diphenyl phases.
- Improved separations of dioxin or furan congeners.
- Greater thermal stability than 5% diphenyl phases or high-cyano confirmation columns.

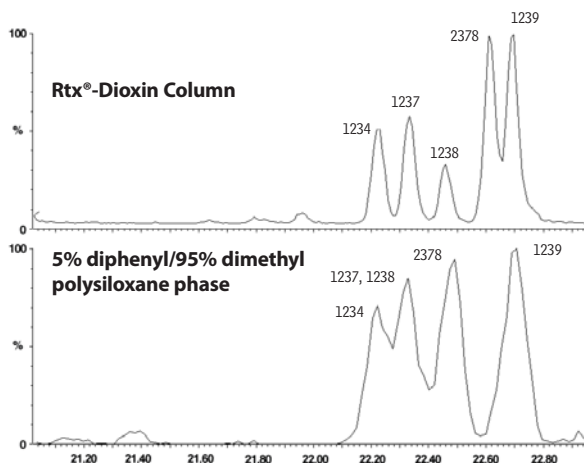
also **available**

Rtx®-Dioxin2 columns.
See **page 87**.

Rtx®-Dioxin Columns (fused silica)

| ID | df (µm) | temp. limits | 60-Meter |
|--------|---------|----------------|----------|
| 0.25mm | 0.15 | -60°C to 380°C | 10755 |

Rtx®-Dioxin column separates all five components in the TCDD resolution check mixture.



Temperature program:

| Time (min.) | Rate (°C/min.) | Temp. (°C) |
|-------------|----------------|------------|
| 0 | 52 | 200 |
| 10.2 | 2.9 | 235 |
| 10 | 6.9 | 300 |
| 24 | | |

Injector temp.: 270°C
Flow: 1.2mL/min. (constant pressure)

Column: Rtx®-Dioxin, 40m, 0.18mm ID, 0.11µm
Initial temp.: 130°C
Instrument: Micromass Altima high resolution GC/MS

Chromatography courtesy of Karen MacPherson and Eric Reiner, Ontario Ministry of the Environment, Etobicoke, ON, Canada.



“We test every fused silica, PLOT, and MXT® column against stringent quality standards to ensure you get the best columns on the market.”

Restek’s Quality Assurance Group

pictured: Sara Eyster, Dianne Shaffer, Lenny Miller, Corby Hillard, Glenn Gerhab, Chris Zucco, Deb Conklin, Trisha Houser, John Kalmbach (not pictured: Kayne Milhomme, Adam Clark, Tyler Brown, Abby Caporuscio, Brett Ripka)

Dioxin & Furan Congeners Analysis

Rtx®-Dioxin2 (proprietary Crossbond® phase)

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

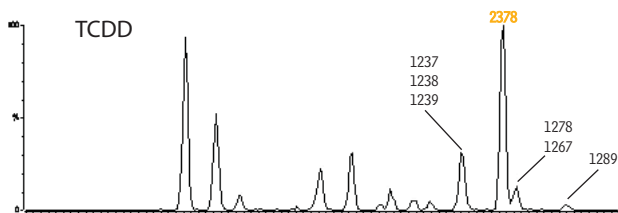
restek **innovation!**

Excellent for dioxins or furans.

Rtx®-Dioxin2 Columns (fused silica)

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

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

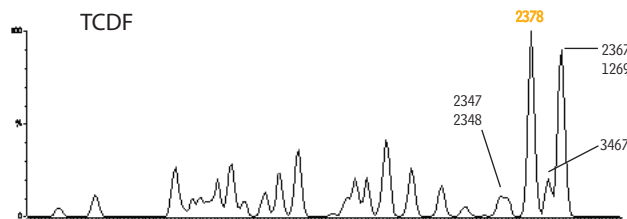


Other peak identifications available upon request.

GC_EV00948

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

Tetrachlorodibenzofuran congeners on an Rtx®-Dioxin2 column.



Other peak identifications available upon request.

GC_EV00949

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

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



free literature

Rtx®-Dioxin2 Column: 2,3,7,8-TCDD and 2,3,7,8-TCDF Specificity in One GC Column

All 128 tetra through octa dioxin and furan congeners acquired on the Rtx®-Dioxin2 column.

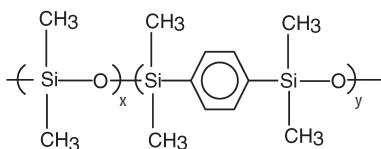
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Flyer

lit. cat.# 580119A

Polycyclic Aromatic Hydrocarbon (PAH) Analysis

Rxi™-5Sil MS Structure



Rxi®-5Sil MS (low polarity Crossbond® silarylene phase; selectivity close to 5% diphenyl/95% 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 polycyclic aromatic compounds, chlorinated hydrocarbons, phthalates, phenols, amines, organochlorine pesticides, organophosphorus pesticides, drugs, solvent impurities, and hydrocarbons.
- Temperature range: -60°C to 350°C.

similar phases

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

also available

Get the protection without the connection!

For Rxi®-5Sil MS columns with built-in Integra-Guard™ guard columns, see [page 33](#).

Other Dimensions!

See [page 42](#) for our complete listing of Rxi®-5Sil MS columns.

Rxi®-5Sil MS Columns (fused silica)

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

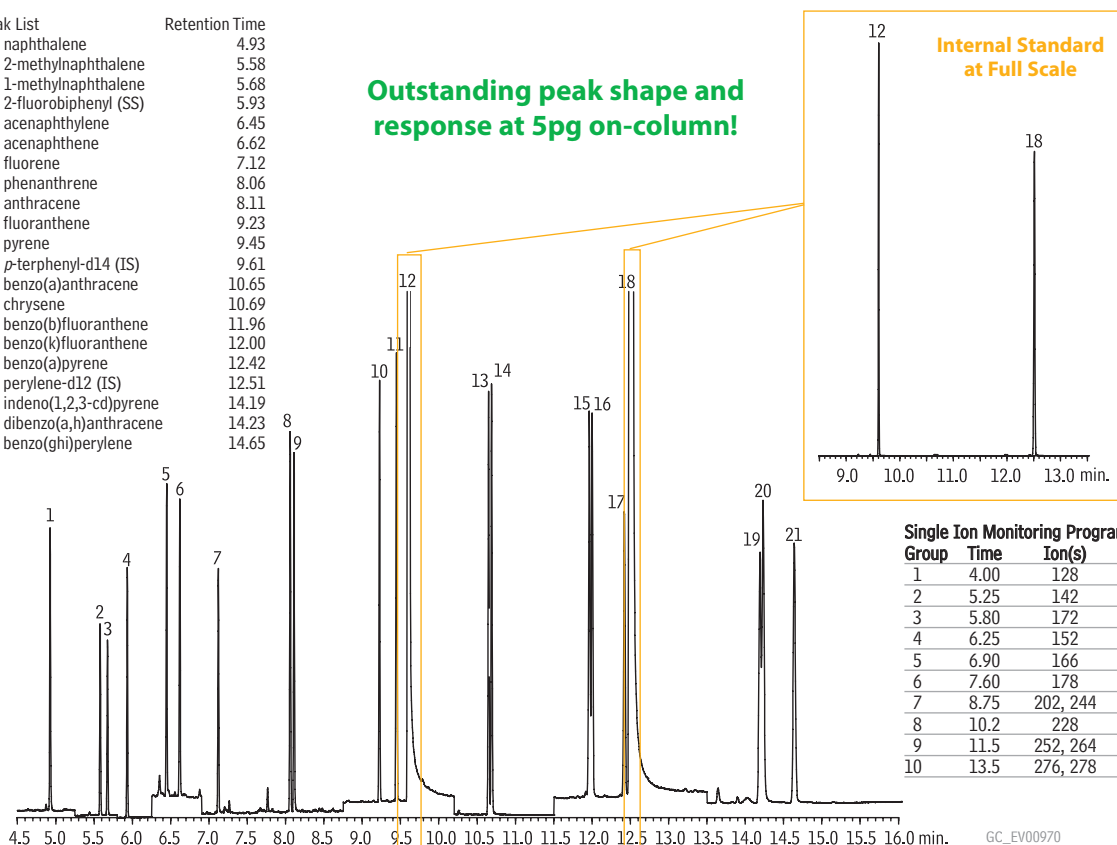
| ID | df (µm) | temp. limits | 15-Meter | 30-Meter | 60-Meter |
|--------|---------|------------------|----------|----------|----------|
| 0.25mm | 0.10 | -60 to 330/350°C | 13605 | 13608 | |
| | 0.25 | -60 to 330/350°C | 13620 | 13623 | 13626 |
| | 0.50 | -60 to 330/350°C | 13635 | 13638 | |

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

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

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

Outstanding peak shape and response at 5pg on-column!



Single Ion Monitoring Program

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

Column: Rxi®-5Sil MS, 30m, 0.25mm ID, 0.25µm (cat.# 13623)
Sample: PAH mix, 1µL of 0.005µg/mL (IS 2µg/mL)
SV Calibration Mix #5 (cat.# 31011)

1-methylnaphthalene (cat.# 31283)
2-methylnaphthalene (cat.# 31285)
2-fluorobiphenyl (cat.# 31091)
Inj.: 1.0µL (5pg on-column concentration),
4mm Drilled Uniliner® (hole near top) inlet liner w/wool (cat.# 21055-200.5),
pulsed splitless: pulse 20psi @ 0.2 min., 60mL/min. @ 0.15 min.

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

Polycyclic Aromatic Hydrocarbon (PAH) Analysis

Rt[®]-PAH (polar, proprietary liquid crystalline phase)

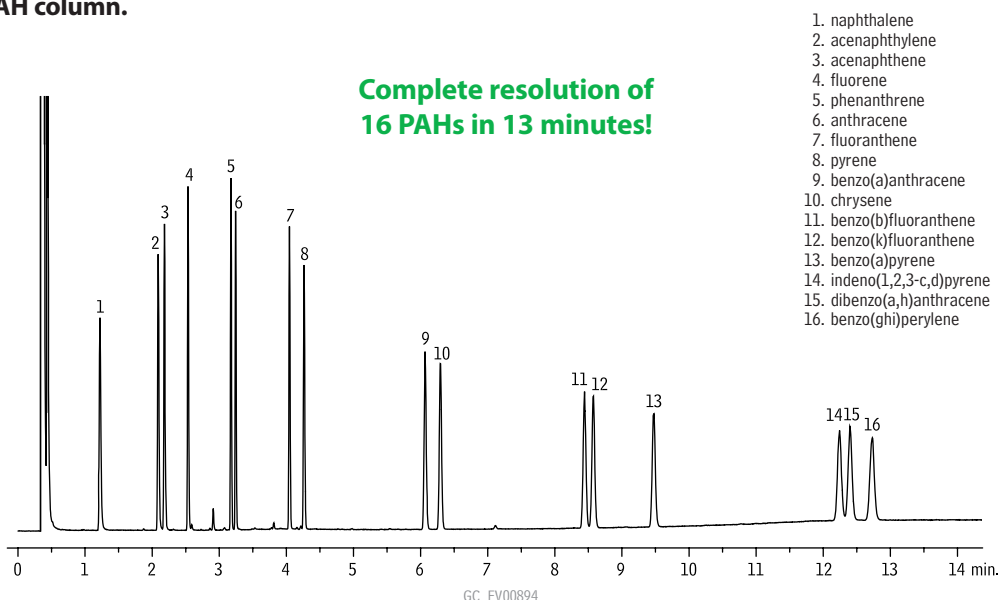
- Specially designed for the analysis of polycyclic aromatic hydrocarbons (PAHs) listed in US EPA methods 610 and 8100.
- Low bleed at 285°C.
- Temperature range: 80°C to 285°C.

Rt[®]-PAH Columns (fused silica)

| ID | df (μm) | temp. limits | 12-Meter |
|--------|---------|---------------|----------|
| 0.25mm | 0.15 | 80°C to 285°C | 19733 |

Separation of 16 regulated polycyclic aromatic hydrocarbons (PAHs) in less than 15 minutes on an Rt[®]-PAH column.

Complete resolution of
16 PAHs in 13 minutes!



1. naphthalene
2. acenaphthylene
3. acenaphthene
4. fluorene
5. phenanthrene
6. anthracene
7. fluoranthene
8. pyrene
9. benzo(a)anthracene
10. chrysene
11. benzo(b)fluoranthene
12. benzo(k)fluoranthene
13. benzo(a)pyrene
14. indeno(1,2,3-c,d)pyrene
15. dibenzo(a,h)anthracene
16. benzo(ghi)perylene

GC_EV00894

Column: Rt[®]-PAH, 12m, 0.25mm ID, 0.15μm (cat.# 19733)
 Sample: 16 component EPA Method 610 PAH standard
 (20ng/μl of each component in dichloromethane)
 Inj.: 1.0μL split (split ratio 10:1)
 Inj. temp.: 225°C
 Carrier gas: helium, 110kPa column head pressure
 Oven temp.: 80°C to 220°C @ 40°C/min., 220°C to 285°C @ 8°C/min. (hold 5 min.)
 Detector: FID @ 290°C

Chromatogram courtesy of J&K Scientific.

Rt[®]-LC50 (polar, dimethyl (50% liquid crystal) polysiloxane)

- General purpose column with selectivity for dioxin or furan congeners, or PCB congeners.
- Low bleed at 270°C.
- Temperature range: 100°C to 270°C.

The unique liquid crystalline Rt[®]-LC50 stationary phase resolves compounds of similar structure and boiling point. It has proven effective for resolving many polycyclic aromatic hydrocarbons; other potential applications include dioxin, furan, or PCB congeners.

Rt[®]-LC50 Columns (fused silica)

| ID | df (μm) | temp. limits | 10-Meter | 20-Meter |
|--------|---------|----------------|----------|----------|
| 0.10mm | 0.10 | 100°C to 270°C | 19736 | — |
| 0.18mm | 0.10 | 100°C to 270°C | 19735 | — |
| 0.25mm | 0.10 | 100°C to 270°C | — | 19734 |

Volatile Organics Analysis

restek innovation!

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

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

Rtx®-VMS (proprietary Crossbond® phase)

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

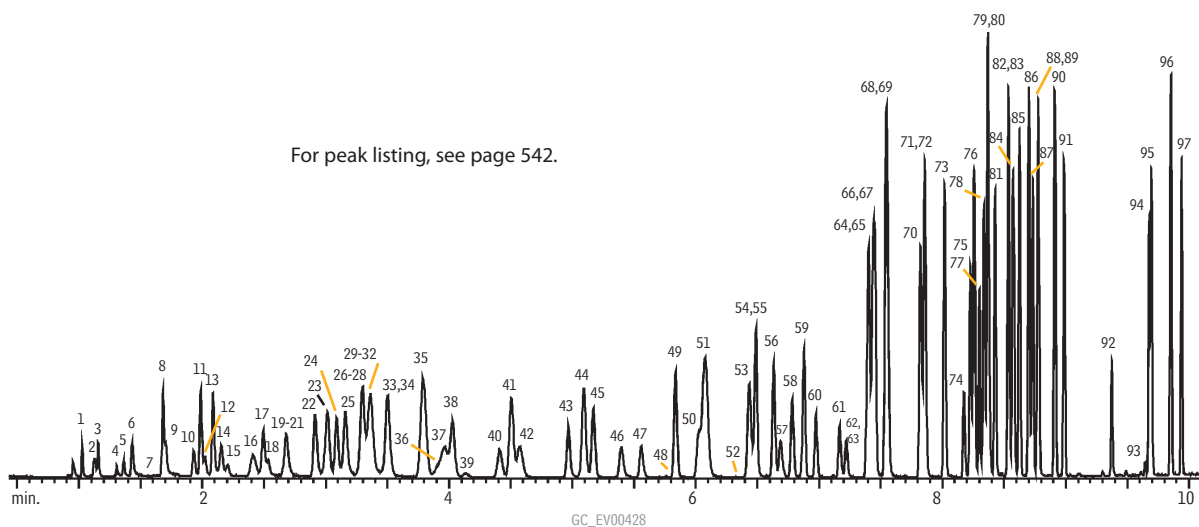
Rtx®-VMS columns offer lower bleed, better selectivity, and overall faster analysis for separating volatile organic compounds, such as those listed in US EPA Method 8260B. The Rtx®-VMS stationary phase is a highly stable polymer that provides outstanding analysis of volatile compounds, in combination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

Rtx®-VMS Columns (fused silica)

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

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

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



For peak listing, see page 542.

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

Volatile Organics Analysis

Rtx®-VRX (proprietary Crossbond® phase)

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

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

Rtx®-VRX Columns (fused silica)

(proprietary Crossbond® phase)

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

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

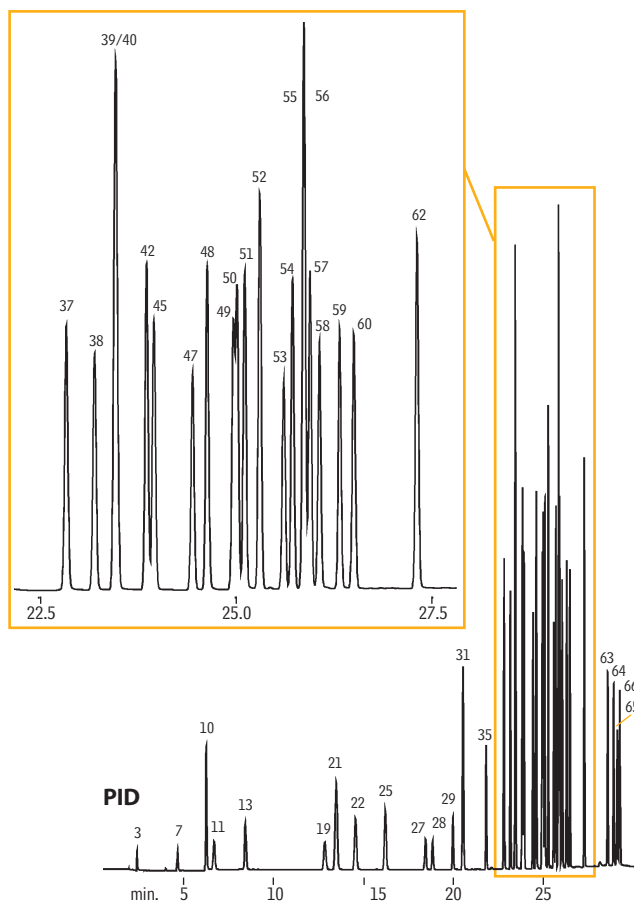
similar phases

DB-VRX

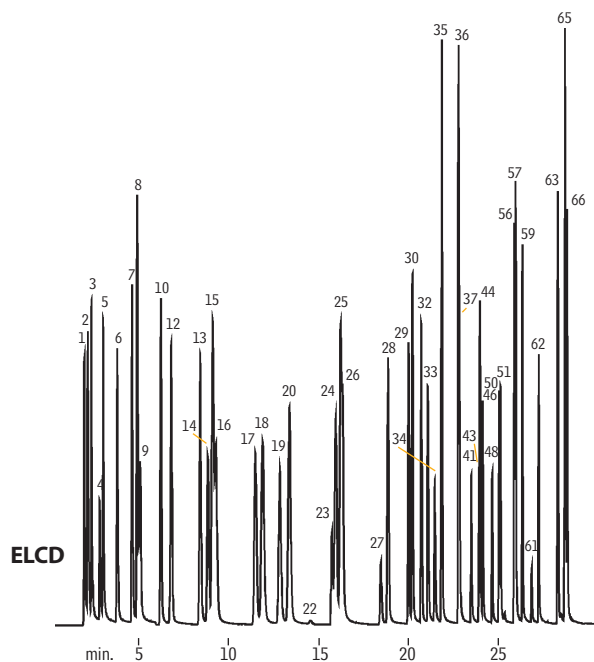
Need a column for a
volatiles analysis?

see page 537

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



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



GC_EV00001

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



Volatile Organics Analysis

Rtx®-502.2 (proprietary Crossbond® diphenyl/dimethyl polysiloxane phase)

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

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

Rtx®-502.2 Columns (fused silica)

(proprietary Crossbond® diphenyl/dimethyl polysiloxane phase)

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

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

similar phase

DB-502.2

also available

MXT® Columns

Rugged, flexible, Siltek® treated stainless steel tubing; inertness comparable to fused silica tubing. See **pages 111** for our MXT®-502.2 and MXT®-Volatiles columns.

Rtx®-Volatiles (proprietary Crossbond® diphenyl/dimethyl polysiloxane phase)

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

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

Rtx®-Volatiles Columns (fused silica)

(proprietary Crossbond® diphenyl/dimethyl polysiloxane phase)

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

similar phase

VOCOL



Searching for a chromatogram?
www.restek.com

Volatile Organics Analysis

Rtx[®]-624 (low to midpolarity phase; Crossbond[®] 6% cyanopropylphenyl/94% dimethyl polysiloxane)

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

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

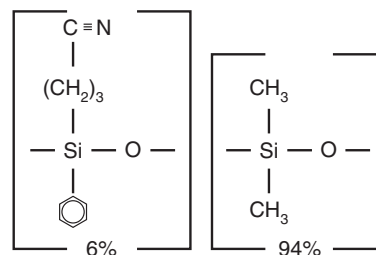
Rtx[®]-624 Columns (fused silica)

(Crossbond[®] 6% cyanopropylphenyl/94% dimethyl polysiloxane)

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

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

Rtx[®]-624 Structure



similar phases

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

also available

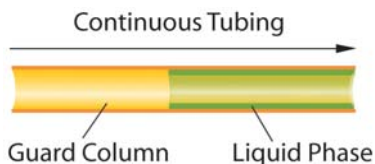
MXT[®] Columns

Rugged, flexible, Siltek[®] treated stainless steel tubing; inertness comparable to fused silica tubing. See [page 111](#) for our MXT[®]-624 columns.

Integra-Guard™ built-in guard column

Get the protection without the connection!

For Rtx[®]-624 columns with built-in Integra-Guard™ guard columns, see [page 33](#).



Explosives Analysis

Rtx[®]-TNT/Rtx[®]-TNT2 (proprietary Crossbond[®] phase)

- Application-specific columns for explosives in US EPA Method 8095.
- Low bleed—ideal for ECD analysis.
- Complete analysis in less than 20 minutes.
- Rtx[®]-TNT2 confirmation column provides 8 elution order changes under same conditions.
- Economical 3-packs.
- Stable to 310°C.

We designed Rtx[®]-TNT and Rtx[®]-TNT2 columns specifically for analyses of nitroaromatic compounds by GC/ECD, such as the 16 analytes listed in US EPA Method 8095. They provide better resolution and higher thermal stability than any other currently recommended columns. Operate the Rtx[®]-TNT primary column and Rtx[®]-TNT2 confirmation column under identical GC oven temperature programs.

Rtx[®]-TNT Columns (fused silica)

| ID | df (μm) | temp. limits | 6-Meter/3-pk. |
|--------|---------|------------------|---------------|
| 0.53mm | 1.50 | -20 to 300/310°C | 12998 |

Rtx[®]-TNT2 Columns (fused silica)

| ID | df (μm) | temp. limits | 6-Meter/3-pk. |
|--------|---------|------------------|---------------|
| 0.53mm | 1.50 | -20 to 300/310°C | 12999 |

restek innovation!

Improved resolution of nitroaromatic compounds such as those listed in US EPA Method 8095.

GC COLUMNS PLOT COLUMNS

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Rt-Q-BOND, Rt-QS-BOND, Rt-S-BOND, Rt-U-BOND



Top: Kelsea Miller, Caging Technician
Bottom: Kim Shaffer, Manufacturing Group Leader



Features & Benefits of Restek PLOT Columns

Features

Highest quality porous materials.

Consistency in porosity and uniformity in particle and pore size are major concerns in designing the solid stationary phase. We developed a unique synthesis and selection technology to yield uniform, small diameter particles that are ideal for a specific separation.

Particles are 100% bonded to the tubing.

Restek coating and bonding techniques produce strong, uniform particle adherence to the inside of the capillary tubing. Customers have described Restek's Rt[®]-Msieve 5A PLOT column as "bulletproof," meaning that the stationary phase is bonded so strongly that particle generation is minimized.

Reproducible quality.

Because we use advanced technology to make these columns, the entire manufacturing process is simple and stable. Each step of the column-making process is meticulously quality-checked, allowing Restek to offer the best quality PLOT columns available.

Benefits

The most consistent and efficient analyses obtainable.

Reduced particle generation and flow restriction.

Reproducible performance.

Quick Reference Chart

| PLOT Column | Application | Page |
|-------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| Rt-Alumina BOND (Na ₂ SO ₄ deactivation) | C1–C5 hydrocarbons. Purity analysis of ethylene, propylene, butenes, butadiene | 98 |
| Rt-Msieve 5A | Permanent gas analysis. He, Ne, Ar, O ₂ , N ₂ , Xe, Rn, SF ₆ , and CH ₄ , C ₂ H ₂ , CO | 99 |
| Rt-Q-BOND | Nonpolar porous polymer. High retention for solvents, alcohols, polar volatiles, CO ₂ , sulfur, and ppm water in solvents | 100 |
| Rt-QS-BOND | Intermediate polarity porous polymer. Neutral solvents, ketones, esters, hydrocarbons, and baseline separation of ethane, ethene, acetylene | 100 |
| Rt-S-BOND | Intermediate polarity porous polymer. Light gases in ethylene and propylene, ketones, esters, hydrocarbons | 100 |
| Rt-U-BOND | Polar porous polymer. More retention for polar compounds | 100 |

PLOT Column Phase Cross-Reference: Similar Selectivity

| Restek | Porous Layer | Agilent/J&W | Supelco | Alltech | Varian/Chrompack | Quadrex |
|-------------------------------------------------------------------|-------------------------------------------------|-------------------------------------|------------------|--------------|-------------------------------------------------------|---------|
| Rt-Alumina BOND (Na ₂ SO ₄ deactivation) | Aluminum oxide | GS-Alumina, HP PLOT S, HP PLOT M | Alumina-PLOT | AT-Alumina | CP-Al ₂ O ₃ /NA:SO ₄ | — |
| Rt-Msieve 5A | Molecular sieve 5A | GS-Molsieve, HP PLOT/Molesieve | Molsieve 5A PLOT | AT-Molesieve | CP-Molesieve 5A | PLT-5A |
| Rt-Q-BOND | DVB porous polymer | — | Supel-Q-PLOT | AT-Q | CP-PoraPlot Q, PoraBond Q | — |
| Rt-QS-BOND | Intermediate polarity porous polymer | GS-Q | — | — | — | — |
| Rt-S-BOND | DVB vinylpyridine polymer | — | — | — | CP-PoraPlot S | — |
| Rt-U-BOND | DVB ethyleneglycol- dimethylacrylate polymer | HP-UPLLOT | — | — | CP-PoraPlot U, PoraBond U | — |

New Generation Porous Layer Open Tubular (PLOT) Columns

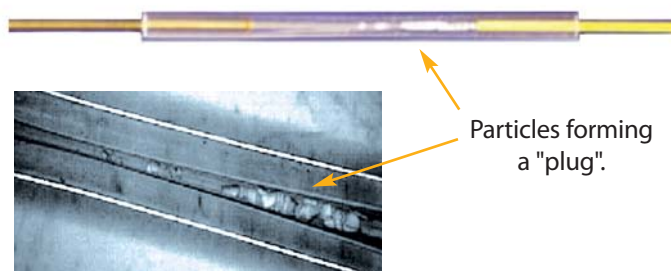
- Stabilized particle layers improve robustness and reproducibility of retention and flow; no retention time changes between columns.
- Fully compatible with valve switching and Deans switching systems.
- Highly efficient, reproducible analyses; ideal for permanent gases, solvents, and hydrocarbons.
- New manufacturing procedure improves performance of porous polymers and molecular sieves.

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

Traditional PLOT Columns Offer Poor Stability

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

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



New Stabilized PLOT Columns Minimize Particle Release

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

Consistent Flow Restriction Factor (F) Guarantees Reproducible Flow

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

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



In order to evaluate flow restriction reproducibility, Restek is introducing a new factor: the flow restriction factor (F). The flow restriction factor is based on the retention time of an unretained compound (Equation 1). It can be used to assess the degree of restriction of the column and to evaluate the reproducibility of the column coating process. Percent flow restriction can also be calculated as shown in Equation 2. Figure 3 shows what typically happens when a conventional PLOT column manufacturing process is used. Because of the difference in flow restriction, individual columns have very different flow characteristics. In contrast, Figure 4 shows results for columns generated using the new process (Rt[®]-QS-BOND, bonded porous polymer). Clearly, the new PLOT column process results in greater consistency in both column coating thickness and flow restriction.

Figure 3 Traditional PLOT columns show significant flow variability, indicating inconsistent column coating thicknesses (n=12).

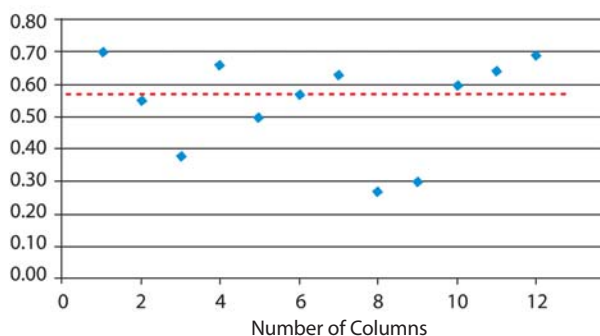
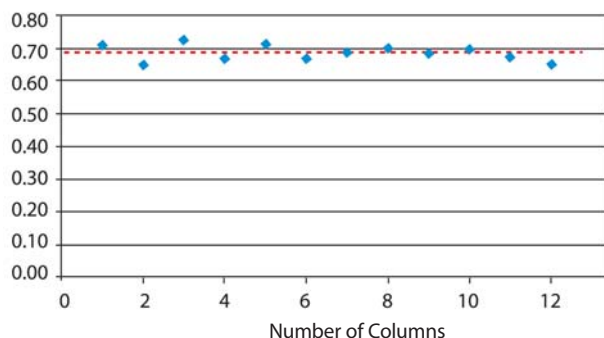


Figure 4 Restek's new stabilized PLOT columns offer consistent flow resistance, giving more reproducible results column-to-column.



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

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.

Equation 2 Percent flow restriction of coated column.

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

NEW! advanced technology
Details on pages 96-97.

did you know?

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

i tech tip

Trace water in the carrier gas can affect the selectivity and retention of the Rt[®]-Alumina BOND column. The column can be regenerated by baking out the water (50°C to 200°C @ 8°C/min., 50cm/sec. flow rate). Periodic conditioning ensures excellent run-to-run retention time reproducibility.

The maximum programmable temperature for an Rt[®]-Alumina BOND column is 200°C. Higher temperatures cause irreversible changes to the porous layer adsorption properties.

NEW! Rt[®]-Alumina BOND columns now available with KCl deactivation!

Rt[®]-Alumina BOND Column Characteristics

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

Guaranteed Reproducibility

Each Rt[®]-Alumina BOND column is tested with a hydrocarbon test mix to ensure proper phase thickness and selectivity. 1,3-Butadiene is used to calculate k (capacity factor), which is a measure of phase thickness. Selectivity is measured using retention indices for propadiene and methyl acetylene. The resolution of *trans*-2-butene and 1-butene is also verified. To measure coating efficiency, plates per meter are checked using 1,3-butadiene.

With our new technology, both Na₂SO₄ and KCl are available with the Rt[®]-Alumina BOND columns.

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

(Na₂SO₄ deactivation)

| ID | df (μm) | temp. limits | 30-Meter | | 50-Meter | |
|--------|---------|--------------|----------|---------|----------|---------|
| 0.32mm | 5 | to 200°C | 19757 | enquire | 19758 | enquire |
| 0.53mm | 10 | to 200°C | 19755 | enquire | 19756 | enquire |

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

(KCl deactivation)

| ID | df (μm) | temp. limits | 30-Meter | | 50-Meter | |
|--------|---------|--------------|----------|---------|----------|---------|
| 0.32mm | 5 | to 200°C | 19761 | enquire | 19762 | enquire |
| 0.53mm | 10 | to 200°C | 19759 | enquire | 19760 | enquire |

Restek Customer Service

In the U.S.

Call: 800-356-1688 (ext. 3) or 814-353-1300 (ext. 3)

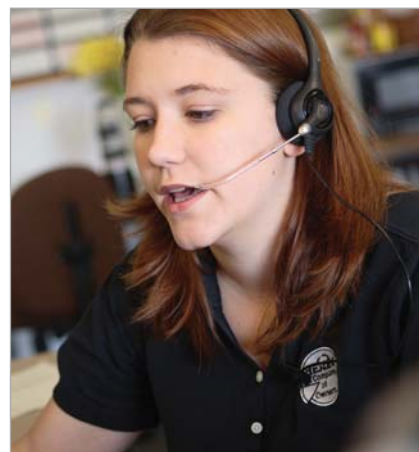
Monday–Friday 8:00 a.m.–6:00 p.m. ET

Fax: 814-353-1309—24-hours a day

Online: www.restek.com—24-hours a day

Outside the U.S.

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



Melissa Decker, Customer Service

Rt[®]-Msieve 5A PLOT Columns

Rt[®]-Msieve 5A PLOT columns are designed for efficient separation of Ar/O₂ and other permanent gases, including CH₄, C₂H₆, and CO. Special coating and deactivation procedures ensure chromatographic efficiency and the integrity of the porous layer coating. Molecular sieves have very high retention, allowing separations of permanent gases at temperatures above ambient. Additionally, Restek's unique immobilization process guarantees that the uniform particles remain adhered to the tubing—even after continuous valve-cycling.

Our revolutionary molecular sieve 5A PLOT columns separate Ar/O₂ and H₂/He at ambient temperature or above (see figure). These columns also are an excellent choice for rapid separation of permanent gases in refinery or natural gas.

Our deactivation technology also allows the CO peak to elute as a sharp peak. This is in contrast with other suppliers where CO often tails badly and cannot be quantified below % levels.

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

| ID | df (μm) | temp. limits | 15-Meter | 30-Meter |
|--------|---------|--------------|----------|----------|
| 0.32mm | 30 | to 300°C | 19720 | 19722 |
| 0.53mm | 50 | to 300°C | 19721 | 19723 |

MXT[®]-Msieve 5A (Siltek[®]-treated stainless steel PLOT)

| ID | df (μm) | temp. limits | 30-Meter |
|--------|---------|--------------|---------------|
| 0.53mm | 50 | to 300°C | 79723 enquire |



advanced technology
Details on **pages 96-97**.

did you know?

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



Metal PLOT columns are back!

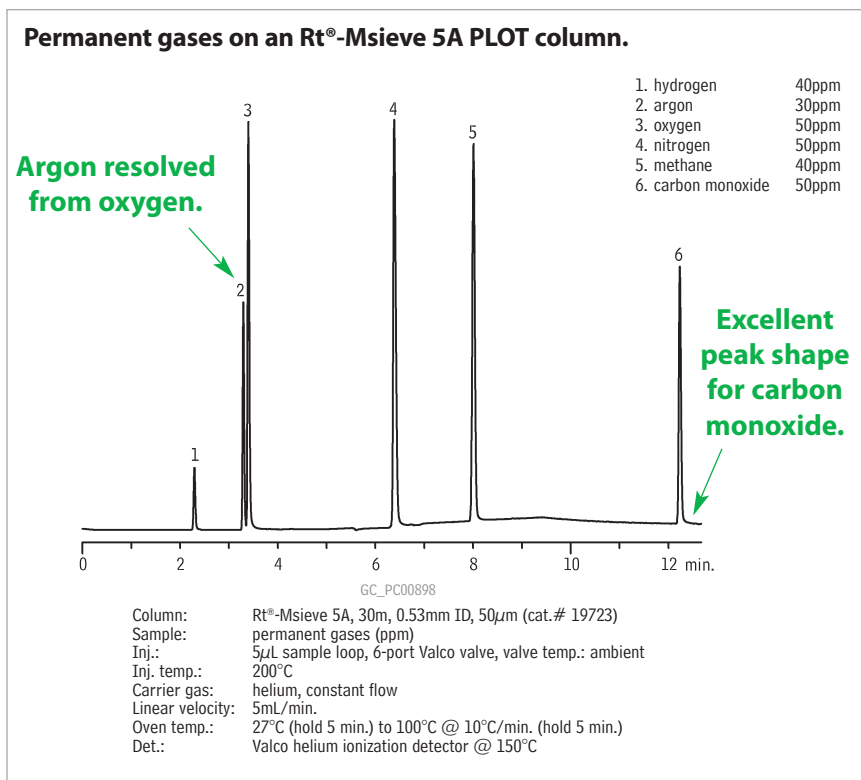
i tech tip

Because molecular sieve materials are very hydrophilic, they will adsorb water from the sample or carrier gas. Water contamination can have a detrimental effect on peak symmetry and can reduce the resolution of all compounds. If water contamination occurs, reactivate your Rt[®]-Msieve 5A PLOT column by conditioning at 300°C with dry carrier gas flow for 3 hours.

did you know?

ShinCarbon ST micropacked columns are another alternative for analyzing permanent gases.

See **page 120** for information.



Searching for a chromatogram?
www.restek.com



advanced technology

Details on pages 96-97.

Porous Polymers: Rt[®]-Q-BOND, Rt[®]-QS-BOND, Rt[®]-S-BOND, Rt[®]-U-BOND

Restek chemists have developed a new process for the manufacturing of porous polymer PLOT columns. The process incorporates the particles to the walls of the tubing, so there is virtually no particle generation. Because of the particle adhering to the walls of the tubing, there is reproducible performance from column to column, including selectivity and flow.

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

100% divinylbenzene

- Nonpolar PLOT column incorporating 100% divinyl benzene.
- Excellent for analysis of C1 to C3 isomers and alkanes up to C12.
- CO₂ and methane separated from O₂/N₂/CO (Note: O₂/N₂/CO not separated at room temperature).
- Use for analysis of oxygenated compounds and solvents.
- Maximum temperature of 320°C.

| ID | df (μm) | temp. limits | 15-Meter | 30-Meter |
|--------|---------|--------------|----------|----------|
| 0.32mm | 10 | to 300/320°C | 19743 | 19744 |
| 0.53mm | 20 | to 300/320°C | 19741 | 19742 |

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

porous divinyl benzene homopolymer

- Intermediate polarity PLOT column incorporating divinyl benzene homopolymer.
- Separates ethane, ethylene and acetylene to baseline.

| ID | df (μm) | temp. limits | 15-Meter | 30-Meter |
|--------|---------|--------------|----------|----------|
| 0.32mm | 10 | to 250°C | 19739 | 19740 |
| 0.53mm | 20 | to 250°C | 19737 | 19738 |

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

divinylbenzene 4-vinylpyridine

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

| ID | df (μm) | temp. limits | 15-Meter | 30-Meter |
|--------|---------|--------------|----------|----------|
| 0.32mm | 10 | to 250°C | 19747 | 19748 |
| 0.53mm | 20 | to 250°C | 19745 | 19746 |

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

divinylbenzene ethylene glycol/dimethylacrylate

- Polar PLOT column, incorporating divinylbenzene ethylene glycol/dimethylacrylate.
- Use for the analysis of polar and nonpolar compounds.

| ID | df (μm) | temp. limits | 15-Meter | 30-Meter |
|--------|---------|--------------|----------|----------|
| 0.32mm | 10 | to 190°C | 19751 | 19752 |
| 0.53mm | 20 | to 190°C | 19749 | 19750 |



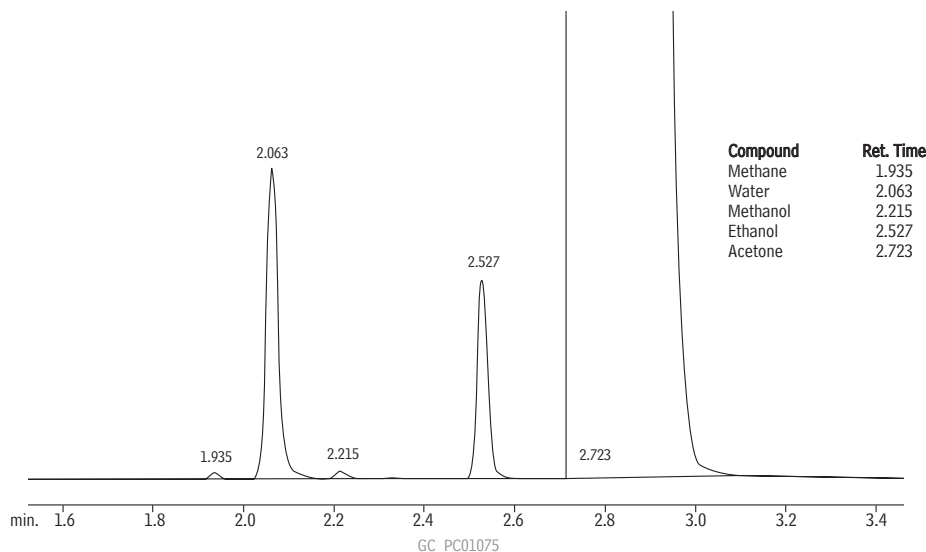
PLOT Column Particle Trap

- Includes two Press-Tight[®] connectors and a 2.5m column.
- Connect particle trap between column and detector or valve.
- Eliminates detector spikes and scratches in valve rotors.

The technology used to adhere particles in PLOT columns is excellent; however, there is still a possibility for particles to dislodge. When using PLOT columns with a valve-switching system or GC/MS, we recommend using a particle trap at the outlet end of the column.

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

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



Column: Rt[®]-Q-BOND, 30m, 0.53mm ID, 20 μ m (cat.# 19742)
 Sample: 0.5% water and ethanol in acetone
 Inj.: 3 μ L split (split ratio 11:1), 4mm single gooseneck liner w/ wool (cat.# 22405)
 Inj. temp.: 250°C
 Carrier gas: helium, constant flow
 Linear velocity: 28.7cm/sec. @ 200°C
 Oven temp.: 200°C, isothermal
 Det.: TCD @ 260°C



“Our chemists and process engineers are dedicated to effective scale-up and continuous process improvement. We make sure the exceptional performance of Restek products is maintained from development all the way through manufacturing.”

Restek's Process Development Group

pictured: Steve Constable, Wendy Henninger, Brian Salisbury, Rick Crago, Jennifer Weston, Tom Vezza (not pictured: Greg Hargrove)

GC COLUMNS METAL (MXT[®]) COLUMNS

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Top: Aaron Decker, Manufacturing Technician
Bottom: Bryan Wolcott, CFO and Tina Welch, HR Director



What is an MXT® column?

MXT® columns are made from stainless steel tubing that has had the internal surface treated with our exclusive Siltek® surface treatment. The Siltek® layer makes the surface as inert as deactivated fused silica. The unique Siltek® process enables us to offer MXT® columns in a wide range of internal diameters, including 0.18mm, 0.25mm, 0.32mm, and 0.53mm. Because the Siltek® layer permeates the stainless steel surface, rather than simply coating it, the layer is exceptionally flexible, so the tubing can be coiled to very small diameters. The standard coil diameter for MXT® columns is 4.5 inches. The minimum coil diameter for 0.53mm ID columns is 2.5 inches, and the minimum coil diameter for 0.25mm ID columns is 1.5 inches.



The unique properties of the Siltek® treated surface enable us to treat the tubing with a wide variety of polymer phases. The many choices of MXT® columns include:

- MXT®-1
- MXT®-5
- MXT®-1HT Sim Dist
- MXT®-2887
- MXT®-20
- MXT®-35
- MXT®-50
- MXT®-65
- MXT®-65TG
- MXT®-1301
- MXT®-1701
- MXT®-200
- MXT®-WAX
- MXT®-502.2
- MXT®-Volatiles
- MXT®-624
- MXT®-Biodiesel TG
- Guard tubing

Compare MXT® columns and fused silica columns:

- Metal tubing allows MXT® columns to be used to higher temperatures (430°C) than fused silica columns (standard rating is 360°C). This is because the polyimide resin that encases the fused silica becomes brittle over time at high temperatures. MXT® columns do not become brittle over time.
- Inertness of MXT® columns and fused silica columns is similar, due to the unique properties of the Siltek® surface treatment in MXT® columns.
- Coating efficiency (plates/meter) of MXT® columns is equivalent to that of fused silica.
- MXT® columns will not break under stress, and they can be coiled to small diameters.

MXT®-Biodiesel TG columns are undamaged by high thermal cycles compared to high-temperature fused silica columns which break down under the same conditions.

MXT®-Biodiesel TG columns are undamaged by high thermal cycles.

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



HT fused silica columns, labeled as stable to 430°C, show pitting and breakdown.

MXT® columns are your best choice for:

- Situations in which the potential for column breakage is high:
 - field instruments
 - process GC
 - GCs with small ovens, such as portable instruments, requiring tightly coiled columns.
- High temperature chromatography. Siltek® deactivated stainless steel tubing can withstand temperatures exceeding 430°C; the only limitation to oven temperature is the polymer itself.

Custom MXT® columns

We are able to supply 0.18, 0.25, 0.28, 0.32, and 0.53mm ID columns with the phases listed above in many different configurations. If you do not see the column you need listed in the following pages, call us or your Restek representative, and we will be happy to help.

Intermediate-Polarity Deactivated MXT® Guard/Retention Gap Columns/Transfer Lines (passivated stainless steel)

- Useful for a wide range of applications.
- Use with most common solvents.
- Maximum temperature: 430°C

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

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

- Extend analytical column lifetime by preventing degradation by harsh “steam-cleaning” water injections.
- Maximum temperature: 430°C.

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

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

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

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

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

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

a plus 1 story

“Since now almost 15 years, the Laboratoire Interuniversitaire des Systèmes Atmosphériques (LISA) of the University of Paris XII has been developing GC subsystems for on-board space probe GCMS experiments dedicated to the *in situ* analysis of extraterrestrial environments. Most of the capillary columns used in these subsystems were and still are provided by the Restek company.



One capillary column, MXT®-1701¹, was aboard the Huygens probe of the Cassini-Huygens mission which explored successfully in 2005 the atmosphere of Titan, the largest moon of Saturn. Four columns, MXT®-1, 20, 1701 and MXT®-UPL0T², are “en route” towards the comet Churyumov-Gerasimenko in the frame of the ESA Rosetta mission launched in 2004 to arrive by 2014. They will be used for the first time *in situ* analysis of a cometary nucleus. And finally, so far, 4 other PLOT (MXT® U) and WCOT^{3,4} (MXT®-1, 20 and CLP) columns have been selected and are currently being built in the GC of the Sample Analysis at Mars (SAM) Pyr/GCMS instrument, part of the payload of the NASA MSL 2009 Mars exploratory mission.

I would like to mention that all the columns selected for space mission are Silcosteel® treated metal capillary columns and they have all been submitted successfully to space qualification tests such as vibration, radiation and thermal cycles⁵, which demonstrated their robustness for space application.

Since the beginning, the Restek company has been more than a manufacturer providing LISA with columns. Indeed, it has been strongly collaborating and helping LISA to develop custom-made columns able to meet the requirements of such an unusual scientific goal for chromatographic columns. That is why LISA is very grateful to Restek for being this ideal partner without the help of which the study and development of chromatographic columns for space use could not have been possible.”

Robert STERNBERG

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

References

¹Sternberg, R., C. Szopa, D. Coscia, S. Zubrzycki, F. Raulin, C. Vidal-Madjar, H. Niemann and G. Israel *J. Chromatogr.*, 846, 307-315, (1999)

²C. Szopa, R. Sternberg, F. Raulin and H. Rosenbauer *Planetary and Space Science*, 51 (13) 863-877 (2003)

³Cabane, M., P. Coll, C. Szopa, G. Israël, F. Raulin, R. Sternberg, P. Mahaffy, A. Person, C. Rodier, R. Navarro-Gonzalez, H. Niemann, D. Harpold and W. Brinckerhoff *Adv. Space Research*, 33, 2240-2245 (2004)

⁴Zampolli, M-G., D. Meunier, R. Sternberg, C. Szopa., F. Raulin, M. C. Pietrogrande, F. Dondi *Chirality* 18 (5):383-394 (2006)

⁵C. Szopa, U.J. Meierhenrich, D. Coscia, L. Janin, F. Goesmann, R. Sternberg, J.-F. Brun, G. Israel, M. Cabane, R. Roll, F. Raulin, W. Thiemann and C. Vidal-Madjar and H. Rosenbauer *J. Chromatogr. A*, 982 303-312 (2002)

Restek Tubing Scorer for MXT® Columns

- Makes perfect cuts every time.
- Easy to use.
- Leaves column entrance perfectly round.

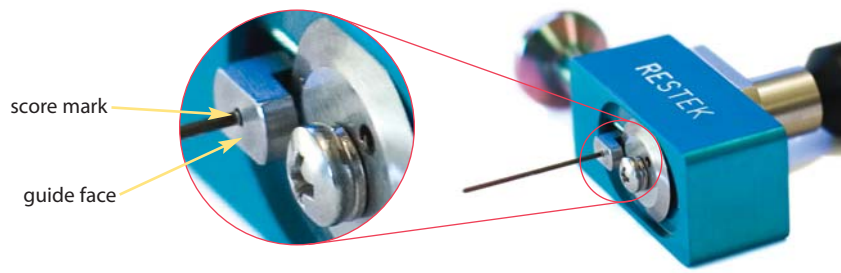


Metal MXT® columns are easy to cut. Scoring wafers can be used, but may leave the column end irregularly shaped. The Restek tubing scorer is designed to make a perfect cut every time, leaving the column entrance perfectly round.



Make a perfect column cut every time!

Enlarged view—score mark flush with guide face.

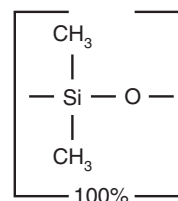


| Description | qty. | cat.# | PRICE |
|----------------------------------------------------------------------|------|-------|-------|
| Restek Tubing Scorer for MXT Columns (0.25-0.53mm ID & 0.5-0.8mm OD) | ea. | 20523 | |
| Replacement Scoring Wheel | ea. | 20522 | |

MXT®-1 (nonpolar phase; Crossbond® 100% dimethyl polysiloxane)

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

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

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

(Crossbond® 100% dimethyl polysiloxane)

| ID | df (μm) | temp. limits | 6-Meter | 15-Meter | 30-Meter | 60-Meter | 105-Meter |
|--------|---------|------------------|---------|----------|----------|----------|-----------|
| 0.25mm | 0.10 | -60 to 330/430°C | | 70105 | 70116 | 70117 | 70114 |
| | 0.25 | -60 to 430°C | | 70120 | 70123 | 70126 | 70129 |
| | 0.50 | -60 to 400°C | | 70135 | 70138 | 70141 | 70144 |
| | 1.00 | -60 to 340/360°C | | 70150 | 70153 | 70156 | 70159 |
| 0.28mm | 0.10 | -60 to 430°C | 70102 | 70106 | 70109 | | |
| | 0.25 | -60 to 430°C | | 70121 | 70124 | 70127 | |
| | 0.50 | -60 to 400°C | | 70136 | 70139 | 70142 | |
| | 1.00 | -60 to 320/360°C | | 70151 | 70154 | 70157 | |
| | 3.00 | -60 to 285/360°C | | 70181 | 70184 | 70187 | |
| 0.53mm | 0.15 | -60 to 430°C | 70101* | 70107 | | | |
| | 0.25 | -60 to 430°C | | 70122 | 70125 | 70128 | |
| | 0.50 | -60 to 400°C | | 70137 | 70140 | 70143 | |
| | 1.00 | -60 to 320/360°C | | 70152 | 70155 | 70158 | |
| | 1.50 | -60 to 310/360°C | | 70167 | 70170 | 70173 | |
| | 3.00 | -60 to 285/360°C | | 70182 | 70185 | 70188 | 70189 |
| | 5.00 | -60 to 270/360°C | | 70177 | 70179 | 70183 | |
| | 7.00 | -60 to 250/360°C | | 70191 | 70192 | 70193 | |

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

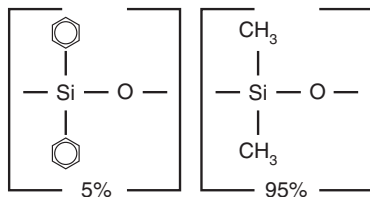
Maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

*For simulated distillation.

similar phases

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

MXT®-5 Structure

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

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

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

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

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

| ID | df (μm) | temp. limits* | 15-Meter | 30-Meter | 60-Meter |
|--------|------------------|------------------|----------|----------|----------|
| 0.25mm | 0.10 | -60 to 430°C | 70205 | 70208 | 70211 |
| | 0.25 | -60 to 430°C | 70220 | 70223 | 70226 |
| | 0.50 | -60 to 400°C | 70235 | 70238 | 70241 |
| | 1.00 | -60 to 340°C | 70250 | 70253 | 70256 |
| 0.28mm | 0.25 | -60 to 430°C | 70221 | 70224 | 70227 |
| | 0.50 | -60 to 400°C | 70236 | 70239 | 70242 |
| | 1.00 | -60 to 325/360°C | 70251 | 70254 | 70257 |
| | 3.00 | -60 to 290/360°C | 70281 | 70284 | 70287 |
| 0.53mm | 0.25 | -60 to 430°C | 70222 | 70225 | 70228 |
| | 0.50 | -60 to 400°C | 70237 | 70240 | 70243 |
| | 1.00 | -60 to 325/360°C | 70252 | 70255 | 70258 |
| | 1.50 | -60 to 300/360°C | 70267 | 70270 | 70273 |
| | 3.00 | -60 to 290/360°C | 70282 | 70285 | 70288 |
| 5.00 | -60 to 270/360°C | 70277 | 70279 | 70283 | |

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

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

MXT®-2887 (nonpolar phase; Crossbond® 100% dimethyl polysiloxane)

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

MXT®-2887 columns' stationary phase, column dimensions, and film thickness have been optimized to exceed the resolution and skewing factor requirements currently specified in ASTM method D2887. Each column is individually tested to guarantee a stable baseline with low bleed and reproducible retention times. The Crossbond® methyl silicone stationary phase has increased stability compared to packed columns, ensuring stable baselines and shorter conditioning times. Manufactured from Siltek®-treated stainless steel tubing, MXT® columns are the most durable high temperature GC columns available.

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

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

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

similar phases

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

Note: DB-5MS is a silarylene based polymer similar to Rxi®-5Sil MS.

similar phases

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

MXT®-Biodiesel TG

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

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

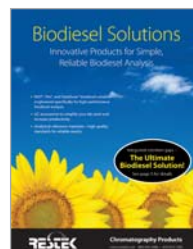
| Description | temp. limits | cat.# | price |
|----------------------------------------------------|------------------|-------|-------|
| 14m, 0.53mm ID, 0.16 w/2m Integra-Gap* | -60 to 380/430°C | 70289 | |
| 10m, 0.32mm ID, 0.10 | -60 to 380/430°C | 70292 | |
| 10m, 0.32mm ID, 0.10 w/2m x 0.53mm Retention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

*Total column length=16 meters.

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



MXT®-Biodiesel TG column now available in more dimensions.



free literature

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Flyer
lit. cat.# 580207

MXT®-1HT Sim Dist/MXT®-1 Sim Dist/MXT®-500 Sim Dist (nonpolar phases)

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

Manufactured from Siltek® treated stainless steel tubing, MXT® columns are the most durable high temperature GC columns available. As outlined in ASTM Method D6352, high temperature simulated distillation requires a column that can withstand temperatures to 430°C. MXT®-1HT Sim Dist and MXT®-500 Sim Dist columns exhibit excellent peak shape and low bleed, even at 430°C! The unique MXT®-1HT Sim Dist methyl silicone polymer gives the correct retention time/boiling point curve. The MXT®-500 Sim Dist carborane siloxane polymer offers a slight shift in the calculated boiling range distribution for petroleum samples containing aromatic hydrocarbons.

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

| ID | df (µm) | temp. limits | 5-Meter |
|--------|---------|------------------|---------|
| 0.53mm | 0.10 | -60 to 430°C | 70100 |
| | 0.20 | -60 to 400/430°C | 70103 |



MXT®-1HT Sim Dist column now available in 0.20µm film thickness.

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

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

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

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

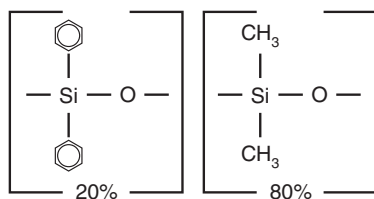
similar phases

DB-1HT, CP-HT-Simdist CB

Polywax® Calibration Materials

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

MXT®-20 Structure



similar phases

SPB-20, VOCOL

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

- General purpose columns for volatile compounds, flavor compounds, and alcoholic beverages.
- Temperature range: -20°C to 340°C.
- Equivalent to USP G28, G32 phases.

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

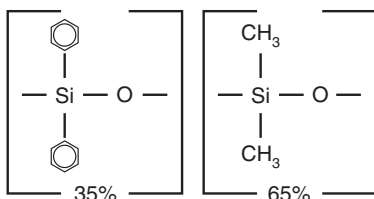
MXT®-20 Columns (Siltek® treated stainless steel)

(Crossbond® 20% diphenyl/80% dimethyl polysiloxane)

| ID | df (μm) | temp. limits* | 15-Meter | 30-Meter | 60-Meter |
|--------|---------|------------------|----------|----------|----------|
| 0.25mm | 0.25 | -20 to 320/340°C | 70320 | 70323 | 70326 |
| | 1.00 | -20 to 300/340°C | 70350 | 70353 | 70356 |
| 0.28mm | 0.25 | -20 to 310/340°C | 70321 | 70324 | 70327 |
| | 1.00 | -20 to 295/340°C | 70351 | 70354 | 70357 |
| | 3.00 | -20 to 260/340°C | 70381 | 70384 | 70387 |
| 0.53mm | 0.25 | -20 to 310/340°C | 70322 | 70325 | 70328 |
| | 1.00 | -20 to 295/340°C | 70352 | 70355 | 70358 |
| | 3.00 | -20 to 260/340°C | 70382 | 70385 | 70388 |

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

MXT®-35 Structure



similar phases

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

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

- General purpose columns for organochlorine pesticides, PCB congeners or (e.g.) Aroclor mixes, herbicides, pharmaceuticals, sterols, rosin acids, and phthalate esters.
- Temperature range: 0°C to 340°C.
- Equivalent to USP G42 phase.

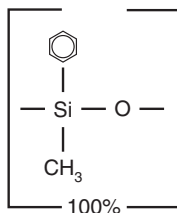
MXT®-35 Columns (Siltek® treated stainless steel)

(Crossbond® 35% diphenyl/65% dimethyl polysiloxane)

| ID | df (μm) | temp. limits* | 15-Meter | 30-Meter | 60-Meter |
|--------|---------|----------------|----------|----------|----------|
| 0.25mm | 0.50 | 0 to 310/340°C | 70435 | 70438 | |
| | 1.00 | 0 to 300/340°C | 70450 | 70453 | |
| 0.53mm | 1.00 | 0 to 260/340°C | 70452 | 70455 | 70458 |
| | 1.50 | 0 to 250/340°C | 70467 | 70470 | 70473 |
| | 3.00 | 0 to 240/340°C | 70482 | 70485 | 70488 |

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

MXT®-50 Structure



similar phases

HP-17, SPB-50, SP-2250

MXT®-50 (midpolarity phase; Crossbond® 100% methylphenyl polysiloxane)

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

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

(Crossbond® 100% methylphenyl polysiloxane)

| ID | df (μm) | temp. limits* | 15-Meter | 30-Meter | 60-Meter |
|--------|---------|----------------|----------|----------|----------|
| 0.53mm | 0.83 | 0 to 270/300°C | | 70569 | |
| | 1.00 | 0 to 260/280°C | 70552 | 70555 | 70558 |
| | 1.50 | 0 to 250/280°C | 70567 | 70570 | 70573 |

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

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

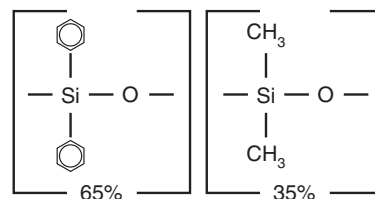
- General purpose columns for phenols and fatty acids.
- Temperature range: 50°C to 300°C.
- Equivalent to USP G17 phase.

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

(Crossbond® 65% diphenyl/35% dimethyl polysiloxane)

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

MXT®-65/MXT®-65TG Structure



similar **phases**

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

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

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

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

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

(Crossbond® 65% diphenyl/35% dimethyl polysiloxane)

| ID | df (µm) | temp. limits | 15-Meter | 30-Meter |
|--------|---------|--------------|----------|----------|
| 0.25mm | 0.10 | 20 to 370°C | 77005 | 77008 |
| 0.53mm | 0.10 | 20 to 370°C | 77007 | 77010 |

MXT®-1301 (low to midpolarity phase; Crossbond® 6% cyanopropylphenyl/94% dimethyl polysiloxane)

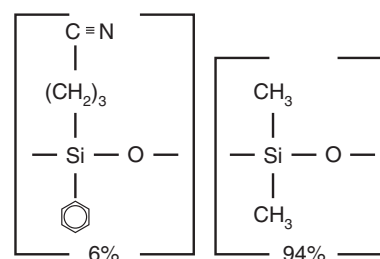
- General purpose columns for residual solvents, alcohols, oxygenates, and volatile organic compounds.
- Temperature range: -20°C to 280°C.
- Equivalent to USP G43 phase.

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

(Crossbond® 6% cyanopropylphenyl/94% dimethyl polysiloxane)

| ID | df (µm) | temp. limits* | 15-Meter | 30-Meter | 60-Meter |
|--------|---------|------------------|--------------|----------|----------|
| 0.25mm | 0.25 | -20 to 280°C | 76020 | 76023 | 76026 |
| | 1.00 | -20 to 260/280°C | 76050 | 76053 | 76056 |
| | 0.28mm | 0.25 | -20 to 280°C | 76021 | 76024 |
| 0.28mm | 1.00 | -20 to 260/280°C | 76051 | 76054 | 76057 |
| | 1.50 | -20 to 250/280°C | 76066 | 76069 | 76072 |
| | 0.53mm | 0.25 | -20 to 280°C | 76022 | 76025 |
| 1.00 | | -20 to 260/280°C | 76052 | 76055 | 76058 |
| 1.50 | | -20 to 250/280°C | 76067 | 76070 | 76073 |
| | 3.00 | -20 to 240/280°C | 76082 | 76085 | 76088 |

MXT®-1301 Structure

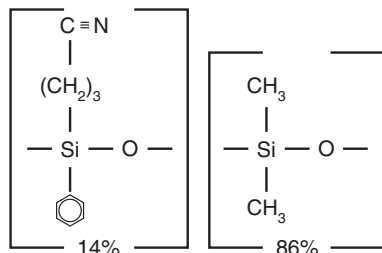


similar **phases**

DB-1301, DB-624, HP-1301, SPB-1301, SPB-624

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

MXT®-1701 Structure



similar phases

DB-1701, HP-1701, SPB-1701

MXT®-1701 (midpolarity phase; Crossbond® 14% cyanopropylphenyl/86% dimethyl polysiloxane)

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

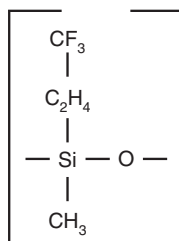
MXT®-1701 Columns (Siltek® treated stainless steel)

(Crossbond® 14% cyanopropylphenyl/86% dimethyl polysiloxane)

| ID | df (μm) | temp. limits* | 15-Meter | 30-Meter | 60-Meter |
|--------|---------|------------------|----------|----------|----------|
| 0.25mm | 0.25 | -20 to 280°C | 72020 | 72023 | 72026 |
| | 1.00 | -20 to 260°C | 72050 | 72053 | 72056 |
| | 1.50 | -20 to 250°C | 72066 | 72069 | 72072 |
| 0.28mm | 0.25 | -20 to 280°C | 72021 | 72024 | 72027 |
| | 1.00 | -20 to 260°C | 72051 | 72054 | 72057 |
| | 1.50 | -20 to 250°C | 72067 | 72070 | 72073 |
| 0.53mm | 0.25 | -20 to 280°C | 72022 | 72025 | 72028 |
| | 0.50 | -20 to 270/280°C | 72037 | 72040 | 72043 |
| | 1.00 | -20 to 260°C | 72052 | 72055 | 72058 |
| | 1.50 | -20 to 250°C | 72067 | 72070 | 72073 |
| | 3.00 | -20 to 240°C | 72082 | 72085 | 72088 |

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

MXT®-200 Structure



similar phases

DB-200, DB-210

MXT®-200 (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.

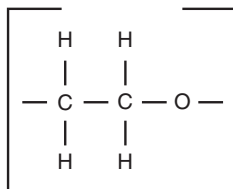
MXT®-200 Columns (Siltek® treated stainless steel)

(Crossbond® trifluoropropylmethyl polysiloxane)

| ID | df (μm) | temp. limits* | 15-Meter | 30-Meter | 60-Meter |
|--------|---------|------------------|----------|----------|----------|
| 0.25mm | 0.50 | -20 to 400°C | 75035 | 75038 | |
| | 1.00 | -20 to 310/360°C | 75050 | 75053 | |
| 0.53mm | 1.00 | -20 to 290/360°C | 75052 | 75055 | 75058 |
| | 1.50 | -20 to 280/360°C | 75067 | 75070 | 75073 |
| | 3.00 | -20 to 260/360°C | 75082 | 75085 | 75088 |

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

MXT®-WAX Structure



similar phases

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

MXT®-WAX (polar phase; Crossbond® Carbowax® polyethylene glycol)

- General purpose columns for FAMES, flavor compounds, essential oils, amines, solvents, xylene isomers, and US EPA Method 603 (acrolein/acrylonitrile).
- Resistant to oxidative damage.
- Temperature range: 40°C to 260°C.
- Equivalent to USP G14, G15, G16, G20, and G39 phases.

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

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

| ID | df (μm) | temp. limits | 15-Meter | 30-Meter | 60-Meter |
|--------|---------|-----------------|----------|----------|----------|
| 0.25mm | 0.10 | 40 to 260°C | 70605 | 70608 | 70611 |
| | 0.25 | 40 to 260°C | 70620 | 70623 | 70626 |
| | 0.50 | 40 to 260°C | 70635 | 70638 | 70641 |
| 0.28mm | 0.25 | 40 to 250/260°C | 70621 | 70624 | 70627 |
| | 0.50 | 40 to 250/260°C | 70636 | 70639 | 70642 |
| | 1.00 | 40 to 240/250°C | 70651 | 70654 | 70657 |
| 0.53mm | 0.25 | 40 to 250/260°C | 70622 | 70625 | 70628 |
| | 0.50 | 40 to 250/260°C | 70637 | 70640 | 70643 |
| | 1.00 | 40 to 240/250°C | 70652 | 70655 | 70658 |
| | 1.50 | 40 to 230/250°C | 70666 | 70669 | 70672 |
| | 2.00 | 40 to 220/250°C | 70667 | 70670 | |

MXT®-502.2 (proprietary Crossbond® diphenyl/dimethyl polysiloxane phase)

- Application-specific columns with unique selectivity for volatile organic pollutants, cited in US EPA Method 502.2 and in many gasoline range organics (GRO) methods for monitoring underground storage tanks. Excellent separation of trihalomethanes; ideal polarity for light hydrocarbons and aromatics.
- Temperature range: -20°C to 320°C.

An MXT®-502.2 column will enable you to quantify all compounds listed in US EPA methods 502.2 or 524.2, whether you use a mass spectrometer or a PID in tandem with an ELCD. The diphenyl/dimethyl polysiloxane based MXT®-502.2 stationary phase provides low bleed and thermal stability to 320°C. A 105-meter column can separate the light gases specified in EPA methods without subambient cooling.

MXT®-502.2 Columns (Siltek® treated stainless steel)

(proprietary Crossbond® diphenyl/dimethyl polysiloxane phase)

| ID | df (µm) | temp. limits | 30-Meter | 60-Meter | 105-Meter |
|--------|---------|------------------|----------|----------|-----------|
| 0.25mm | 1.40 | -20 to 270/320°C | 70915 | 70916 | |
| 0.28mm | 1.60 | -20 to 250/320°C | 70919 | 70920 | 70921 |
| 0.53mm | 3.00 | -20 to 270/320°C | 70908 | 70909 | 70910 |

| ID | df (µm) | temp. limits | 10-Meter | 20-Meter |
|--------|---------|------------------|----------|----------|
| 0.18mm | 1.00 | -20 to 270/320°C | 71891 | 71892 |

MXT®-Volatiles (proprietary Crossbond® diphenyl/dimethyl polysiloxane phase)

- Application-specific columns for volatile organic pollutants.
- Temperature range: -20°C to 320°C.

MXT®-Volatiles columns were the first columns designed specifically for analyses of the 34 volatile organic pollutants listed in US EPA methods 601, 602, and 624. With these columns, you can quantify all compounds listed in these methods, whether you use a mass spectrometer or a PID in tandem with an ELCD. The diphenyl/dimethyl polysiloxane based MXT®-Volatiles stationary phase provides low bleed and thermal stability to 320°C.

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

(proprietary Crossbond® diphenyl/dimethyl polysiloxane phase)

| ID | df (µm) | temp. limits* | 30-Meter | 60-Meter | 105-Meter |
|--------|---------|------------------|----------|----------|-----------|
| 0.25mm | 1.00 | -20 to 280/320°C | 70900 | 70903 | |
| 0.28mm | 1.25 | -20 to 280/320°C | 70924 | 70926 | 70928 |
| 0.53mm | 2.00 | -20 to 280/320°C | 70925 | 70927 | 70929 |
| | 3.00 | -20 to 250/320°C | 70922 | 70923 | |

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

MXT®-624 (low to midpolarity phase; Crossbond® 6% cyanopropylphenyl/94% dimethyl polysiloxane)

- Application-specific columns for volatile organic pollutants. Recommended in US EPA methods for volatile organic pollutants.
- Temperature range: -20°C to 280°C.
- Equivalent to USP G43 phase.

The unique polarity of “624” columns makes them ideal for analyses of volatile organic pollutants. Although the MXT®-502.2 column is recommended in many methods, MXT®-624 columns offer the best separation of the early-eluting gases.

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

(Crossbond® 6% cyanopropylphenyl/94% dimethyl polysiloxane)

| ID | df (µm) | temp. limits | 30-Meter | 60-Meter |
|--------|---------|------------------|----------|----------|
| 0.25mm | 1.40 | -20 to 240/280°C | 70968 | 70969 |
| 0.53mm | 3.00 | -20 to 240/280°C | 70971 | 70973 |

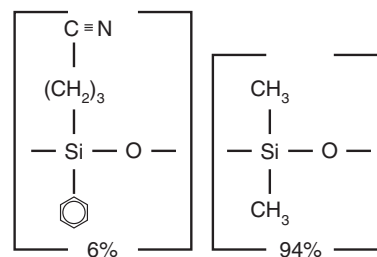
| ID | df (µm) | temp. limits | 10-Meter | 20-Meter |
|--------|---------|------------------|----------|----------|
| 0.18mm | 1.00 | -20 to 240/280°C | 71893 | 71894 |

similar phase

DB-502.2

similar phase

VOCOL

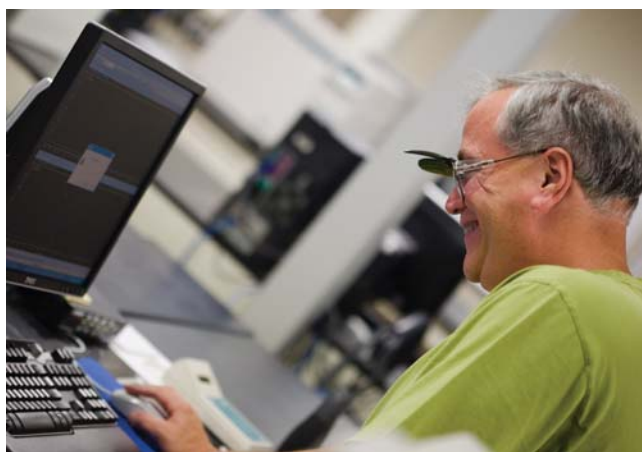
MXT®-624 Structure

similar phases

DB-624, HP-624

GC COLUMNS PACKED/ MICROPACKED COLUMNS

| | |
|---------------------------------------------------|-------------|
| Bonded Stationary Phases | 113-114,116 |
| Packed Column Tubing | 115 |
| Stock Packed Columns | 116-117 |
| Specialty Packed Columns | 118-121 |
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| Packed Column Configurations | 133 |



Top: Scott Grossman, Applications Chemist
Bottom: Glenn Gerhab, Quality Assurance

Restek's packed columns deliver the

1-2-3 PUNCH!

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

Bonded Stationary Phases

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

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

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

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

n=9 columns

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

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

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

Columns can be configured for all GC models.

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

The most complete line of packing materials available.

Bonded Packed Column Stationary Phases

- Short conditioning times.
- Low bleed levels.
- Higher sensitivities.
- Longer column lifetimes.
- Unsurpassed inertness for active compounds.

Bonded phases are used in capillary columns because they provide a dramatic increase in column quality. To truly bridge the gap between traditional packed columns and capillary columns, it was necessary to develop bonded liquid phases for packed columns. Packed column chromatographers can expect shorter conditioning times, lower bleed, and longer column lifetimes by using Restek bonded phase packed columns.

Bonded phases also last much longer than nonbonded phases. Bonded phases are more resistant to oxidation than nonbonded phases because of the stronger intermolecular forces produced by cross-linking. Because the material is thoroughly cross-linked, the phase will not migrate or puddle, as often happens with nonbonded phases. Figure 1 shows a comparison of a bonded and a nonbonded methyl silicone column after 170 temperature cycles. The results show the impressive durability of bonded phases.

Restek's packed columns deliver the**1-2-3 PUNCH!**

1. Bonded stationary phases mean short conditioning times, low bleed, and unsurpassed column lifetimes.

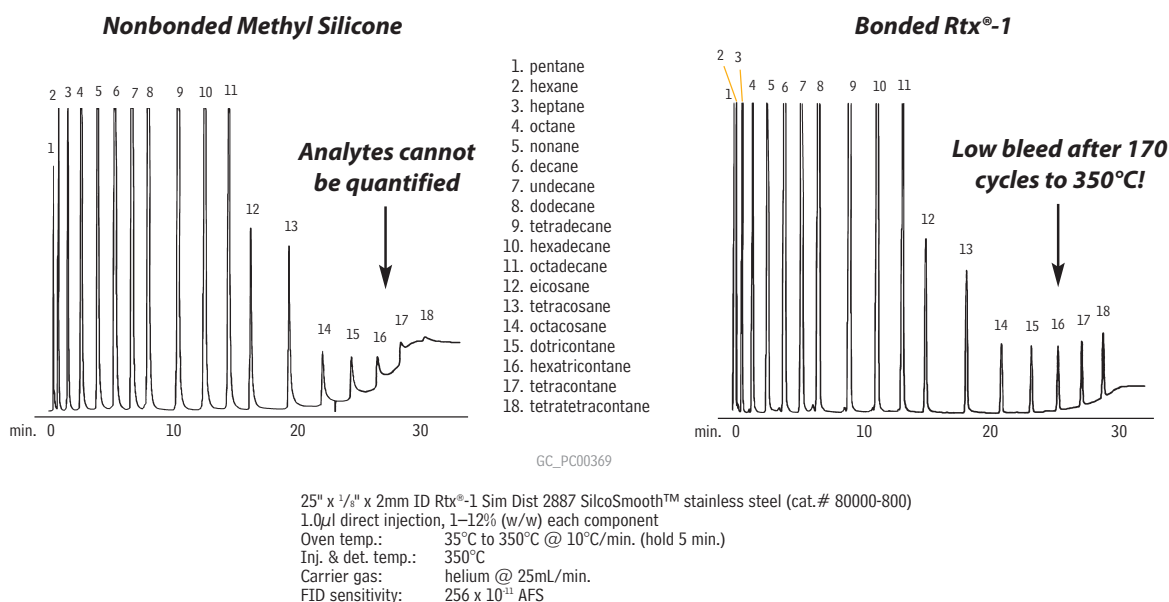
2. SilcoSmooth™ tubing provides the inertness of glass and the durability of stainless steel.

3. Silcoport™ diatomaceous earth provides unsurpassed inertness for trace analysis.

Equivalent Liquid Phases

| | |
|------------------|-------------------------------------------------------------------------------|
| | BP-1, CC-1, CP-Sil 5CB, DB-1, DC-200, GE-SF-96, HP-1, HP-101, OV-1, OV-101, |
| Rtx-1 | RSK-150, RH-1, SE-30, SP-2100, SPB-1, UCC W-98 |
| Rtx-5 | BP-5, CB-5, CC-5, CP-Sil 8CB, DB-5, HP-5, OV-73, SE-52, SE-54, SPB-5, Ultra-5 |
| Stabilwax | BP-20, CP-Wax, CW-20, DB-Wax, HP-Innowax, PE-Wax, Supelcowax-10 |

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



Packed Column Tubing

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

SilcoSmooth™ Tubing

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

Stainless Steel Tubing

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

Hastelloy® Tubing

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

Nickel Tubing

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

Copper Tubing

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

Teflon® Tubing

Teflon® tubing is often used for reactive compounds or other special applications. Note that this tubing is permeable to gases.

Table I Packed column tubing dimensions

| Material | 1/4-inch OD x 5.3mm ID | 3/16-inch OD x 3.1mm ID ¹ | 1/8-inch OD x 2.0mm ID ² | 1/16-inch OD x 1.2mm ID ³ | 1/16-inch OD x 1.0mm ID ³ | 0.95mm OD x 0.75mm ID ⁴ |
|-----------------|---------------------------|-----------------------------------------|----------------------------------------|-----------------------------------------|-----------------------------------------|---------------------------------------|
| SilcoSmooth | ✓ | ✓ | ✓ | | ✓ | ✓ |
| Stainless Steel | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Hastelloy | | | ✓ | | | |
| Nickel | | | ✓ | | | |
| Copper | ✓ | | ✓ | | | |
| Teflon | | | ✓ | | | |

¹ 3/16-inch OD x 3.1mm ID replaces 1/4-inch OD x 4mm ID glass columns.

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

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

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

1/8- or 3/16-inch OD columns are easily adaptable to 1/4-inch or 5mm ID injection ports, using inexpensive adaptors. All Restek packed columns can be coiled to fit any instrument configuration.

please note

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

did you know?

Restek's advanced packed column technology provides columns with unmatched inertness and efficiency.

Packed Column Reduction Fittings

We will weld tubing reducers or VCR fittings to your column. Call Customer Service (ext. 3), or your Restek representative, for pricing & availability.



Welded Tubing Reducers



Welded VCR Fittings

Bonded Packed Column Stationary Phases

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

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

please note

These columns are for on-column injections. For not-on-column configurations, add suffix -901.

Chromosorb®-Based Packed Columns

| On 100/120 Silcoport W*** | L (ft.) | Stainless Steel Tubing | | | | price | SilcoSmooth Tubing** | | | | price |
|-----------------------------|------------|------------------------|------------|---------|--|-------|----------------------|-------------|------------|---------|-------|
| | | 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 | 80400- | | |
| 3% Rt-2100 | 6 | 1/8 | 2.1 | 80462- | | 2 | 1/8 | 2 | 80420- | | |
| 5% Rt-1200/1.75% Bentone 34 | 6 | 1/8 | 2.1 | 80463- | | 2 | 1/8 | 2 | 80125- | | |
| 5% Rt-1200/5% Bentone 34 | 6 | 1/8 | 2.1 | 80464- | | 2 | 1/8 | 2 | 80129- | | |

for custom columns

see page 131

| On Chromosorb PAW | Mesh | L (ft.) | Stainless Steel Tubing | | | | price | SilcoSmooth Tubing** | | | | price |
|-------------------|---------|------------|------------------------|------------|---------|--|-------|----------------------|-------------|------------|---------|-------|
| | | | 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 | 80126- | | |
| 23% Rt-1700 | 80/100 | 30 | 1/8 | 2.1 | 80466- | | 9.2 | 1/8 | 2 | 80128- | | |

please note

Temperature limits for stationary phases are listed on page 128.

Porous Polymers

Restek offers a full range of porous polymers, including HayeSep®, Porapak, Chromosorb® Century Series polymers, and Tenax® TA packing, for analyses of volatile components and light solvents. Our QA procedures give you the confidence that every batch you purchase will deliver consistent column-to-column performance.

Porous Polymer Packed Columns

| Porous Polymers 80/100 Mesh | L (ft.) | Stainless Steel Tubing | | | | price | SilcoSmooth Tubing** | | | | price |
|--------------------------------|------------|------------------------|------------|---------|--|-------|----------------------|-------------|------------|---------|-------|
| | | OD (in.) | ID (mm) | cat.#** | | | L (m) | OD (in.) | ID (mm) | cat.#** | |
| HayeSep Q | 6 | 1/8 | 2.1 | 80467- | | 2 | 1/8 | 2 | 80433- | | |
| Porapak Q | 6 | 1/8 | 2.1 | 80468- | | 2 | 1/8 | 2 | 80427- | | |
| Porapak QS | 6 | 1/8 | 2.1 | 80469- | | 2 | 1/8 | 2 | 80426- | | |
| Porapak R | 6 | 1/8 | 2.1 | 80470- | | 2 | 1/8 | 2 | 80425- | | |
| Chromosorb 101 | 6 | 1/8 | 2.1 | 80471- | | 2 | 1/8 | 2 | 80435- | | |
| Chromosorb 102 | 6 | 1/8 | 2.1 | 80472- | | 2 | 1/8 | 2 | 80434- | | |

also available

Chromosorb®, Porapak, HayeSep®, and Tenax® packing materials.
See pages 126-127.

*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.

CarboBlack Solid Supports

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

also **available**

CarboBlack packing materials. See [page 124](#).

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

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

| On CarboBlack C | Mesh | Stainless Steel Tubing | | | | | SilcoSmooth Tubing** | | | | |
|-------------------------------------------------------|--------|------------------------|----------|---------|---------|-------|----------------------|----------|---------|---------|-------|
| | | L (ft.) | OD (in.) | ID (mm) | cat.#** | price | L (m) | OD (in.) | ID (mm) | cat.#** | price |
| 0.2% Carbowax 1500 | 60/80 | 6 | 1/8 | 2.1 | 80456- | | 2 | 1/8 | 2 | 80121- | |
| 0.2% Carbowax 1500 | 80/100 | 6 | 1/8 | 2.1 | 80457- | | 2 | 1/8 | 2 | 80122- | |
| 0.1% Rt-1000 | 80/100 | 6 | 1/8 | 2.1 | 80458- | | 1.8 | 1/8 | 2 | 80205- | |
| 0.19% picric acid | 80/100 | 6 | 1/8 | 2.1 | 80459- | | 2 | 1/8 | 2 | 80311- | |
| 0.3% Carbowax 20M/0.1% H ₃ PO ₄ | 60/80 | 2.5 | 3/16 | 3.1 | 80460- | | 0.75 | 3/16 | 3.1 | 80111- | |

Column Instrument Configurations



General Configuration
Suffix -800



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



Varian 3700, Vista Series, FID:
Suffix -820



PE 900-3920, Sigma 1,2,3:
Suffix -830



PE Auto System 8300, 8400, 8700
(Not On-Column):
Suffix -840

See page 133 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 1/8" void on detector side.

Improved Molecular Sieves

Molecular sieve packed columns easily separate permanent gases at above-ambient temperatures. Restek's R&D chemists have developed a process for preparing molecular sieve packings, which result in excellent batch-to-batch reproducibility. In addition, our molecular sieves are preactivated and ready to use. Each column comes with metal end-fittings to prevent water or carbon dioxide from adsorbing into the packing during shipment.

Molecular Sieve Packed Columns

| Molecular Sieve | Mesh | Stainless Steel Tubing | | | | | SilcoSmooth Tubing** | | | | |
|-----------------|--------|------------------------|----------|---------|---------|-------|----------------------|----------|---------|---------|-------|
| | | L (ft.) | OD (in.) | ID (mm) | cat.#** | price | L (m) | OD (in.) | ID (mm) | cat.#** | price |
| Molesieve 5A | 60/80 | 6 | 1/8 | 2.1 | 80473- | | 2 | 1/8 | 2 | 80428- | |
| Molesieve 5A | 80/100 | 3 | 1/8 | 2.1 | 88015- | | 1 | 1/8 | 2 | 80440- | |
| Molesieve 5A | 80/100 | 6 | 1/8 | 2.1 | 80474- | | 2 | 1/8 | 2 | 80429- | |
| Molesieve 5A | 80/100 | 10 | 1/8 | 2.1 | 88014- | | 3.05 | 1/8 | 2 | 80430- | |
| Molesieve 13X | 60/80 | 6 | 1/8 | 2.1 | 80475- | | 2 | 1/8 | 2 | 80480- | |
| Molesieve 13X | 80/100 | 6 | 1/8 | 2.1 | 80476- | | 2 | 1/8 | 2 | 80439- | |

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

**Siltek-treated stainless steel.

Aromatics Analysis

D3606 Application Column (2 column set)

- Complete resolution of ethanol and benzene, with a resolution value > 3.00.
- Accurate quantification of benzene and toluene.
- Fully conditioned two column set—ready to use out of the box.
- A chromatogram is provided with each column set demonstrating conformance to the method.

Conforms to the specifications established in ASTM method D-3606-06 for the quantitation of benzene and toluene in spark ignition fuel containing ethanol.

D3606 Application Column (2 column set)

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

*Please add column instrument configuration suffix number to cat.# when ordering. See chart on page 133.

**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.



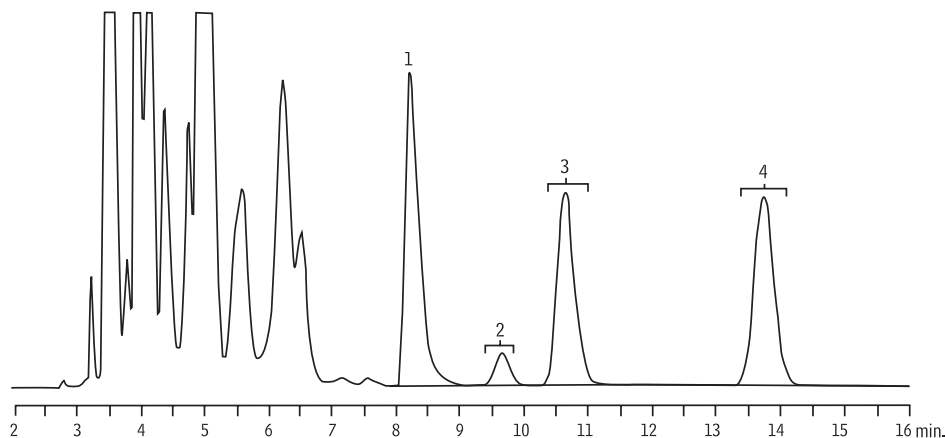
free literature

Resolve Benzene and Toluene in Spark Ignition Fuels Containing Ethanol

Download your free copy from www.restek.com

lit. cat.# 580227

Gasoline on a D3606 Application Column Set.



1. benzene
2. 2-butanol
3. toluene

GC_PC01079

Column: D3606 Application Column (2 column set, cat.# 83606-800)
Column 1: nonpolar Rbx®-1, 6' (1.8m), 1/8" OD, 2.0mm ID
Column 2: proprietary packing material, 16' (4.9m), 1/8" OD, 2.0mm ID

Sample: 1.5µL gasoline
Inj.: 200°C
Backflush: ~1 min.
Carrier gas: helium, constant flow
Flow rate: 25mL/min.
Oven temp.: 135°C, isothermal
Det.: TCD @ 200°C

Chromatogram courtesy of Boguslaw Dudek, Conoco Phillips, Linden, NJ.

Light Hydrocarbon Analysis

Special Columns for Unsaturated Light Hydrocarbons

- Faster separations of C1 to C4 hydrocarbons.
- Res-Sil™ packing replaces Porasil materials.

n-Octane on Res-Sil™ C Packed Column

This packed column has unique selectivity for resolving unsaturated light hydrocarbons (Figure 1).

OPN on Res-Sil™ C Packed Column

This column separates the light hydrocarbons, and baseline resolves *cis*-2-butene from 1,3-butadiene (Figure 2).

2abc Refinery Gas Column Set

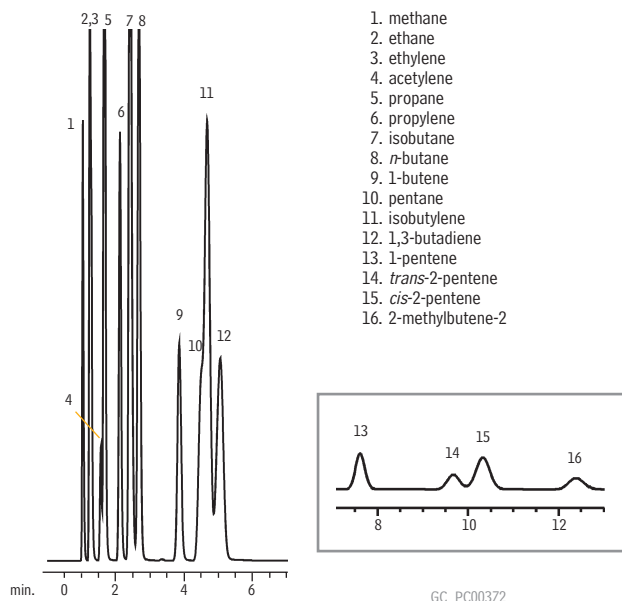
This 3-column set is finely tuned to resolve light hydrocarbons. When used in the proper valving system, it will elute C5+ hydrocarbons ahead of C1 through C4 hydrocarbons (Figure 3).

| Description | cat.#** | PRICE |
|------------------------------------------------------------------------------|---------|-------|
| <i>n</i> -Octane on Res-Sil™ C, 80/100 (20', 2.0mm ID, 1/8" Silcosmooth™ OD) | 80436- | |
| OPN on Res-Sil™ C, 80/100 (12', 2.0mm ID, 1/8" Silcosmooth™ OD) | 80437- | |
| 2abc Refinery Gas Column Set (3 column set)** | 88000- | |

*Please add column instrument configuration suffix number to cat.# when ordering. See chart on page 133.

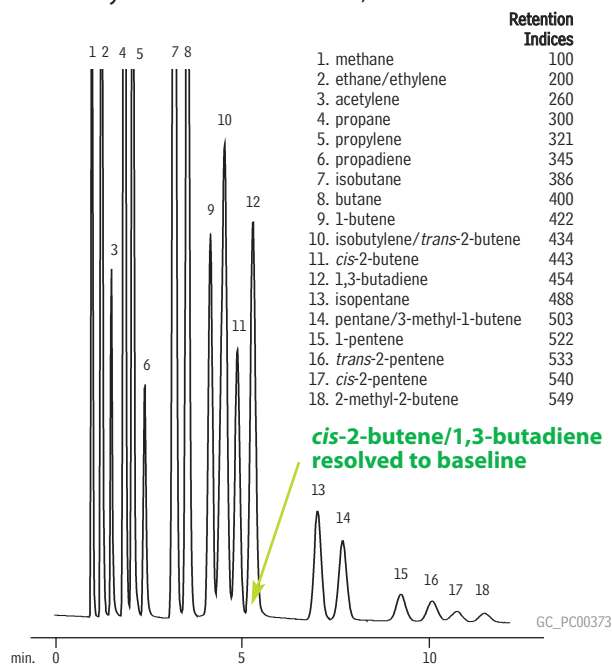
**This column set is for a valving system; therefore, packing material is filled to ends of columns.

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



n-octane 80/100 Res-Sil™ C
20', 1/8" OD x 2mm ID, SilcoSmooth™ tubing (cat. # 80436)
Oven temp.: 60°C
Inj. temp.: 150°C
Det. temp.: 150°C FID
Flow rate: 30mL/min. He
Sample: refinery gas C1-C5
Sample size: 20µL

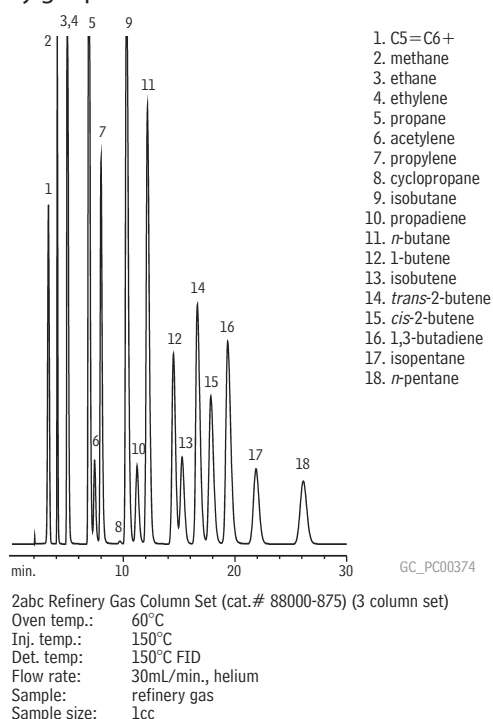
Figure 2 OPN on Res-Sil™ C packing has unique selectivity for *cis*-2-butene and 1,3-butadiene.



OPN on Res-Sil™ C, 80/100 mesh, 12' x 2mm ID x 1/8" OD in SilcoSmooth™ tubing (cat. # 80437). 20µL on-column injection of refinery gas.
Concentration: 0.1-6 absolute mole %
Oven temp.: 50°C
Inj. & det. temp.: 200°C
Carrier gas: helium
Flow rate: 30mL/min

Reference standard courtesy of AC Analytical Controls, Bensalem, PA.

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



2abc Refinery Gas Column Set (cat.# 88000-875) (3 column set)
Oven temp.: 60°C
Inj. temp.: 150°C
Det. temp.: 150°C FID
Flow rate: 30mL/min., helium
Sample: refinery gas
Sample size: 1cc

for **more** info

See page 125 for more information on Res-Sil™ packing materials.

Permanent Gases & Hydrocarbon Analysis

ShinCarbon ST Packed/Micropacked Columns

- Separate permanent gases, including CO/CO₂, without cryogenic cooling.
- Rapid separations of permanent gas/light hydrocarbon mixtures.
- Excellent compatibility with most GC detectors—minimal bleed, minimal baseline rise.
- Preconditioned, less than 30 minutes to stabilize.

Analyze oxygen, nitrogen, methane, carbon monoxide, and carbon dioxide with one column and at room temperature. ShinCarbon ST material, a high surface area carbon molecular sieve (~1,500 m²/g), is the ideal medium for separating gases and highly volatile compounds by GSC. The rapid, above-ambient analyses these columns provide will be a great convenience. Excellent thermal stability of the high surface area carbon, combined with careful conditioning during column manufacturing, ensures low-bleed operation and rapid stabilization when installing a new column. Custom-made ShinCarbon ST columns are available on request.

ShinCarbon ST is a highly stable material. Its 330°C upper temperature limit minimizes bleed and baseline rise during temperature programming, making the material compatible with most detection systems used for gas analysis, including TCD or HID. All ShinCarbon ST columns are fully conditioned in an oxygen/moisture free environment to prevent contamination. This minimizes stabilization time (less than 30 minutes) when installing a new column which, in turn, minimizes downtime.

ShinCarbon ST 80/100 Packed Columns (SilcoSmooth™ Stainless Steel)*

| OD | ID | 2-Meter |
|------------------|-------|---------|
| 1/8" Silcosmooth | 2.0mm | 80486- |

ShinCarbon ST 100/120 Micropacked Columns**

| OD | ID | 1-Meter | 2-Meter |
|--------|--------|---------|---------|
| 1/16" | 1.0mm | 19809 | 19808 |
| 0.95mm | 0.75mm | 19810 | — |

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

**Order installation kit separately. See page 123.

it's a fact

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

also available

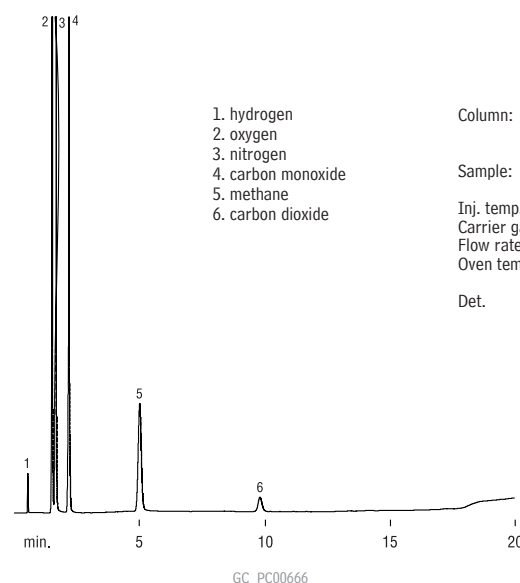
For adapter kits for installing packed/micropacked columns, see [page 123](#).

a plus 1 story

"Being one of the first labs to utilize the ShinCarbon column in a real working environment, I was pleased to find that I was able to do all my permanent gas analysis on one column instead of the customary two. The peaks were sharper than I had experienced in the past and run time was significantly reduced. We are extremely pleased with the performance of the ShinCarbon column and will continue to find even more applications for it."

Bruce Nasser,
Quality Control Chemist, Oxygen Service Spec Lab

Separate permanent gases in 10 minutes, without cryogenics.



1. hydrogen
2. oxygen
3. nitrogen
4. carbon monoxide
5. methane
6. carbon dioxide

Column: ShinCarbon ST, 100/120 mesh, 2m, 1mm ID micropacked (cat.# 19808)
 Sample: 5µL permanent gases mix, approx. 5 mol. percent each
 Inj. temp.: 100°C
 Carrier gas: helium
 Flow rate: 10mL/min.
 Oven temp.: 40°C (hold 3 min.) to 250°C @ 8°/min. (hold 10 min.)
 Det. HID @ 200°C

please note

For additional example applications for ShinCarbon ST columns, see [pages 650, 652, and 654](#) in the Applications section.

Sulfur Analysis

Rt®-XLSulfur Packed/Micropacked Columns

- Optimized columns for low ppbv sulfur analyses.
- Eliminate the need for Teflon® tubing.
- Column and end-fittings are Siltek® treated for maximum inertness.

Sulfur analyses are traditionally performed using Teflon® tubing to improve column inertness. Unfortunately, Teflon® tubing is gas permeable, difficult to pack with high efficiency, prone to shrinkage, and has poor thermal stability. The Rt®-XLSulfur packed or micropacked column eliminates these problems. The packing material for Rt®-XLSulfur columns is extensively deactivated for analysis of low ppbv levels of hydrogen sulfide and methyl mercaptan. It is then treated to achieve effective separation of hydrocarbons from sulfur compounds. The interior wall and the end-fittings of the Rt®-XLSulfur column are Siltek® treated, making the column as inert as Teflon®. The extra care taken to manufacture this column ensures more accurate analyses of sulfur compounds.

Rt®-XLSulfur Packed Columns*

| OD | ID | 1-Meter | 2-Meter |
|-------|-------|---------|---------|
| 1/8" | 2.0mm | 80484- | 80485- |
| 3/16" | 3.1mm | 80482- | 80483- |

Rt®-XLSulfur Micropacked Columns**

| OD | ID | 1-Meter | 2-Meter |
|--------|--------|---------|---------|
| 1/16" | 1.0mm | 19804 | 19805 |
| 0.95mm | 0.75mm | 19806 | 19807 |

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

**Order installation kit separately. See page 123.

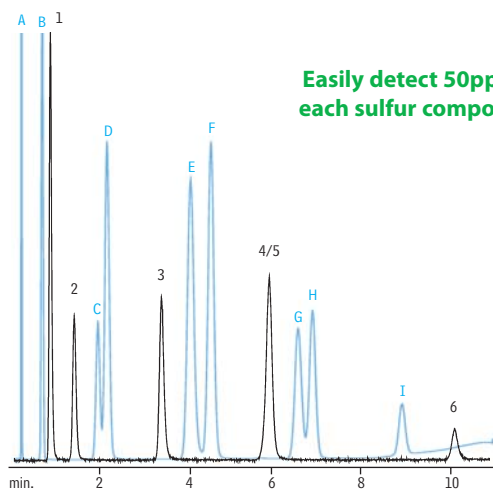
did you know?

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

also available

For adapter kits for installing packed/micropacked columns, see [page 123](#).

Rt®-XLSulfur micropacked column separates hydrocarbons from sulfur compounds.



Easily detect 50ppb of each sulfur compound!

sulfurs

1. hydrogen sulfide
2. carbonyl sulfide
3. methyl mercaptan
4. ethyl mercaptan
5. dimethyl sulfide
6. dimethyl disulfide

hydrocarbons

- A. methane
- B. ethane
- C. propylene
- D. propane
- E. isobutane
- F. butane
- G. isopentane
- H. pentane
- I. hexane

GC_PC00436

Column: Rt®-XLSulfur micropacked column, 1m, 0.75mm ID (cat.# 19806)
 Conc.: 50ppb each
 Oven temp.: 60°C to 230°C @ 15°C/min.
 Carrier gas: helium
 Flow rate: 9mL/min.
 Det.: SCD/FID

Sulfur standards courtesy of DCG Partnership 1 Ltd., Pearland, TX.

Column Instrument Configurations



General Configuration
Suffix -800



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



Varian 3700, Vista Series, FID:
Suffix -820



PE 900-3920, Sigma 1,2,3:
Suffix -830



PE Auto System 8300, 8400, 8700
(Not On-Column):
Suffix -840

See page 133 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.



also **available**

For adapter kits for installing micropacked columns, see **page 123**.



All micropacked columns are made with inert SilcoSmooth™ tubing, see **page 115**.

also **available**

0.53mm ID micropacked columns. Please contact Technical Service for more information.

Micropacked Columns

- Increased efficiency over traditional packed columns.
- Higher capacity than PLOT columns.
- Made from inert, flexible Siltek®-treated stainless steel tubing.
- Siltek®-treated, braided-wire end plug keeps packing intact, even under intense pressure surges during valve switching.
- Wide range of packings available.

Efficient, inert, and flexible

Micropacked columns are highly efficient and provide good sample capacity. With our inert Siltek® treatment, micropacked columns are a powerful tool for solving many difficult application problems. Because the Siltek® treatment permeates the stainless steel surface, the column can 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. 1mm ID, standard wall (1/16-inch OD) micropacked columns offer improved efficiency in packed column instruments, without the expense of converting to capillary injection systems. 0.75mm ID, thin wall (0.95mm OD) micropacked columns install easily into a capillary injector, using slightly larger ferrules. Micropacked columns operate at flows exceeding 10cc/min., for trouble-free operation.

Braided wire end plugs

Glass wool end plugs can be dislodged easily by carrier gas pressure surges. Restek's chemists insert braided wire into the column and secure it by making a small crimp near the column outlet. End plugs are Siltek® treated—the sample contacts only inert surfaces.

Micropacked Columns

| | | ID | OD | Temp. Range | 0.56-Meter | |
|-----------------------------------|-------------|-----------|-----------|--------------------|----------------|----------------|
| 20% TCEP on 80/100 Chromosorb PAW | | | | | | |
| | | 0.75mm | 1/16" | 0–120°C | 19040 | |
| | Mesh | ID | OD | Temp. Range | 1-Meter | 2-Meter |
| HayeSep R | 100/120 | 0.75mm | 0.95mm | up to 250°C | 19014 | 19015 |
| HayeSep R | 100/120 | 1.00mm | 1/16" | up to 250°C | 19012 | 19013 |
| HayeSep Q | 100/120 | 0.75mm | 0.95mm | up to 275°C | 19018 | 19019 |
| HayeSep Q | 100/120 | 1.00mm | 1/16" | up to 275°C | 19016 | 19017 |
| HayeSep N | 100/120 | 0.75mm | 0.95mm | up to 165°C | 19022 | 19023 |
| HayeSep N | 100/120 | 1.00mm | 1/16" | up to 165°C | 19020 | 19021 |
| HayeSep S | 100/120 | 0.75mm | 0.95mm | up to 250°C | 19010 | 19011 |
| HayeSep S | 100/120 | 1.00mm | 1/16" | up to 250°C | 19008 | 19009 |
| Molesieve 5A | 80/100 | 0.75mm | 0.95mm | up to 300°C | 19002 | 19003 |
| Molesieve 5A | 80/100 | 1.00mm | 1/16" | up to 300°C | 19000 | 19001 |
| Molesieve 13X | 80/100 | 0.75mm | 0.95mm | up to 350°C | 19006 | 19007 |
| Molesieve 13X | 80/100 | 1.00mm | 1/16" | up to 350°C | 19004 | 19005 |

Searching **for a product?**

Don't see the column you need?

Contact our Technical Service team at 800-356-1688 or 814-353-1300, ext. 4, or contact your Restek representative, to obtain the column needed for your application.

Packed Column Inlet Adaptor Kits

- Use 1/8" and 3/16" OD columns in 1/4" on-column injection ports.
- Centers column perfectly in injection port to eliminate bent syringe needles.
- Slotted design prevents carrier gas occlusion.
- Vespel®/graphite reducing ferrules make installation easy.
- Includes all nuts & ferrules used to attach tubing to the injector or detector.



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

| Description | For 1/8" Columns | | | For 3/16" Columns | | |
|------------------------------------------------------------------|------------------|-------|-------|-------------------|-------|-------|
| | qty. | cat.# | price | qty. | cat.# | price |
| Packed Column Inlet Adaptor Kit for 1/4" Injection Ports | kit | 21651 | | kit | 21650 | |
| Packed Column Inlet Adaptor Kit for Shimadzu 5mm Injection Ports | kit | 21119 | | kit | 21120 | |
| Packed Column Inlet Adaptor Kit for Carlo-Erba GCs | kit | 21129 | | kit | 21130 | |

Installation Kits

| Description | qty. | cat.# | price |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------|-------|
| Micropacked Column Installation Kit for 0.75mm ID columns; for valve applications. Kit contains: 1/16" Valco nut (1), 1/16" Vespel/graphite ferrule (1), 1/16" graphite ferrule (1), 1/16" Sulfinert union (1), 1/16" to 1/16" stainless steel union (1), Sulfinert tubing, 1/16" OD x 0.04" ID (1ft/0.3m), stainless steel ferrule (1), graphite ferrules (2), Vespel/graphite ferrules (2). | kit | 21062 | |
| Micropacked Column Installation Kit for 0.75mm ID columns; for split applications. Kit contains: graphite ferrules (2), Vespel/graphite ferrules (2). | kit | 21063 | |
| Micropacked Column Installation Kit for 0.75mm ID columns; for all Agilent GCs. Kit contains: graphite ferrule (1), graphite ferrule (1), Vespel/graphite ferrule (1), Vespel/graphite ferrule (1). | kit | 21064 | |
| Micropacked Column Installation Kit for 1mm ID columns; for valve applications. Kit contains: 1/16" Valco nut (1), 1/16" stainless steel nut (1), 1/16" Vespel/graphite ferrule (1), 1/16" graphite ferrule (1), stainless steel ferrule (1), 1/16" stainless steel front ferrule (1), 1/16" stainless steel back ferrule (1). | kit | 21065 | |
| Micropacked Column Installation Kit for 1mm ID columns; for direct injections. Kit contains: 1/16" stainless steel nuts (2), 1/16" Vespel/graphite ferrules (2), 1/16" graphite ferrules (2), 1/16" stainless steel front ferrules (2), 1/16" stainless steel back ferrules (2). | kit | 21066 | |
| Packed Column Installation Kit for 2mm ID columns; for valve applications. Kit contains: 1/4" stainless steel nut (1), stainless steel Valco nut (1), 1/8" 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 | |

Micropacked Inlet Conversion Kits

Convert a capillary GC split/splitless inlet for use with 1/16" OD micropacked columns.

- For use with Agilent 5890 and 6890 GCs.
- Sample pathways deactivated for ultimate inertness.

| Description | qty. | cat.# | price |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------|-------|
| Micropacked Column Adaptor Kit for Split/Splitless Injection* <i>Complete kit with FID and injection port adaptors</i> Kit includes: Dual Vespel Ring Inlet Seal, large bore; reducing nut, large bore; FID adaptor, large bore; 1/4" ferrule, Vespel/graphite; 1/4" nut, stainless steel; 1/16" ferrules, Vespel/graphite (2); 4mm splitless liner, intermediate polarity deactivated; 1/16" nuts, stainless steel (2) | kit | 22424 | |
| Micropacked Column Adaptor Kit for On-Column Injection* <i>Complete kit with FID and injection port adaptors</i> Kit includes: Dual Vespel Ring Inlet Seal, large bore; reducing nut, large bore; FID adaptor, large bore; 1/4" ferrule, Vespel/graphite; 1/4" nut, stainless steel; 1/16" ferrules, Vespel/graphite (2); Siltek treated metal liner installation guide; 1/16" nuts, stainless steel (2) | kit | 22425 | |
| Micropacked Column Adaptor Kit for Split/Splitless Injection <i>Injection Port Adaptor Kit</i> Kit includes: Dual Vespel Ring Inlet Seal, large bore; reducing nut, large bore; 1/16" ferrule, Vespel/graphite; 1/16" nut, stainless steel; 4mm splitless liner, intermediate polarity deactivated | kit | 22426 | |
| Micropacked Column Adaptor Kit for On-Column Injection <i>Injection Port Adaptor Kit</i> Kit includes: Dual Vespel Ring Inlet Seal, large bore; reducing nut, large bore; 1/16" ferrule, Vespel/graphite; Siltek treated metal liner installation guide; 1/16" nut, stainless steel | kit | 22427 | |
| Micropacked Column Adaptor Kit for FID* <i>FID Adaptor Kit</i> Kit includes: FID adaptor, large bore; 1/4" ferrule, Vespel/graphite; 1/4" nut, stainless steel; 1/16" nut, stainless steel; 1/16" ferrule, Vespel/graphite | kit | 22428 | |
| Replacement Inlet Seals for Micropacked Column Adaptor Dual Vespel Ring Inlet Seals, large bore (2) | 2-pk. | 22429 | |
| Replacement Metal Liner Installation Guide for On-Column Injection Siltek treated metal liner installation guide | ea. | 22430 | |
| Replacement 4mm Splitless Liner | ea. | 20772 | |

*For use with packed column FIDs only.



Large-Bore Dual Vespel® Ring Inlet Seals



1/4" SS Nut



Large-Bore FID Adaptor



1/4" Vespel®/Graphite Ferrule



1/16" SS Nut



Large-Bore Reducing Nut



1/16" Vespel®/Graphite Ferrules



22430



20772



Silcoport™ Support Materials Outperform Any Deactivated Diatomaceous Earth Supports Available!

- Superior deactivation technology for improved inertness.
- Available in 80/100 and 100/120 mesh.
- Uniform particle distribution for maximum efficiency.

restek
innovation!

The increased sensitivity of modern detection systems and the desire to reduce detection limits requires a solid support to meet the challenging demands faced by analysts. Unlike conventional dimethyldichlorosilane (DMDCS) deactivation, Silcoport™ incorporates our proprietary fused silica deactivation technology on diatomaceous earth solid supports. Silcoport™ supports were developed using a special mixture of deactivants that yields the highest inertness without changing the polarity of the stationary phase. Silcoport™ supports from Restek are the perfect match for highly inert SilcoSmooth™ tubing.

did you know?

Silcoport support replaces

- Supelcoport
- Chromosorb W HP
- GasChrom Q 2

Silcoport W BW support replaces

- GasChrom Q

Silcoport™ Packing Materials

| Description | Temp. Limit (°C) | Mesh | Min. Qty.† | cat.# | price/g |
|-------------------|------------------|---------|------------|-------|---------|
| Silcoport P* | 400 | 80/100 | 100g | 25641 | |
| | 400 | 100/120 | 100g | 25642 | |
| Silcoport W** | 400 | 80/100 | 100g | 25689 | |
| | 400 | 100/120 | 100g | 25673 | |
| Silcoport W BW*** | 400 | 100/120 | 100g | 25674 | |

*Prepared from Chromosorb P; Restek acid washed deactivation.

**Prepared from Chromosorb W; Restek acid washed deactivation.

***Prepared from Chromosorb W; Restek base washed deactivation.

†Bulk quantities are available.

please note

Silcoport™ is available uncoated or coated with the liquid stationary phase of your choice on 80/100 or 100/120 mesh sizes. Call Restek at 800-356-1688 or 814-353-1300, ext. 3, or contact your Restek representative, for pricing and availability.

CarboBlack Packing Materials

| Description | Temp. Limit (°C) | Mesh | Min. Qty. | cat.# | price/g |
|--------------------------------------------|------------------|--------|-----------|-------|---------|
| CarboBlack B | 500 | 60/80 | 10g | 25500 | |
| | 500 | 80/120 | 10g | 25501 | |
| CarboBlack C | 500 | 60/80 | 10g | 25502 | |
| | 500 | 80/100 | 10g | 25503 | |
| CarboBlack BHT-100 | 150 | 40/60 | 10g | 25504 | |
| CarboBlack III (F) | 175 | 80/100 | 10g | 25506 | |
| 5% Carbowax 20m on CarboBlack B | 225 | 80/120 | 10g | 25507 | |
| 6.6% Carbowax 20m on CarboBlack B | 225 | 80/120 | 10g | 25508 | |
| 4% Carbowax 20m / 0.8% KOH on CarboBlack B | 220 | 60/80 | 10g | 25509 | |
| 0.19% picric acid on CarboBlack C | 120 | 80/100 | 10g | 25510 | |
| 4% Carbowax 20m on CarboBlack B-DA | 200 | 80/120 | 10g | 25511 | |

Res-Sil™ C Packings

- Unique separation of saturated and unsaturated hydrocarbons.
- Innovative bonding chemistry for batch-to-batch reproducibility, excellent thermal stability, and long life.
- Wide range of bonded phases available.
- Equivalent to Waters Durapak packings.

Bonded silica packings with *n*-octane or cyanopropyl (OPN) functional groups yield faster separations of C1 to C4 hydrocarbons, higher thermal stability, shorter conditioning times, and longer lifetimes than conventional packings. However, bonded silica packings have had inconsistent reproducibility and limited availability. Restek's research team has solved these age-old problems by developing Res-Sil™ C packings for consistent performance.

Unique Selectivity for Process GC and High-Speed Analysis of Petrochemicals

Res-Sil™ C bonded packings are ideal for fast resolution of difficult-to-separate saturated and unsaturated C4 hydrocarbons (e.g., see page 119). This unique selectivity, when combined with other columns in series, provides petroleum and petrochemical method developers with a powerful tool for fast determination of C1 to C5 hydrocarbons.¹

Innovative Research and Stringent QA Provide Batch-to-Batch Consistency

Restek's synthesis procedure eliminates batch-to-batch variations. The amount of bonded liquid phase is precisely controlled in every batch, for reproducible retention times and separations. Each production batch of Res-Sil™ C packing is tested with a complex hydrocarbon mixture to meet demanding retention time and retention index specifications. Column bleed is also evaluated to ensure that there are no retention shifts or high baselines.

OPN on Res-Sil™ C Packing—the Latest in a Line of Bonded GC Phases

Restek offers a wide range of bonded packings for packed column GC, including Rtx®-1, Stabilwax®, and Carbowax® phases. We have extended this technology to make *n*-octane on Res-Sil™ C packing, and OPN on Res-Sil™ C packing. Each of these packings has low bleed, conditioning times of less than 30 minutes, long lifetime, and consistent batch-to-batch reproducibility.

also available

Custom packing materials are also available. See page 130.

Res-Sil™ Packing Materials

| Description | Temp. Limit (°C) | Mesh | Min. Qty. | cat.# | price/g |
|-------------------------------|------------------|--------|-----------|-------|---------|
| Res-Sil C | 300 | 60/80 | 10g | 25400 | |
| | 300 | 80/100 | 10g | 25028 | |
| Res-Sil B | 300 | 60/80 | 10g | 25401 | |
| | 300 | 80/100 | 10g | 25080 | |
| 1% TCEP on Res-Sil B | 175 | 80/100 | 10g | 25081 | |
| OPN on Res-Sil C | 150 | 80/100 | 10g | 25042 | |
| <i>n</i> -Octane on Res-Sil C | 150 | 80/100 | 10g | 25030 | |
| 2% Carbowax 1540 on Res-Sil C | 150 | 80/100 | 10g | 25044 | |

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

did you know?

Res-Sil replaces

- Porasil B
- Porasil C



Technical Service

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

Contact us:

For quick answers to commonly asked questions any time of the day, visit www.restek.com/answers or contact us directly:

In the U.S.

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

Outside the U.S.

Contact your Restek representative.

Chromosorb® Diatomaceous Earth Supports

Restek offers the full line of Chromosorb® solid supports. Choosing the appropriate support will depend on your application. Need assistance? Call Technical Service at 800-356-1688 or 814-353-1300, ext. 4, or contact your Restek representative.

Chromosorb® P (used to prepare Silcoport™ P)

Chromosorb® P support is manufactured from hard firebrick, making it a rugged material. This support is available acid washed (AW), nonacid washed (NAW), and traditional dimethyldichlorosilane (DMDCS) treated. Chromosorb® P support can hold up to 30 weight% of liquid stationary phase, making it the highest loading support available.

Chromosorb® W (used to prepare Silcoport™ W and Silcoport™ BW)

Chromosorb® W support is a flux-calcinated diatomite. This solid support is very fragile but offers the highest inertness of all diatomaceous earth supports. It can be prepared with up to 25 weight% of liquid stationary phase. Chromosorb® W support is available in AW, NAW, and DMDCS, or treated with Restek's proprietary (Silcoport™) deactivation. Chromosorb® W-HP is an acid washed, silanized version of Chromosorb® W.

Chromosorb® G

Chromosorb® G support is the hardest support available and has the lowest surface area of all the diatomaceous earth supports. Chromosorb® G support is available as AW, NAW, and DMDCS-treated. It can hold up to 10 weight% of liquid stationary phase.

Chromosorb® T

Chromosorb® T support is made from Teflon® material and is an extremely inert solid support.

Chromosorb® G and Chromosorb® T are available as custom products. Contact us for more information.

Chromosorb® Packings

| Description | Mesh | gm/btl.* | cat.# | price |
|----------------------|---------|----------|-------|-------|
| Chromosorb PNAW | 45/60 | 100g | 25629 | |
| | 60/80 | 100g | 25630 | |
| | 80/100 | 100g | 25631 | |
| | 100/120 | 100g | 25632 | |
| Chromosorb PAW | 60/80 | 100g | 25634 | |
| | 80/100 | 100g | 25635 | |
| | 100/120 | 100g | 25636 | |
| Chromosorb PAW/DMDCS | 60/80 | 100g | 25638 | |
| | 80/100 | 100g | 25639 | |
| | 100/120 | 100g | 25640 | |
| Chromosorb WNAW | 60/80 | 100g | 25657 | |
| | 80/100 | 100g | 25658 | |
| | 100/120 | 100g | 25659 | |
| Chromosorb WAW | 60/80 | 100g | 25661 | |
| | 80/100 | 100g | 25662 | |
| | 100/120 | 100g | 25663 | |
| Chromosorb WAW/DMDCS | 60/80 | 100g | 25665 | |
| | 80/100 | 100g | 25666 | |
| | 100/120 | 100g | 25667 | |
| Chromosorb W-HP | 60/80 | 100g | 25668 | |
| | 80/100 | 100g | 25669 | |
| | 100/120 | 100g | 25670 | |

*Please call for larger quantities (>100gm bottles) of Chromosorb packings.

NAW—nonacid washed
AW—acid washed
DMDCS—dimethyldichlorosilane
BW—base washed

Chromosorb® Century Packings

| Description | Temp. Limits (°C) | g/btl. | Mesh 60/80 | | Mesh 80/100 | | Mesh 100/120 | |
|----------------|-------------------|--------|---------------------------|-------|-------------|-------|--------------|-------|
| | | | cat.# | price | cat.# | price | cat.# | price |
| Chromosorb 101 | 275/325 | 50g | 25608 | | 25609 | | 25610 | |
| Chromosorb 102 | 250/300 | 50g | 25611 | | 25612 | | 25613 | |
| Chromosorb 103 | 275/300 | 50g | 25614 | | 25615 | | 25616 | |
| Chromosorb 104 | | | (equivalent to HayeSep C) | | | | | |
| Chromosorb 105 | 250/275 | 50g | 25617 | | 25618 | | 25619 | |
| Chromosorb 106 | 250/275 | 50g | 25620 | | 25621 | | 25622 | |
| Chromosorb 107 | 250/275 | 50g | 25623 | | 25624 | | 25625 | |
| Chromosorb 108 | 250/275 | 50g | 25626 | | 25627 | | 25628 | |

Porapak Series Packings

| Description | Temp. Limit (°C) | g/btl. | Mesh 50/80 | | Mesh 80/100 | | Mesh 100/120 | |
|-------------|------------------|--------|------------|-------|-------------|-------|--------------|-------|
| | | | cat.# | price | cat.# | price | cat.# | price |
| Porapak P | 250 | 20g | 25576 | | 25577 | | 25578 | |
| Porapak PS | 250 | 20g | 25579 | | 25580 | | 25581 | |
| Porapak Q | 250 | 26g | 25582 | | 25583 | | 25584 | |
| Porapak QS | 250 | 26g | 25585 | | 25586 | | 25587 | |
| Porapak R | 250 | 24g | 25588 | | 25589 | | 25590 | |
| Porapak S | 250 | 26g | 25591 | | 25592 | | 25593 | |
| Porapak N | 190 | 29g | 25594 | | 25595 | | 25596 | |
| Porapak T | 190 | 31g | 25597 | | 25598 | | 25599 | |

also available

Custom packing materials are also available. See page 130.

HayeSep® Series Packings

| Description | Temp. Limit (°C) | g/btl. | Mesh 60/80 | | Mesh 80/100 | | Mesh 100/120 | |
|-------------|------------------|--------|------------------|-------|-------------|-------|--------------|-------|
| | | | cat.# | price | cat.# | price | cat.# | price |
| HayeSep A | 165 | 24g | 22560 | | 25032 | | 25033 | |
| HayeSep B | 190 | 24g | 25561 | | 25034 | | 25035 | |
| HayeSep C | 250 | 24g | 25562 | | 25036 | | 25037 | |
| HayeSep D | 290 | 24g | 25563 | | 25038 | | 25039 | |
| HayeSep DIP | 290 | 24g | 25564 | | 25565 | | 25566 | |
| HayeSep DB | 290 | 24g | 25567 | | 25568 | | 25569 | |
| HayeSep DOX | | | (Use HayeSep DB) | | | | | |
| HayeSep N | 165 | 24g | 25570 | | 25045 | | 25046 | |
| HayeSep P | 250 | 24g | 25571 | | 25047 | | 25048 | |
| HayeSep Q | 275 | 24g | 25572 | | 25049 | | 25050 | |
| HayeSep R | 250 | 24g | 25573 | | 25051 | | 25052 | |
| HayeSep S | 250 | 24g | 25574 | | 25053 | | 25054 | |
| HayeSep T | 165 | 24g | 25575 | | 25055 | | 25056 | |

Tenax® Packings

| Description | Temp. Limit (°C) | Min. Qty. | Mesh 60/80 | | Mesh 80/100 | |
|-------------|------------------|-----------|------------|---------|-------------|---------|
| | | | cat.# | price/g | cat.# | price/g |
| Tenax-TA | 350 | 10g | 25550 | /g | 25551 | /g |
| Tenax-GR | 350 | 10g | 25552 | /g | 25553 | /g |



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Liquid Phases

We can prepare packed columns from the extensive list of liquid phases shown here. We have many more liquid phases. If you don't see the phase you need, call technical service or contact your Restek representative for availability.

| Phase | min./max. temp. (°C) | Phase | min./max. temp. (°C) |
|---------------------------------------------------------------------------------------------------|-------------------------|-------------------------------------------|-------------------------|
| Apiezon L | 50/300 | OV-22, phenyl methyl diphenyl, 65% phenyl | 0/350 |
| <i>p,p'</i> -Azoxydiphenetole | 132/140 | OV-25, phenyl methyl diphenyl, 75% phenyl | 0/350 |
| BC-120 | 0/125 | OV-61, diphenyl, 33% phenyl | 0/350 |
| Bentone-34 | 0/180 | OV-73, 5.5% diphenyl | 0/325 |
| bis (2-ethoxyethyl) adipate | 0/150 | OV-101, dimethyl (fluid) | 0/350 |
| bis (2-ethylhexyl) phthalate | 150 max. | OV-105, cyanopropyl methyl | 0/275 |
| bis (2-methoxyethyl) adipate | 20/100 | OV-202, trifluoropropyl (fluid) | 0/275 |
| <i>n,n'</i> -Bis(<i>p</i> -methoxybenzylidene)- α,α' -bi- <i>p</i> -toluidine (BMBT) | 189/225 | OV-210, trifluoropropyl (fluid) | 0/275 |
| Carbowax 1000 | 40/150 | OV-215, trifluoropropyl (gum) | 0/275 |
| Carbowax 1540 | 50/175 | OV-225, cyanopropyl methylphenyl methyl | 0/265 |
| Carbowax 20M | 60/225 | OV-275, dicyanoallyl | 25/250 |
| Carbowax 20M-terephthalic acid | 60/225 | OV-330, silicone - Carbowax | 0/250 |
| Carbowax 400 | 10/100 | OV-351 | 50/270 |
| Carbowax 600 | 30/125 | OV-1701, vinyl | 0/250 |
| Cyclohexanedimethanol succinate | 100/250 | Phenyldiethanolamine succinate | 0/230 |
| DC-11 | 0/300 | Polethylene glycol adipate (EGA) | 100/225 |
| DC-200 | 0/200 | Polyphenyl ether (5 rings) OS-124 | 0/200 |
| DC-550 | 20/250 | Polyphenyl ether (6 rings) OS-138 | 0/225 |
| DEGS-PS | 20/200 | Polypropylene glycol | 0/150 |
| Dexsil 300 carborane/methyl silicone | 50/540 | Rtx-1 (Rt-101) | 0/350 |
| Di(2-ethylhexyl)sebacate | 0/125 | Rt-1000 | 50/250 |
| Diethylene glycol succinate (DEGS) | 20/200 | Rt-1200 | 25/200 |
| Diethylene glycol adipate (DEGA) | 0/200 | Rt-1220 | 50/200 |
| Diisodecyl phthalate | 0/175 | Rt-1500, Rt-1510 | 50/230 |
| 2,4-Dimethylsulfolane | 0/50 | Rt-2100 | 0/350 |
| Di- <i>n</i> -decyl phthalate | 10/175 | Rt-2300 | 20/275 |
| Dinonyl phthalate | 20/150 | Rt-2330, Rt-2340 | 25/275 |
| Ethylene glycol adipate | 100/225 | Rt-608Pkd | 0/275 |
| Ethylene glycol phthalate | 100/200 | Rt-Sebaconitrile | 25/110 |
| Ethylene glycol succinate | 100/200 | Rt-XLSulfur | 300 max. |
| FFAP | 50/250 | SE-30, SE-52, SE-54 | 50/300 |
| Fluorad FC-431, 50% solution in ethyl acetate | 40/200 | Silar 5 CP, Silar 10 CP | 0/250 |
| Hallcomid M-18-OL | 8/150 | Sorbitol | 150 max. |
| Halocarbon 10-25 | 20/100 | Squalane | 20/100 |
| Halocarbon K-352 | 0/250 | Squalene | 0/100 |
| Halocarbon wax | 50/150 | Stabilwax | 40/240 |
| Igepal CO-880 (Nonoxynol) | 100/200 | Tetracyanoethylated pentaerythritol | 30/175 |
| Igepal CO-890 | 100/200 | THEED (Tetrahydroxyethylenediamine) | 0/125 |
| Krytox | -30/260 | β,β -Thiodipropionitrile (TDPN) | 100 |
| Neopentyl glycol adipate | 50/225 | Tricresyl phosphate | 20/125 |
| Neopentyl glycol sebacate | 50/225 | 1,2,3-Tris (2-cyanoethoxy) propane (TCEP) | 0/175 |
| Neopentyl glycol succinate | 50/225 | Triton X-100, Triton X-305 | 0/200 |
| Nonoxynol (Igepal CO-880) | 100/200 | UC W982 | 0/300 |
| β,β -Oxydipropionitrile | 0/75 | UCON 50-HB-2000 | 0/200 |
| OV-1, dimethyl (gum) | 100/350 | UCON 50-HB-280-X | 0/200 |
| OV-1, vinyl | 100/350 | UCON 50-HB-5100 | 0/200 |
| OV-3, phenyl methyl | 0/350 | UCON HB-1800-X | 200 max. |
| OV-7, phenyl methyl dimethyl, 20% phenyl | 0/350 | UCON LB-550-X | 0/200 |
| OV-11, phenyl methyl dimethyl, 35% phenyl | 0/350 | Versamid 9000 | 190/275 |
| OV-17, phenyl methyl, 50% phenyl | 0/375 | | |

Advantages of using Restek packed columns

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

USP Liquid Phase & Solid Support Cross-Reference

Restek can meet all of your packed column needs for US Pharmacopeia methods. Commonly used USP liquid phases and supports are listed below. Call Restek or your representative for a quote on your next packed column for pharmaceuticals.

| USP | Phase Description | Restek-Supplied Equivalent |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|
| G1 | dimethylpolysiloxane oil | Rt-2100, OV-101, Rtx-1 |
| G2 | dimethylpolysiloxane gum | OV-1, Rtx-1 |
| G3 | 50% phenyl-50% methylpolysiloxane | Rt-2250, OV-17 |
| G4 | diethylene glycol succinate polyester | Rt-DEGS |
| G5 | 3-cyanopropylpolysiloxane | Rt-2340 |
| G6 | trifluoropropylmethylpolysiloxane | Rt-2401, OV-210 |
| G7 | 50% 3-cyanopropyl-50% phenylmethylsilicone | Rt-2300 |
| G8 | 80% bis (3-cyanopropyl)-20% phenylpolysiloxane | Rt-2330 |
| G9 | methylvinylpolysiloxane | UCW 98 |
| G10 | polyamide | polyamide |
| G11 | bis(2 ethylhexyl) sebecate polyester | bis(2 ethylhexyl) sebecate polyester |
| G12 | phenyldiethanolamine succinate polyester | phenyldiethanolamine succinate polyester |
| G13 | sorbitol | sorbitol |
| G14 | polyethylene glycol (average mol. wt. 950-1050) | Carbowax 1000 |
| G15 | polyethylene glycol (average mol. wt. 3000-3700) | Carbowax 4000 |
| G16 | polyethylene glycol compound (average mol. wt. 15,000), a high molecular weight compound of polyethylene glycol and a diepoxide linker | Carbowax 20M |
| G17 | 75% phenyl-25% methylpolysiloxane | OV-25 |
| G18 | polyalkylene glycol | UCON LB 550X |
| G19 | 25% phenyl-25% cyanopropyl-50% methylsilicone | OV 225 |
| G20 | polyethylene glycol (average mol. wt. 380-420) | Carbowax 400 |
| G21 | neopentyl glycol succinate | neopentyl glycol succinate |
| G22 | bis(2 ethylhexyl) phthalate | bis(2 ethylhexyl) phthalate |
| G23 | polyethylene glycol adipate | EGA |
| G24 | diisodecyl phthalate | diisodecyl phthalate |
| G25 | polyethylene glycol compound TPA, a high molecular weight compound of a polyethylene glycol and a diepoxide that is esterified with terephthalic acid | Carbowax 20M TPA |
| G26 | 25% 2-cyanoethyl-75% methylpolysiloxane | Rt-XE 60 |
| G27 | 5% phenyl-95% methylpolysiloxane | SE-52, Rtx-5 |
| G28 | 25% phenyl-75% methylpolysiloxane | DC 550 |
| G29 | 3,3'-thiodipropionitrile | TDPN |
| G30 | tetraethylene glycol dimethyl ether | tetraethylene glycol dimethyl ether |
| G31 | nonylphenoxypoly(ethyleneoxy)ethanol (average ethyleneoxy chain length is 30): nonoxynol 30 | Igepal CO 880 |
| G32 | 20% phenylmethyl-80% dimethylpolysiloxane | OV-7 |
| G33 | 20% Carborane®-80% methylsilicone | Dexsil 300 |
| G34 | diethylene glycol succinate polyester stabilized with phosphoric acid | Rt-DEGS PS |
| G35 | a high molecular weight compound of a polyethylene glycol and a diepoxide that is esterified with nitroterephthalic acid | Rt-1000 |
| G36 | 1% vinyl-5% phenylmethylpolysiloxane | SE 54, Rtx-5 |
| G37 | polyimide | polyimide |
| G38 | phase G1 containing a small amount of tailing inhibitor | Rt-2100/0.1% Carbowax 1500 |
| G39 | polyethylene glycol (average mol. wt. 1500) | Carbowax 1500 |
| G40 | ethylene glycol adipate | Rt-EGA |
| USP | Support Description | Restek-Supplied Equivalent |
| S1A | siliceous earth, see method for details on treatment | Silcoport W |
| S1AB | siliceous earth, treated as S1A and both acid- and base-washed | Silcoport WBW |
| S1C | crushed firebrick, calcined or burned with a clay binder >900°C, acid-washed, may be silanized | Chromosorb PAW or PAW DMDCS |
| S1NS | untreated siliceous earth | Chromosorb W- Non Acid Washed |
| S2 | styrene-divinylbenzene copolymer with nominal surface area of less than 50m ² /g and an average pore diameter of 0.3 to 0.4µm | Chromosorb 101 |
| S3 | ethylvinylbenzene-divinylbenzene copolymer with nominal surface area of 500 to 600m ² /g and an average pore diameter of 0.0075µm | Hayesep Q |
| S4 | styrene-divinylbenzene copolymer with aromatic -O and -N groups having a nominal surface area of 400 to 600m ² /g and an average pore diameter of 0.0076µm | Hayesep R |
| S5 | high molecular weight tetrafluorethylene polymer, 40- to 60-mesh | Chromosorb T |
| S6 | styrene-divinylbenzene copolymer having a nominal surface area of 250 to 350m ² /g and an average pore diameter of 0.0091µm | Chromosorb 102 |
| S7 | graphitized carbon having a nominal surface area of 12m ² /g | CarboBlack C |
| S8 | copolymer of 4-vinyl-pyridine and styrene-divinylbenzene | Hayesep S |
| S9 | porous polymer based on 2,6-diphenyl-p-phenylene oxide | Tenax TA |
| S10 | highly cross-linked copolymer of acrylonitrile and divinylbenzene | HayeSep C |
| S11 | graphitized carbon having a nominal surface area of 100m ² /g, modified with small amounts of petrolatum and polyethylene glycol compound | CarboBlack B 80/120 3% Rt 1500 |
| S12 | graphitized carbon having a nominal surface area of 100m ² /g | CarboBlack B |

Custom Coated Packing Materials

Custom coated packing materials can be made with any of the supports listed below. The liquid stationary phases available are listed on page 128 and the coating ranges are listed in the chart. Coated packings are available in minimum orders of 20 grams.

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

- 1) stationary phase and stationary phase concentration
- 2) support and support mesh size
- 3) amount of packing needed

Ordering Example: (3%) (Rtx[®]-1) (Silcoport[™] P) (80/100) (20g).

| 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 |
| Chromosorb 101-108 | 5%*/10%** | 60/80, 80/100, 100/120 |
| Chromosorb W HP | 20% | 45/60, 60/80, 80/100, 100/120 |
| Chromosorb G HP | 20% | 45/60, 60/80, 80/100, 100/120 |
| Chromosorb G, P or W (AW or NAW) | 10% (G) 25% (W) 30% (P) | 45/60, 60/80, 80/100, 100/120 |
| Chromosorb G, P or W (AW or DMDCS) | 10% (G) 25% (W) 30% (P) | 45/60, 60/80, 80/100, 100/120 |
| Chromosorb T | 15% | 40/60 |
| HayeSep | 15% | 60/80, 80/100, 100/120 |
| Porapak | 15% | 50/80, 80/100, 100/120 |
| Silcoport P | 30% | 80/100, 100/120 |
| Silcoport W BW | 20% | 80/100, 100/120 |
| Silcoport W (replacement for Chromosorb 750) | 20% | 80/100, 100/120 |

*Nonsilicone phase.

**Silicone phase.

For coatings over 15% or quantities over 50 grams, please call your Restek representative.

NAW—nonacid washed
 AW—acid washed
 DMDCS—dimethyldichlorosilane
 BW—base washed
 DA—deactivated for acidic compounds

please note

Special phases that require a surcharge:
 OV[®]-275, OV[®]-330, OV[®]-225, BMBT,
 2,4-dimethylsulfolane, Silar, OV[®]-1701,
 XE-60, and Dexsil[®]

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

| (μ m) | 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 |

Custom Packed Columns

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

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

Ordering Example: (6' x 1/8") (stainless steel) (3%) (Rtx®-1) (Silcoport™ P) (80/100) (Agilent 6890) (on-column injection) (fittings kit).

Please use the custom order form on page 132.



ordering note

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

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, and treatment)
- 3) installation kit (see page 123)

Ordering Example: (2m x 1/16" OD x 1.00mm ID) (Siltek®-treated tubing) (5%) (Carbowax® 20M) (CarboBlack B) (80/120) (installation kit for valve applications, cat. #21065)

Please use the custom order form on page 132.

Packed/Micropacked Column Custom Order Form

Order: _____ Quote: _____ Reference # from previous order (if available): _____

Date: _____

Restek Account #: _____

Contact: _____

Company: _____

Address: _____

Phone: _____

Fax: _____

Restek Use Only:

Custom No.: _____

Stock No.: _____

Price: _____

Fitting Costs: _____

Authorization: _____

Number of Columns: _____

1) Column Dimensions:

Length _____ OD x ID: _____

2) Tubing (choose one): SilcoSmooth™ Stainless Steel Hastelloy® Nickel Copper Teflon®

3) Packing Description:

Liquid Phase A (% + description): _____

Liquid Phase B (% + description): _____

Liquid Phase C (% + description): _____

Solid Support: _____ Mesh: _____

4) Column Configuration:

Instrument (mfr. + model): _____

Inlet: Packed Full? Yes No, leave _____" void (for on-column injection)

Outlet: Packed Full? Yes No, leave _____" void

Do you want this column preconditioned? Yes (additional charge) No

Standard configuration suffix number (next page): _____

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

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

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

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

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

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

KIT B
1/8" brass nuts
1/8" brass front & back ferrules
No additional charge

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

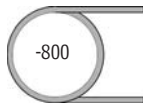
for a **quote:**

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

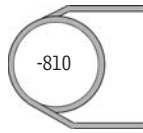
V/G = Vespel®/graphite

Standard Configurations (choose one)

General Configuration



Agilent 5880, 5890, 5987, 6890, 7890



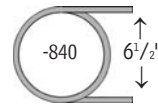
Varian 3700, Vista Series, FID



PE 900-3920, Sigma 1,2,3



PE Auto System 8300, 8400, 8700



- 810 Agilent 5880, 5890, 5987, 6890, 7890
- 811 Agilent 6850
- 820 Varian 3700, Vista Series, FID
- 821 Varian 3800
- 830 PerkinElmer 900-3920, Sigma 1,2,3
- 840 PerkinElmer Auto System 8300, 8400, 8700, Clarus 500 (C500)
- 841 PerkinElmer Auto Sys XL
- 845 ABB 3100, AAI (4" coil)
- 850 Shimadzu 14A, 2014
- 851 Shimadzu 8A

- 852 Shimadzu 9A
- 853 Shimadzu 17A, 2010
- 854 Shimadzu Mini 2
- 860 Thermo Scientific - TRACE 2000
- 865 Carlo Erba
- 870 Tometrics/Tracor
- 874 HNU 310 & 311 (4.5" coil)
- 875 Analytical Controls Configuration
- 880 Carle 40030
- 881 Hitachi 263
- 885 Pye Unicam 4500

- 890 Gow Mac 590
- 891 Gow Mac 550
- 892 Gow Mac 750
- 893 Gow Mac 816 (3" coil, 3" spread on the arms, and a total height of 5")
- 894 Gow Mac 580
- 895 SRI 8610C
- 895R SRI 8610C Dual GC Right Side
- 895L SRI 8610C Dual GC Left Side
- 896 SRI 9300

Custom Configurations (Please provide dimensions on order form, page 132.)

