

# RESTEK Advantage

## New Rtx®-VMS Revolutionary New Column Designed for GC/MS Analysis

by Chris English, Environmental Applications Chemist



In the past, stationary phases for gas chromatography (GC) were developed without consideration for their final application. This resulted in long analysis times, high bleed, and coelutions. With the use of computer modeling, Restek has been able to create a new stationary phase that achieves the fewest number of coelutions and the fastest analysis time for the separation of volatile organic compounds, such as those listed in US Environmental Protection Agency (EPA) Method 8260.

### Optimizing performance for GC/MS systems yields higher productivity.

Restek has developed the new Rtx®-VMS column with lower bleed, better selectivity, and an overall faster analysis time than the "624/1301" phase. The Rtx®-VMS stationary phase is a highly stable polymer designed to provide outstanding analysis of volatile compounds using the more sensitive ion traps and HP 5973 mass spectrometers (MS).

Oven cycle time, not analysis time, is the most important factor in increasing productivity. The Rtx®-VMS column was designed for a 40°C starting GC oven temperature, allowing a shorter total oven cycle time (Table I), without sacrificing resolution of the six gases listed in Method 8260.

The Rtx®-VMS column has been optimized in multiple internal diameters; 0.18, 0.25, 0.32, 0.45, and 0.53mm ID, giving the analyst choices on how they prefer to run volatile compounds. The 0.18 and 0.25mm ID columns allow splitting at the injection port, eliminating the added expense and maintenance of a jet-separator. The 0.45mm ID column is recommended because it has a faster analysis time and better efficiency over the 0.53mm ID equivalent, and still has sufficient flow to sweep the sample off the trap and onto the column. The 0.45mm ID Rtx®-VMS optimized phase and column dimensions produce a 17-minute analysis time (Figure 1, pg. 2).

**Table I**

**HP 5890 oven cool-down time decreases drastically when starting at 40°C.**

Temperature (C°)	Cool Down Time (min.)
220 to 40	6.0
240 to 40	7.5
220 to 35	9.5
240 to 35	10.5

### Rtx®-VMS columns overcome the challenge of coelutions.

The Rtx®-VMS column was designed to resolve all compounds using primary quantitation ions. Coeluting compounds cannot share quantitation ions or have minor ions that interfere with the primary ion of the coeluting analyte. US EPA methods updates such as Method 524.2, rev. IV, have added coeluting compounds with minor ions of one compound interfering with the quantitation of another compound. An example of this problem occurs when using the "624/1301" 75m x 0.53mm ID column with methyl acrylate and propionitrile. The quantitation ion for methyl acrylate is 55. Propionitrile has a minor ion of 55, which can interfere with determining actual concentrations of methyl acrylate in "real world" samples. Another

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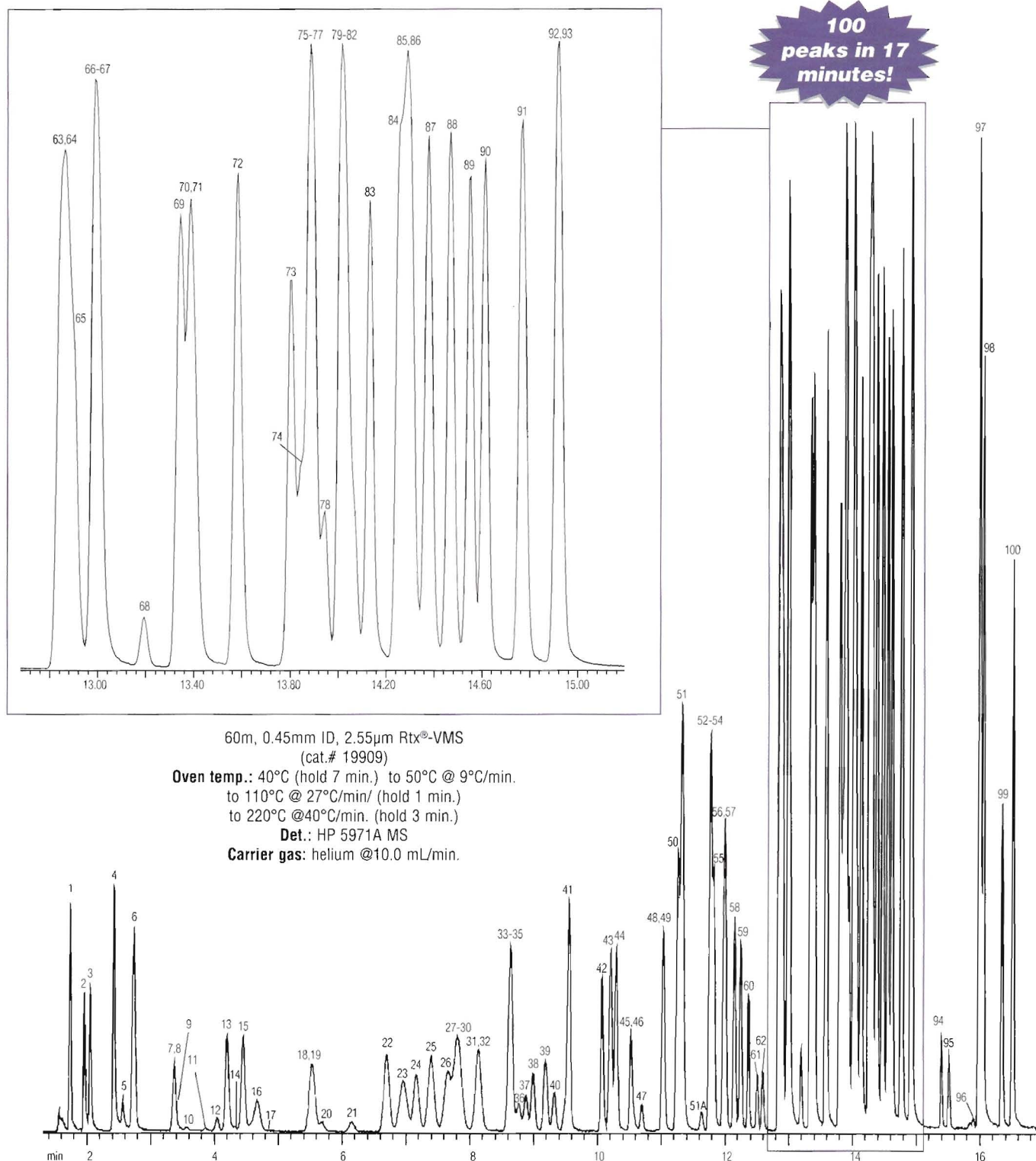


# New Rtx<sup>®</sup>-VMS

## Faster and Better Volatile Organics GC/MS Analysis

Figure 1

A 0.45mm ID Rtx<sup>®</sup>-VMS column analyzes US EPA Method 8260 compounds in less than 17 minutes.



Acknowledgment: Special thanks for technical contribution to Darrel Robbins, STL Laboratories, Burlington, VT.

1. dichlorofluoromethane
2. chloromethane
3. vinyl chloride
4. bromomethane
5. chloroethane
6. trichlorofluoromethane
7. 1,1-dichloroethane
8. carbon disulfide
9. Freon® 113
10. iodomethane
11. acrolein
12. allyl chloride
13. methylene chloride
14. acetone
15. *trans*-1,2-dichloroethane
16. methyl-*tert*-butyl-ether
17. *tert*-butyl alcohol
18. chloroprene
19. 1,1-dichloroethane
20. acrylonitrile
21. vinyl acetate
22. *cis*-1,2-dichloroethane
23. 2,2-dichloropropane
24. bromochloromethane
25. chloroform
26. carbon tetrachloride
27. tetrahydrofuran
28. methyl acrylate
29. ethyl acetate
30. 1,1,1-trichloroethane
31. 2-butanone
32. 1,1-dichloropropene
33. propionitrile
34. benzene
35. methacrylonitrile
36. 1,2-dichloroethane-d4
37. 1,2-dichloroethane
38. isobutyl alcohol
39. fluorobenzene
40. isopropyl acetate
41. trichloroethene
42. dibromomethane
43. 1,2-dichloropropane
44. bromodichloromethane
45. methyl methacrylate
46. 1,4-dioxane
47. *n*-propyl acetate
48. 2-chloroethyl-vinyl-ether
49. *cis*-1,3-dichloropropene
50. toluene-d8
51. toluene
- 51A. 1,1-dichloro-2-propanone
52. 4-methyl-2-pentanone
53. tetrachloroethene
54. *trans*-1,3-dichloropropene
55. 2-bromo-1-chloropropane
56. 1,1,2-trichloroethane
57. ethyl methacrylate
58. dibromochloromethane
59. 1,3-dichloropropane
60. 1,2-dibromoethane
61. *n*-butyl acetate
62. 2-hexanone
63. chlorobenzene
64. ethylbenzene
65. 1,1,1,2-tetrachloroethane
66. *m*-xylene
67. *p*-xylene
68. 1-chloro-2-fluorobenzene
69. *o*-xylene
70. styrene
71. bromoform
72. isopropylbenzene
73. 4-bromo-1-fluorobenzene
74. *cis*-1,4-dichloro-2-butene
75. bromobenzene
76. 1,4-dichlorobutane
77. *n*-propylbenzene
78. 1,1,2,2-tetrachloroethane
79. 2-chlorotoluene
80. 1,2,3-trichloropropane
81. 1,3,5-trimethylbenzene
82. *trans*-1,4-dichloro-2-butene
83. 4-chlorotoluene
84. *tert*-butylbenzene
85. pentachloroethane
86. 1,2,4-trimethylbenzene
87. *sec*-butylbenzene
88. *p*-isopropyltoluene
89. 1,3-dichlorobenzene
90. 1,4-dichlorobenzene
91. *n*-butylbenzene
92. 1,2-dichlorobenzene-d4
93. 1,2-dichlorobenzene
94. 4-bromo-1-chlorobenzene
95. 1,2-dibromo-3-chloropropane
96. nitrobenzene
97. hexachlorobutadiene
98. 1,2,4-trichlorobenzene
99. naphthalene
100. 1,2,3-trichlorobenzene

difficult pair to separate on the "624/1301" column is 1,1-dichloro-2-propanone and 4-methyl-2-pentanone, which share ion 43. These compounds can be resolved on the "624/1301" 60m x 0.32mm ID column in more than 30 minutes. The Rtx®-VMS column was designed specifically to overcome these challenges and those of the branched aromatics, which share parent ions, in less time than any other column available.

#### Interfacing the column to the MS ion source.

Conventional MS systems operate optimally when the flow of carrier gas into the ionizing chamber is 1mL/min. Flow rates higher than this will increase noise at a greater rate than the increase in sensitivity, resulting in a net loss of the signal-to-noise ratio. Higher flow rates also strain turbo-molecular pumps, adding to maintenance and downtime. The Rtx®-VMS column in 0.18mm and 0.25mm IDs are run optimally at flow rates of 1mL/min, thereby, allowing a direct interface to the MS ion source. To interface the 0.32, 0.45, and 0.53mm ID columns to the MS and keep the flow at 1mL/min, an open split interface (OSI) or jet separator is used.

The OSI generally splits off the carrier gas 10:1, resulting in a 10-fold decrease in sample quantity entering the detector. Due to more sensitive instrumentation like the ion trap and HP5973 quadrupole MS, splitting of the sample at the MS interface still allows for method detection limits (MDLs) to be achieved. Less sensitive instrumentation can overcome the loss of sample and achieve the detection limit required by US EPA Method 8260 and 524.2, rev. IV, by increasing the sample size

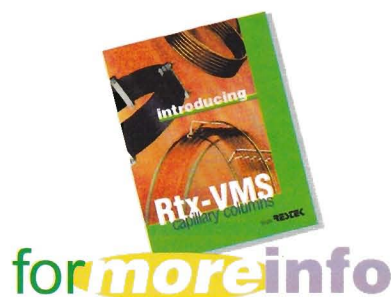
from 5mL to 25mL, thus introducing approximately five times more sample to the column. However, it is more difficult to achieve MDLs for the ketones and other poor-purging compounds using 25mL volume of sample.

The jet separator uses a vacuum pump to pull the carrier gas away from the analytes, allowing a majority of sample to pass into the MS source. Except for the most volatile compounds, 90% of the analytes from the column reach the MS detector. This method is more expensive than the OSI and requires additional maintenance, but the analysis can be accomplished by purging only 5mL of sample to achieve detection limits on less sensitive instrumentation.

Choosing the internal column diameter of the Rtx®-VMS column to interface with the MS ion source is a matter of preference. The Rtx®-VMS column is available in 0.53, 0.45, 0.32, 0.25, and 0.18mm ID column configurations, allowing you to decide which dimension is best for your analysis.

#### Conclusion

The Rtx®-VMS column is the first in a series of volatile columns that Restek has designed to target specific method requirements. Using computer modeled stationary phase development, it is possible to produce a column with unsurpassed separation of US EPA Method 8260B and 524.2, rev. IV, analytes. This column is capable of accurate and fast GC separations, even at a 40°C starting temperature, and exhibits exceptionally low bleed at 240°C allowing optimum performance with ion trap and HP5973 MS systems.



Request the Rtx®-VMS Benefits Brochure  
(lit. cat.# 59209).

#### Rtx®-VMS (Stable to 280°C)

ID	df (µm)	Temp. Limits	30-Meter	60-Meter	105-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	19958	19988	19974
ID	df (µm)	Temp. Limits	20-Meter	40-Meter	
0.18mm	1.00	-40 to 240/260°C	49914	49915	

If you're analyzing volatile compounds,  
attend our upcoming

**Environmental GC Seminar.**

See page 14 for more information.



# Siltek® Deactivation

## Minimize Breakdown of Chlorinated Pesticides

by Deb Salabsky, Applications Chemist

Gas chromatographic (GC) analysis of chlorinated pesticides presents unique challenges to environmental laboratories because the compounds are analyzed at trace levels and are susceptible to decomposition. Analytical methods have stringent breakdown and reproducibility criteria (such as the US Environmental Protection Agency (EPA) Methods 8081 and 608).

Breakdown occurs when a compound decomposes into related compounds, generally from a thermal or chemical reaction that has taken place. Two pesticides prone to breakdown are endrin, which breaks down into endrin aldehyde and endrin ketone, and DDT, which breaks down into DDE and DDD. The source of breakdown is most commonly caused by active sites in the GC system. Routine maintenance of the injection port, prevention of sample flashback, and thorough deactivation of the inlet liner and GC columns are essential to minimize compound breakdown.

A study on the effect of inlet liner deactivation on endrin and DDT breakdown shows that breakdown can be decreased drastically by using Siltek™ products (Figure 1). When a direct injection of a pesticide standard is injected into an untreated glass Uniliner®, endrin breakdown is calculated at 62% and DDT breakdown is less than 1%. In a Siltek™ Uniliner® inlet liner, endrin and DDT breakdown measured less than 1%.

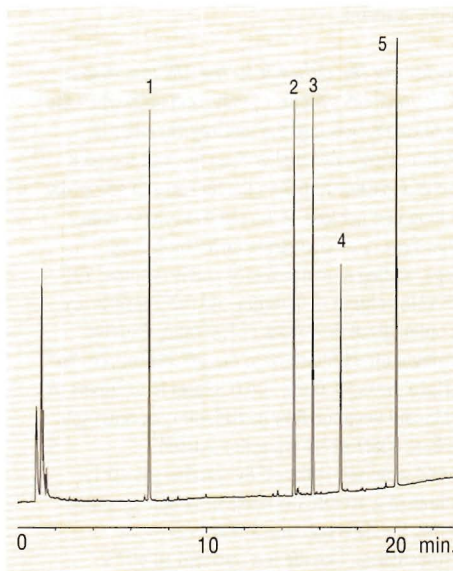
We also studied the effects of hot metal surfaces on endrin and DDT breakdown. For more information, request Applications Note #59111.

Our research demonstrates that direct injection into a Siltek™ Uniliner® inlet liner provides the best protection against problematic breakdown in the injection port when analyzing chlorinated pesticides. Endrin is more prone to breakdown on glass surfaces than metal, and DDT is more prone to breakdown on metal surfaces. Restek's Siltek™ deactivation can yield a minimal endrin breakdown of 1%!

For a complete, highly inert pathway for chlorinated pesticides, Restek also offers Rtx®-CLPesticides and Rtx®-CLPesticides2 columns and Siltek™ guard columns.

### Now available!

New, improved Siltek™ pesticide column kits! Kit includes a Rtx®-CLPesticides column and a Rtx®-CLPesticides2 column; a 5m Siltek™ guard column; and a Siltek™ universal, angled "Y" Press-Tight® connector. (Note: columns are not pre-connected in these kits).



**Figure 1**

**A direct flash injection using a Siltek® inlet liner results in less than 1% breakdown for endrin and DDT.**

1. 2,4,5,6-tetrachloro-*m*-xylene
2. endrin
3. 4,4'-DDT
4. methoxychlor
5. decachlorobiphenyl

30m, 0.53mm ID, 0.42µm Rtx®-CLPesticides2 (cat.# 11340).

Inj.: 1µL of 50pg/µL standard.

Oven temp.: 40°C (hold 1 min.) to 300°C @ 9°C/min. (hold 10 min.)

Inj. temp.: 250°C

Det.: ECD, 300°C

Carrier gas: helium.

### Siltek™ Inlet Liners

Refer to the *Restek 2000 Chromatography Products Guide* or call customer service for liner cat.#'s, then add one of the following suffixes to receive Siltek™ liners.

qty.	Siltek™		Siltek™ inlet liner with Siltek™ wool		Siltek™ inlet liner with CarboFrit™	
each	-214.1,	addl. cost	-213.1,	addl. cost	-216.1,	addl. cost
5-pk.	-214.5,	addl. cost	-213.5,	addl. cost	-216.5,	addl. cost
25-pk.	-214.25,	addl. cost	-213.25,	addl. cost	-216.25,	addl. cost

### Siltek™ Guard Columns

nominal ID	nominal OD	5-meter	10-meter
0.25mm	0.37 ±0.04mm	10026	10036
0.32mm	0.45 ±0.04mm	10027	10037
0.53mm	0.69 ±0.04mm	10028	10038

### Siltek™ Press-Tight® Connectors

type	qty.	cat.#
straight	25-pk.	20449
angled "Y"	3-pk.	20469

### Rtx®-CLPesticides Kits

ID (mm)	cat.#
0.25	11199
0.32	11198
0.53	11197

### Siltek™ Borosilicate Wool

qty.	cat.#
10 g	21100



# Updated Calibration Mixtures Match European Pharmacopoeia Limits

by Christopher Cox, Senior R&D Chemist

The United States Pharmacopoeia (USP) <467> Method has been revised in the 24th edition of USP, effective January 1, 2000<sup>1</sup>. The biggest change was to the limit test concentrations for all five residual solvents. The revised test concentrations for the five USP <467> residual solvents are now the same as the concentrations used by the European Pharmacopoeia<sup>2</sup> and as adopted by the International Conference on Harmonization<sup>3</sup>.

Restek has developed two new products to meet this change. These products (cat.# 36006, dissolved in methanol, and cat.# 36007, dissolved in dimethylsulfoxide) are now available from stock for immediate shipment. The Rtx®-G43 GC column is the best choice for USP <467> (Figure 1).

1. USP 24 - NF 19, Organic Volatile Impurities <467>, p. 1877-1878.
2. European Pharmacopoeia, Supplement 1999, pp. 14- 15, 208.
3. International Conference on Harmonization, Note for Guidance on impurities: Residual Solvents, July 17, 1997.

References not available from Restek.

**Figure 1**  
Rtx®-G43 column provides the resolution and detection limits needed for USP <467> revised limit test concentrations.

1. methylene chloride	600µg/mL
2. chloroform	60
3. benzene	2
4. trichloroethylene	80
5. 1,4-dioxane	380

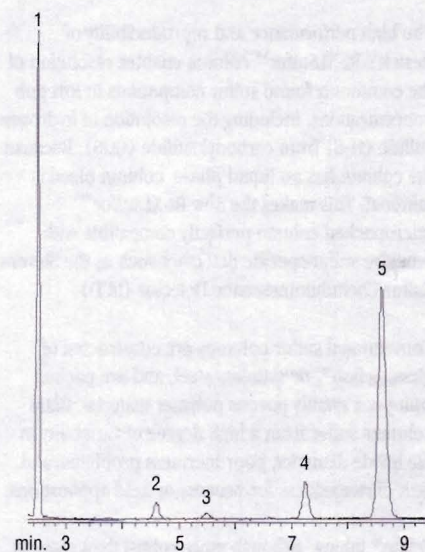
30m, 0.53mm ID, 3.0µm Rtx®-G43 with 5m phenylmethyl Integra-Guard™ guard column (cat.# 16085-126)  
1µL direct injection of USP <467> Calibration Mix #5 (cat.# 36007)

Oven temp.: 40°C (hold 20 min.) to 240°C @ 35°C/min. (hold 10 min.)

Inj.: 180°C

Carrier gas: helium, 40cm/sec.

Det.: FID, 260°C, 1 x 10<sup>-11</sup>AFS



## USP <467> Calibration Mix #4

Prepared in methanol, 1mL per ampul.

benzene	2µg/mL
chloroform	60
1,4-dioxane	380
methylene chloride	600
trichloroethene	80

Each	10-pk.
36006	36106

## USP <467> Calibration Mix #5

Prepared in dimethylsulfoxide, 1mL per ampul.

benzene	2µg/mL
chloroform	60
1,4-dioxane	380
methylene chloride	600
trichloroethene	80

Each	10-pk.
36007	36107

## Rtx®-G43 Column

30m, 0.53mm ID, 3.0µm with 5m, 0.53mm ID Integra-Guard™ column  
Temp. limit: -60 to 240°C

cat.# 16085-126



**for more info**

Request the Siltek™ Deactivation Brochure  
(lit. cat.# 59803).

“You guys did a great job!”

That's what John Syslo, an analytical chemist at Lockheed-Martin, says about Siltek™ deactivation. Pleased with the results of an analysis performed with a Siltek™ deactivated liner, John explains, "I have evaluated the Siltek™ liners against standard silanized deactivation and found significantly lower breakdown for endrin and DDT. The Siltek™ liners are superior to any other deactivation I've seen in relation to inertness."



# Rt-XLSulfur™

## Designed for Low-Concentration Sulfur Analysis

by Barry Burger, Petrochemical Applications Chemist

Restek's research and development team has designed the ultimate micropacked column specifically for the separation and quantitation of COS, H<sub>2</sub>S, SO<sub>2</sub>, CH<sub>3</sub>SH, (CH<sub>3</sub>)<sub>2</sub>S and (CH<sub>3</sub>)<sub>2</sub>S<sub>2</sub> at low ppb levels. These sulfur compounds typically are found in pulp mill by-products, natural gas, and petroleum products. Their reactive properties make them difficult to handle, transport, and analyze, especially at concentrations below 1 ppm.

The high performance and reproducibility of Restek's Rt-XLSulfur™ column enables resolution of the commonly found sulfur compounds in low ppb concentrations, including the resolution of hydrogen sulfide (H<sub>2</sub>S) from carbonyl sulfide (COS). Because the column has no liquid phase, column bleed is minimal. This makes the new Rt-XLSulfur™ micropacked column perfectly compatible with sensitive sulfur-specific detectors such as the Sievers Sulfur Chemiluminescence Detector (SCD).

Conventional sulfur columns are constructed of glass, Teflon®, or stainless steel, and are packed with poor quality porous polymer material. Glass columns suffer from a high degree of variability in the inside diameter, poor inertness problems, and lack of ruggedness for process or field applications.

Teflon® tubing, although more robust than glass, is plagued by three distinct problems: (1) Shrinkage upon oven cool-down results in carrier gas leakage and subsequent back-diffusion of O<sub>2</sub> and H<sub>2</sub>O into the packing material. If not corrected, retention times can vary as much as 15%. (2) O<sub>2</sub> and H<sub>2</sub>O diffusion through the tubing wall significantly decreases column longevity and causes reproducibility problems. (3) Maximum temperature of only 210°C limits the rapid analysis of high molecular weight sulfur compounds.

Stainless steel columns are not recommended because they can absorb low-level sulfur compounds such as H<sub>2</sub>S and methyl mercaptan.

To achieve the high degree of inertness required for the analysis of these reactive, low-level sulfur compounds every aspect of the sample pathway must be addressed (i.e., the porous polymer packing material, column tubing, column end closures, inlet sleeve, and sample loop). The porous polymer has a unique surface modification, which results in excellent peak symmetry and thermal stability to 300°C. There is virtually no bleed after initial installation, purge, and a brief conditioning period. The column tubing, column end closures, inlet sleeve, and sample loop are deactivated with

- ✓ Sulfinert™ deactivation allows low ppb analysis of sulfur compounds.
- ✓ Batch-tested for reproducibility.
- ✓ Low bleed and high thermal stability to 300°C.
- ✓ Rugged column results in longer life and easy field use.

Restek's new revolutionary Sulfinert™ deactivation process, the most inert surface available for trace sulfur compounds. Deactivation of the inlet system for sulfur compounds can provide a high sensitivity and reliability for your low-level sulfur analyses.

The Rt-XLSulfur™ column can resolve several common sulfur compounds at 50ppb levels in nitrogen using the SCD (Figure 1). At this demanding level, column bleed, peak symmetry, and resolution of the sulfurs is excellent.

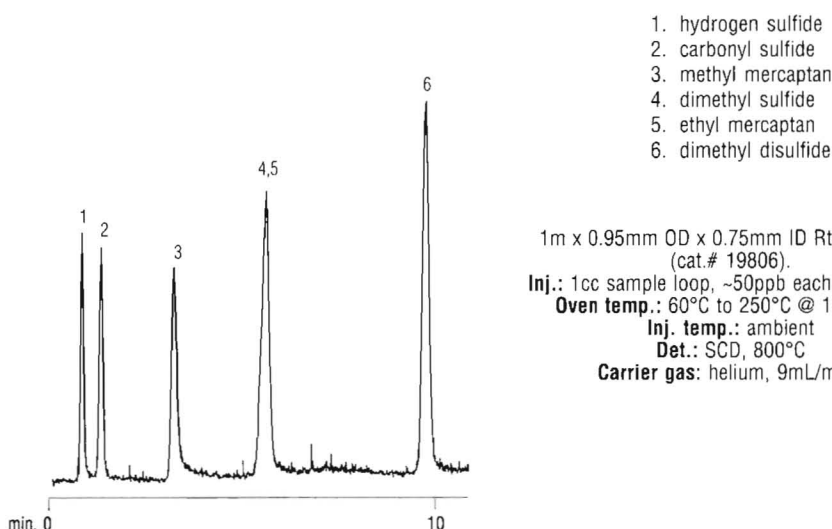
The Rt-XLSulfur™ micropacked column is the one capable of analyzing ppb levels of sulfurs while still offering all the characteristics required in a GC column: inertness, low bleed, high sample capacity, and robustness.

**formoreinfo**

For more information on Sulfinert™ coatings, request lit. cat.# 59203.

**Figure 1**

The Rt-XLSulfur™ analyzes 50ppb levels of sulfur compounds, providing low bleed and good peak symmetry.



1m x 0.95mm OD x 0.75mm ID Rt-XLSulfur™  
(cat.# 19806).  
Inj.: 1cc sample loop, ~50ppb each component  
Oven temp.: 60°C to 250°C @ 15°C/min.  
Inj. temp.: ambient  
Det.: SCD, 800°C  
Carrier gas: helium, 9mL/min..

Rt-XLSulfur™ Packed & Micropacked Columns			
OD (in.)	ID (mm)	1-meter	2-meter
3/16	3.2	80482	80483
1/8	2.0	80484	80485
1/16	1.0	19804	19805
0.95mm	0.75	19806	19807



# Rtx®-VRX

## Specialized for GC Analysis of Volatile Compounds

by Christopher English, Environmental Applications Chemist

Traditionally, stationary phases for gas chromatography (GC) were developed without consideration for their final application. This resulted in long analysis times, high bleed, and coelutions. Restek has designed the new Rtx®-VRX column with low bleed, excellent selectivity, and an overall faster analysis time than the conventional 502.2, VOCOL™, and other GC phases. The Rtx®-VRX stationary phase and column dimensions have been optimized to provide excellent resolution and fast analysis times for volatile compound analyses such as US Environmental Protection Agency (EPA) Methods 8021 and 502.2. Figure 1 illustrates the resolution of closely eluting analytes and the 30-minute analysis time, permitting high sample throughput and increased laboratory efficiency.

- ✓ Excellent selectivity for volatile compound analysis.
- ✓ Equivalent performance to J&W DB™-VRX column.
- ✓ Excellent column choice for US EPA Methods 8021 and 502.2.

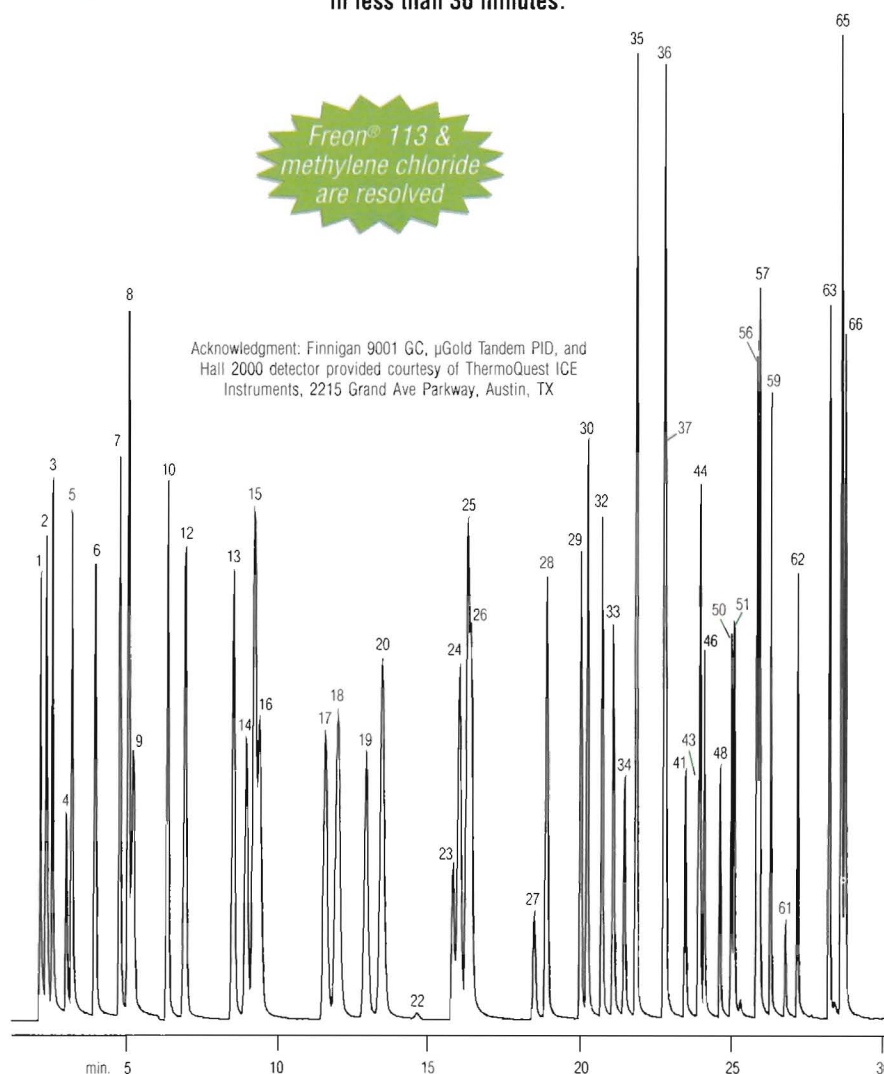
**Figure 1**

The Rtx®-VRX provides excellent separation of 66 volatile compounds in less than 30 minutes.

Freon® 113 & methylene chloride are resolved

20ppb in 5mL of RO Water.  
75m, 0.45mm ID, 2.55µm Rtx®-VRX (cat.# 19309)  
Concentrator: Tekmar LSC-3000 Purge and Trap  
Trap: Vocab 3000; Purge: 11 min. @ 40 mL/min.  
Dry Purge: 1 min. @ 40mL/min. (MCS by-passed with Silcosteel tubing (cat.# 21035))  
Desorb Preheat: 245°C; Desorb: 250°C for 2 min.  
Bake: 260°C for 8 min.  
Interface: direct  
Transfer Line: 0.32mm ID Siltek™ tubing  
GC: Finnigan 9001  
GC Program:  
35°C (hold 12 min.) to 60°C @ 5°C/min. (hold 1 min.) to 220°C @ 17°C/min. (hold 3 min.)  
Carrier: helium 9mL/min.  
Detectors: µGold Tandem PID/HALL  
PID: makeup 7mL/min., purge 7mL/min. set @ 0.35mV base temp 200°C.  
Hall2000: RxnGas 25mL/min., RxnTemp.: 940°C, propanol flow 470 µL/min.

- |                                       |                                 |
|---------------------------------------|---------------------------------|
| 1. dichlorodifluoromethane            | 34. 1,2-dibromoethane           |
| 2. chloromethane                      | 35. tetrachloroethene           |
| 3. vinyl chloride                     | 36. 1,1,1,2-tetrachloroethane   |
| 4. bromomethane                       | 37. chlorobenzene               |
| 5. chloroethane                       | 38. ethyl benzene               |
| 6. trichlorofluoromethane             | 39. <i>m</i> -xylene            |
| 7. 1,1-dichloroethene                 | 40. <i>p</i> -xylene            |
| 8. methylene chloride                 | 41. bromoform                   |
| 9. Freon®113                          | 42. styrene                     |
| 10. <i>trans</i> -1,2-dichloroethene  | 43. 1,4-dichlorobutane          |
| 11. methyl- <i>tert</i> -butyl-ether  | 44. 1,1,2,2-tetrachloroethane   |
| 12. 1,1-dichloroethane                | 45. <i>o</i> -xylene            |
| 13. <i>cis</i> -1,2-dichloroethene    | 46. 1,2,3-trichloropropane      |
| 14. bromochloromethane                | 47. isopropyl benzene           |
| 15. chloroform                        | 48. bromobenzene                |
| 16. 2,2-dichloropropane               | 49. <i>n</i> -propyl benzene    |
| 17. 1,2-dichloroethane                | 50. 2-chlorotoluene             |
| 18. 1,1,1-trichloroethane             | 51. 4-chlorotoluene             |
| 19. 1,1-dichloropropene               | 52. 1,3,5-trimethylbenzene      |
| 20. carbon tetrachloride              | 53. <i>tert</i> -butylbenzene   |
| 21. benzene                           | 54. 1,2,4-trimethylbenzene      |
| 22. fluorobenzene                     | 55. <i>sec</i> -butylbenzene    |
| 23. dibromomethane                    | 56. 1,3-dichlorobenzene         |
| 24. 1,2-dichloropropane               | 57. 1,4-dichlorobenzene         |
| 25. trichloroethene                   | 58. <i>p</i> -isopropyl toluene |
| 26. bromodichloromethane              | 59. 1,2-dichlorobenzene         |
| 27. 2-chloroethylvinylether           | 60. <i>n</i> -butylbenzene      |
| 28. <i>cis</i> -1,3-dichloropropene   | 61. 1,2-bromo-3-chloropropane   |
| 29. <i>trans</i> -1,3-dichloropropene | 62. 4-bromo-1-chlorobenzene     |
| 30. 1,1,2-trichloroethane             | 63. 1,2,4-trichlorobenzene      |
| 31. toluene                           | 64. naphthalene                 |
| 32. 1,3-dichloropropane               | 65. hexachlorobutadiene         |
| 33. dibromochloromethane              | 66. 1,2,3-trichlorobenzene      |



Acknowledgment: Finnigan 9001 GC, µGold Tandem PID, and Hall 2000 detector provided courtesy of ThermoQuest ICE Instruments, 2215 Grand Ave Parkway, Austin, TX

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		



# Rtx®-5SilMS

## The New Standard in Semivolatile GC/MS Columns

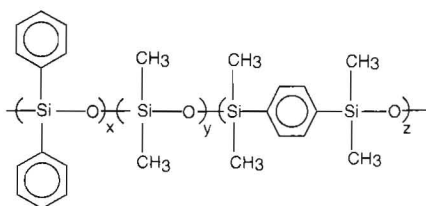
by Frank Dorman, Ph.D., Senior R&D Chemist

- ✓ Superior inertness provides more accurate quantitation at lower concentrations.
- ✓ Optimized dimensions improve resolution and provide more linear calibration curves.
- ✓ Lower bleed than phenyl/methyl phases.

Gas chromatography/mass spectrometry (GC/MS) analysis of semivolatile organic compound extracts from solid waste, soils, air, and water samples is extremely challenging. The target list contains acidic, basic, and neutral compounds ranging in volatility from fluorophenol to high-boiling polycyclic aromatic hydrocarbons (PAHs), all within a single analysis. In addition, the concentrations of both target and non-target contaminants can range from ng/μL to μg/μL levels. Because semivolatile methods monitor such a broad range of compound classes and detection limits, significant demands are placed on the inertness, efficiency, bleed, and ruggedness of the analytical column.

When choosing a GC/MS capillary column for semivolatile analyses, each column parameter must be optimized to provide the required resolution, fast analysis times, and low GC/MS bleed. The column also must have adequate sample capacity to accurately quantitate target analytes from ng to μg levels. Restek has designed the Rtx®-5Sil MS column to address these. The 30m, 0.28mmID, 0.50μm Rtx®-5Sil MS column features optimized column dimensions and stationary phase composition

**Figure 1**  
The Rtx®-5Sil MS phase structure provides ultra-low bleed.



(Figure 1), providing inherently low bleed and exceptional inertness for GC/MS semivolatile analysis.

The Rtx®-5Sil MS stationary phase formulation is based on a silarylene polymer that provides optimal separation of the semivolatile pollutants and exhibits lower GC/MS column bleed than traditional phenyl/methyl phases. By using a 0.28mm ID, the sample capacity of the column is increased to improve method detection and linearity (but column flow rate does not exceed the pumping capacity limits of a

bench-top mass spectrometer). The 0.50μm film thickness provides the necessary capacity for target analytes, while minimizing column bleed and analysis times (Figure 2).

If your lab is involved in GC/MS semivolatile analysis, Restek's new Rtx®-5Sil MS column can improve the consistency and reliability of your analytical data. Every column is tested to ensure excellent inertness towards semivolatile pollutants and provide low GC/MS bleed.



**formoreinfo**

Request the Rtx®-5SilMS Capillary Columns flyer  
(lit. cat.# 59204).

### Rtx®-5Sil MS Columns

ID	df (μm)	Temp. Limits	15-Meter	30-Meter
0.25mm	0.10	-60 to 330/350°C	12705	12708
	0.25	-60 to 330/350°C	12720	12723
	0.50	-60 to 330/350°C	12735	12738
	1.00	-60 to 325/350°C	12750	12753
0.28mm	0.25	-60 to 330/350°C	12790	12793
	0.50	-60 to 330/350°C	12791	12794
	1.00	-60 to 325/350°C	12792	12795
0.32mm	0.10	-60 to 330/350°C	12706	12709
	0.25	-60 to 330/350°C	12721	12724
	0.50	-60 to 330/350°C	12736	12739
	1.00	-60 to 325/350°C	12751	12754
0.53mm	0.50	-60 to 320/340°C	12737	12740
	1.00	-60 to 320/340°C	12752	12755
	1.50	-60 to 310/330°C	12767	12770

### Integra-Guard™ Columns

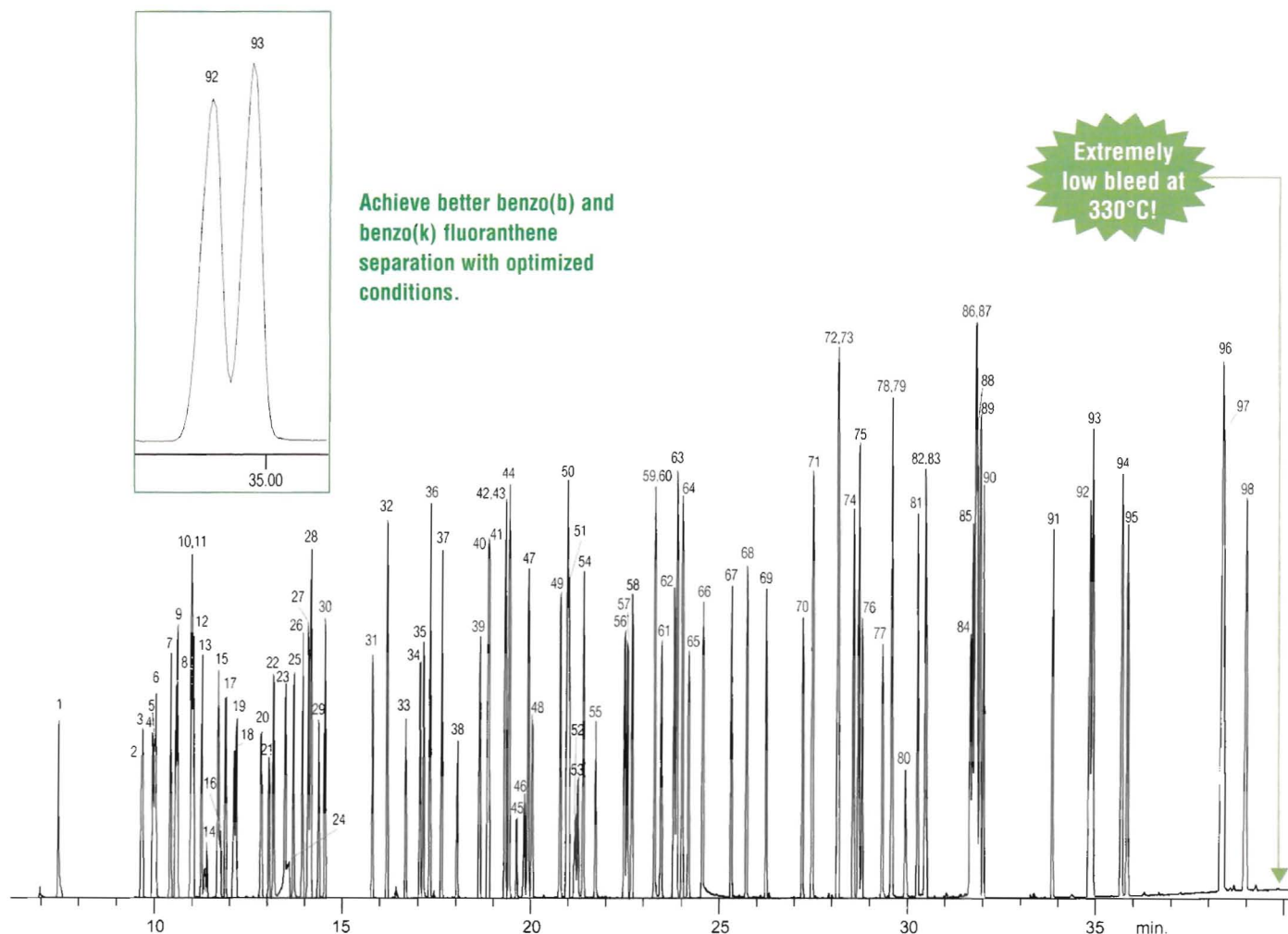
ID	Length	Suffix #	price
0.25mm	5m	-124	
	10m	-127	
0.28mm	5m	-243	
	10m	-244	
0.32mm	5m	-125	
	10m	-128	
0.53mm	5m	-126	
	10m	-129	

Ordering is simple. Just add the appropriate suffix number and price to the analytical column's catalog number and price.



Figure 2

Optimized Rtx®-5Sil MS column provides excellent resolution of EPA Method 8270 semivolatiles and improved resolution of benzo(b) and benzo(k) fluoranthene.



1. 2-fluorophenol
2. phenol-d6
3. phenol
4. bis(2-chloroethyl)ether
5. 2-chlorophenol-d4
6. 2-chlorophenol
7. 1,3-dichlorobenzene
8. 1,4-dichlorobenzene
9. 1,2-dichlorobenzene
10. 1,4-dichlorobenzene-d4 (ISTD)
11. 1,2-dichlorobenzene-d4
12. benzyl alcohol
13. 2-methylphenol (*o*-cresol)
14. 2,2'-oxybis-(1-chloropropane)
15. *N*-nitrosodi-*n*-propylamine
16. 4-methylphenol (*p*-cresol)
17. hexachloroethane
18. nitrobenzene-d5
19. nitrobenzene
20. isophorone
21. 2-nitrophenol
22. 2,4-dimethylphenol
23. bis(2-chloroethoxy)methane
24. 2,4-dichlorophenol
25. benzoic acid
26. 1,2,4-trichlorobenzene
27. naphthalene-d8 (ISTD)
28. naphthalene

29. 4-chloroaniline
30. hexachlorobutadiene
31. 4-chloro-3-methylphenol
32. 2-methylnaphthalene
33. hexachlorocyclopentadiene
34. 2,4,6-trichlorophenol
35. 2,4,5-trichlorophenol
36. 2-fluorobiphenyl
37. 2-chloronaphthalene
38. 2-nitroaniline
39. dimethyl phthalate
40. 2,6-dinitrotoluene
41. acenaphthylene
42. 3-nitroaniline
43. acenaphthene-d10 (ISTD)
44. 2,4-dinitrophenol
45. acenaphthene
46. 4-nitrophenol
47. 2,4-dinitrotoluene
48. dibenzofuran
49. diethyl phthalate
50. 4-nitroaniline
51. fluorene
52. 4-chlorophenyl phenyl ether
53. 4,6-dinitro-2-methylphenol
54. *N*-nitrosodiphenylamine
55. 2,4,6-tribromophenol
56. 4-bromophenyl phenyl ether

57.  $\alpha$ -HCH
58. hexachlorobenzene
59.  $\beta$ -HCH
60.  $\gamma$ -HCH (lindane)
61. pentachlorophenol
62. phenanthrene-d10 (ISTD)
63. phenanthrene
64. anthracene
65.  $\delta$ -HCH
66. carbazole
67. heptachlor
68. di-*n*-butyl phthalate
69. aldrin
70. heptachlor epoxide
71. fluoranthene
72. pyrene
73. endosulfan I
74. 4,4'-DDE
75. *p*-terphenyl-d14
76. dieldrin
77. endrin
78. endosulfan II
79. 4,4'-DDD
80. endrin aldehyde
81. butyl benzyl phthalate
82. 4,4'-DDT
83. endosulfan sulfate
84. endrin ketone

30m, 0.28mm ID, 0.5 $\mu$ m Rtx®-5Sil MS (cat.# 12794)  
4mm single gooseneck liner with fused silica wool  
(cat.# 22405)

Oven temp.: 35°C (hold 1 min.) to 330°C @  
10°C/min. (hold 15 min.)

Splitless hold time: 1min.

Inj. temp.: 250°C

Det. temp.: 310°C

Det.: HP 5971A MS, full scan

Carrier gas: helium @1.0 mL/min.

85. 3,3'-dichlorobenzidine
86. methoxychlor
87. benzo(a)anthracene
88. chrysene-d12 (ISTD)
89. chrysene
90. bis(2-ethylhexyl)phthalate
91. di-*n*-octyl phthalate
92. benzo(b)fluoranthene
93. benzo(k)fluoranthene
94. benzo(a)pyrene
95. perylene-d12 (ISTD)
96. dibenzo(ah)anthracene
97. ideno(1,2,3-cd)pyrene
98. benzo(ghi)perylene



# Allure™ PFP Propyl

## Improved LC/MS Analyses of Basic Compounds

by Vernon Bartlett, HPLC R&D Chemist

- ✓ Increased LC/MS signal.
- ✓ Better analyte retention.
- ✓ Improved peak shape.

High performance liquid chromatography (HPLC) methods must be optimized to provide the greatest selectivity and sensitivity, and the best peak shape. Unfortunately, many analysts consider switching the stationary phase—the heart of the HPLC system—only as a last resort. Too often, analysts coax the stationary phase to perform a non-native separation by using modifiers and ion pairing agents (the C18 phase is the one most often misused). Use of modifiers and ion pairing agents lead to reduced sensitivity and equilibration problems. Selection of the proper stationary phase for your separation can improve LC/mass spectrometry (MS) sensitivity, analyte retention, and peak shape without the use of modifiers or ion pairing agents. For example, Restek's Allure™ pentafluorophenyl propyl (PFP Propyl) HPLC column easily performs separation of many basic analytes.

Basic analytes are difficult to retain on C18 phases if the analytes have a  $pK_a$  greater than 8. They can be retained on C8 or C18 columns by using modifiers, but at the expense of sensitivity.<sup>1</sup> Sensitivity can be further reduced on LC/MS ESI interfaces when the buffer concentrations exceed 50mM. The Allure™ PFP Propyl column eliminates the need for

modifiers, and analytes such as cocaine (COC) and ecgonine methyl ester (EME) can be separated and retained using 90% acetonitrile in under 4.5 minutes (Figure 1). As the concentration of the organic solvent in the mobile phase increases, the desolvation process becomes more effective and the LC/MS ESI signal increases.<sup>2</sup> Because of this interaction, using the Allure PFP Propyl column with a high organic concentration increases the response of COC twelve times over that from a C18 column.<sup>3</sup>

Proper retention also is needed to separate basic analytes from naturally occurring substances in the blood, urine, or other bodily tissues. If the analytes elute too closely to the void volume, ionization suppression can occur.<sup>4</sup> To be cost effective, however, the analytes should be separated in less than 6 minutes. The high selectivity of the Allure™ PFP Propyl column more than adequately separates EME from COC.<sup>5</sup>

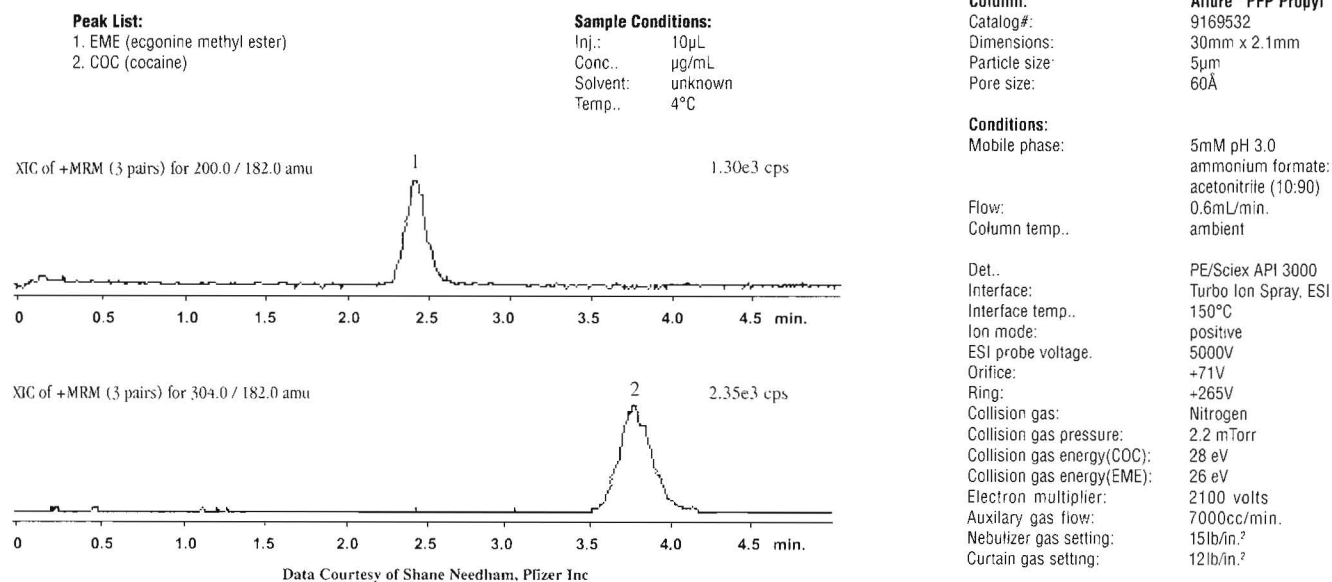
From the research conducted, the Allure™ PFP Propyl stationary phase not only provides the greatest retention for basic analytes such as beta blockers and tricyclic antidepressants, but also the best peak shape. "The results indicate that both the fluorine groups and the propyl chain are important on the phenyl ring to obtain the best peak shape and retention of the basic solutes when ammonium formate:acetonitrile (10:90) is used as the mobile phase."<sup>6</sup> As peak asymmetry approaches unity, sensitivity is increased.



Restek's Allure™ PFP Propyl column is the best choice for analysis of basic analytes. COC, ERP, quinine, morphine, beta blockers, and tricyclic antidepressants have been successfully analyzed in urine, blood, or other tissue samples. Analytes with a  $pK_a$  greater than 8 are retained without modifiers and with superior peak shape. The high level of organic solvent used in the mobile phase and the improved peak shape increase the analytical sensitivity.

1. J. Svensson, *J. Anal. Toxicol.* 10 (1986) 122-124.
  2. P. Sjoberg and K. Markides, *J. Chromatogr. A.* 855 (1999) 317-327.
  3. S. R. Needham, *op. cit.*
  4. B. Matuszewski, M. Constanzer, and C. Chavez-Eng, *Anal. Chem.* 70 (1998) 882-889.
  5. S. R. Needham, *op. cit.*
  6. S. R. Needham, P. R. Brown, and K. Duff, *Rapid Commun. Mass Spectrom.* 13, 2231-2236 (1999).
- References not available from Restek.

**Figure 1** The Allure™ PFP Propyl baseline separates Cocaine Ester (COC) and its hydroxyl precursor, Ecgonine Methyl Ester (EME), with excellent peak shape in less than five minutes.





## Allure™ PFP Propyl, 5µm Columns

Particle Size:	1.0mm ID	2.1mm ID	3.2mm ID	4.6mm ID
5µm	cat.#	cat.#	cat.#	cat.#
30mm length	9169531	9169532	9169533	9169535
50mm length	9169551	9169552	9169553	9169555
100mm length	9169511	9169512	9169513	9169515
150mm length	9169561	9169562	9169563	9169565
200mm length	9169521	9169522	9169523	9169525
250mm length	9169571	9169572	9169573	9169575

## Allure™ PFP Propyl, 5µm Columns with Trident™ Inlet

Particle Size:	2.1mm ID	3.2mm ID	4.6mm ID
5µm	cat.#	cat.#	cat.#
30mm length	9169532-700	9169533-700	9169535-700
50mm length	9169552-700	9169553-700	9169555-700
100mm length	9169512-700	9169513-700	9169515-700
150mm length	9169562-700	9169563-700	9169565-700
200mm length	9169522-700	9169523-700	9169525-700
250mm length	9169572-700	9169573-700	9169575-700

for more info

Request the Applications Note *Allure™ PFP Propyl HPLC Column Provides Improved LC/MS Analyses of Basic Compounds* (lit. cat.# 59118).



## Free HPLC wall chart and LC/MS Catalog

Request a free wall chart (lit. cat.# 59894) and catalog (lit. cat.# 59607, international lit. cat.# 59606).

# Reference Materials

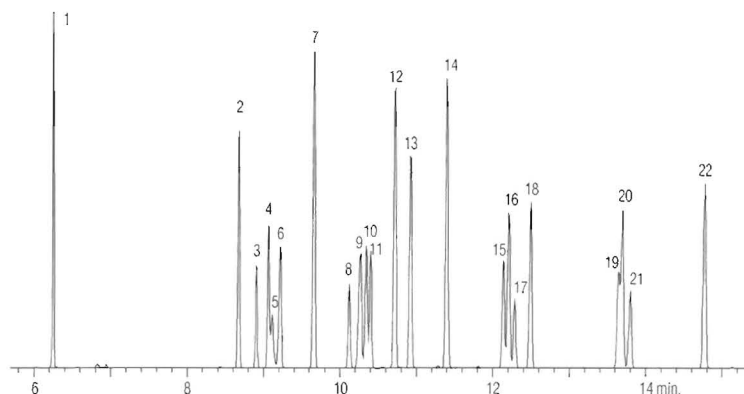
## Minnesota Dept. of Agriculture Adds Dimethenamid to Incident Investigations

by Eric Steindl, Analytical Reference Materials Product Line Manager

Effective January 2000, Minnesota Department of Agriculture has added a new compound to their List 1 pesticide (neutrals) incident investigation requirements.<sup>1</sup> This compound, dimethenamid (CAS # 87674-68-8), has been manufactured by several companies under various trade names. Active product registrations exist for American Cyanamid, BASF, and E.I. DuPont de Nemours. Inactive product registrations exist for Sandoz Agro Inc.

Restek has arranged to purchase dimethenamid from one of the primary manufacturers with the intent to provide calibration mixtures required in this analysis. As with all Restek quantitative environmental mixtures, a complete data pack is available to meet stringent audit requirements.

1. "Analytical Lists for Pesticide Incident Investigations", Minnesota Department of Agriculture, Guidance Document 26 (3/99). St. Paul, MN. For a copy of this and other Minnesota Department of Agriculture documents, visit their web site at: [www.mda.state.mn.us](http://www.mda.state.mn.us)



30m, 0.28mmID, 0.5µm Rtx®-5SiIMS (cat. # 12794)

Oven temp.: 35°C (hold .5 min.) to 160°C @ 50°C/min. to 190°C @ 10°C/min. to 300°C @ 5°C/min.

1µL splitless 0.5 min., 10ppm calibration standard in methylene chloride/acetone, 10ng on column concentration  
GC: HP 6890 GC: Inj. temp: 250°C; Inj: 1µL splitless 0.5 min., 10ppm calibration standard in methylene chloride/acetone, 10ng on column concentration: Det: HP 5973 MS, scan 35 - 550 amu

## Minnesota Ag List 1 Pesticides Mix A

200ppm each in Acetone  
1mL per ampul  
Mix contains compounds in peak list marked \*

Each	5-pk.	10-pk.
32406	32406-510	—
w/ data pack		
32406-500	32406-520	32506

## Minnesota Ag List 1 Pesticides Mix B

200ppm each in Acetone  
1mL per ampul  
Mix contains compounds in peak list marked †

Each	5-pk.	10-pk.
32407	32407-510	—
w/ data pack		
32407-500	32407-520	32507

- |                                |   |
|--------------------------------|---|
| 1. EPTC†<br>(eptam, eradicane) | 12. terbufos†                             |
| 2. propachlor*                 | 13. fonofos†                              |
| 3. ethalfuralin*               | 14. triallat†                             |
| 4. trifluralin*                | 15. dimethenamid*                         |
| 5. desisopropylatrazine*       | 16. acetochlor*                           |
| 6. desethylatrazine*           | 17. metribuzin*                           |
| 7. phorate†                    | 18. alachlor*                             |
| 8. prometon*                   | 19. metolachlor*                          |
| 9. simazine*                   | 20. chlorpyrifos†<br>(chlorpyrifos ethyl) |
| 10. atrazine*                  | 21. cyanazine*                            |
| 11. propazine*                 | 22. pendimethalin*                        |

## Minnesota Ag List 1 Pesticides Kit

Contains Minnesota Ag List Pesticides Mix A & B: 32408, (ea.) 32408-500, (ea. w/data pack)



# Reference Materials

## US EPA Method 8095 GC Explosives Analysis

by Christopher Cox, Senior R&D Chemist



The standard environmental test method for nitroaromatic, nitramine, and nitroester analyses is US Environmental Protection Agency (EPA) method 8330<sup>1</sup>. This method uses high performance liquid chromatography

(HPLC) separation and detection by ultra-violet absorption. Unfortunately, this method typically results in high solvent usage, multiple coelutions, and long run times. Analysts have been interested in developing a gas chromatography (GC) method that overcomes the disadvantages of HPLC method.

US EPA Method 8095<sup>2</sup> has been proposed as a GC/electron capture detection (ECD) alternative to the HPLC explosives analysis in Method 8330. This proposed GC/ECD method was developed at the US Army Cold Regions Research and Engineering Laboratory<sup>3</sup>. It includes all of the Method 8330 target compounds plus 3,5-dinitroaniline, nitroglycerine, and pentaerythritol tetranitrate (PETN).

The calibration mixtures listed at right contain the additional compounds at the concentration ratios appropriate for ECD. Restek also will be introducing a set of capillary columns—the Rtx®-TNT and Rtx®-TNT2 columns—designed specifically for this method using two new proprietary stationary phases. These 6-meter columns will provide better resolution than the columns recommended in Method 8095. They will use identical temperature programs, allowing simultaneous, dual-column confirmation analysis. Look for future mailings with the details of these columns.

1. U. S. Environmental Protection Agency. *Test Methods for Evaluating Solid Waste. Physical/Chemical Methods. SW-846 Update III*. Office of Solid Waste, Washington, DC, 1997.

2. U. S. Environmental Protection Agency. *Test Methods for Evaluating Solid Waste. Physical/Chemical Methods. SW-846. Proposed Draft Update IVB*. Office of Solid Waste, Washington, DC, 1999.

3. M. E. Walsh, T. Ranney, "Determination of Nitroaromatic, Nitramine, and Nitrate Ester Explosives in Water Using Solid-Phase Extraction and Gas Chromatography-Electron Capture Detection: Comparison with High-Performance Liquid Chromatography," *Journal of Chromatographic Science*, vol. 36, p. 406-416, August 1998.

References not available from Restek.

### 8095 Calibration Mix A

	ppm
2-amino-4,6-dinitrotoluene	1000
4-amino-2,6-dinitrotoluene	1000
1,3-dinitrobenzene	1000
2,4-dinitrotoluene	1000
2,6-dinitrotoluene	1000
HMX	1000
RDX	1000
Tetryl	1000
1,3,5-trinitrobenzene	1000
2,4,6-trinitrotoluene	1000
1000µg/mL ea. in acetonitrile, 1mL/ampul	

Each	5-pk.	10-pk.
31607	31607-510	-----
w/ data pack		
31607-500	31607-520	31707

### 8095 Calibration Mix B

	ppm
3,5-dinitroaniline	1000
nitrobenzene	5000
nitroglycerine	5000
2-nitrotoluene	5000
3-nitrotoluene	5000
4-nitrotoluene	5000
PETN	5000
Prepared in acetonitrile, 1mL/ampul	

Each	5-pk.	10-pk.
31608	31608-510	-----
w/ data pack		
31608-500	31608-520	31708

### Matrix Spike Solutions

#### 8095 Matrix Spike Mix A

	ppm
2-amino-4,6-dinitrotoluene	200
4-amino-2,6-dinitrotoluene	200
1,3-dinitrobenzene	200
2,4-dinitrotoluene	200
2,6-dinitrotoluene	200
HMX	2000
RDX	200
Tetryl	200
1,3,5-trinitrobenzene	200
2,4,6-trinitrotoluene	200
Prepared in acetonitrile, 1mL/ampul	

Each	5-pk.	10-pk.
31609	31609-510	-----
w/ data pack		
31609-500	31609-520	31709

### 8095 Matrix Spike Mix B

	ppm
3,5-dinitroaniline	200
nitrobenzene	1000
nitroglycerine	1000
2-nitrotoluene	1000
3-nitrotoluene	1000
4-nitrotoluene	1000
PETN	1000
Prepared in acetonitrile, 1mL/ampul	

Each	5-pk.	10-pk.
31610	31610-510	-----
w/ data pack		
31610-500	31610-520	31710

### 8095 Surrogates

2,5-dinitrotoluene  
1000µg/mL in methanol, 1mL/ampul

Each	5-pk.	10-pk.
31611	31611-510	-----
w/ data pack		
31611-500	31611-520	31711

3,4-dinitrotoluene  
1000µg/mL in methanol, 1mL/ampul

Each	5-pk.	10-pk.
31452	31452-510	-----
w/ data pack		
31452-500	31452-520	31552

2-methyl-4-nitroaniline  
1000µg/mL in methanol, 1mL/ampul

Each	5-pk.	10-pk.
31612	31612-510	-----
w/ data pack		
31612-500	31612-520	31712

Restek's Analytical Reference Materials team:  
(left to right) Joe Moodler, Rick Parmely,  
Mary Ellen Wood, John Lidgett, Chris Cox, Diane  
Shaffer, Eric Steindl, Andrea Gill, Jason Martin,  
Scott Strohm, (sitting at table) Denise Witherite  
and Joe Tallon.





# Rtx®-CLPesticides

## Analysis of Aroclor® Mixtures Using Specialized Columns

by Lydia Nolan, Environmental Applications Chemist

Polychlorinated biphenyls (PCBs) are a group of industrial organochlorine chemicals that have become a major environmental concern. Since the 1950's, over one-million metric tons of PCBs have been produced. They were used commercially because they are chemically inert liquids and are difficult to burn; they have low vapor pressures, are inexpensive to make, and are excellent electrical insulators. As a result, they were used extensively as coolant fluids in transformers and capacitors; and later as plasticizers, de-inking solvents, heat transfer fluids in machinery, and water-proofing agents, among other uses.

Because of their persistence and their solubility in fatty tissue, PCBs in food chains undergo biomagnification. Strong heating of PCBs in the presence of oxygen can lead to the formation of polychloro dibenzofurans (PCDF), which are structurally and toxicologically similar to dioxins. Toxicity also depends on where the chlorine substitution resides on the biphenyl molecule; the congeners without chlorine substitution on the ortho positions are the most toxic. These coplanar PCBs are "dioxin-like," and the most toxic is one-tenth the toxicity of 2,3,7,8-tetrachloro dibenzo dioxin, the most toxic compound known. The coplanar PCBs also have been listed as endocrine disrupters.<sup>1</sup>

It is important, therefore, when designing a PCB analysis method to determine if the separation will be by specific congener (for toxicity) or by Aroclor® mixture (commercial mixture). The commercial synthesis of PCBs result in chlorination of the biphenyl molecule, and this reaction produces a mixture of many of the 209 congeners of the PCB family.

Due to the unreactive nature of the PCBs, instrument conditions and column choice is less critical than when analyzing chlorinated pesticides. The important points are to choose an inlet technique that can handle reasonable levels of contamination and injection volume. When choosing columns, it is important to select stationary phases that have low bleed and high thermal stability; allowing the columns to be baked out at the end of the run to prevent carryover. Because many instruments used for the analysis of PCBs also may be used for pesticide and herbicide analyses, the column pair of choice is the Rtx®-CLPesticides and Rtx®-CLPesticides2 columns. This column pair provides excellent separation of pesticide and herbicide compounds, low bleed, high thermal stability, and are designed to compliment each other for primary column analysis and secondary column confirmation.

Figure 1 shows a dual-column analysis of Aroclor® 1242 on the Rtx®-CLPesticides and Rtx®-CLPesticides2 columns. This configuration is used to minimize injection port maintenance issues, and uses a Siltek™ guard column and 'Y' Press-Tight® connector to connect the two analytical columns to the single injection port. To see chromatograms of all nine of the most common Aroclor® mixtures,

peak identifications, and the elution order for all 209 congeners on these columns, request Applications Note #59120.

1. Environmental Chemistry, Colin Baird, W.H. Freeman and Co., 1998, pp. 337-353.

References not available from Restek.

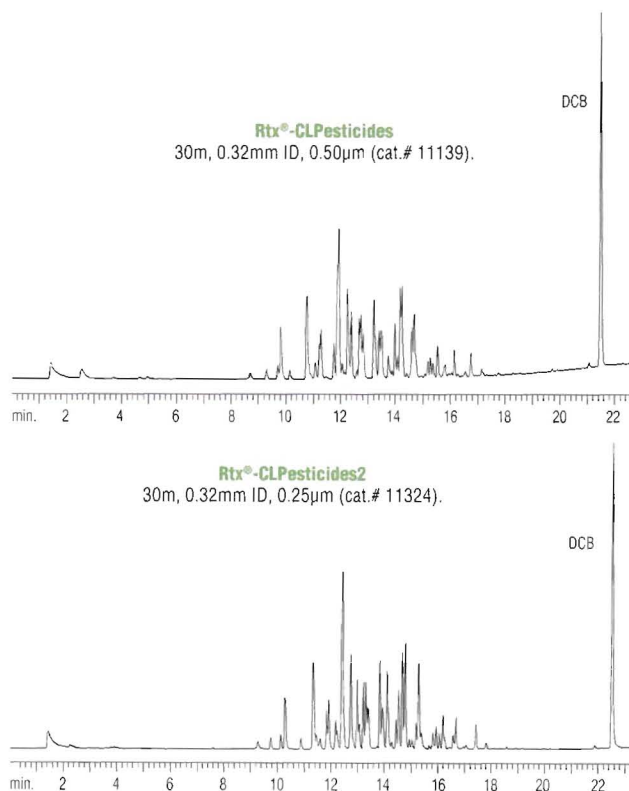
for more info

Request the Applications Note *Analysis of PCB Congeners Using Rtx®-CLPesticides Columns* (lit. cat.# 59120).

**Figure 1** Rtx®-CLPesticides columns provide excellent separation of Aroclor® 1242.

#### Dual-Column Analysis Conditions:

Inj.: 0.5µL direct injection  
Aroclor® 1242 mixture,  
0.16ng concentration  
Oven temp.: 120°C (hold 1 min.)  
to 300°C @ 9°C/min.  
(hold 10 min.)  
Inj. temp.: 210°C; Det.: ECD with  
anode purge, 310°C  
Carrier gas: helium



#### Rtx®-CLPesticides Kits

ID (mm)	cat.#
0.25	11199
0.32	11198
0.53	11197

#### Each kit includes:

- 1-Rtx®-CLPesticides column
- 1-Rtx®-CLPesticides2 column
- 1-Siltek™ Angled "Y" Press-Tight® connector
- 1-Siltek™ guard column



# Peak Performers

## Focal Inlet Liners

- ✓ Wool is placed at the injection point to maximize vaporization and help wipe the needle during injection.
- ✓ Designed for easy changing of the wool.
- ✓ No more guessing where the wool should be placed.
- ✓ Wool stays in position during pressure pulses in the inlet and during injection.
- ✓ 100% polymeric deactivation.





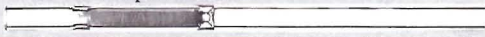



## Low Pressure Drop Liner

for HP 6890  
Split/Splitless Injection Port

- ✓ OD slightly smaller than standard splitless liners for increased flow during injection.
- ✓ Dual taper design for reproducible positioning of wool.
- ✓ Wool positioned to allow wiping of the syringe on injection.
- ✓ Glass bead at end of liner to allow easier installation.



cat # 21032, (ea.)  
cat# 21033, (5-pk.)

Instrument	each	5-pk.
HP 4mm Split Focal Liner 	21022	21023
Varian 1078/1079 Split Focal Liner 	21024	21025
Shimadzu 17A Split Focal Liner 	21020	21021
Varian 1075/1077 Split Focal Liner 	21030	21031
Fisons 5mm Split Focal Liner 	21028	21029
PE Auto SYS Split Focal Liner 	21026	21027

# ON-THE-ROAD

## Environmental GC Seminar

Restek is "On-the-Road" again! A new tour is being added to our popular comprehensive GC tour—"Chromatography Training for the Environmental Industry." This seminar is scheduled to begin in the spring of 2000 and is cost-effective.

### Who Should Attend?

The environmental seminar will teach basic and advanced concepts on environmental analyses. Whether you are a novice, an expert, or a manager, this seminar will prove useful. The content is technical in nature and provides solutions for a variety of problems related to environmental analyses. Those who attend should be familiar with the basics of gas chromatography (GC). This one-day course covers semi-volatile and volatile organics, pesticides and PCB's, and air analysis. Materials, refreshments, and lunch are provided.

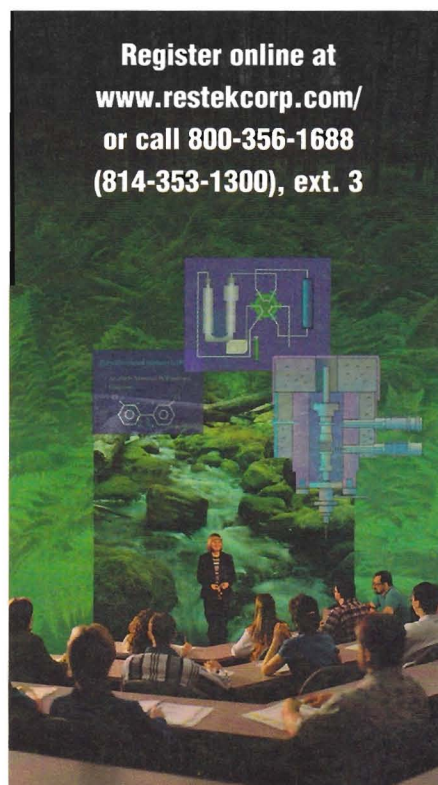
**for more info**

Request the *Environmental GC Seminar* brochure for an agenda and a registration form.  
(lit. cat.# 59210).

Location	Date	Cat.#
San Jose, CA	March 30	65400
Seattle, WA	March 31	65401
Tampa, FL	April 3	65402
Jacksonville, FL	April 4	65403
Atlanta, GA	April 5	65404
Durham, NC	April 10	65405
Baltimore, MD	April 12	65406
Philadelphia, PA	April 13	65407
Somerset, NJ	April 14	65408

### Can't attend? Here are some recommended reference materials:

- ✓ *Guide to Environmental Analytical Methods, 4th Edition*, cat.# 20465
- ✓ *Solid Phase Extraction, Principles and Practice* (E.M. Thurman & M.S. Mills) cat.# 20494
- ✓ *GC/MS: A Practical User's Guide* (M. McMaster & C. McMaster), cat.# 20496
- ✓ *A Technical Guide for Static Headspace Using GC*, cat.#59895
- ✓ *Helpful Hints for Analyzing Volatile Organics*, cat.# 59887

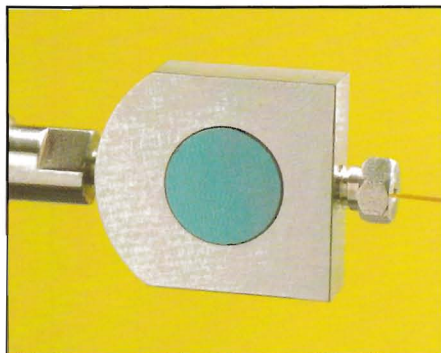


Register online at  
[www.restekcorp.com/](http://www.restekcorp.com/)  
or call 800-356-1688  
(814-353-1300), ext. 3



# EZ-Vent™ 2000

## Saving You Time and Money When Changing GC/MS Columns



We designed a common sense, affordable solution to the hassle of changing columns in your mass spectrometer (MS). By using the Restek EZ-Vent™ 2000 interface, you can avoid the typical, lengthy vent and pump-down cycles every time you want to change a column.

The EZ-Vent™ 2000 MS interface will revolutionize the way you connect columns to your MS. When the outlet of a capillary column is inserted into an MS vacuum, the negative pressure propagates several meters inside the column thus decreasing efficiency. Using the EZ-Vent™ 2000 interface minimizes this effect, thereby increasing the effective length of the column. The EZ-Vent™ 2000 interface does not require any additional plumbing and works on a critical orifice principle, thereby eliminating the need to plumb your MS interfaces with purge gases. Plus, it's easy to install! Just connect the EZ-Vent™ 2000 transfer line and connectors and you are ready to begin using your MS without worry of pumping it down during the next column change.

Restek's EZ-Vent™ 2000 interface is available for Hewlett-Packard 5971, 5972, and 5973 MS and Varian Saturn MS systems.

### Feature

- ✓ Save time
- ✓ Cost effective
- ✓ Save money
- ✓ Very low dead volume fittings and small ID tubing.
- ✓ All metal components are Silcosteel®-coated and transfer lines are deactivated for maximum inertness.

### Benefit

- Decreased column changing time.
- Costs associated with cool-downs and pump-downs are now investments in analytical runs.
- Many times less expensive than other models with equal performance.
- Ensure no band broadening or change in analytical performance.
- Less adsorption or loss of reactive compounds = more accurate analyses.

### EZ-Vent™ 2000 for HP GCs:

Includes EZ-Vent™ 2000, 1/16" SS nut, two 0.4mm ferrules, 100µm deactivated transfer line, and EZ-Vent™ column plug; cat.# 21013, (kit)

### EZ-Vent™ 2000 for Varian GCs:

Includes, EZ-Vent™ 2000, 1/16" SS nut, two 0.4mm ferrules, 100µm deactivated transfer line, and EZ-Vent™ column plug; cat.# 21014, (kit)

### Replacement EZ-Vent™ 2000 ferrules:

0.4mm ID: cat.# 21015, (2-pk.)

0.5mm ID: cat.# 21016, (2-pk.)

### Replacement EZ-Vent™ 2000 union:

cat.# 21017, (ea.)

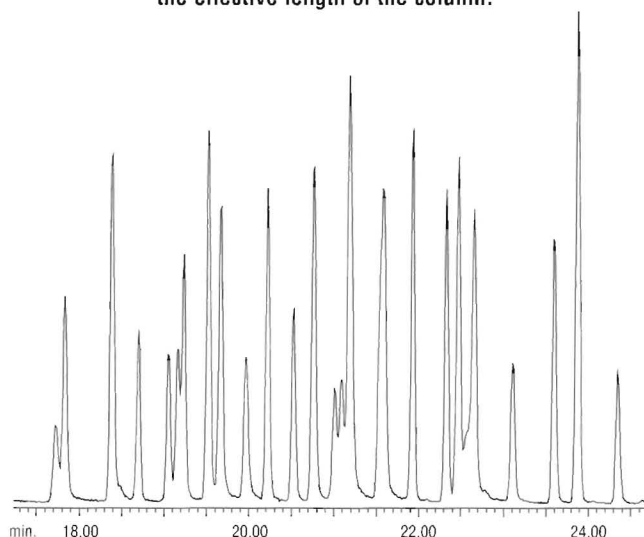
### Replacement EZ-Vent™ 2000 deactivated transfer line :

100µm: cat.# 21018, (3 ft.)

### Open-end wrench tool (1/4" - & 5/16"-inch):

cat.# 20110, (2-pk.)

**Figure 1** The EZ-Vent™ interface causes no peak broadening and increases the effective length of the column.



30m, 0.25mm ID, 0.5µm Rtx®-5MS (cat.# 12638)  
4mm single gooseneck liner with fused silica wool (cat.# 22405)  
Inj.: 50ng/µL semivolatle standard

Oven temp.: 35°C (hold 1 min.) to 300°C @ 10°C/min. (hold 20 min.); Splitless hold time: 1min.; Inj. temp.: 300°C;  
Det. temp.: 310°C; Det.: HP 5971A MS, full scan; Carrier gas: helium @ 15psi

**for more info**

Request the EZ-Vent™ 2000 Fast Fact  
(lit. cat.# 59307).

Try the handy  
**chromatogram  
search wizard**

[www.restekcorp.com/  
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