# the RESTEK Pittcon® Edition Advantage

*Innovators of High Resolution Chromatography Products*

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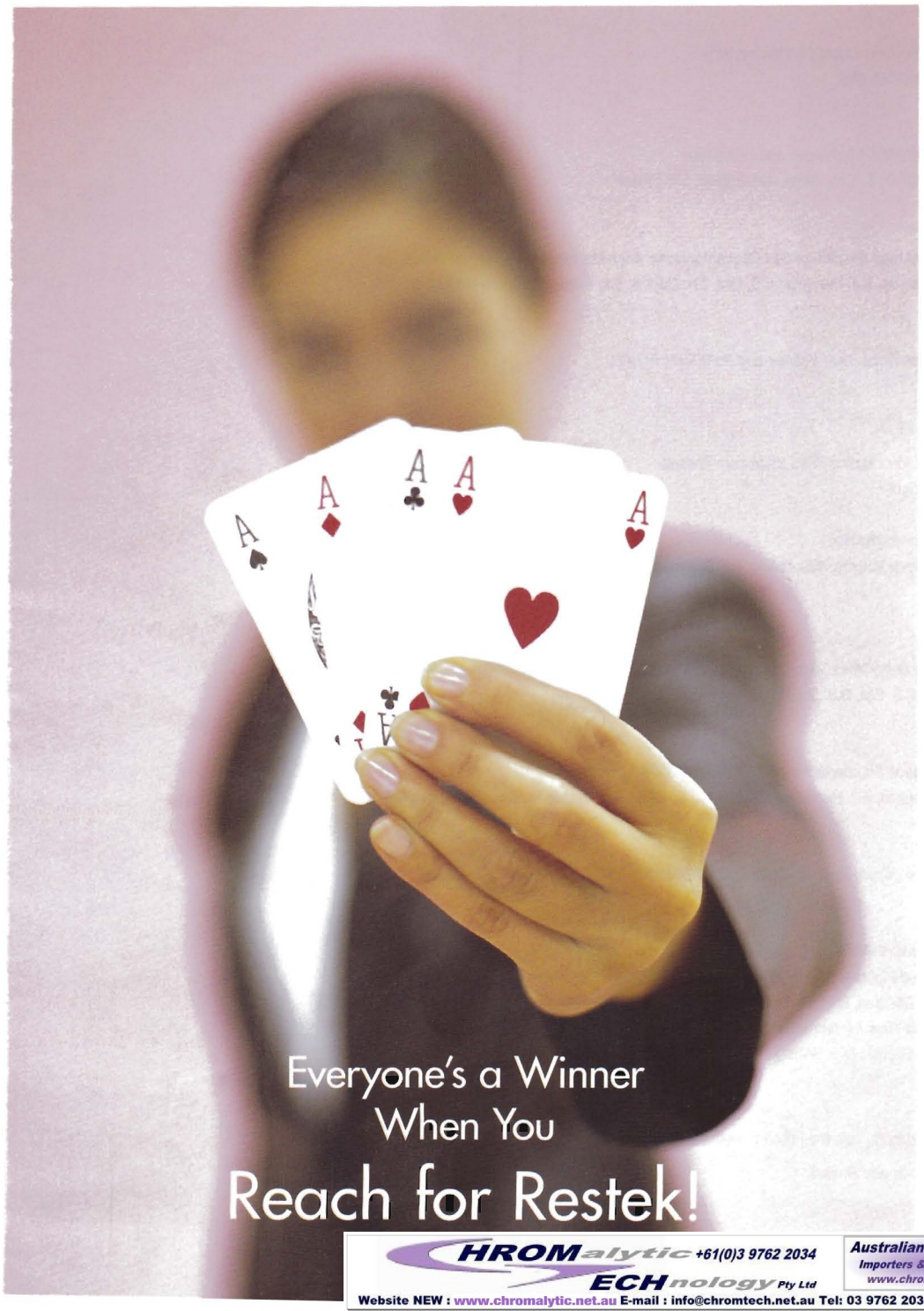


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# Posters and Oral Presentations

Sunday, March 7

Poster Session 1700 (Sunday)

### New Developments in Analytical Instrumentation and Software

1700-700 P *Analysis of Permanent Gases (including $CO_2$), Fluorocarbons, C1-C2 Hydrocarbons and $SO_2$ on a Single Micropacked Column*
B.L. Burger

Monday, March 8

Poster Session 4500 (Monday morning)

### Solutions in Gas Chromatography

4500-1200 P *Analyses of Chlorophenoxy Acid Herbicides by High Resolution Gas Chromatography*
K.M. May*, G.B. Stidsen, L. Nolan, R.E. Wittrig, K.J. Herwehe, C.S. Cox, J.H. Lidgett, S.E. Eyster, D.F. Rhoads

4500-2000 P *A New Secure, Reliable Connector for Use with Gas Chromatography Columns*
B.R. Rightnour*, M. Goss

4500-2300 P *Resolution of Complex Volatile Organic Mixtures, Using Stop-Flow Modulation with Two Gas Chromatography Columns in Series*
R.E. Wittrig*, M. Goss, C.M. English

Oral Session 7000 (Monday afternoon, Room S505b)

### Multidimensional Gas Chromatography

7000-200 P *Using Computer Modeling to Predict and Optimize Separations for Comprehensive 2-Dimensional Gas Chromatography*
1:50 pm F.L. Dorman*, P.D. Schettler, L.A. Vogt, J.W. Cochran

Tuesday, March 9

Poster Session 9800 (Tuesday morning)

### Analysis of Agricultural Materials

9800-600 P *Analyzing Phenoxyacid Herbicides Using Liquid Chromatography*
R.E. Wittrig*, S. Gardner, L. Nolan, K.M. May

Poster Session 9900 (Tuesday morning)

### Environmental: Soils and Solids

9900-200 P *UST and DRO Analysis Across America: Challenges and Limitations*
M.W. Badger*, C.S. Cox, C.M. English, K.J. Herwehe, J.H. Lidgett, S.E. Eyster

Poster Session 10000 (Tuesday morning)

### GC-MS

10000-100 P *Calibration Standard Stability and High Resolution Gas Chromatography Analyses for US EPA Method 525.2*
K.M. May*, C.M. English, G.B. Stidsen, K.J. Herwehe, C.S. Cox, J.H. Lidgett, S.E. Eyster, R. Morehead, D.F. Rhoads

Poster Session 10300 (Tuesday morning)

### LC Techniques

10300-200 P *A Practical Investigation of Extracolumn Dead Volume and Its Effects in HPLC*
R.L. Romesberg*, C.V. Bartlett

Poster Session 13300 (Tuesday afternoon)

### Materials Characterization

13300-500 P *Temperature and pH Stability of Silica Based HPLC Stationary Phases*
C.V. Bartlett*, T.S. Reid, B.A. Albright

Wednesday, March 10

Poster Session 18700 (Wednesday afternoon)

### Environmental: Improvements in Instrumentation

18700-200 P *Minimize Injector Active Sites, Dead Volume, Adsorption, and Discrimination, Using a Drilled GC Inlet Liner*
B.R. Rightnour*, M. Goss

Poster Session 18800 (Wednesday afternoon)

### Environmental: VOC Analysis

18800-200 P *Purge-and-Trap/Gas Chromatography/Mass Spectroscopy Applications Using a New Polymer Formulation*
C.M. English*, D.V. Patwardhan, C.S. Cox, G.B. Stidsen

Thursday, March 11

Oral Session 20700 (Thursday morning, Room S502a)

### GC-MS: Environmental

20700-300 P *Simplified Preparation of Calibration Standards for US EPA Method 8270D and Appendix IX*
9:10 am K.M. May*, G.B. Stidsen, C.M. English, K.J. Herwehe, J.H. Lidgett, C.S. Cox, S.E. Eyster, F.L. Dorman, R. Morehead

Poster Session 21800 (Thursday morning)

### Environmental: Air Analysis

21800-400 P *Stability Study of Low-Level (1ppb-20ppb) Reactive Sulfurs in Canisters*
D.M. Shelow

Poster Session 21900 (Thursday morning)

### Environmental: Analysis of SemiVolatiles, PAHs, PCBs, Pesticides, Dioxins

21900-200 P *GC-MS Analysis of Polychlorinated Biphenyl Congeners Using a New Capillary GC Column*
F.L. Dorman*, G.B. Stidsen, J.W. Cochran, C.M. English, L. Nolan

21900-300 P *Improved Sensitivity and Analysis Time for Semivolatile Organic Compound Analysis by USEPA Method 8270C*
F.L. Dorman*, G.B. Stidsen, C.M. English, M.S. Wittrig

# Short Course

For information about content and registration for Pittcon® short courses, visit the Pittcon® website: www.pittcon.org

471 *Chromatographic Analysis of Foods and Flavors*
8:30-5:00 pm R.E. Wittrig
**Thursday, March 11**

the RESTEK Advantage
Innovators of High Resolution Chromatography Products

# Ultra-Low-Bleed Rtx®-XLB Columns

## Maximize Performance from High-Sensitivity GC/MS Systems

By Christopher English, Environmental Innovations Chemist,
and Neil Mosesman, GC Columns Product Marketing Manager

new

- ✔ Low bleed for GC/MS applications requiring high sensitivity.
- ✔ Ideal for analysis of semivolatile environmental pollutants - pesticides - PCBs.
- ✔ Thermally stable to 340°C.

Recent improvements to the design of GC/MS systems have produced significant improvements in instrument sensitivity. Because of these improvements, what was formerly considered acceptable column bleed now often is a problem that prevents an analyst from taking full advantage of the sensitivity of the system.

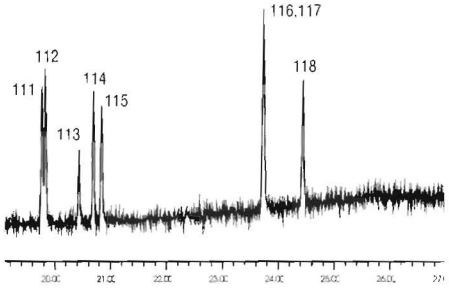
To address the need for lower column bleed, Restek has developed Rtx®-XLB columns. Improvements in polymer synthesis and tubing deactivation have enabled us to develop an inert, stable column that minimizes bleed interference with high temperature analyses: our bleed specification for these new 30m x 0.25mm, 0.25µm columns is less than 6pA at 340°C.

The new Rtx®-XLB stationary phase, in combination with your sensitive GC/MS system, is especially well suited for analyses of high molecular weight active compounds. Figure 1 shows the column bleed from an Rtx®-XLB column at 330°C, the high-temperature end in an analysis of US EPA Method 525 semivolatile analytes (2.5ng each analyte), as observed with an Agilent 6890/5973 GC/MS. Clearly, there is no column bleed interference in this chromatogram.

Semivolatile pollutants such as the EPA Method 525 analytes are commonly analyzed by GC/MS. The great sensitivity of newer GC/MS systems, including ion traps, allows analysts to use split injection techniques while still meeting the detection limit requirements of the methods they are following. Split injections make for much lower on-column concentrations, which in turn, call for a column not only with low bleed, but also with excellent inertness. Analysts using Rtx®-XLB columns can achieve exceptional sensitivity and low bleed with on-column concentrations of 5ng (Figure 2), or less. Figure 2 also shows that, in addition to low bleed and inertness, Rtx®-XLB columns offer good resolution of challenging isomer pairs such as benzo(b)fluoranthene and benzo(k)fluoranthene (peaks 111 and 112).

Relative to columns produced through older synthesis technologies, low-bleed Rtx®-XLB columns help ensure lower detection limits and greater instrument stability in semivolatiles analysis. If baseline problems are keeping you from taking full advantage of your high sensitivity system, or if you are having resolution problems with semivolatile environmental analytes, an Rtx®-XLB column is the best choice for solving your problem.

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




Rtx®-XLB 30m, 0.25mm ID, 0.25µm (cat.# 12823)
**Sample:** US EPA Method 525 standards, 1µL, 2.55ng per analyte
See Figure 2.

## HOT Tech Tip!

Simple adjustments to the injection conditions help to improve sensitivity for Method 525.2 target compounds. A Drilled Uniliner® inlet liner and pulsed injection help to minimize breakdown in the injection port. (Do not exceed 50psi when using the pulsed splitless mode, to avoid breaking the seal between the column and the liner.) An initial temperature of 35°C helps ensure excellent peak shapes for early eluting compounds.

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## in this issue



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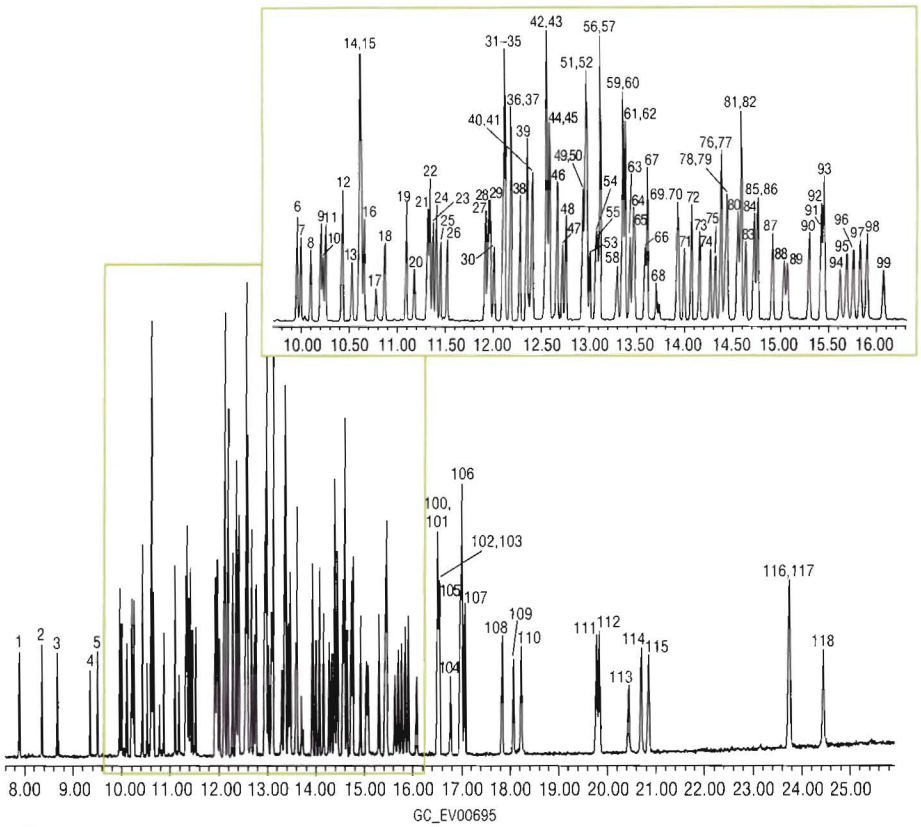
2004 vol. 1

**Figure 2** An Rtx®-XLB column offers low bleed, inertness, and good resolution of semivolatile environmental pollutants.




Rtx®-XLB 30m, 0.25mm ID, 0.25µm (cat.# 12823)

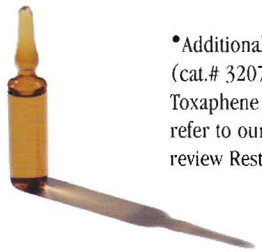
| | |
|---|---|
| Sample: | US EPA Method 525 standards, 1µL 5ng per analyte<br>standards used: 31824, 32420, 32421, 32422, 32423, 31825, 31826, 31828, 32291, 32415, 32436.• |
| Inj.. | pressure pulsed (0.4 min. @ 30psi), splitless (hold 0.4 min.), 4mm Drilled Uniliner® (cat.# 21055) |
| Inj. Temp.: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

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

## Rtx®-XLB Columns (fused silica) (proprietary low-polarity phase)

| ID | df (µm) | temp. limits* | 15-Meter | | 30-Meter | | 60-Meter | |
|---|---|---|---|---|---|---|---|---|
| 0.25mm | 0.10 | 30 to 340/360°C | | | 12808 | $455 | | |
| | 0.25 | 30 to 340/360°C | 12820 | $265 | 12823 | $445 | 12826 | $710 |
| | 0.50 | 30 to 340/360°C | | | 12838 | $445 | | |
| | 1.00 | 30 to 340/360°C | 12850 | $265 | 12853 | $445 | | |
| 0.32mm | 0.10 | 30 to 340/360°C | | | 12809 | $475 | | |
| | 0.25 | 30 to 340/360°C | 12821 | $285 | 12824 | $470 | 12827 | $770 |
| | 0.50 | 30 to 340/360°C | | | 12839 | $470 | | |
| | 1.00 | 30 to 340/360°C | | | 12854 | $470 | | |
| ID | df (µm) | temp. limits | 12-Meter | | 20-Meter | | 25-Meter | |
| 0.18mm | 0.18 | 30 to 340/360°C | | | 42802 | $360 | | |
| 0.20mm | 0.33 | 30 to 340/360°C | 42815 | $260 | | | 42820 | $400 |

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



•Additional mixes for Method 525 include individual Aroclor® PCB solutions (cat.# 32075, 32077, 32079, 32081, 32083, 32085, 32087) and TCLP Toxaphene (cat.# 32015). For information about Method 525.2 reference mixes, refer to our *2004 Chromatography Supplies Catalog* (available on request) or review Restek *Advantage* 2003 v.3 on our website.

## Method 525.2 Semivolatile Mix

| | |
|---|---|
| acenaphthylene | dimethylphthalate |
| anthracene | di-*n*-butylphthalate |
| benzo(a)anthracene | 2,4-dinitrotoluene |
| benzo(a)pyrene | 2,6-dinitrotoluene |
| benzo(b)fluoranthene | fluorene |
| benzo(ghi)perylene | hexachlorobenzene |
| benzo(k)fluoranthene | hexachlorocyclopentadiene |
| benzylbutylphthalate | indeno(1,2,3-cd)pyrene |
| bis(2-ethylhexyl)adipate | isophorone |
| bis(2-ethylhexyl)phthalate | pentachlorophenol* |
| chrysene | phenanthrene |
| dibenzo(a,h)anthracene | pyrene |
| diethylphthalate | |

1,000µg/mL each in acetone, (*pentachlorophenol at 4,000µg/mL, per method requirement), 1mL/ampul

| Each | 5-pk. | 10-pk. |
|---|---|---|
| 31824 $75 | 31824-510 $337.50 | — |
| | w/data pack | |
| 31824-500 $85 | 31824-520 $375 | 31924 $675 |

# HPLC Analysis of Phenylurea Pesticides

## Use New Restek Reference Mixes and Restek HPLC Columns for Reliable Results

Katia May, Ph.D., R&D Chemist, and Rebecca Wittrig, Ph.D., HPLC Product Marketing Manager

- ✔ All materials needed for analysis of phenylurea pesticides.
- ✔ Mix formulation keeps poorly soluble analytes in solution.
- ✔ HPLC analysis using an Ultra C18 column; confirmation using an Ultra Cyano column.

Phenylurea pesticides are used to control a wide range of broadleaf weeds, grasses, and mosses, for both selective and total weed control. While drinking water usually is free of pesticides and herbicides after treatment, when violations are reported they are mainly due to phenylurea, triazine, or phenoxy-acid pesticides. Phenylurea pesticides in ground and drinking water are potential endocrine disrupters.

The US Environmental Protection Agency developed Method 532 for determining phenylurea compounds in drinking water. Solid-phase extraction (SPE) cartridges containing a bonded C18 organic phase are used to extract the pesticides from the sample, the analytes are eluted from the cartridges with methanol, and the concentrated extracts are analyzed by HPLC with ultraviolet detection. Phenylurea pesticides are not suitable for gas chromatography because they are thermally unstable.

Restek chemists have formulated a calibration solution and surrogate standard for determining target phenylurea pesticides in the latest version of EPA Method 532. The calibration mix contains 200µg/mL of each pesticide in acetonitrile, the organic mobile phase in the HPLC assay. Because diflubenzuron has limited solubility in acetonitrile, and thidiazuron is especially difficult to dissolve, we include a small amount of acetone in the formulation to enhance solubility of these two compounds. The early-eluting acetone does not interfere with any of the analytes. Our surrogate standard contains monuron and carbazole at 500µg/mL each in 50:50 methanol/acetonitrile (monuron is soluble in methanol, carbazole is soluble in acetonitrile).

Method 532 requires two HPLC columns: a C18 column plus a confirmation column with a dissimilar stationary phase. Figure 1 shows an analysis of the phenylurea pesticides and surrogates on Restek's Ultra C18 column. The high carbon load of this column ensures excellent retention and selectivity. The phenylurea mix and the surrogates also are separated well, with one peak reversal (Figure 2) on an Ultra Cyano cyanopropyl stationary phase—our recommendation for the confirmation column. If your laboratory performs analyses for phenylurea pesticides, Restek is now the source for all of the reference materials and HPLC columns you need.

**Figure 1** Phenylurea pesticides are resolved to baseline in less than 20 minutes by an Ultra C18 column.

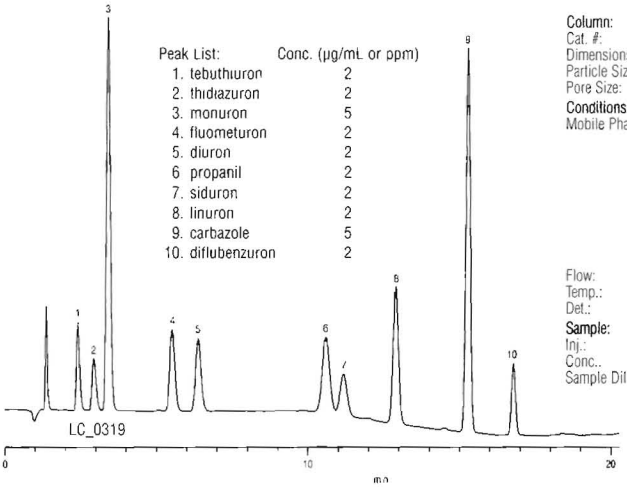
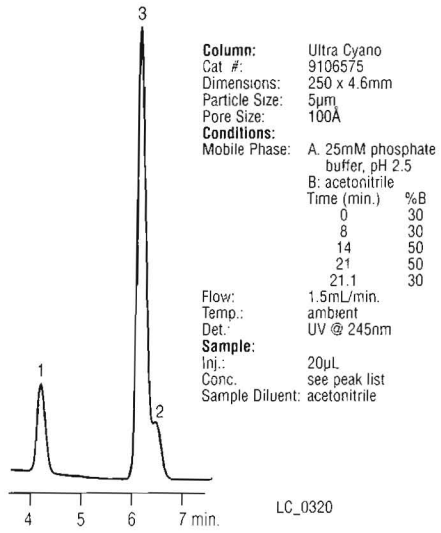



**Figure 2** Peaks 2 and 3 reversed, relative to Ultra C18 on an Ultra Cyano confirmation column.





***Environmental HPLC: Applications, Columns, Reference Materials***
(lit. cat.# 59741)
Restek HPLC columns support environmental HPLC applications with rapid analysis times and effective resolution of target analytes. Sample turn-around can be 50% faster, or more, than with alternative columns. Applications in this 8-page publication include polyaromatic hydrocarbons, carbamates, phenoxyacid herbicides, explosives, and carbonyls. Analytical reference materials and solid phase extraction sample clean-up products also are listed.

### Ultra C18 HPLC Column

fully end-capped; pore size: 100Å; pH range: 2.5 to 7.5; temperature limit: 80°C; carbon load: 20%

5µm, 150 x 4.6mm, cat. # 9174565, (ea) $356

### Ultra Cyano HPLC Column

fully end-capped; pore size: 100Å; pH range: 2.5 to 7.5; temperature limit: 80°; carbon load: 8%

5µm, 250 x 4.6mm, cat. # 9106575, (ea) $407

### Phenylurea Pesticide Mixture

| | |
|---|---|
| diflubenzuron | propanil |
| diuron | siduron |
| fluometuron | tebuthiuron |
| linuron | thidiazuron |

200µg/mL each in acetonitrile:acetone, 1mL/ampul

| Each | 5-pk. | 10-pk. |
|---|---|---|
| 32434 $50 | 32434-510 $225 | — |
| | w/data pack | |
| 32434-500 $60 | 32434-520 $250 | 32534 $450 |

### Phenylurea Surrogate Mixture

carbazole monuron

500µg/mL each in methanol:acetonitrile, 1mL/ampul

| Each | 5-pk. | 10-pk. |
|---|---|---|
| 32433 $35 | 32433-510 $157.50 | — |
| | w/data pack | |
| 32433-500 $45 | 32433-520 $175 | 32533 $315 |

**For more info**

Restek offers a full line of HPLC columns, guard cartridges, bulk packings, and HPLC accessories. Refer to our *2004 Chromatography Supplies Catalog* (lit. cat.# 59854) or visit our website.

# Introducing Stop-Flow GC, for High-Speed/High-Resolution GC Analysis

Frank Dorman, Ph.D., Director of Technical Development, and Rebecca Wittrig, Ph.D., HPLC Product Marketing Manager

Restek Innovation!

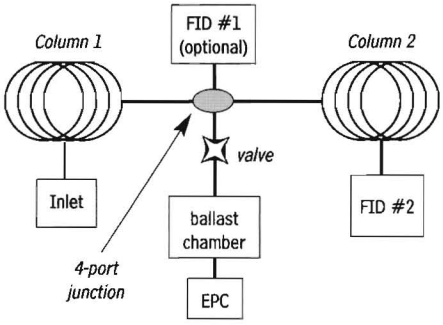
Developed in cooperation with investigators at the University of Michigan.

- ✔ Reduce analysis time by up to 70% while gaining resolution in difficult separations.
- ✔ Easy 30-minute installation.
- ✔ Complete system available from Restek.

*Introduction*

Analysis time is very important in GC applications but, often, shortening analysis time can sacrifice resolution. A powerful technique for separating difficult mixtures, developed by Dr. Richard Sachs and his colleagues at the University of Michigan, can greatly accelerate an analysis while maintaining—or improving—peak resolution. Stop-flow gas chromatography is performed by carefully timing interruptions to carrier gas flow at the junction of two series-coupled capillary columns that have differing selectivity for the target compounds in the analysis.[1-3] A low dead-volume valve (Figure 1), connected to a source of carrier gas at or above the GC inlet pressure, is used to program the flow through the column ensemble:[3] by opening the valve, carrier gas flow is stopped or slightly reversed in the first column, but continues at the same rate, or at an accelerated rate, in the second column.

**Figure 1** Schematic of a stop-flow GC system.




When using two GC columns in series (typically a non-polar stationary phase and a polar phase), there are four chromatographic possibilities for two closely-eluting analytes:

1) The compounds are resolved by the first column, and remain resolved at the outlet of the second column.
2) The compounds coelute on the first column, but are resolved on the second column.

In either case, the separation can be allowed to proceed without interference.

3) The compounds coelute on both the first column and on the second column.

In this case, other stationary phase combinations should be investigated to find a pair that separates the compounds.

4) The compounds are resolved by the first column, but coelute at the outlet of the second column.

In this case, the compounds can be kept separated if the valve is opened briefly (gas flow in the first column is stopped) when the leading compound in the pair has passed the junction, but while the trailing compound is still on the first column. The duration of the flow pulse is adjusted to ensure that the two compounds remain separated at the outlet of the second column.

**Table 1** Commonly analyzed chlorinated pesticides used to illustrate stop-flow separations.

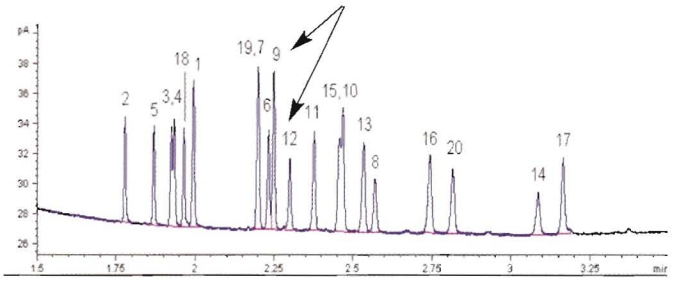
| | |
|---|---|
| 1. aldrin | 11. dieldrin |
| 2. α-BHC | 12. endosulfan I |
| 3. β-BHC | 13. endosulfan II |
| 4. δ-BHC | 14. endosulfan sulfate |
| 5. γ-BHC (lindane) | 15. endrin |
| 6. α-chlordane | 16. endrin aldehyde |
| 7. γ-chlordane | 17. endrin ketone |
| 8. 4,4'-DDD | 18. heptachlor |
| 9. 4,4'-DDE | 19. heptachlor epoxide |
| 10. 4,4'-DDT | 20. methoxychlor |

*Example Application:*
*Analysis of Chlorinated Pesticides*

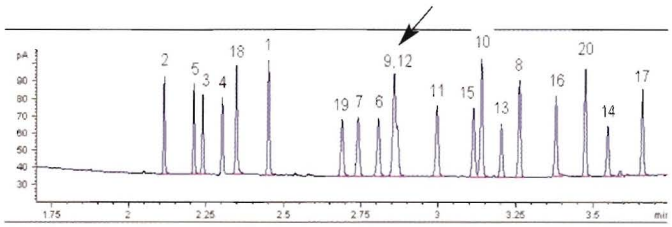
By using series-coupled capillary columns, stop-flow pulses, and fast oven temperature programming, analysis times of less than four minutes are possible for the 20 commonly analyzed chlorinated pesticides listed in Table 1 (cat.# 32291).

In this example, the column ensemble consisted of two 10m x 0.18mm ID columns. Column 1 incorporated a 0.20µm trifluoropropylmethyl polysiloxane bonded (polar) stationary phase, Rtx®-200. Column 2 had a 0.18µm 5% phenyl / 95% dimethyl polysiloxane bonded (non-polar) stationary phase, Rtx®-5. The columns were joined at a four-port junction, as shown in Figure 1. A flame ionization detector (FID) also was connected to the column junction, using deactivated fused silica tubing. Approximately 10% of the effluent was diverted to this detector, to monitor the analytes as they eluted from the first column. Flow interruption was provided by an external source of carrier gas, through a low-dead-volume valve connected to the crosspiece, as depicted in Figure 1. The valve was opened to slightly reverse carrier gas flow in the first column

**Figure 2** Analysis of 20 chlorinated pesticides, using a polar column / nonpolar column ensemble.
(a) FID chromatogram from column 1.
(b) FID chromatogram at the outlet of the column ensemble, no stop-flow pulse applied.
***Conditions*—Sample:** 20-component chlorinated pesticide mix (cat.#32291, components listed in Table 1), diluted 1:20 in hexane to 10µg/mL each component; **GC Inlet Pressure:** 45.0 psig; **Inlet Temp.:** 300°C; **Oven Temp.:** 60°C (0.4 min. hold) to 220°C at 100°C/min., to 235°C at 15°C/min., to 300°C at 120°C/min. (0.5 min. hold) (total time 4 min.); **Injection:** splitless, 0.2-0.5µL, 0.25 min. splitless hold, 75mL/min. splitless purge flow, 2mm ID splitless injection liner (cat.#20712); **Detection:** dual FIDs, 300°C, 40mL/min. hydrogen flow, 400mL/min. air flow, 40mL/min. helium (make-up) flow, data collection rate set at 100Hz for both detectors.




a) Peaks 9 and 12 separated by the first column.



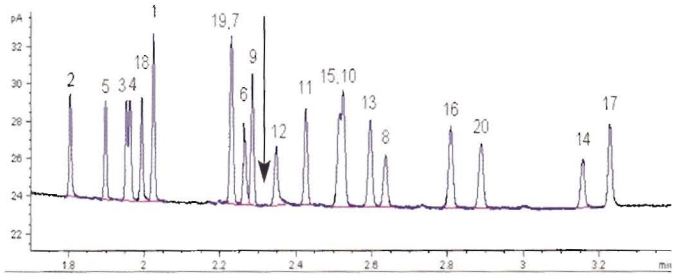

b) Peaks 9 and 12 coelute at the outlet of the second column.

(pressure at the junction point was set at 59 psig, 14 psig above the inlet pressure, causing a slight reverse flow on the first column while the valve was open). Ballast chamber pressure is controlled by an electronic pressure controller. The majority of the effluent was sent to the second FID to record the separation profile from the column ensemble.

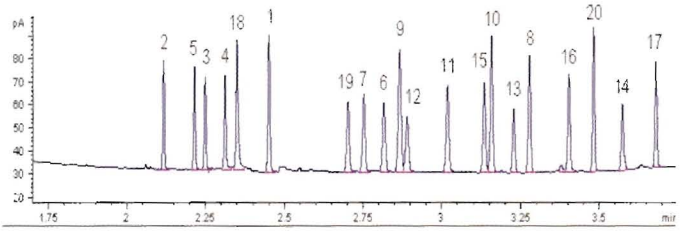
We analyzed the pesticides mix in the splitless mode, using the parameters described. Note that the inlet pressure and the temperature ramp are much higher/steeper than typical for this analysis. In order for the stop-flow technique to enhance the separation of a critical pair, the component bands must be completely separated by the first column in the ensemble. One peak pair in the sample, 4,4'-DDE and endosulfan I, was resolved at the column junction (Figure 2a), but was not adequately resolved by the column ensemble (Figure 2b); we used a stop-flow pulse to improve this separation. Typically, the valve is opened for up to 10 seconds for each targeted component pair. In this study, we used a 5-second pulse.

Figure 3a shows the signal from the FID monitoring the effluent from the first column, with an arrow indicating the time of the stop-flow pulse. When a 5-second pulse was applied beginning 136 seconds after injection, the 4,4'-DDE band had passed onto the second column, but the endosulfan I band had not reached the junction. Consequently, endosulfan I was retained on the first column during the pulse, while 4,4'-DDE continued to move along the second column. Figure 3b, the chromatogram at the end of the column ensemble (produced by the second FID), shows 4,4'-DDE and endosulfan I were resolved. Figure 3c is an enlarged view of the 4,4'-DDE and endosulfan I peaks with and without the stop-flow pulse. With the stop-flow pulse, the 20 chlorinated pesticides were resolved in less than 4 minutes.

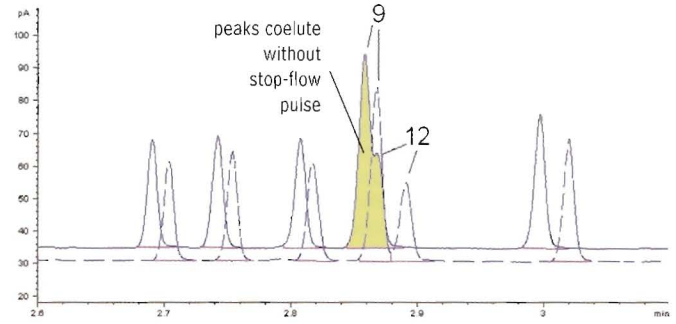
**Figure 3** Stop-flow GC enhances separation of 4,4'-DDE and endosulfan I, while reducing analysis time by 70%.
(a) FID chromatogram from Column 1; arrow indicates initiation of stop-flow pulse.
(b) FID chromatogram at the outlet of the column ensemble, one stop-flow pulse applied as shown in 3a.
(c) Separation of 4,4'-DDE and endosulfan I, with and without the stop-flow pulse.
Conditions: See Figure 2.




a) Chromatogram from first column, used to determine timing of stop-flow pulse.




b) Stop-flow pulse maintains separation of peaks 9 and 12.




c) Peaks 9 and 12 with and without stop-flow pulse.

with stop-flow

without stop-flow

This relatively simple use of the stop-flow system shows the tremendous potential of the technique—in this example, we reduced analysis time by approximately 70% (13 min. to 4 min.). Additional information is available in reference 6. Stop-flow GC, in combination with well-chosen column stationary phases, can dramatically improve many separations.

To find out how stop-flow GC can speed your analysis and improve problematic separations, contact us at support@restekcorp.com. We'll be happy to discuss column combinations and other particulars with you.

*References*


1. Smith, H., Sacks, R. *Anal. Chem.* 70: 4960 (1998).
2. Grall, A.; Zellers, E.T.; Sacks, R. *Env. Sci. Technol.* 65: 163 (2001).
3. Leonard, C.; Sacks, R. *Anal. Chem.* 71: 5501 (1999).
4. Veriotti, T.; McGuigan, M.; Sacks, R. *Anal. Chem.* 73: 279 (2001).
5. Veriotti, T.; Sacks, R. *Anal. Chem.* 73: 813 (2001).
6. Wittrig, R.E.; Dorman, F.L.; English, C.M.; Sachs, R.D. *J. Chromatogr. A* 1027: 75-82 (2004).


## Stop-Flow GC Kit for Agilent 6890 GCs

| Description | qty. | cat.# | price |
|---|---|---|---|
| Stop-Flow System for use with Cool On-Column EPC (includes: Stop-Flow enclosure, top mounting plate, 1-line weldment, and interface cable) | kit | 21168 | $3800 |
| Stop-Flow System for use with Split/Splitless EPC (includes: Stop-Flow enclosure, top mounting plate, 2-line weldment, and interface cable) | kit | 21169 | $3800 |


Stop-Flow system easily attaches to your Agilent 6890 GC.

# Fast, Efficient HPLC Analysis for Polynuclear Aromatic Hydrocarbons

## Using Pinnacle II™ PAH Columns and New Restek Reference Materials

by Katia May, Ph.D., R&D Chemist, and Rebecca Wittrig, Ph.D., HPLC Product Marketing Manager

- ✔ Pinnacle II™ PAH columns quickly and effectively resolve PAHs.
- ✔ All reference materials needed for US EPA Method 8310, 550.1, or 610.
- ✔ New calibration and quality control check mixes include 1- and 2-methylnaphthalene.

Polynuclear aromatic hydrocarbons (PAHs) are multiple ring structures found in fossil fuel products or as products of coal or oil combustion. Known mutagens and carcinogens, these compounds are monitored worldwide in drinking water, wastewater, soil, and hazardous waste. Methods for identifying and quantifying PAHs include GC with flame ionization detection and HPLC with ultraviolet or fluorescence detection. GC is the more sensitive technique, but interferences from other carbonaceous materials are a concern. HPLC combines suitable sensitivity with higher specificity.

The US Environmental Protection Agency (EPA) developed Method 8310, a reversed phase HPLC approach, for determining concentrations of target PAHs in groundwater and wastes. The method provides conditions for detecting PAHs at parts-per-billion levels. Water samples are extracted at neutral pH, using methylene chloride. Alternatively, aqueous samples may be extracted by a liquid-solid extraction technique, using cartridges or disks coated with a chemically bonded C18 organic phase. Solid waste samples are extracted using Soxhlet extraction (EPA Method 3540) or sonication extraction (EPA Method 3550). The extract is concentrated to 1mL and the solvent is exchanged to acetonitrile. For the analysis, EPA Method 8310 recommends a reversed phase HPLC column, making it consistent with EPA methods 550.1 and 610.

For some time, Restek has offered reference mixes of 16 target PAHs in several alternative combinations of solvent and analyte concentration. We now have a calibration mix and a quality control check mix of 18 PAHs that can be used with EPA Method 8310—or with EPA Method 550.1 or EPA Method 610. In addition to the 16 PAHs listed in these methods, we include 1-methylnaphthalene and 2-methylnaphthalene in the two new mixes: many of our customers must resolve these two additional compounds, and they are included in Florida PAH methodology. We prepare these mixes in acetonitrile, an appropriate solvent for HPLC analysis for PAHs. Solubility of some of the target PAHs is limited in acetonitrile, so we prepare the stock calibration solution at 500µg/mL, the highest concentration possible using acetonitrile as the diluent. We also offer decafluorobiphenyl as a surrogate, as recommended in EPA Method 8310. (*Continued on pg. 8.*)

**Figure 1** Baseline resolution of 18 PAHs in less than 18 minutes, using a Pinnacle II™ PAH column.

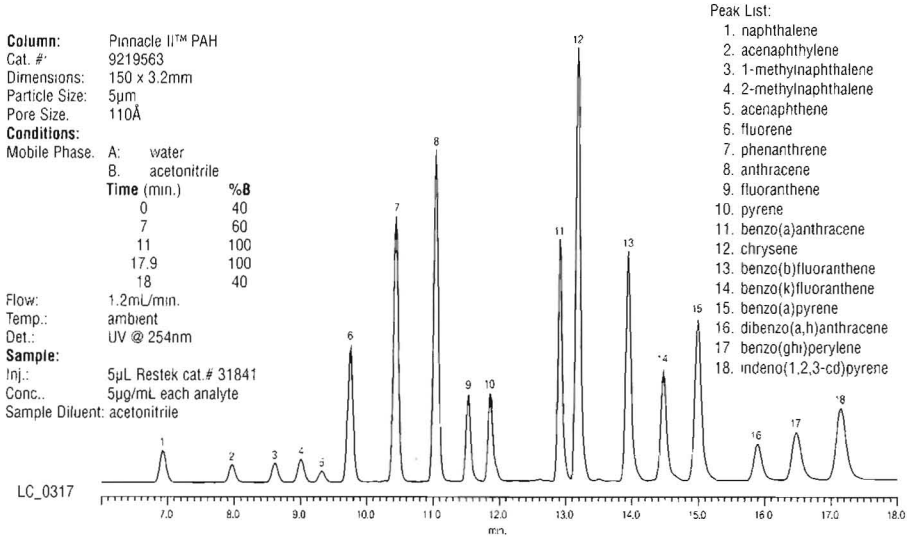
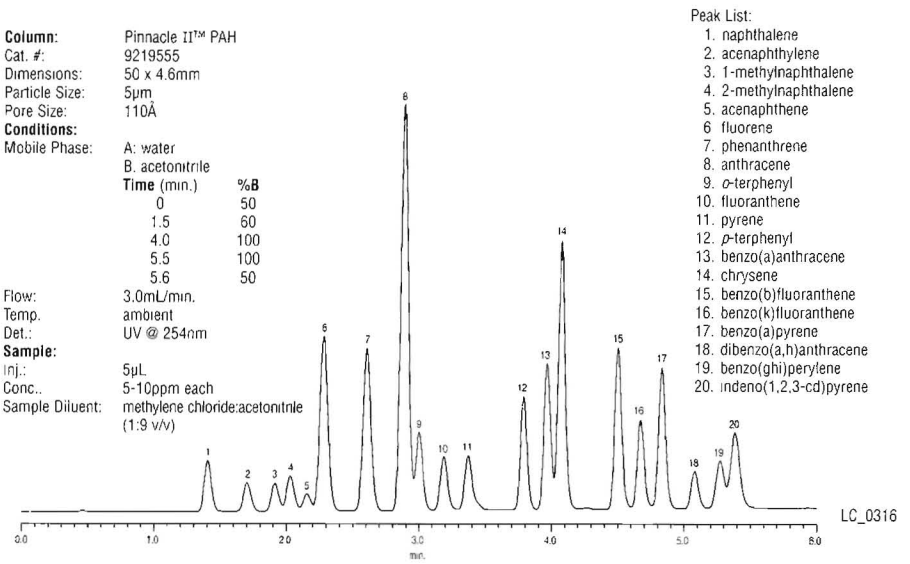



**Figure 2** Effective separation of 20 PAHs in 6 minutes on a 5µm Pinnacle II™ PAH column.




### EPA Method 8310 Quality Control Check Mix

| | | | |
|---|---|---|---|
| acenaphthene | 100µg/mL | dibenzo(a,h)anthracene | 10 |
| acenaphthylene | 100 | fluoranthene | 10 |
| anthracene | 100 | fluorene | 100 |
| benzo(a)anthracene | 10 | indeno(1,2,3-cd)pyrene | 10 |
| benzo(a)pyrene | 10 | 1-methylnaphthalene | 100 |
| benzo(b)fluoranthene | 10 | 2-methylnaphthalene | 100 |
| benzo(ghi)perylene | 10 | naphthalene | 100 |
| benzo(k)fluoranthene | 5 | phenanthrene | 100 |
| chrysene | 10 | pyrene | 10 |

In acetonitrile, 1mL/ampul

| Each | 5-pk. | 10-pk. |
|---|---|---|
| 31843 $42 | 31843-510 $189 | — |
| | w/data pack | |
| 31843-500 $52 | 31843-520 $199 | 31943 $357 |

### EPA Method 8310 PAH Mixture

| | |
|---|---|
| acenaphthene | dibenzo(a,h)anthracene |
| acenaphthylene | fluoranthene |
| anthracene | fluorene |
| benzo(a)anthracene | indeno(1,2,3-cd)pyrene |
| benzo(a)pyrene | 1-methylnaphthalene |
| benzo(b)fluoranthene | 2-methylnaphthalene |
| benzo(ghi)perylene | naphthalene |
| benzo(k)fluoranthene | phenanthrene |
| chrysene | pyrene |

500µg/mL each in acetonitrile, 1mL/ampul

| Each | 5-pk. | 10-pk. |
|---|---|---|
| 31841 $57 | 31841-510 $256.50 | — |
| | w/data pack | |
| 31841-500 $67 | 31841-520 $266.50 | 31941 $484.50 |

**HPLC columns and additional reference mixes listed on page 8.**

# Simplify GC/MS Calibration for Volatile Organic Compounds

## Rtx®-VMS Column Reduces Analysis Time, Provides Key Separations

by Christopher English, Environmental Innovations Chemist, and Katia May, Ph.D., R&D Chemist

- ✔ Fast turnaround: **analysis completed in 11 minutes** on an Rtx®-VMS column.
- ✔ 84 Method 524.2 target compounds in only 3 mixes—new MegaMix™ includes 73 compounds.
- ✔ Gases and ketones in separate mixes.

According to methodology established by most regulatory agencies, volatile organic compounds and surrogates with low solubility in water (purgeable organics) are extracted from the sample matrix by a purge and trap procedure, then are analyzed by GC/MS. The US Environmental Protection Agency developed Method 524.2 for analysis of purgeable organic compounds in drinking water. The EPA method is applicable to a wide range of organic compounds, including four trihalomethane disinfection by-products that have suitable volatility/water solubility characteristics (bromodichloromethane, bromoform, chlorodibromomethane, chloroform).

Our new calibration mix for volatiles, Drinking Water VOA MegaMix™ 524.2 Rev 4.2, consists of 73 target compounds in EPA Method 524.2. The only compounds listed in Method 524.2 not included in the MegaMix™ are the six compounds that are gases under standard pressure and temperature conditions, and five ketones that present long-term stability problems. We have offered a calibration mix of the six gases for some time (cat.# 30042), and now introduce a mix of the five ketones, in a purge & trap methanol/water (90:10) solution. Our research showed that this solvent system protects the keto groups and prevents acetal formation, a potential problem with ketones in 100% methanol. These optimizations assure accurate analytical results. We also offer the additional oxygenates specified by the State of California. Our fortification solution (cat.# 30201) completes the selection of reference materials needed for the method.

Productivity is very important to environmental laboratories, and in volatiles analysis purge and trap cycle time and oven cycle time are the limiting parameters. A 30m x 0.25mm ID x 1.4µm Rtx®-VMS column (cat.# 19915) is an excellent choice for analyzing the 84 volatile organic compounds listed in EPA Method 524.2 (Figure 1). The narrow bore column rapidly separates the target compounds and surrogates and improves resolution of traditionally coeluting compounds, such as carbon tetrachloride / 1,1,1-trichloroethane (peaks 23 and 25). Rtx®-VMS columns were designed specifically to be compatible with higher starting temperatures: an initial temperature of 40°C shortens analysis time, compared to the 35°C initial temperature dictated by most columns, and the six early eluting gases still are resolved to the baseline (Figure 1).

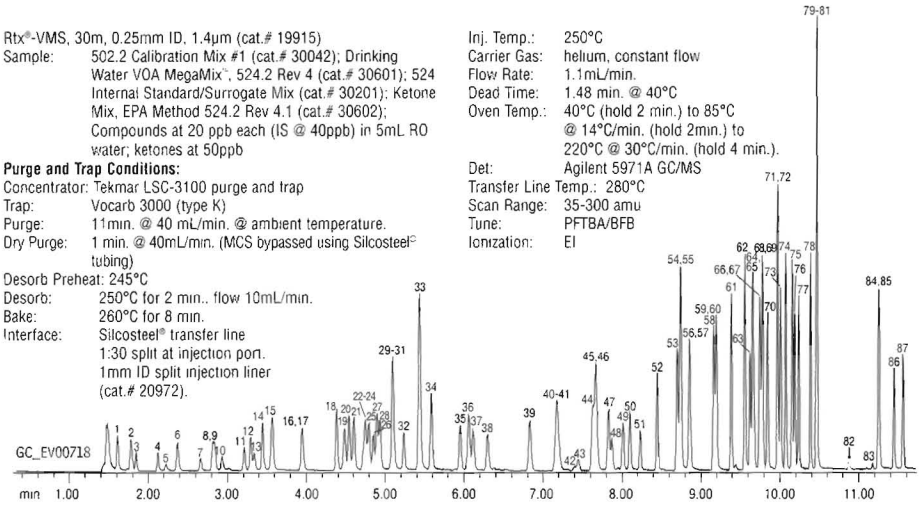
Additional resolution between these pairs is possible with a slower initial ramp rate. Analysis time is less than 12 minutes, and cycle time is 16 minutes, a total well below the cycle time for a standard purge and trap system. This allows the fastest analyses currently available using a Tekmar 3100 purge and trap unit coupled with a single GC. *(Continued on pg. 8.)*

**Figure 1** 11-minute separation of the volatile organic target compounds in US EPA Method 524.2, with improved resolution, using an Rtx®-VMS column.

Rtx®-VMS, 30m, 0.25mm ID, 1.4µm (cat.# 19915)
Sample: 502.2 Calibration Mix #1 (cat.# 30042); Drinking Water VOA MegaMix™, 524.2 Rev 4 (cat.# 30601); 524 Internal Standard/Surrogate Mix (cat.# 30201); Ketone Mix, EPA Method 524.2 Rev 4.1 (cat.# 30602); Compounds at 20 ppb each (IS @ 40ppb) in 5mL RO water; ketones at 50ppb

**Purge and Trap Conditions:**
Concentrator: Tekmar LSC-3100 purge and trap
Trap: Vocarb 3000 (type K)
Purge: 11min. @ 40 mL/min. @ ambient temperature.
Dry Purge: 1 min. @ 40mL/min. (MCS bypassed using Silcosteel® tubing)
Desorb Preheat: 245°C
Desorb: 250°C for 2 min., flow 10mL/min.
Bake: 260°C for 8 min.
Interface: Silcosteel® transfer line 1:30 split at injection port. 1mm ID split injection liner (cat.# 20972).

Inj. Temp.: 250°C
Carrier Gas: helium, constant flow
Flow Rate: 1.1mL/min.
Dead Time: 1.48 min. @ 40°C
Oven Temp.: 40°C (hold 2 min.) to 85°C @ 14°C/min. (hold 2min.) to 220°C @ 30°C/min. (hold 4 min.).
Det: Agilent 5971A GC/MS
Transfer Line Temp.: 280°C
Scan Range: 35-300 amu
Tune: PFTBA/BFB
Ionization: EI




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

### Drinking Water VOA MegaMix™, 524.2 Rev. 4.1

acrylonitrile
allyl chloride
benzene
bromobenzene
bromochloromethane
bromodichloromethane
bromoform
*n*-butylbenzene
*sec*-butylbenzene
*tert*-butylbenzene
carbon disulfide
carbon tetrachloride
chloroacetonitrile
chlorobenzene
1-chlorobutane
chlorodibromomethane (dibromochloromethane)
chloroform
2-chlorotoluene
4-chlorotoluene
1,2-dibromo-3-chloropropane (DBCP)
1,2-dibromoethane (ethylene dibromide)
dibromomethane
1,2-dichlorobenzene
1,3-dichlorobenzene
1,4-dichlorobenzene
*trans*-1,4-dichloro-2-butene
1,1-dichloroethane
1,2-dichloroethane
1,1-dichloroethene
*cis*-1,2-dichloroethene
*trans*-1,2-dichloroethene
1,2-dichloropropane
1,3-dichloropropane
2,2-dichloropropane
1,1-dichloropropene
*cis*-1,3-dichloropropene
*trans*-1,3-dichloropropene
diethyl ether (ethyl ether)
ethylbenzene
ethyl methacrylate
hexachlorobutadiene
hexachloroethane
iodomethane (methyl iodide)
isopropylbenzene (cumene)
4-isopropyltoluene (*p*-cymene)
methacrylonitrile
methyl acrylate
methylene chloride (dichloromethane)
methyl methacrylate
methyl *tert*-butyl ether (MTBE)
naphthalene
nitrobenzene
2-nitropropane
pentachloroethane
propionitrile (ethylcyanide)
*n*-propylbenzene
styrene
1,1,1,2-tetrachloroethane
1,1,2,2-tetrachloroethane
tetrachloroethene
tetrahydrofuran
1,2,3-trichlorobenzene
1,2,4-trichlorobenzene
1,1,1-trichloroethane
1,1,2-trichloroethane
trichloroethene
1,2,3-trichloropropane
1,2,4-trimethylbenzene
1,3,5-trimethylbenzene
toluene
*m*-xylene
*o*-xylene
*p*-xylene

2,000µg/mL each in P&T methanol, 1mL/ampul

| Each | 5-pk. | 10-pk. |
|---|---|---|
| 30601 $133.90 | 30601-510 $602.55 | — |
| | w/data pack | |
| 30601-500 $143.90 | 30601-520 $669.50 | 30701 $1205.10 |

**GC columns and additional reference mixes listed on page 8.**

# Fast, Efficient HPLC Analysis for Polynuclear Aromatic Hydrocarbons

continued from page 6

*(cont. from p. 6)* Available exclusively from Restek, Pinnacle II™ HPLC columns are prepared with silica we manufacture in our own facilities, for better control of quality and reproducibility. Consequently, Pinnacle II™ columns offer excellent performance and high lot-to-lot consistency. Among the most recent additions to the Pinnacle II™ column line are Pinnacle II™ PAH columns. Available in several dimensions, Pinnacle II™ PAH columns are specifically designed for analysis of PAHs, based on molecular shape of the target compounds. Figure 1 (pg. 6) shows baseline resolution of 18 PAHs in less than 18 minutes, using a 150 x 3.2mm, 5µm Pinnacle II™ PAH column. If your sample load demands very rapid analyses. Figure 2 (pg. 6) shows you can resolve 20 PAHs in less than 6 minutes by using a 50 x 4.6mm, 5µm Pinnacle II™ PAH column!

## Pinnacle II™ PAH Columns

**Physical Characteristics:** particle size: 5µm, spherical; pore size: 110Å; temperature limit: 80°C; fully end-capped; pH range: 2.5 to 7.5

| | 2.1mm ID | | 3.2mm ID | | 4.6mm ID | |
|---|---|---|---|---|---|---|
| Length | cat.# | price | cat.# | price | cat.# | price |
| 5µm Columns | | | | | | |
| 50mm | 9219552 | $340 | 9219553 | $340 | 9219555 | $340 |
| 100mm | — | — | 9219513 | $350 | 9219515 | $350 |
| 150mm | — | — | 9219563 | $365 | 9219565 | $365 |
| 200mm | — | — | 9219523 | $380 | 9219525 | $380 |
| 250mm | 9219572 | $380 | 9219573 | $380 | 9219575 | $380 |

A Pinnacle II™ PAH column will provide the resolution and short run times that you require for analyzing PAHs by HPLC. In addition, Restek can be your source for all reference materials for EPA Method 8310, EPA Method 550.1, or EPA Method 610. If you need a custom-prepared reference material for your analysis, we'll be happy to make it for you. Contact our Custom Reference Materials Group by Fax (814-355-2895) or through our web site (http://www.restekcorp.com/solutions), or contact your Restek representative.0

## EPA Method 8310 Surrogate Standard

decafluorobiphenyl

1,000µg/mL in acetonitrile, 1mL/ampul

| Each | 5-pk. | 10-pk. |
|---|---|---|
| 31842 $21.70 | 31842-510 $97.70 | — |
| | w/data pack | |
| 31842-500 $31.70 | 31842-520 $107.70 | 31942 $184.50 |

To order a 2.1mm, 3.2mm, or 4.6mm ID column with a Trident™ Integral Inlet Fitting, add "-700" to the catalog number for the column. Example: 100mm x 4.6mm ID Ultra C18 column with Trident™ Integral Inlet Fitting: 9174315-700. Nominal additional charge $15.00.

# Simplify GC/MS Calibration for Volatile Organic Compounds

continued from page 7

*(cont. from p. 7)* Laboratories using either dual purge and trap technology or newer purge and trap units with rapid cycle times are encouraged to use our 20m x 0.18mm x 1.0µm Rtx®-VMS capillary column, for sub-10 minute runtimes.[1,2] The 30m x 0.25mm ID column is our recommendation for the best gas resolution. Even at a concentration of 20ppb in 5mL of reverse osmosis water the gases are better than 90% resolved with a 40°C starting temperature (Figure 1). For best gas resolution using a Tekmar 3100 unit we optimized the method by using an alternate packing material in the trap, as described in the conditions for Figure 1 (pg. 7).

## 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 | $445 | 19916 | $735 | | |
| 0.32mm | 1.80 | -40 to 240/260°C | 19919 | $470 | 19920 | $795 | | |
| 0.45mm | 2.55 | -40 to 240/260°C | 19908 | $535 | 19909 | $865 | | |
| 0.53mm | 3.00 | -40 to 240/260°C | 19985 | $535 | 19988 | $865 | 19974 | $940 |
| **ID** | **df (µm)** | **temp. limits** | **20-Meter** | | **40-Meter** | | | |
| 0.18mm | 1.00 | -40 to 240/260°C | 49914 | $375 | 49915 | $650 | | |

If you are analyzing volatile environmental target analytes, Restek offers the columns, reference materials, accessories, and technical knowledge you need to get your system running quickly and accurately.

*References*


1. Butler J.C., E. Phillips, M. Conoley *A Quick, Sensitive Solution for Meeting Short Holding Times for VOAs in Drinking Water* Application Note AN9197, Thermo Electron Corporation, 2215 Grand Avenue Parkway, Austin, TX (2003).
2. Hilling, A.L. and G. Smith *Environmental Testing & Analysis* 10 (3),15-19 (2001).


## Ketones Mix, 524.2 Rev. 4.1

acetone
2-butanone (MEK)
1,1-dichloro-2-propanone
2-hexanone
4-methyl-2-pentanone (MIBK)

5,000µg/mL each in P&T methanol:water (90:10), 1mL/ampul

| Each | 5-pk. | 10-pk. |
|---|---|---|
| 30602 $28.90 | 30602-510 $130.05 | — |
| | w/data pack | |
| 30602-500 $38.90 | 30602-520 $144.50 | 30702 $260.10 |

## 524 Internal Standard/Surrogate Mix

*fortification solution*

4-bromofluorobenzene
1,2-dichlorobenzene-d4
fluorobenzene

2,000µg/mL each in P&T methanol, 1mL/ampul

| Each | 5-pk. | 10-pk. |
|---|---|---|
| 30201 $23.70 | 30201-510 $103.60 | — |
| | w/data pack | |
| 30201-500 $34 | 30201-520 $114.70 | 30301 $201 |

## 502.2 Calibration Mix #1 (gases)

bromomethane
chloroethane
chloromethane
dichlorodifluoromethane
trichlorofluoromethane
vinyl chloride

| Each | 5-pk. | 10-pk. |
|---|---|---|
| 2,000µg/mL each in P&T methanol, 1mL/ampul | | |
| 30042 $34 | 30042-510 $151.30 | — |
| 30042-500* $44.30 | 30042-520* $167.50 | 30142* $292.40 |
| 200µg/mL each in P&T methanol, 1mL/ampul | | |
| 30439 $23.70 | 30439-510 $103.60 | — |
| 30439-500* $34 | 30439-520* $114.70 | 30539* $201 |

*w/data pack

## Fluorobenzene Mix

*internal standard*

fluorobenzene

2,000µg/mL in P&T methanol, 1mL/ampul

| Each | 5-pk. | 10-pk. |
|---|---|---|
| 30030 $21.70 | 30030-510 $96 | — |
| | w/data pack | |
| 30030-500 $32 | 30030-520 $106.60 | 30130 $191.90 |

**Searching for the Perfect Solution?**

Let Restek create the perfect mixture—to your exact specifications. Contact the Technical Service Team or visit us online at www.restekcorp.com/solutions

# New Environmental and Petroleum Reference Mixes; Glass Deactivation Solution

new

by Katia May, Ph.D., R&D Chemist

## Environmental Reference Materials

### Carbamate Calibration Mix for HPLC / Post-Column Derivatization *new*

- ✔ Complete set of materials for N-methylcarbamoyloximes and N-methylcarbamates.
- ✔ New mix satisfies latest update of EPA method (531.2).
- ✔ Formulated in acetonitrile for stability and convenience for HPLC analysis.

Because carbamates, especially aldicarb sulfone, are unstable, carbamates analyses usually are HPLC based. The US EPA method for monitoring these compounds in drinking water, Method 531, calls for HPLC with post-column derivatization. 1-Naphthol, a fluorescent metabolite of carbaryl, was added to the analyte list in 2003. Our new 531.2 Carbamate Pesticides Calibration Mixture includes 1-naphthol. We offer the internal standard, 4-bromo-3,5-dimethylphenyl N-methylcarbamate,(cat.# 32274) and the performance check mix (cat.# 32275) in our current catalog.

#### 531.2 Carbamate Pesticide Calibration Mixture

aldicarb
aldicarb sulfone
aldicarb sulfoxide
carbaryl (sevin)
carbofuran
3-hydroxycarbofuran
methiocarb
methomyl
1-naphthol
oxamyl
propoxur (Baygon®)

100µg/mL in acetonitrile, 1mL/ampul

| Each | 5-pk. | 10-pk. |
|---|---|---|
| 32435 $44 | 32435-510 $198 | — |
| | w/data pack | |
| 32435-500 $54 | 32435-520 $220 | 32535 $396 |

### Formaldehyde-DNPH Mix *new*

- ✔ High concentration
- ✔ Acetonitrile solvent—suitable for HPLC analysis.

Sampling for airborne carbonyl compounds in EPA Method TO-11A and other methods involves a reaction between the target compounds and 2,4-dinitrophenylhydrazine (DNPH), coated on a silica gel adsorbent. We recently introduced a 15-component aldehyde/ketone-DNPH calibration mix (cat.# 31808). To meet the needs of investigators analyzing only for formaldehyde, we offer this new formulation.

#### Formaldehyde-DNPH Mix

formaldehyde-DNPH

500µg/mL in acetonitrile, 1mL/ampul

| Each | 5-pk. |
|---|---|
| 31837 $25 | 31837-510 $112.50 |

## Petroleum Reference Materials

### Massachusetts Volatile Petroleum Hydrocarbons (VPH) Mixes *new*

- ✔ New standard and matrix spike mixes for current Massachusetts VPH method: surrogate included.
- ✔ More analyses per ampul—standard with surrogate is 10,000µg/mL.
- ✔ Matrix spike mix at 50µg/mL, per updated method.

We include the two new target compounds in the latest revision of the Massachusetts MA VPH Method, *n*-decane and *n*-butylcyclohexane, in our new mixes. We also include the recommended surrogate standard, 2,5-dibromotoluene, in both mixes. A commercial gasoline reference standard suitable for the method is available from our catalog (cat.# 30096).

#### MA VPH Standard with Surrogate (Revised)

benzene
*n*-butylcyclohexane
*n*-decane (C10)
2,5-dibromotoluene
ethylbenzene
2-methylpentane
methyl *tert*-butyl ether (MTBE)
naphthalene
*n*-nonane (C9)
*n*-pentane (C5)
toluene
1,2,4-trimethylbenzene
2,2,4-trimethylpentane (isooctane)
*m*-xylene
*o*-xylene
*p*-xylene

10,000µg/mL in P&T methanol, 1mL/ampul

| Each | 5-pk. | 10-pk. |
|---|---|---|
| 30604 $39 | 30604-510 $175.50 | — |
| | w/data pack | |
| 30604-500 $49 | 30604-520 $195 | 30704 $351 |

#### MA VPH Matrix Spike Mix with Surrogate (Revised)

benzene
*n*-butylcyclohexane
*n*-decane (C10)
2,5-dibromotoluene
ethylbenzene
2-methylpentane
methyl *tert*-butyl ether (MTBE)
naphthalene
*n*-nonane (C9)
*n*-pentane (C5)
toluene
1,2,4-trimethylbenzene
2,2,4-trimethylpentane (isooctane)
*m*-xylene
*o*-xylene
*p*-xylene

50µg/mL in P&T methanol, 1mL/ampul

| Each | 5-pk. | 10-pk. |
|---|---|---|
| 30605 $39 | 30605-510 $175.50 | — |
| | w/data pack | |
| 30605-500 $49 | 30605-520 $195 | 30705 $351 |

### Hydraulic Oil Standard *new*

- ✔ For total petroleum hydrocarbon pattern recognition of hydraulic oil.
- ✔ High concentration—50,000µg/mL in methylene chloride.

Regardless of source or quality, the fingerprint of all hydraulic oils is essentially the same. We now offer a high concentration hydraulic oil reference mix to help our customers identify petroleum products associated with hydraulic oil.

#### Hydraulic Oil Standard

hydraulic oil

50,000µg/mL in methylene chloride, 1mL/ampul

| Each | 5-pk. | 10-pk. |
|---|---|---|
| 31839 $34 | 31839-510 $153 | — |
| | w/data pack | |
| 31839-500 $44 | 31839-520 $170 | 31939 $306 |

### Creosote Oil Standard *new*

- ✔ For total petroleum hydrocarbon pattern recognition of creosote oil.
- ✔ High concentration—50,000µg/mL in methylene chloride.

Creosote oil, a widely used wood preservative produced by distilling coal tar, contains chemicals that are classified as carcinogens (e.g., benzo(a)pyrene). New regulations in Europe ban the sale of creosote to consumers. We offer this new, high concentration standard to analysts monitoring creosote oil.

#### Creosote Oil Standard

creosote oil

50,000µg/mL in methylene chloride, 1mL/ampul

| Each | 5-pk. | 10-pk. |
|---|---|---|
| 31838 $34 | 31838-510 $153 | — |
| | w/data pack | |
| 31838-500 $44 | 31838-520 $170 | 31938 $306 |

### Deactivation Reagent *new*

- ✔ Easy deactivation of liners and other glass surfaces.
- ✔ Convenient—20mL ampul deactivates 50 inlet liners.
- ✔ Tested to ensure consistent quality and effectiveness.

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

#### Dimethyldichlorosilane (DMDCS)

dimethyldichlorosilane (DMDCS)

Neat, 20mL/ampul

| Each | 5-pk. |
|---|---|
| 31840 $20 | 31840-510 $90 |

# Miniature Air Sampling Canisters

by Donna Lidgett, Air Monitoring Products Marketing Manager

- ✔ Ideal for indoor air, personal, emergency response, or soil gas sampling.
- ✔ 400cc or 1000cc.
- ✔ Low pressure applications not exceeding 40psig.
- ✔ Available with quick-connect fitting that is compatible with sampling and analysis instruments.
- ✔ Also available with non-treated or Sulfinert®-treated valve.

These small canisters are designed for controlled sampling, such as personal air sampling, as an alternative to tube and pump samplers. The 1000cc canister is suitable for sampling volatile organic compounds in air according to US EPA Methods TO-14 and TO-15.

Restek offers these products in stainless steel or with Sulfinert® treatment for greatest inertness. We continue to offer passive coating technologies that are unmatched in the air sampling industry—try a Sulfinert®-treated canister and achieve the ultimate in analyte stability.

Quick-Connect body fitting

Quick-Connect stem fitting

Dimensions:
400cc = 2.75" diameter, 5.35" long
1000cc = 2.75" diameter, 11.92" long

## Miniature Air Sampling Canisters with Quick-Connect Stem Fittings

| Description | Volume | qty. | cat.# | price |
|---|---|---|---|---|
| Electro-Polished Miniature Canister with Quick-Connect Stem Fitting | 400cc | ea. | 24188 | $210 |
| | 1000cc | ea. | 24194 | $250 |
| Sulfinert®-Coated Miniature Canister with Quick-Connect Stem Fitting | 400cc | ea. | 24189 | $250 |
| | 1000cc | ea. | 24195 | $295 |
| Sulfinert®-Coated Miniature Canister with Sulfinert®-Treated Quick-Connect Stem Fitting | 400cc | ea. | 24190 | $290 |
| | 1000cc | ea. | 24196 | $345 |

## Miniature Air Sampling Canisters with Metal-Seated Diaphragm Valve

| Description | Volume | qty. | cat.# | price |
|---|---|---|---|---|
| Electro-Polished Miniature Canister with Metal-Seated Diaphragm Valve | 400cc | ea. | 24191 | $325 |
| | 1000cc | ea. | 24197 | $365 |
| Sulfinert®-Coated Miniature Canister with Metal-Seated Diaphragm Valve | 400cc | ea. | 24192 | $350 |
| | 1000cc | ea. | 24198 | $395 |
| Sulfinert®-Coated Miniature Canister with Sulfinert®-Treated Diaphragm Valve | 400cc | ea. | 24193 | $390 |
| | 1000cc | ea. | 24199 | $445 |

Miniature canister

Metal-seated diaphram valve

## Quick-Connect Fittings for Miniature Air Sampling Canisters

Connection: ¼" tube fitting.

| Description | qty. | cat.# | price |
|---|---|---|---|
| Quick-Connect Stem Fitting | ea. | 24185 | $68 |
| Sulfinert®-Treated Quick-Connect Stem Fitting | ea. | 24186 | $95 |
| Quick-Connect Body Fitting | ea. | 24187 | $95 |

## Tedlar® Sampling Bags

- Sizes ranging from 0.5 liters to 100 liters.
- Unique all-in-one septum and valve fitting make these lightweight and easy to use.
- Polypropylene or stainless steel valve.

| Description | | qty. | Polypropylene Valve cat.# | Polypropylene Valve price | Stainless Steel Valve cat.# | Stainless Steel Valve price |
|---|---|---|---|---|---|---|
| 0.5L | 6" x 6" | 10-pk. | 22049 | $122 | 22038 | $179 |
| 1L | 7" x 7" | 10-pk. | 22050 | $117 | 22039 | $171 |
| 3L | 9.5" x 10" | 10-pk. | 22051 | $138 | 22040 | $206 |
| 5L | 12" x 12.5" | 10-pk. | 22052 | $171 | 22041 | $236 |
| 10L | 11.75" x 18" | 10-pk. | 22053 | $201 | 22042 | $260 |
| 12L | 13" x 20" | 10-pk. | 22054 | $226 | 22043 | $283 |
| 25L | 17.5" x 24" | 5-pk. | 22055 | $140 | 22044 | $166 |
| 40L | 24" x 24.25" | 5-pk. | 22056 | $166 | 22045 | $188 |
| 80L | 28.25" x 30.5" | 5-pk. | 22057 | $196 | 22046 | $222 |
| 100L | 28" x 36" | 3-pk. | 22058 | $148 | 22047 | $156 |
| Replacement Septum | | 10-pk. | 22059 | $15 | 22048 | $23 |

## A Good Word

*"Restek has consistently provided high quality chromatography columns and supplies to me for well over a decade. Over the last two years, I have extensively been involved with air analysis, TO-15, etc., and Restek provides the highest quality canisters, mini-cans, and flow controllers in the market today."*

**Scott Van Etten,** IH Laboratory Manager, EMSL Analytical

## Did you know?

We also offer sampling kits, thermal desorption tubes, and a range of gas reference standards to meet your environmental gas sampling requirements. For more information, request our *Chromatography Supplies Catalog* (lit. cat. #59854).

# Restek Air Sampling Products

by Donna Lidgett, Air Monitoring Product Marketing Manager

- ✔ Inert canisters—accurate collection and recovery of low-level active analytes.
- ✔ Many reference mixes, including a 62-component TO-15 mix.
- ✔ Pre-cleaned adsorbent resin and PUF plugs; sampling cartridge kit.

Restek Innovation!


## SilcoCan™ Canisters

- Excellent stability for long-term storage of sulfur volatile organic compounds.
- More accurate sampling than with untreated canisters.
- Available with gauge—accurately measure from 30" Hg to 60psig (other gauges are available).

### SilcoCan™ Canisters

| volume | qty. | cat.# | price |
|---|---|---|---|
| 1L | ea. | 24112 | $505 |
| 3L | ea. | 24113 | $525 |
| 6L | ea. | 24114 | $545 |
| 15L | ea. | 24115 | $845 |

### SilcoCan™ Canisters with Silcosteel® Valve

| volume | qty. | cat.# | price |
|---|---|---|---|
| 1L | ea. | 24112-650 | $560 |
| 3L | ea. | 24113-650 | $580 |
| 6L | ea. | 24114-650 | $600 |
| 15L | ea. | 24115-650 | $900 |

### SilcoCan™ Canisters with Vacuum/Pressure Gauges**

| volume | qty. | cat.# | price |
|---|---|---|---|
| 1L | ea. | 24116 | $705 |
| 3L | ea. | 24117 | $725 |
| 6L | ea. | 24118 | $745 |
| 15L | ea. | 24119 | $1045 |

## TO-Can™ Air Monitoring Canisters

- SUMMA® canister equivalent.
- Excellent analyte recovery —even after 14 days of storage.

### TO-Can™ Canisters

| volume | qty. | cat.# | price |
|---|---|---|---|
| 1L | ea. | 24150 | $400 |
| 3L | ea. | 24152 | $425 |
| 6L | ea. | 24153 | $425 |
| 15L | ea. | 24154 | $745 |

### TO-Can™ Canisters with Vacuum/Pressure Gauges

| volume | qty. | cat.# | price |
|---|---|---|---|
| 1L | ea. | 24155 | $550 |
| 3L | ea. | 24156 | $575 |
| 6L | ea. | 24157 | $575 |
| 15L | ea. | 24158 | $995 |

Did you know?

SilcoCan™ canisters are cleaned prior to shipping.

**Silcosteel® valves are available for these SilcoCan™ canisters at an additional cost. ($55) Add the suffix number "-650" to the catalog number for the canister.

## TO-14 and TO-15 Air Monitoring Gas Standards

- ISO 9001-approved gas manufacturer—Spectra Gas.
- Only vendor of 62-component TO-15 gas standard.

***For compositions of these and other air monitoring mixes, refer to our general catalog or visit our website.***

### TO-14A Calibration Mix (39 components)

| 1ppm | 100ppb |
|---|---|
| 34400 (ea.) $1325 | 34421 (ea.) $1445 |

### TO-14A 43 Component Mix

| 1ppm | 100ppb |
|---|---|
| 34432 (ea.) $1545 | 34433 (ea.) $1675 |

### TO-14A Chlorinated Hydrocarbon Mix (19 components)

| 1ppm | 100ppb |
|---|---|
| 34402 (ea.) $1090 | 34422 (ea.) $1195 |

### TO-15 62 Component Mix

| 1ppm | 100ppb |
|---|---|
| 34436 (ea.) $3300 | 34437 (ea.) $3500 |

### TO-14A 41 Component Mix

| 1ppm | 100ppb |
|---|---|
| 34430 (ea.) $1425 | 34431 (ea.) $1545 |

### TO-14A Aromatics Mix (14 components)

| 1ppm | 100ppb |
|---|---|
| 34404 (ea.) $970 | 34423 (ea.) $1055 |

### TO-15 Subset 25 Component Mix

| 1ppm | 100ppb |
|---|---|
| 34434 (ea.) $1050 | 34435 (ea.) $1150 |

### TO-14A CFC/HCFC Mix (4 components)

| 1ppm | 100ppb |
|---|---|
| 34410 (ea.) $510 | 34426 (ea.) $595 |

### TO-14A GC/MS Tuning Mix (1 component)

| 1ppm | 100ppb |
|---|---|
| 34406 (ea.) $265 | 34424 (ea.) $350 |

### TO-14A Internal Standard Mix (3 components)

| 1ppm | 100ppb |
|---|---|
| 34412 (ea.) $540 | 34427 (ea.) $625 |

**All TO-14 and TO-15 air moniitoring standards listed on this page:** Cylinder Construction: aluminum; Cylinder Size: 8 x 24 cm., Volume/Pressure: 104 liters of gas @ 1800psig; Cylinder Fitting: CGA-180 outlet; Weight: 1.5 lbs.; in nitrogen

## Sampling Supplies for TO-13 Semivolatiles in Air

We have everything you need for sampling semivolatile compounds in air: Ultra-Clean™ Resin, filters, PUF plugs, and sampling cartridges. Refer to the general catalog or our website for a complete air sampling products offering.

### Sampling Cartridge Kit

Kit includes 2.5" OD glass cartridge, 2 small mesh screens, 2 large mesh screens, and 2 PTFE caps. Order PUF plug separately.

| Description | qty. | cat.# | price |
|---|---|---|---|
| Sampling Cartridge Kit | kit | 24135 | $144 |
| Pre-Cleaned PUF Plug (7.6cm length, 6cm diameter) | ea. | 24295 | $40.50 |
| **Replacement Sampling Kit Parts** | **qty.** | **cat.#** | **price** |
| Sampling Cartridge (2.5" OD) | ea. | 24136 | $44 |
| Large Mesh Screens (200 micron) | 2-pk. | 24139 | $22 |
| Small Mesh Screens (16 micron) | 2-pk. | 24138 | $22 |
| PTFE Caps | 2-pk. | 24137 | $66 |

### Ultra-Clean™ Resin: Performance equal to XAD®-2 Resin!

To eliminate time-consuming clean-up but meet TO-13 method requirements, we do the cleaning for you! We test each batch by capillary GC/flame ionization detector to ensure it meets the specified cleanliness.

| Description | qty. | cat.# | price |
|---|---|---|---|
| Ultra-Clean™ Resin | 100 grams | 24230 | $185 |
| Ultra-Clean™ Resin | 500 grams | 24231 | $895 |

# Siltek™, Sulfinert®, and Silcosteel-CR® Treated Swagelok® Fittings

new

## High-Quality System Fittings Made Inert for Demanding Applications

by Gary Barone, Manager, Restek Performance Coatings

Restek *Performance* Coatings

- ✔ Siltek™ treatment ensures ultimate inertness.
- ✔ Silcosteel®-CR treatment enhances corrosion resistance by 10X, or more.
- ✔ Custom treatment available for any Swagelok® fitting or other system parts.

Restek is pleased to set the new standard for tubing system components: Swagelok® fittings made inert or corrosion resistant through proprietary Restek surface treatments. These items represent the first of two steps in applying our surface treatments to Swagelok®-manufactured parts—later this year we anticipate introducing valves that are assembled and tested by Swagelok after receiving surface treatment at Restek.

Swagelok® fittings are world-renowned for being manufactured to the highest standards. Now, you can obtain these superior products with Restek's unparalleled surface treatments. Unlike coatings, Restek surface treatments produce a layer that is integral with the fitting surface—it cannot chip, flake, or delaminate, even in the most stressful applications. Fittings available from stock have received our most inert surface treatment, Siltek™ treatment, our second generation coating for inertness, succeeding the Silcosteel® surface treatment we introduced in the late 1980s. In most situations Siltek™ treatment is the ideal choice for ultimate inertness. A closely related process produces Sulfinert® treated fittings, which are intended specifically for systems used to collect, store, and transfer active sulfur-containing compounds. A Siltek™ or Sulfinert® layer can be applied at a thickness of up to 0.12µm. At this thickness even parts-per-billion levels of the most reactive materials will not interact with the surface. Silcosteel®-CR treated fittings also are available. This new treatment enhances the corrosion resistance of stainless steel by an order of magnitude, or more. Until now, inferior surface coatings or expensive special alloys have been employed to protect system components from corrosive mineral acid environments. We developed the Silcosteel®-CR treatment specifically to protect equipment exposed to hydrochloric acid, nitric acid, sulfuric acid, or marine environments. In independent tests, Silcosteel®-CR treatment upgraded the corrosion resistance of 300-grade stainless steels by more than an order of magnitude. Table 1 summarizes data from pitting and crevice corrosion testing of Silcosteel®-CR treated 316L stainless steel samples and bare steel samples (ASTM G48, Method B). Silcosteel®-CR treatment enhanced corrosion protection more than tenfold, and, as demonstrated in Figure 1, completely protected the samples against crevice corrosion.

If you need highly inert system fittings for demanding applications, you will not find more suitable fittings than Restek-treated Swagelok® fittings. All Restek surface treatments can be applied to other fittings or parts on a custom basis. To find out if Restek-treated components will improve your system's performance, use our Technical Service extension (ext. 4) and ask for our coating experts, or contact your Restek representative.

For current products and prices, please contact our Customer Service representatives (ext. 3) or your local Restek representative.

Let the Restek Performance Coatings Team solve your surface activity problems. Contact us at 800-356-1688 or 814-353-1300, or contact your local Restek representative

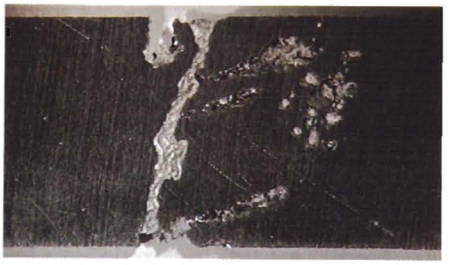
**Table 1** Silcosteel®-CR treatment enhances corrosion protection of 316L stainless steel by an order of magnitude (results of ASTM G48, Method B)

| Sample | Weight Loss ($g/m^2$)* |
|---|---|
| Silcosteel®-CR treated sample 17 | 19 |
| Silcosteel®-CR treated sample 28 | 25 |
| Silcosteel®-CR treated sample 47 | 25 |
| Bare steel sample 27 | 231 |
| Bare steel sample 34 | 209 |
| Bare steel sample 37 | 228 |

*After 72 hours exposure to 6% w/w ferric chloride solution.

**Figure 1** Silcosteel®-CR treated 316L stainless steel samples show no crevice corrosion and only slight pitting corrosion, while bare 316L stainless steel samples exhibit severe crevice corrosion.


Silcosteel®-CR-treated 316L stainless steel



Bare 316L stainless steel

# Reliable Connections Made Simple

by Donna Lidgett, GC Accessories Product Marketing Manager

Restek Innovation!

- ✔ Reliable seal integrity—will not unexpectedly disconnect during temperature-programmed analyses.
- ✔ Open design allows visual confirmation of the seals, for added confidence in the connections.
- ✔ Use standard Press-Tight® connectors.

## SeCure™ "Y" Connectors†

new

Connect two analytical columns to a transfer line or guard column.

Combine the simplicity of a "Y" Press-Tight® connector with the strength of a metal union. The "Y" Press-Tight® connector joins the fused silica columns and transfer line or guard column. The ferrules and knurled nuts hold the fused silica tubing in place, which prevents the tubing from unexpectedly disconnecting, even at temperatures as high as 400°C.

### SeCure™ "Y" Connector Kits

Kits include: SeCure™ "Y" connector body, 3 knurled nuts, 1 "Y" Universal Press-Tight® union, and 3 ferrules.

| Description | Ferrules Fit Column ID | qty. | cat.# | price |
|---|---|---|---|---|
| SeCure™ "Y" Connector Kit | 0.25/0.28mm | kit | 20276 | $215 |
| SeCure™ "Y" Connector Kit | 0.28/0.32mm | kit | 20277 | $215 |
| SeCure™ "Y" Connector Kit | 0.45/0.53mm | kit | 20278 | $215 |
| Knurled nut | | 3-pk. | 20279 | $30 |

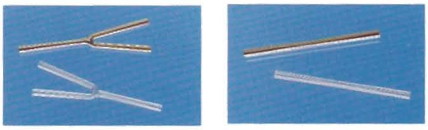
### Graphite Ferrules for SeCure™ "Y" Connectors *

| Ferrule ID | Fits Column ID | Graphite 10-pk./price | | Graphite 50-pk./price | |
|---|---|---|---|---|---|
| 0.4mm | 0.25/0.28mm | 20200 | $25 | 20227 | $100 |
| 0.5mm | 0.28/0.32mm | 20201 | $25 | 20228 | $100 |
| 0.8mm | 0.45/0.53mm | 20202 | $25 | 20224 | $100 |

### Universal "Y" Press-Tight® Connectors**

| Description | ea./price | | 3-pk./price | |
|---|---|---|---|---|
| Universal "Y" Press-Tight® Connector | 20405 | $60 | 20406 | $160 |
| Siltek™-treated Universal "Y" Press-Tight® Connector | 20485 | $62 | 20486 | $166 |

The SeCure™ "Y" connector's open design allows visual confirmation of the seal; secondary seals prevent unexpected disconnection.



Both the SeCure™ "Y" and Vu2 Union™ Connectors use standard Press-Tight® connectors—no expensive, unique inserts to purchase!

## Vu2 Union™ Connectors†

Connect a guard column to an analytical column, a column to a transfer line, two columns in series, or repair a broken column.

### Vu2 Union™ Connector Kits

Kits include: Vu2 Union™ body, 2 knurled nuts, 2 Press-Tight® unions, and 4 ferrules.

| Description | Ferrules Fit Column ID | qty. | cat.# | price |
|---|---|---|---|---|
| Vu2 Union™ Connector Kit | 0.15–0.25mm | kit | 21105 | $128 |
| Vu2 Union™ Connector Kit | 0.28/0.32mm | kit | 21106 | $128 |
| Vu2 Union™ Connector Kit | 0.45/0.50 & 0.53mm | kit | 21107 | $128 |
| Knurled nut | | 2-pk. | 21108 | $25 |

NOTE: Not recommended for GC column-to-MS connections—use the Vacuum Vu-Union® described in our catalog.

### Graphite Ferrules for Vu2 Union™ Connectors*

| Ferrule ID | Fits Column ID | Graphite 2-pk./price | | Graphite 10-pk./price | |
|---|---|---|---|---|---|
| 0.4mm | 0.18–0.25mm | 20280 | $19 | 20281 | $79 |
| 0.5mm | 0.28/0.32mm | 20282 | $19 | 20283 | $79 |
| 0.8mm | 0.45/0.50 & 0.53mm | 20284 | $19 | 20285 | $79 |

### Universal Press-Tight® Connectors**

| Description | 5-pk./price | | 25-pk./price | | 100-pk./price | |
|---|---|---|---|---|---|---|
| Universal Press-Tight® Connectors | 20400 | $38 | 20401 | $152 | 20402 | $450 |
| Siltek™-treated Universal Press-Tight® Connectors | 20480 | $48 | 20449 | $202 | 20481 | $650 |

Make secure, reliable column-to-column connections with Vu2 Union™ connectors.

†Patent pending.
*Stable to 450°C.
** Fit column ODs from 0.33–0.74mm (Restek 0.1mm–0.53mm ID).

# New HPLC Mobile Phase Accessories

## More Accurate, More Reproducible Chromatography

by Rebecca Wittrig, Ph.D., HPLC Product Marketing Manager

### QuickSplit™ Post-Column Flow Splitters for HPLC & LC/MS

- ✔ Split ratio unaffected by changes in viscosity or pressure.
- ✔ Low dead volume—negligible effect on analyte bandwidth.

*Adjustable Flow Splitters*

- Adjustable metering valve gives convenient control of split ratio.
- High operating pressure limit: 5,000 psi.

*Fixed Flow Splitters*

- High operating pressure limit: 10,000 psi.

Fixed Flow Splitter

Adjustable Flow Splitter

Two fluid resistors forming a parallel flow path generate split ratios in a QuickSplit™ Flow Splitter. The interchangeable cartridge design makes changing split ratios a snap, and eliminates tedious adjustments to capillary tubing. Internal volume in the fluid resistors is extremely low, so solvent composition in both resistors is always the same, and viscosity changes during gradient runs do not impact the split ratio. Use QuickSplit™ technology anywhere a controlled, reproducible split ratio is important, including LC/MS, flow fractionation, or capillary LC.

| Description | Split Ratio | qty. | cat.# | price |
|---|---|---|---|---|
| Binary Fixed Flow Splitter | 100:1 | ea. | 25326 | $995 |
| Replacement Fixed Flow Splitter Resistor Set | 100:1 | ea. | 25331 | $495 |
| Binary Fixed Flow Splitter | 50:1 | ea. | 25327 | $995 |
| Replacement Fixed Flow Splitter Resistor Set | 50:1 | ea. | 25332 | $495 |
| Binary Fixed Flow Splitter | 20:1 | ea. | 25328 | $995 |
| Replacement Fixed Flow Splitter Resistor Set | 20:1 | ea. | 25333 | $495 |
| Binary Fixed Flow Splitter | 10:1 | ea. | 25329 | $995 |
| Replacement Fixed Flow Splitter Resistor Set | 10:1 | ea. | 25334 | $495 |
| Binary Fixed Flow Splitter | 5:1 | ea. | 25330 | $995 |
| Replacement Fixed Flow Splitter Resistor Set | 5:1 | ea. | 25335 | $495 |
| Adjustable Flow Splitter | 5:1 to 100:1 | ea. | 25336 | $1950 |
| Replacement Adjustable Flow Splitter Resistor Set | 5:1 to 100:1 | ea. | 25338 | $295 |
| Adjustable Flow Splitter | 1:1 to 20:1 | ea. | 25337 | $1950 |
| Replacement Adjustable Flow Splitter Resistor Set | 1:1 to 20:1 | ea. | 25339 | $295 |

***For the most up-to-date list of HPLC accessories and instrument parts, visit our website at www.restekcorp.com***

### HyperShear™ Static In-Line Mobile Phase Mixers

- ✔ Reduced baseline noise, for increased sensitivity.
- ✔ Improved gradient accuracy—more reproducible results.
- ✔ Greater reaction efficiency in post column derivatization.

ASI HyperShear™ Mixers incorporate a highly efficient cross-flow shearing mechanism to produce vortex sheer mixing over a wide range of flow rates. This technology typically delivers 25–200% greater mixing efficiency, compared to conventional tortuous path mixers. Stainless steel construction.

Choosing the appropriate mixer volume is a trade-off among delay volume, baseline noise, and step gradient definition and repeatability. The following guidelines will help simplify the decision:

- For a given flow rate, the greater the mixing volume, the better the mixing and the lower the baseline noise.
- For a given flow rate, the smaller the mixing volume, the better the definition and sharpness of linear gradients.
- When running linear gradients, multi-pump high pressure gradient systems typically require far less mixing volume than low pressure single-pump gradient systems.

| Description | qty. | cat.# | price |
|---|---|---|---|
| 50µL In-Line Mixer | ea. | 25341 | $440 |
| 150µL In-Line Mixer | ea. | 25342 | $440 |
| 250µL In-Line Mixer | ea. | 25343 | $440 |

### FlatLine™ Pulse Damper

- ✔ Rupture-proof, no diaphragm—minimal risk of failure or leaks.
- ✔ Clean flush-out design—no sample carryover.
- ✔ Low internal volume—negligible effect on analyte bandwidth.

The ASI FlatLine™ Pulse Damper combines performance and reliability in a simple, easy-to-use housing. Standard 10-32 inlet and outlet ports allow quick connection into virtually any HPLC system. Solid core technology provides reliable long-term operation without the down time associated with ruptured or leaking membrane dampers.

| Description | qty. | cat.# | price |
|---|---|---|---|
| FlatLine™ Pulse Damper | ea. | 25340 | $595 |

# Replacement Parts for Agilent Autosamplers and GCs

## All Parts Meet or Exceed OEM Performance

by Donna Lidgett, GC Accessories Product Marketing Manager

***Looking for parts for older Agilent instruments? We are a reliable source for these parts.***

### Injector Mounting Post *new*

| Description | Similar to Agilent part # | qty. | cat.# | price |
|---|---|---|---|---|
| Injector Mounting Post for Agilent 5890 GCs | 18597-60805 | ea. | 21236 | $95 |
| Injector Mounting Post for Agilent 6890 GCs | 07673-21140 | ea. | 21237 | $87 |

Injector Mounting Post

### Vial Turret Assembly *new*

| Description | Similar to Agilent part # | qty. | cat.# | price |
|---|---|---|---|---|
| Vial Turret Assembly for Agilent 7673B | 07673-60605 | ea. | 20160 | $216 |
| Vial Turret Assembly for Agilent 7673A | — | ea. | 20161 | $250 |

Vial Turret Assembly

### Injector Turret Motor *new*

| Description | Similar to Agilent part # | qty. | cat.# | price |
|---|---|---|---|---|
| Injector Turret Motor for Agilent 7673A & 7673B | 07673-60810 | ea. | 20289 | $248 |

Injector Turret Motor

### Injector Plunger Motor *new*

| Description | Similar to Agilent part # | qty. | cat.# | price |
|---|---|---|---|---|
| Injector Plunger Motor for Agilent 7673A & 7673B | 07673-60620 | ea. | 20288 | $297 |

Injector Plunger Motor

### Autosampler Plunger Carrier Belt

| Description | Similar to Agilent part # | qty. | cat.# | price |
|---|---|---|---|---|
| Autosampler Plunger Carrier Belt for Agilent 7673A and 7673B | 07673-61275 | ea. | 22695 | $22.50 |

Autosampler Plunger Carrier Belt

### Carriage Motor Belt

| Description | Similar to Agilent part # | qty. | cat.# | price |
|---|---|---|---|---|
| Carriage Motor Belt for Agilent 7673A and 7673B | 1500-0676 | ea. | 22692 | $12.25 |

Carriage Motor Belt

### Carriage Motor

| Description | Similar to Agilent part # | qty. | cat.# | price |
|---|---|---|---|---|
| Carriage Motor for Agilent 7673A and 7673B | 07673-60890 | ea. | 22693 | $255 |

Carriage Motor

### Ribbon Cable *new*

| Description | Similar to Agilent part # | qty. | cat.# | price |
|---|---|---|---|---|
| Ribbon Cable, main board to sensor board | 07673-60690 | ea. | 20292 | $60 |

Ribbon Cable

### Oven Flap Motor *new*

| Description | Similar to Agilent part # | qty. | cat.# | price |
|---|---|---|---|---|
| Oven Flap Motor for Agilent 5890 GC | 05890-60945 | ea. | 20293 | $170 |
| Oven Flap Motor for Agilent 6890 GC | G1530-60945 | ea. | 21233 | $165 |

Oven Flap Motor

### Oven Fan Motor *new*

| Description | Similar to Agilent part # | qty. | cat.# | price |
|---|---|---|---|---|
| Oven Fan Motor for Agilent 5890 GC | 05890-67020 | ea. | 21200 | $383 |
| Oven Fan Motor for Agilent 6890 GC | G1530-67030 | ea. | 21234 | $348 |

Oven Fan Motor

### Oven Temp Sensor Assembly *new*

| Description | Similar to Agilent part # | qty. | cat.# | price |
|---|---|---|---|---|
| Oven Temp Sensor for Agilent 5890 GC | 05890-61030 | ea. | 21201 | $140 |
| Oven Temp Sensor for Agilent 6890 GC | — | ea. | 21235 | $150 |

Oven Temperature Sensor Assembly

### Heat Sink for Agilent 5890/6890/6850 GC Split/Splitless Injector

| Description | Similar to Agilent part # | qty. | cat.# | price |
|---|---|---|---|---|
| Heat Sink for Agilent 5890/6890/6850 GCs | 18740-20940 G1544-20570 | ea. | 20409 | $95 |

Heat Sink

# Get Your Wizard Dollars for Nothin', Get Your STAR™ Points for Free*

## Order High Quality Products; Obtain Credits Toward Instrument Service and Repair

by Doug Elliott, STAR Service Rewards Coordinator

Maximize your FREE STAR™ Points by choosing Restek supplies for all your chromatography needs. When you order a column or a reference mix, take a minute to review additional sections in the new 2004 Restek Catalog. You will see the wide variety of quality chromatography supplies you can get from Restek. You can earn even more STAR™ Points and Wizard Dollars by also ordering your everyday chromatography supplies from Restek: our GC instrument maintenance and repair supplies, column installation parts and tools, and corresponding materials for HPLC all are of the highest performance and give good value. Innovative and proven Restek chromatography supplies include:

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- Hamilton & SGE syringes
- HPLC pump and instrument parts
- HPLC lamps
- inlet liners
- inlet seals
- instrument repair parts
- mobile phase accessories
- PEEK© tubing
- PID lamps
- Purus™ gas system/plumbing supplies
- pressure regulators
- Press-Tight® connectors
- septa
- Silcosteel® fittings and tubing
- tools

If you're not participating in the STAR™ program, it's not too late! Register your lab by calling the Restek Customer Service Team at 1-800-356-1688, ext. 3. Just provide your company account number and your ship-to address—that's it! After your lab is registered, you will begin to receive STAR™ Points in your product packages, just like Wizard Dollars—1 STAR™ Point for every $50 increment of Restek products you purchase. Register your lab with the STAR™ Service Reward Program today, then let us know how much you save on instrument service costs in 2004!

***See the current list of service providers on our website at www.restekcorp.com***

*Yes, it sounds better when Dire Straits plays it!

# HPLC Method Development Course

Many analysts anticipate developing a new HPLC method with apprehension. To help de-mystify this process, Restek, in cooperation with ChromVision, offers a dynamic, thorough, two-day course on the subject, presented in a logical and systematic manner by Dr. Yuri Kazakevich, an expert on the effects of adsorbent chemistry and structure on HPLC retention. The course is especially useful to analysts working with pharmaceutical or biological/biochemical analytes. Request the HPLC Method Development Course brochure (lit. cat.# 59005), or visit our website, for a description of the course, and presentation dates and sites for 2004.

# Restek *Still* Recycles!

Recycling is not as popular a subject as it was a decade or so ago, but at Restek we continue to improve our recycling programs. You can read about some of our efforts on the following page of the Pennsylvania Department of Environmental Protection web site:
http://www.dep.state.pa.us/dep/deputate/airwaste/wm/RECYCLE/Business_Rec/Business3.htm

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Please direct your comments on this publication to Carrie Sprout, Graphic Designer, at carrie@restekcorp.com or call 814-353-1300, ext. 2151.

# Free Technical Workshops

All workshops held in seminar room #20.

| | | | |
|---|---|---|---|
| Monday, March 8 | 9:30-10:30 am | Rtx®-XLB: A New, Low Bleed Family of GC Columns | C. English |
| | 10:30-11:30 am | Stx™-500: A New GC Column for Analysis of Brominated Flame Retardants (BFR) | F. Dorman |
| | 11:30-12:30 pm | ShinCarbon ST: New Packed and Micropacked GC Columns for Analysis of Gases | N. Mosesman |
| | 1:00-2:00 pm | Improving Method Performance Through Fast LC | R. Wittrig |
| | 2:00-3:00 pm | Using Temperature as a Variable in LC | R. Wittrig |
| | 3:00-4:00 pm | Current Applications in Environmental LC Analysis | R. Wittrig |
| | 4:00-5:00 pm | Restek Performance Coatings: Introduction and Overview | G. Barone |
| Tuesday, March 9 | 8:30-9:30 am | Advanced Column Connectors for Use with Fused Silica GC Columns | B. Rightnour |
| | 9:30-10:30 am | Restek Reference Materials: Meeting the Needs of the Analytical Laboratory | J. Crissman |
| | 10:30-11:30 am | Rtx®-Dioxin2: A New GC Column for Analysis of Dioxins and Furans | F. Dorman |
| | 11:30-12:30 pm | Passive Sampling and Collection for ambient Air | D. Shelow |
| | 1:00-2:00 pm | Stop-Flow GC: Low-Cost Solution for Fast GC Analysis | F. Dorman |
| | 2:00-3:00 pm | Using Temperature as a Variable in LC | R. Wittrig |
| | 3:00-4:00 pm | Rtx®-VMS: Improved Analysis by EPA Volatile Organics Methods | C. English |
| | 4:00-5:00 pm | Rtx®-5Sil MS: Improved Column Technology for GC/MS Analysis | G. Stidsen |
| Wednesday, March 10 | 8:30-9:30 am | Increase GC/MS Productivity with the EZ No-Vent™ Connector | B. Rightnour |
| | 9:30-10:30 am | Current Applications in Environmental LC Analysis | R. Wittrig |
| | 10:30-11:30 am | New GC Column for Chlorinated Pesticides Analysis | G. Stidsen |
| | 11:30-12:30 pm | Restek Performance Coatings: Introduction and Overview | G. Barone |
| | 1:00-2:00 pm | Stop-Flow GC: Low-Cost Solution for Fast GC Analysis | F. Dorman |
| | 2:00-3:00 pm | Rtx®-Dioxin2: A New Fused Silica GC Column for Analysis of Dioxins and Furans | F. Dorman |
| | 3:00-4:00 pm | Rtx®-XLB: A New, Low Bleed Family of GC Columns | C. English |
| | 4:00-5:00 pm | Collection and Analysis of Low-Level Sulfur Compounds in Air | D. Shelow |

The Chromatography Wizards at Restek are the best in the business. But what good does that expertise do if we don't share it with you? So we offer you these free technical workshops at Pittcon® in the spirit that knowledge is power. Take advantage of these informative, 30–60 minute sessions on topics ranging from selecting the best stationary phase for your analysis to the new Stop-Flow GC technique. There's a session for everyone, and they're all free to Pittcon® attendees.

**The fine print:** To win the digital camera, you must register in person by bringing this completed survey to booth #2472 or by completing the same survey at booth #2472. If you win the camera, completion of the customer survey gives Restek the right to publish your name as winner on our website. Discovery of a unique camera playing card in the promotional Restek deck of playing cards does not imply winning until verified by Restek. Prize value not to exceed $400. Winner is responsible for any applicable sales tax and shipping/handling charges. Value cannot be applied to an account balance, gift certificates, or Wizard Dollar merchandise. Winner need not be present to win, but unique camera playing card must be verified by Restek. Prize must be redeemed by June 1, 2004. For a list of winners, go to www.restekcorp.com after March 25, 2004. Free gift offer good while supplies last. Restek reserves the right to choose camera make and model based on availability at time of prize redemption. Good luck!

# Free gift!

Complete the short survey below, bring it to booth #2472, and pick up your free Restek playing cards. Find the camera card and win a digital camera!

If you're not going to Pittcon® and want a free deck of Restek playing cards, visit us online at www.restekcorp.com/cards

# Customer Survey

Name: _____

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Phone: _____ Fax: _____

E-mail: _____

**I would like to receive Restek's technical literature by:**

❑ E-mail ❑ Mail ❑ Both ❑ Do not wish to receive literature

**Analytical Technique or Product Area:** (please check all that apply)

❑ Analytical Reference Materials (Chemical Standards)

❑ GC ❑ LC ❑ Sample Prep

**Check all of the following that represent your company's work:**

❑ Environmental

❑ Forensics

❑ Chemical

❑ Petrochemical

❑ Other

**Chec**

**Envi**

❑ Vo

❑ Di

❑ Ai

❑ Ex

❑ Ot

**Food**

❑ Fl

❑ Foods ❑ Vitamins ❑ Alcoholic Beverages

❑ Agriculture ❑ Functional Foods ❑ Amino Acids/Proteins

❑ Preservatives ❑ Food Contaminants ❑ Nutraceuticals

❑ Other

**Nutraceuticals**

❑ Dietary Supplements ❑ Food Ingredients ❑ Raw Materials

❑ Other

**Pharmaceutical/Clinical/Forensics**

❑ Pharmaceutical ❑ Narcotics ❑ Residual Solvents-USP 467

❑ NSAIDS ❑ Clinical ❑ Residual Solvents-European

❑ Steroids ❑ Forensics ❑ Amino Acids/Proteins/Peptides

❑ Drugs of Abuse ❑ Analgesics ❑ Alpha- & Beta- Blockers

❑ Vasodilators ❑ Antibiotics ❑ Antiarrhythmics

❑ Antidepressants ❑ Hormones ❑ Calcium Channel Blockers

❑ Erectile Dysfunction ❑ Nutritionals ❑ Oral Contraceptives

❑ Bronchodilators ❑ Antitussives ❑ Anti-Inflammatory

**Surface Preparation/Deactivation—Metal/Glass Coating Needs:**

❑ Passivation of Metal Surfaces ❑ Anti-Coking ❑ Bio-Inert

❑ Passivation of Glass Surfaces ❑ Sulfur Inertness ❑ NOx Gases

# Are You Game?

Visit us at Pitton® booth# 2472 to pick up your free deck of Restek playing cards and a chance to win a digital camera.

Simply complete the short survey on the other side of this page, turn it in at our booth, and a deck of cards is yours. While you're there, talk with the chromatography experts about how innovative Restek products can save time and money in your lab.

Not going to Pittcon®? Visit us online to get your free deck of cards: www.restekcorp.com/cards

Look inside for a schedule of oral and poster presentations, as well as details on free technical workshops.

## The winners of Restek's raffle at the Eastern Analytical Symposium were:

**Monday Nov.17th**

1st Prize Andrea Pless, Cephalon, Inc., West Chester, PA
2nd Prize Samuel Apkarian, Markem Corp, Keene, NH

**Tuesday, Nov. 18th**

1st prize Hajee Mohamed, LNK International, Hauppage, NY
2nd Prize Edmund Buschmann, Johnson & Johnson Consumer Products, Skillman, NJ

**Wednesday, Nov 19th**

1st Prize Vitthal Patel, IVAX Pharmaceutical, Northvale, NJ
2nd Prize Deepti Ahuja, Bristol Myers Squibb, Pennington, NJ

First prize each day was a New Jersey Devils hockey team authentic game jersey; second prize was a Devils team cap or team logo hockey puck.

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