

the

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Advantage

Innovators of High Resolution
Chromatography Products

Secure, Reliable

Column-to-Column Connections

With a Vu2 Union™ Capillary GC Column Connector*



By Mike Goss, Instrument Innovations Team, and Donna Liddett, GC Accessories Marketing Manager

- ✓ Reliable seal integrity under rapid temperature changes or other stress.
- ✓ Easy to use.
- ✓ Visually confirm the seal.
- ✓ Fits all fused silica tubing from 0.33mm - 0.74mm OD.*

Our new Vu2 Union™ connector combines the simplicity of our Press-Tight® union with the durability of a metal union, to reliably couple an analytical column to a transfer line, a guard column, or another analytical column. The columns cannot unexpectedly disconnect if the connector is bumped or vibrated, or after repeated cycles to temperatures as high as 400°C.

How does a Vu2 Union™ connector work?

A Press-Tight® union in the Vu2 Union™ connector joins the fused silica ends together (Figure 1); the ferrule and knurled nut at each end of the connector hold the tubing in place via a secondary seal between the ferrule and the Press-Tight® union. The knurled nuts apply pressure to the ferrules, to make a leak-tight seal. These ultra-strong connections will not unexpectedly disconnect when subjected to tem-

perature changes, vibrations, or other stresses normally encountered in GC analyses. The open design allows visual evaluation of the seal between the column and the Press-Tight® union, to confirm the connection. The connector is designed to hang from the column cage, to minimize stress on the connections.

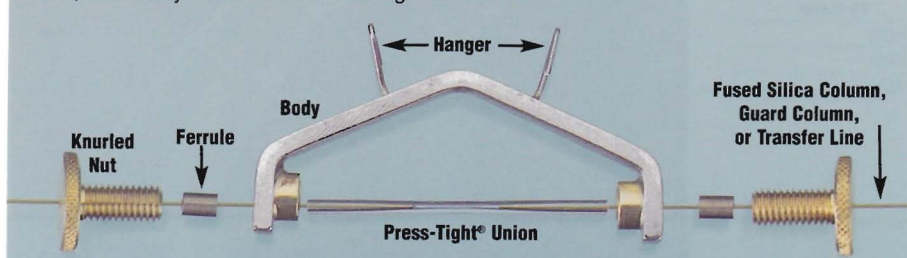
Who will benefit from using Vu2 Union™ connectors?

Any analyst using guard columns, transfer lines, or restrictor tubing, or performing a dual-column analysis with columns connected in series, or seeking to repair a broken column will find a Vu2 Union™ connector the simple, reliable, easy-to-use solution to their connection need (Figure 2, page 2).

•Patent pending.

*Restek 0.1mm - 0.53mm ID tubing.

Figure 1 — The Vu2 Union™ connector's open design allows visual confirmation of the seal; secondary seals ensure a leak-tight connection



When should you use a Vu2 Union™ connector?

Use a Vu2 Union™ connector when you:

- Connect a guard column to an analytical column.
- Connect a column to a transfer or restrictor line.
- Connect two columns in series.
- Repair a broken column.

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- Detector Components
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Vespe® Ring Inlet Seals.
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in this issue

Vu2 Union™ Connector Kits

Each kit includes: Vu2 Union™ body, 2 Press-Tight® unions, 2 knurled nuts, and 4 ferrules. Change column diameters - even mix column diameters - in the Vu2 Union™ body in any of the kits simply by ordering appropriate ferrules for the columns you wish to connect.

Description	Fits Column ID	qty.	cat.#
Vu2 Union™ Connector	0.15–0.25mm	kit	21105
Vu2 Union™ Connector	0.28/0.32mm	kit	21106
Vu2 Union™ Connector	0.45/0.50 & 0.53mm	kit	21107
Knurled nut		2-pk.	21108

Universal Press-Tight® Connectors

- Connect guard columns to analytical columns.
- Repair broken columns.
- Connect column outlets to transfer lines.

qty.	cat.#
5-pk.	20400
25-pk.	20401
100-pk.	20402

Deactivated, Universal Press-Tight® Connectors

- High-temperature silanization for excellent inertness.
- Ideal for trace analysis of active compounds.
- Ideal for analysis of pesticides, semivolatile pollutants, or clinical/forensic samples.

qty.	cat.#
5-pk.	20429
25-pk.	20430
100-pk.	20431

Intermediate-Polarity Deactivated Guard Columns & Transfer Lines

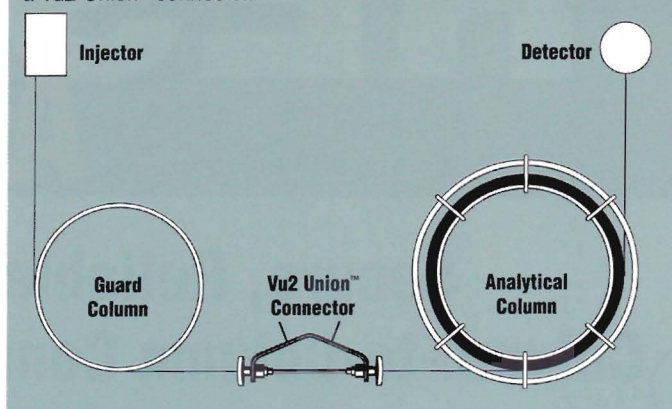
Nominal ID	Nominal OD	5-Meter	5-Meter/6-pk.
0.10mm	0.363 ± 0.012mm	10041	
0.15mm	0.363 ± 0.012mm	10042	
0.18mm	0.37 ± 0.04mm	10046	
0.25mm	0.37 ± 0.04mm	10043	10043-600
0.28mm	0.37 ± 0.04mm	10003	10003-600
0.32mm	0.45 ± 0.04mm	10044	10044-600
0.45mm	0.69 ± 0.04mm	10005	10005-600
0.53mm	0.69 ± 0.05mm	10045	10045-600

Nominal ID	Nominal OD	10-Meter	10-Meter/6-pk.
0.25mm	0.37 ± 0.04mm	10049	10049-600
0.32mm	0.45 ± 0.04mm	10048	10048-600
0.53mm	0.69 ± 0.05mm	10047	

Polar Deactivated Guard Columns & Transfer Lines

Nominal ID	Nominal OD	5-Meter	10-Meter
0.25mm	0.37 ± 0.04mm	10065	10068
0.32mm	0.45 ± 0.04mm	10066	10069
0.53mm	0.69 ± 0.05mm	10067	10070

Figure 2 — A guard column connected to an analytical column by a Vu2 Union™ connector.



Graphite Ferrules for Vu2 Union™ Connectors

- High-purity, high-density graphite.
- Stable to 450°C.
- No binders that can off-gas or adsorb analytes.
- Smooth surface and clean edges.



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



Vu2 Union™

Efficient Analysis of Water-Miscible Solvents in Cleaning Products

Using an Rtx[®]-VMS Capillary GC Column

By Rebecca Wittrig, Ph.D., Senior Innovations Chemist

- ✓ Higher initial oven temperatures allow greater sample throughput.
- ✓ Excellent selectivity for resolving closely-related alcohols and other solvents.
- ✓ Consistent column-to-column performance for quality control analyses.

Consumers use a wide range of products to promote personal hygiene, improve personal appearance, and reduce levels of microorganisms in the home environment. Their choices make the cleaning and personal care products industry a multi-billion dollar industry.¹ The Soap and Detergent Association (SDA)² groups soaps and detergents into four general categories: personal cleansing, laundry, dishwashing, and household cleansing. As with all other consumer products, there is a need to test both raw materials and final products in each of these categories. Composition and quality control analyses for many of these products can be performed by gas or liquid chromatography. For example, volatile components, such as alcohols, can be monitored by using an Rtx[®]-VMS capillary GC column.

Various ingredients are needed in cleaning and personal care products, to solubilize soils, wet surfaces,

mask odors, provide color, or perform other functions. Solvents are included in these products primarily to dissolve organic soils. Aside from safety considerations, the main criterion for a solvent used in cleaning products is miscibility with water, as the solvent must form a solution with other water-soluble components. Solvents that meet the criteria for use in consumer cleaning products include alcohols and glycols. In addition to water miscibility, these solvents clean without leaving residue, making them especially useful in products designed for cleaning environmental surfaces, such as glass cleaners.


Water-soluble solvents in cleaning products are analyzed by gas chromatography to ensure product quality and to further new product development. A 60m x 0.25mm ID x 1.4µm film Rtx[®]-VMS capillary GC column is an excellent choice for analyzing a wide range of cleaning solvents (Figure 1). These

Coming soon!
New technical guide:

Analyzing Cleaning and Personal Care Products by Gas and Liquid Chromatography

columns exhibit excellent selectivity for closely related alcohols, such as ethanol, isopropanol, *tert*-butanol, and *n*-butanol. An Rtx[®]-VMS column is compatible with higher initial oven temperatures—note the 60°C starting temperature in Figure 1—allowing greater sample throughput due to faster oven stabilization time. Analyses of typical consumer cleaning products, an all-purpose cleaner and a glass cleaner, are shown in Figure 2.

Summary

An Rtx[®]-VMS capillary column makes these analyses faster, with highly reliable results, and is an excellent choice for this application. 

References

1. Branna, T. *The I&I Market*. Happy. Nov. 2000.
2. The Soap and Detergent Association. Website: www.sdaq.org

Ordering Information | Rtx[®]-VMS Columns

Rtx[®]-VMS columns are listed on page 4.

Figure 1 — Commonly used cleaning solvents on an Rtx[®]-VMS column. Unique selectivity allows a 60°C starting temperature, for fast sample throughput.

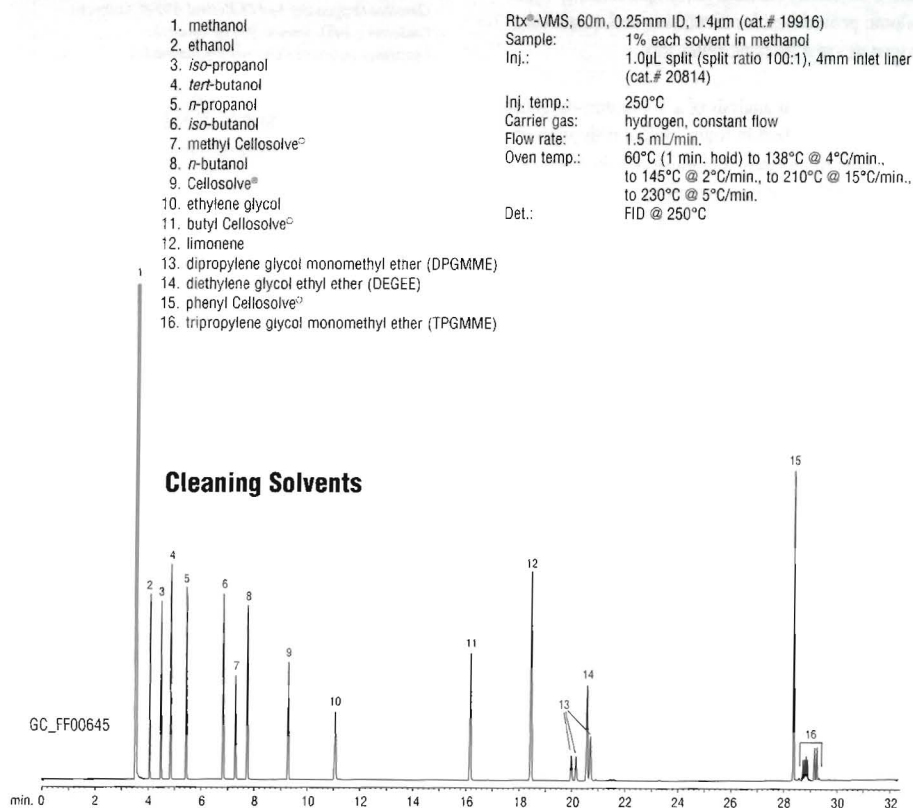
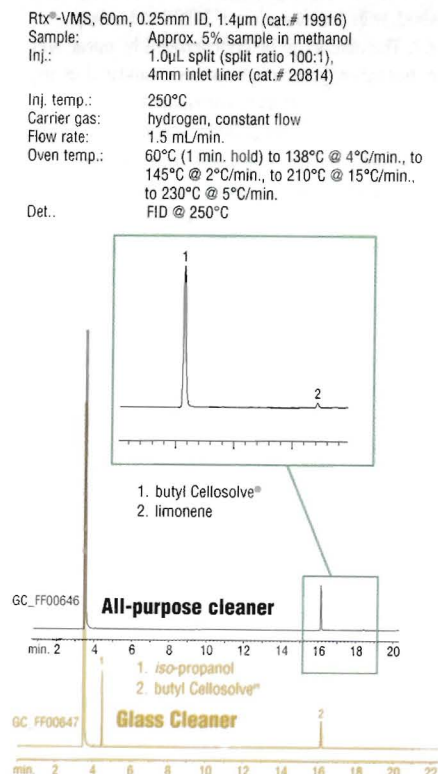


Figure 2 — Use an Rtx[®]-VMS column to quantify a wide range of cleaning solvents.



Resolve Trace Oxygenates from a Gasoline/Water Composite Using an Rtx®-VMS Capillary GC Column

By Christopher English, Environmental Innovations Chemist

- ✓ High accuracy—oxygenate recoveries better than 90%.
- ✓ Resolve oxygenates from potentially interfering gasoline components and volatile target compounds, by US EPA Method 8260.
- ✓ High speed—30-minute cycle time.

With the elimination of lead from gasolines, oxygen-containing compounds have become important performance-enhancing components. Oxygenated compounds most commonly added to gasoline are methanol, ethanol, *tert*-butanol (TBA), methyl *tert*-butyl ether (MTBE), diisopropylether (DIPE), and ethyl-*tert*-butylether (ETBE). Of these, MTBE is the primary additive. Contamination of ground and surface water with these and other gasoline components is a major concern. Identifying and quantifying the oxygenates from among the highly concentrated hydrocarbons in a gasoline/water matrix is a challenging task. Some compounds (e.g., MTBE and TBA) coelute on many capillary GC column stationary phases and share ions used for identification by MS.

Our investigations, and others, show that US EPA Method 8260, a purge and trap / capillary GC / mass spectrometry method, is the most reliable method for detecting oxygenated components in complex gasoline/water samples, regardless of the concentration of the gasoline.¹ In the United States, the oxygenates have not been written into any US EPA Method, with the exception of MTBE in Method 524.2. The ethers can be concentrated by purge and trap, but this approach has not been validated in any SW-846 method. Methanol and ethanol are poorly suited to analysis by purge and trap techniques. In Method 8015, a flame ionization detector (FID) is used to match a known pattern of gasoline with an unknown sample containing peaks that fall within the gasoline pattern range. This method can be used to identify oxygenates by retention time, but the high probability of misidentifications dictates confirmation on a second column. Method 8021 is specifically for analysis of aromatic and halogenated volatiles, with detection by photoionization detector (PID). This is the least desirable of the potential methods for monitoring oxygenates, because the PID is very sensitive to double bonds, but is much less sensitive to oxygenates. Our analysis of a gasoline composite standard, for example, produced a false positive for diisopropyl ether. Using GC/MS for confirmation, the compound was identified as 2-methyl-1-pentene.² Despite this problem, many state GRO methods use PID for the analysis of MTBE.

We evaluated the performance of four stationary phases for recovery of oxygenates, verifying passing criteria using modified EPA Method 5030B and Method 8260.³ Non-oxygenated gasoline samples

were spiked with low (ppb) levels of oxygenates to determine if operating conditions were appropriate for separating and detecting the target compounds in the presence of high concentrations of gasoline hydrocarbons. Purge and trap conditions in Method 5030B were modified for concentrating the oxygenates: we replaced the standard ambient purge with a 40°C purge. When possible, GC oven conditions were optimized for each stationary phase, to overcome coelutions of analytes that share ions (e.g., TBA and MTBE).

The instrument was calibrated using a 5-point curve. We calculated response factors (RFs) & relative standard deviations (RSDs) for the target compounds in Method 8260, then added all of the target compounds and the correct Method 8260 internal and surrogate standards to our calibration mix (84 additional target compounds), to ensure there were no coelutions of 8260 target compounds with the oxygenates. Of the columns used in this investigation, a 30-meter, 0.25mm ID, 1.4µm film Rtx®-VMS column proved best for identifying and quantifying oxygenates in a gasoline/water mix.

Figure 1 shows an analysis of a 1ppm non-oxygenated gasoline standard in water, spiked with 5ppb of each of the oxygenates, and illustrates the value of the Rtx®-VMS column in identifying and quantifying oxygenates in high levels of gasoline hydrocarbons.

The inset to the center in Figure 1 shows a portion of the total ion chromatogram with the extracted ion chromatogram for the oxygenates to scale. The inset to the center is an enlargement of the extracted ion chromatogram for the oxygenates; the clean peaks indicate that there is no interference from non-target gasoline fragmentation ions. TBA and MTBE are well resolved using the 35°C initial temperature. The column elutes the methyl-naphthalenes in less than 23 minutes, with a cycle time of 30 minutes. Using average response factors calculated from the calibration curve, we determined that oxygenate recoveries were better than 90%.⁴

This investigation established that an Rtx®-VMS column resolves oxygenates from potentially interfering gasoline components and Method 8260 target compounds. It is well suited to resolving the expanding Method 8260 target compound list, and can be used to identify low levels of analytes in contaminated/complex matrices. An Rtx®-VMS column is the clear choice for the most demanding volatile organics analysis.✱

References

1. Happel, A.M., E.H. Beckenbach, R.U. Halden, *An Evaluation of MTBE Impacts to California Groundwater Resources* Lawrence Livermore National Laboratory, UCRL-AR-130897 (1988).
<http://www-erd.llnl.gov/mtbe/pdf/mtbe.pdf>
2. C. English, C. Cox, F. Dorman, D. Patwardhan, *The Analysis of Gasoline Oxygenates Using a New Capillary Column Stationary Phase*, Pittsburgh Conference 2001, Session 199 (poster).
<http://www.restekcorp.com/2001/1868P.pdf>
3. U.S. Environmental Protection Agency, *Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS): Capillary Column Technique Method 8260*, July 1992 Revision 0, US EPA Office of Solid Waste, Washington, D.C.
4. C.M. English, E.L. Dorman, G.B. Stidsen, *The Analysis of Gasoline Oxygenates by EPA Method 8260B* Pittsburgh Conference 2003, Session 590-6P (poster).
<http://www.restekcorp/pittcon2003.htm#slides>

For more details of this work, see reference 4.

Ordering Information | Rtx®-VMS (Fused Silica)

ID	df (µm)	temp. limits	30-Meter	60-Meter	75-Meter
0.25mm	1.40	-40 to 240/260°C	19915	19916	
0.32mm	1.80	-40 to 240/260°C	19919	19920	
0.45mm	2.55	-40 to 240/260°C	19908	19909	
0.53mm	3.00	-40 to 240/260°C	19985	19988	19974
ID	df (µm)	temp. limits	20-Meter	40-Meter	
0.18mm	1.00	-40 to 240/260°C	49914	49915	

California Oxygenates Mix

diisopropyl ether 2,000µg/mL
ethyl-*tert*-butyl ether 2,000
tert-amyl methyl ether 2,000
tert-butyl alcohol 10,000
methyl *tert*-butyl ether 2,000
In P&T methanol, 1mL/ampul

Each	5-pk.	10-pk.
30465	30465-510	—
w/data pack		
30465-500	30465-520	30565

8260B MegaMix™ Calibration Mix (76 + 1 components)

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

Each	5-pk.	10-pk.
30475	30475-510	—
w/data pack		
30475-500	30475-520	30575

*2-chloroethyl vinyl ether provided in a separate ampul.

Figure 1 — Detect trace oxygenates, using an Rtx®-VMS column.

Rtx®-VMS, 30m, 0.25mm ID, 1.4µm (cat. # 19915)

Sample: calibration mixes: cat. # 30475 (ampul 1 + ampul 2), 30465, 30006, 30042;
non-oxygenated unleaded gasoline (custom) internal / surrogate
standards: cat. # 30240, 30074**Purge and Trap Conditions**

O.I. 4560 Purge and Trap Concentrator

Sample: 10mL

Sample Temp.: 40°C

Trap: #10 (Tenax®/silica gel/carbon molecular sieve)

Trap Temp.: purge: 20°C; desorb: 190°C; bake: 210°C

Purge: 11 min., 38mL/min.

Desorb: 1.0 min., 32mL/min.

Bake: 10 min.

Chromatography

Inj. Temp.: 250°C, split 25:1

Carrier Gas: helium, constant flow

Flow Rate: 1.3mL/min.

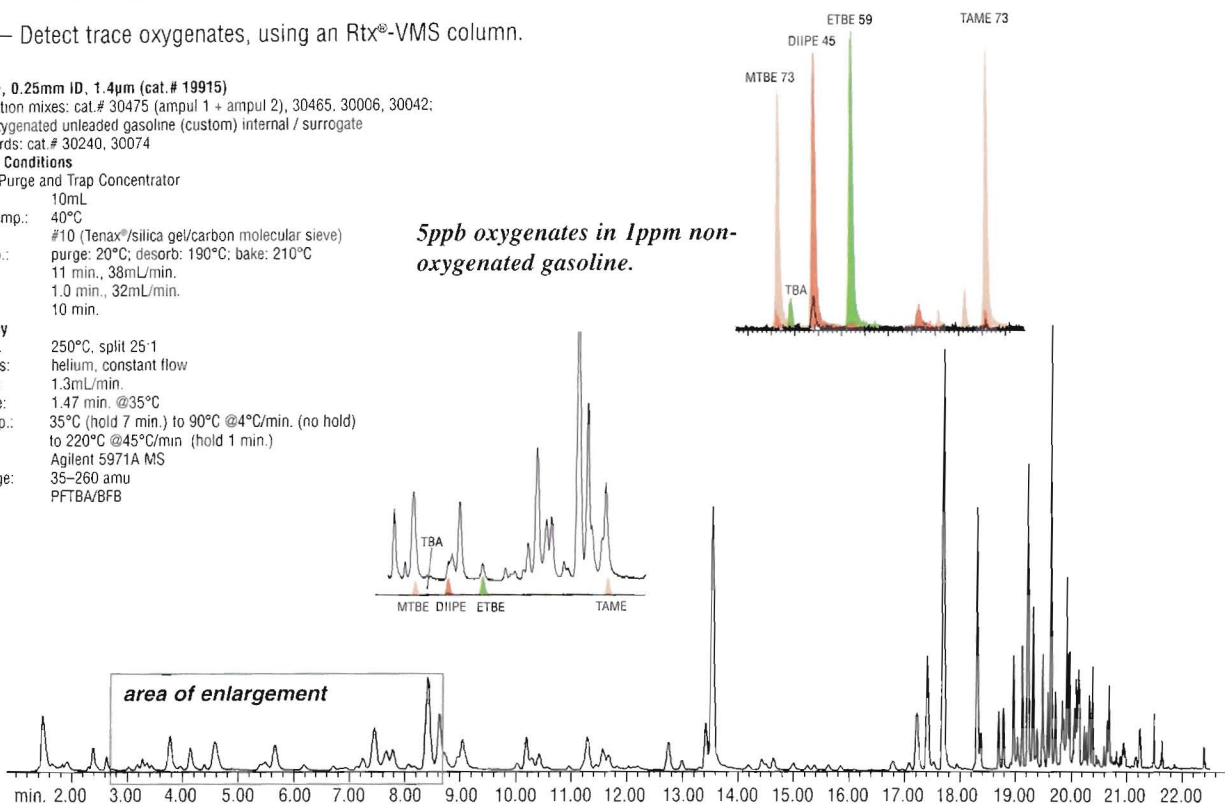
Dead Time: 1.47 min. @35°C

Oven Temp.: 35°C (hold 7 min.) to 90°C @4°C/min. (no hold)
to 220°C @45°C/min (hold 1 min.)

Det.: Agilent 5971A MS

Scan Range: 35–260 amu

Tune: PFTBA/BFB

5ppb oxygenates in 1ppm non-oxygenated gasoline.

GC_EV00679

Acknowledgement: purge and trap courtesy of O.I. Analytical.

US EPA Underground Storage Tank (UST) Monitoring Program

Reference publications for recommended methods

- ✓ Helpful checklists for the latest state and EPA UST methods:
 - analytical reference materials
 - sample preparation supplies
 - chromatography columns and accessories
- ✓ Conveniently organized by method—easy setup / easy reorder of consumables

In the late 1980s the US Environmental Protection Agency (US EPA) established the Office of Underground Storage Tanks (OUST) to enforce federal laws on environmental contamination from petroleum products. Underground Storage Tank (UST) systems installed before December 22, 1988 had no protection against spills or overfills, and were likely to corrode and leak. OUST mandated that by December 22, 1998, all UST systems were to be prevented from contaminating nearby groundwater and soil. Existing systems were to be protected from spills, overfills, and corrosion, or replaced with new systems incorporating such protection.

Many of the unprotected UST systems have been properly treated, but the need for monitoring UST systems persists. OUST has been actively enforcing federal UST regulations.

OUST has recommended specific EPA methods for UST applications. A majority of the states still use these methods, but many states have developed methods of their own for UST analysis.

To help laboratories comply with and use the appropriate analytical procedures, Restek has been active in following EPA and state guidance. Based on our knowledge and experience with these methods, our chemists have developed lists of the appropriate chromatographic tools, and formulated analytical reference products, to help ensure successful analyses. Comprehensive listings of quality chromatographic columns, analytical reference materials, and sample preparation products for latest state methods are featured in an expanding group of Restek publications. In these listings, you will find everything you need to quickly set-up or reorder consumables for UST methods.

Request comprehensive product listings for latest state UST methods

Reference Standards

Pattern Recognition Standards

- GRO – gasoline composites, including composite weathered gasoline standards
- DRO – including a composite arctic range diesel standard
- RRO – motor oil composites, including composite used motor oil
- Weathered fuels and oils
- Mineral oils
- Military fuels

State-specific UST calibration formulations

Retention time marker standards

Internal standards

Surrogate standards

Reference materials conveniently organized by method number

Custom mixtures available - ask us for a quote

For copies of these publications, fill out the reply card at the center of this **Advantage**. Select from these current UST publications: AK - CA - FL - IA - MA - TX - WI - Northwest (WA / OR) or USEPA

For custom mixes, use the quote form in our general catalog, or on our web site (www.restekcorp.com), or fax 814-355-2895.

Remember: we will be happy to provide a quote on any custom reference mixture, column, or other consumable you need!

Improved Resolution of Dioxins and Furans by GC-High-Resolution Mass Spectrometry, Using an Rtx®-Dioxin Capillary Column

By Frank L. Dorman, Ph.D., Director of Technical Development

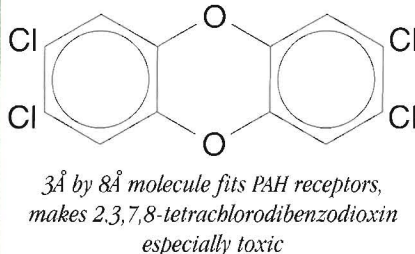
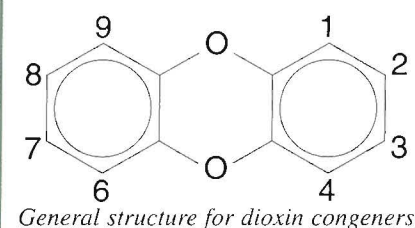
- ✓ Improved separation of dioxin and furan congeners, compared to 5% diphenyl columns.
- ✓ Greater thermal stability than 5% diphenyl columns or high-cyano confirmation columns.
- ✓ May eliminate confirmation analysis.

Gas chromatographic analysis coupled to high-resolution mass spectrometry is a common method of evaluating environmental samples for dioxins and furans. Dioxins and furans are monitored due to the toxicity of congeners that have chlorine substitution at positions 2, 3, 7, and/or 8 (Figure 1). In the US, the most common analysis methods for these compounds are USEPA methods 1613 and 8290, but the analysis is performed similarly in many countries. The overall goal of the analysis is to accurately quantify the 17 toxic dioxin and furan congeners by separating them from 119 other congeners.

In order to achieve the desired separation, most methods describe an initial analysis on a 5% diphenyl/95% dimethyl polysiloxane stationary phase. If 2-, 3-, 7-, and/or 8-substituted congeners are detected in this analysis, most methods require a confirmatory analysis on a stationary phase that separates these congeners from the less toxic congeners. While no single column has been universally agreed upon as the best confirmation column, most analysts use a high-cyano stationary phase. While these columns offer better separation of the 2-, 3-, 7-, 8-substituted congeners, analysts using any of them must contend with poor thermal stability (maximum operating temperatures of approximately 250°C) and poor column lifetimes, compared to 5% diphenyl-type columns used for the primary analysis. The difficulty with using the results from 5% diphenyl columns is that there are several known coelutions of environmentally-occurring 2-, 3-, 7-, 8-substituted congeners with less toxic congeners. This leads to falsely high values for the toxic congeners on the 5% diphenyl column, and to unnecessary confirmatory analysis.

An ideal stationary phase for this application would combine excellent separation, high thermal stability and, thereby, long column lifetime. With these goals in mind, Restek has developed the Rtx®-Dioxin column. The new, proprietary stationary phase, specifically developed for dioxins/furans analysis, is stable to temperatures above 425°C. When coated onto high-temperature fused silica tubing, the thermal limit of the column is a function of the polyimide outer coating: 380°C. Not only is this a major improvement over the thermal stability of high-cyano phases, it is an improvement over the capabilities of 5% diphenyl phases as well.

Figure 1 — Chlorine substitution in the basic dioxin structure creates 136 congeners.



An Rtx®-Dioxin column better separates the dioxin and furan congeners, compared to 5% diphenyl columns. Most analysts experienced with dioxin and furan separations are familiar with the 4-peak tetrachlorodibenzodioxin mass pattern from a 5% diphenyl column, as shown in Figure 2A. An Rtx®-Dioxin column separates all five components in the resolution check mixture for this mass window—a significant improvement (Figure 2B). Note that 1,2,3,7-TCDD and 1,2,3,8-TCDD are tentatively identified; reference materials for individual congeners are not available.

Because few of the individual dioxin and furan congeners are available as reference materials, analysis of fly ash extracts is the accepted test of whether a column resolves the toxic congeners from the non-toxic congeners. In analyses of three fly ash extracts used in a recent international round-robin study, data from an Rtx®-Dioxin column agreed to within $\pm 10\%$ of the "true" values for all 2-, 3-, 7-, 8-substituted congeners, except for one penta- and one hexa-furan. This also is a significant improvement over 5% diphenyl column performance for the primary analysis. Table 1 (page 7) summarizes data for 2,3,7,8-tetrachlorodibenzofuran from an Rtx®-Dioxin column, a 5% diphenyl column, and a high-cyano column, compared to median and mean from an international round-robin study. Excellent agreement between the median and the mean, and between the Rtx®-Dioxin column and the study data, gives confidence in the proximity to the "true" value. Further work toward optimizing flow and oven temperature is in progress, to determine if the Rtx®-Dioxin column could eliminate the need for high-cyano phases for confirmation.

In summary, the new Rtx®-Dioxin column is a significant improvement over 5% diphenyl columns commonly used in the primary analysis for dioxins and

Continued on page 7

Figure 2 — Rtx®-Dioxin column separates all five components in the resolution check mixture.

Conditions

Instrument: Micromass Altima high resolution GC/MS
Column: Rtx®-Dioxin, 40m, 0.18mm ID, 0.10µm (cat.# 10756)
Initial temp.: 130°C

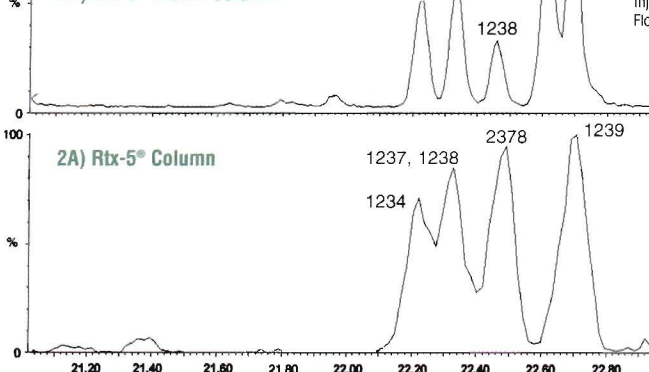
Temperature program:

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

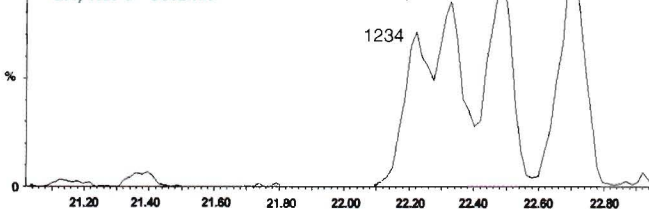
Injector temp.: 270°C
Flow: 1.2mL/min. (constant pressure)

TCDD-resolution mixture

2B) Rtx-5° Dioxin Column




2A) Rtx-5° Column



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

Dioxins and Furans by GC-High Resolution MS... Continued from page 6

furans. The column also shows potential as a replacement for high-cyano confirmation phases with poor thermal stability and short lifetimes. We continue to work to optimize a temperature program that resolves all of the toxic congeners, with a goal of eliminating the need for confirmation.

If you are involved in the analysis of dioxins and furans, and would like additional information about Rtx®-Dioxin columns, please contact Frank Dorman at 1-800-356-1688, ext. 2186, or by e-mail at frank@restekcorp.com 

Acknowledgements

Chromatography courtesy of Karen MacPherson and Eric Reiner, Ontario Ministry of the Environment, Etobicoke, ON, Canada. Reference materials courtesy of Brock Chittam, Wellington Laboratories, Guelph, ON, Canada.

Table 1 — Excellent agreement between Rtx®-Dioxin column and round-robin study data.

Sample	Column / 2,3,7,8-tetrachlorodibenzofuran (pg/g)				
	DB-5*	DB-225**	Rtx®-Dioxin	Median***	Mean***
Fly Ash A	250	21	30	28	32
Fly Ash B	2100	300	378	390	390
Fly Ash C	170	19	28	27	32

*5% diphenyl column.

**high-cyano column.

***n > 110 laboratories.

Ordering Information | Rtx®-Dioxin Columns

ID	df (µm)	temp. limits	40-Meter	60-Meter
0.18mm	0.10	-60°C to 380°C	10756	—
0.25mm	0.15	-60°C to 380°C	—	10755

New Books Available from Restek

Mass Spectrometry Basics

C. G. Herbert and R. A. W. Johnstone
CRC Press, 2002, 496 pp.
ISBN 0-8493-1354-6
cat.# 21461

Liquid Chromatography-Mass Spectrometry: An Introduction

B. Ardrey
John Wiley, 2003, 296 pp.
ISBN 0-471-49799-1
cat.# 21462

DNA Chromatography

D. T. Gjerde, C. P. Hanna and D. Hornby
Wiley-VCH, 2002, 244 pp.
ISBN 3-527-30244-1
cat.# 21463

Chromatography and Separation Science

S. Ahuja
Academic Press, 2002, 250 pp.
ISBN 0-12-044981-1
cat.# 21464

Flavor, Fragrance, and Odor Analysis

R. Marsili
Marcel Dekker, 2001, 440 pp.
ISBN 0-8247-0627-7
cat.# 21465

Solid Phase Microextraction. A Practical Guide

S. A. Scheppers Wercinski
Marcel Dekker, 1999, 264 pp.
ISBN 0-8247-7058-7
cat.# 21466

Advances in Chromatography, Volume 42

P. R. Brown and E. Grushka
Marcel Dekker, 2003, 448 pp.
ISBN 0-8247-0950-0
cat.# 21467

Dioxin 2003

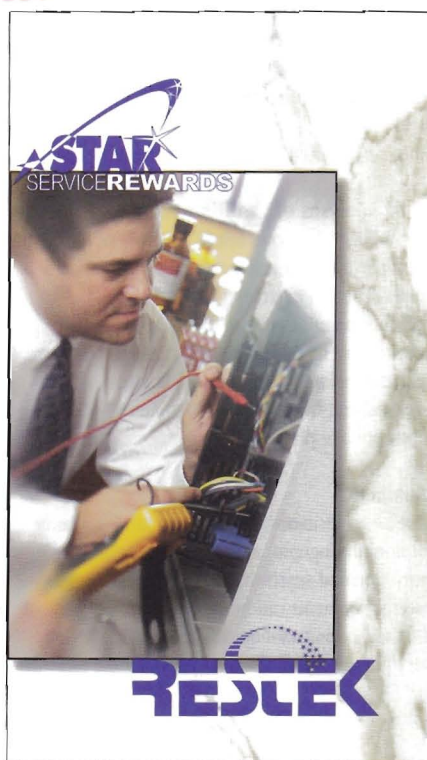
The annual meeting of world experts on these important and controversial materials, the 23rd International Symposium on Halogenated Organic Pollutants and Persistent Organic Pollutants, will be held at the Westin Copley Place Hotel, Boston, MA, August 24-29, 2003.

Specialists in dioxin research will make more than 500 presentations and discuss current knowledge. "Hot topics" sessions will focus on endocrine disrupters, Arctic POPs, neurotoxicity, ultimate trace method, and more.

For details, visit www.dioxin2003.org or contact Laura Biringier, 617-262-3424 / Lbiringier@mpwi.org

Dioxin 2003

new!



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- Call Restek Customer Service at 800-356-1688 ext.3, or
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Faster Separations and Greater Sensitivity

Using Restek HPLC Columns and Fast LC Cartridge Columns

By Vernon Bartlett, Innovations Team Manager, Terrence S. Reid, HPLC Applications Chemist, and Rebecca Wittrig, Ph.D., Senior Innovations Chemist

- ✓ Save time—significant increases in sample throughput; fast re-equilibration in gradient analyses.
- ✓ Save money—reduced solvent consumption reduces purchase and disposal costs.
- ✓ Good screening technique for unknown analytes.
- ✓ Excellent for LC/MS applications.

Analysis time for many HPLC separations can be drastically reduced by using fast LC. In the example separations we show here, analysis times of 20 to 40 minutes by conventional HPLC are reduced by 60 to 75%. Further, because columns employed in fast LC analyses typically are less than 100mm long, analytes spend less time in the column. Consequently, these dramatically reduced analysis times are accompanied by improved sensitivity, due to reduced band spreading.

Fast LC analyses can be performed using either cartridge-style fast LC columns or short, conventional design HPLC columns, typically containing 3µm silica-based packings. In addition to the performance improvements attributable to short columns and small packing particles, gains also can be realized by using optimized, highly selective stationary phases. Selective phases improve separation among sample components with minimal changes in mobile phase strength. Analysts who reduce mobile phase strength

in attempts to improve selectivity and/or retention often find k' is increased drastically, and analysis time is unacceptably prolonged.

There are several precautions to observe before using fast LC columns and methods. Critical separations are more sensitive to system volume; evaluate tubing lengths and system component specifications with a goal of minimizing internal volume. Also, highly selective stationary phases can be required for difficult separations (e.g., structural isomers)—we recommend discussing your intended application with our Technical Service group before ordering columns and attempting a new analysis. Finally, fast LC is not recommended for normal phase separations, nor for ion-pairing separations when gradients are required.

Fast LC Separation of *Digitalis* Derivatives

Figure 1 shows an analysis of *Digitalis* extracts and derivatives on an experimental 30mm x 4.0mm Ultra Alkaloids Fast LC cartridge column, using a simple water:acetonitrile mobile phase gradient. The analysis is completed in 3 minutes, with excellent separation of the sample components. This is dramatically reduced analysis time, relative to the cumbersome analysis on a 30cm C18 column. The fast LC approach, using this specialized stationary phase, can be applied to purification and analysis of digoxin-labeled materials in investigations of biological activity, and is perfect for high-speed cleaning validations.

Figure 1 — *Digitalis* derivatives separated in 3 minutes on a fast LC cartridge.

Peak List:	Conc.	Ret. Time (min.)
1. digoxigenin	100µg/mL	0.40
2. gitoxigenin	100µg/mL	0.80
3. digoxin	100µg/mL	1.10
4. gitoxin	~10µg/mL	2.20
5. digitoxin	100µg/mL	2.60

Sample:
Inj.: 10µL
Sample Diluent: water:acetonitrile (80:20 v/v)

Column: Ultra Alkaloids Fast LC Cartridge
Catalog #: custom column
Dimensions: 30 x 4.0mm
Particle Size: 3µm
Pore Size: 100Å

Conditions:
Mobile Phase: A: water
B: acetonitrile
Time (min.) %B
0.0 20
1.5 20
1.51 35
3.0 35
3.1 20

Flow: 2.0mL/min
Temp.: 27°C
Det.: UV @ 230nm

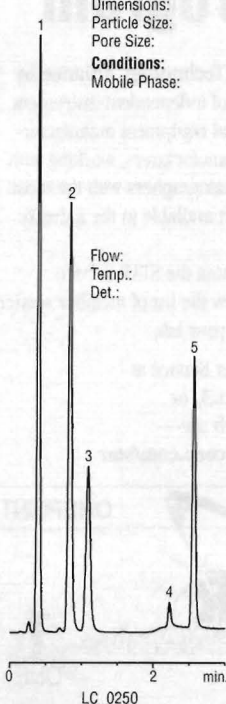
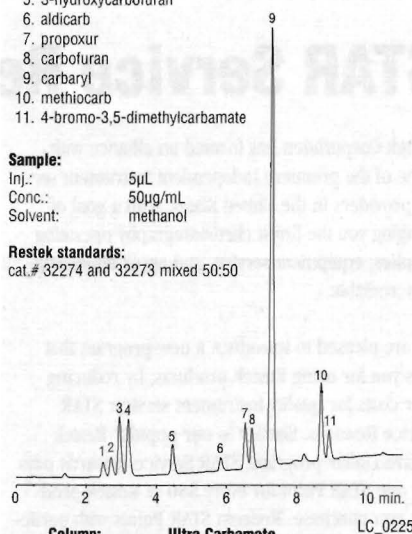


Figure 2 — Separate carbamates and re-equilibrate in 13 minutes, using a short Ultra Carbamate column.

Peak List:
1. aldicarb sulfone
2. aldicarb sulfoxide
3. oxamyl
4. methomyl
5. 3-hydroxycarbofuran
6. aldicarb
7. propoxur
8. carbofuran
9. carbaryl
10. methiocarb
11. 4-bromo-3,5-dimethylcarbamate

Sample:
Inj.: 5µL
Conc.: 50µg/mL
Solvent: methanol

Restek standards:
cat.# 32274 and 32273 mixed 50:50



Column: Ultra Carbamate

Catalog #: 9177355
Dimensions: 50 x 4.6mm
Particle size: 3µm
Pore size: 100Å

Conditions:
Mobile Phase: A: 90:10 water:methanol
B: 90:10 methanol:acetonitrile
Time (min): %B
0 10
10 90

Flow: 1.5mL/min
Temp.: 27°C
Det.: UV @ 220nm

Fast LC Separation of Carbamates

Figures 2 and 3 (page 9) illustrate fast LC analyses of carbamate pesticides by HPLC/UV and LC/MS, respectively. Total time for the HPLC/UV analysis is approximately 13 minutes; the LC/MS analysis is slightly longer, but is less than 20 minutes. Table 1 (page 9) summarizes conditions for the LC/MS analysis. Including re-equilibration time, the conventional analysis on a 250mm x 4.6mm column takes 40 minutes. Designed especially for carbamate analyses, Ultra Carbamate columns are available in several dimensions in addition to the 50mm x 4.6mm and 100mm x 4.6mm columns used here.

Fast LC Analyses of Vanillin and Vanilla Extract

Figure 4 (page 9) shows fast LC analyses of vanillin/ethyl vanillin and vanilla bean extract on a 50mm x 4.0mm Pinnacle™ DB C18 column. Excellent separations are achieved in less than 5 minutes. Conventional analyses on 150mm x 4.6mm C8 columns take 25 minutes overall with a mobile phase gradient, or more than 40 minutes with an isocratic mobile phase.

In Summary

In diverse applications, fast LC separations enhance laboratory throughput, reduce solvent waste, and improve method sensitivity. In some cases, mobile phase requirements can be simplified, from gradient elution to isocratic elution, when an optimized stationary phase is used, dramatically reducing analysis time.

With these precautions observed, fast LC can be an excellent time- and money-saving tool for many analysts and many applications. If you would like to discuss whether this approach is suitable for your application, please contact our Technical Service Group; they are ready to help you. ☛

Table 1 — Chromatographic conditions for LC/MS analysis of carbamates.

Column: Ultra Carbamate
Catalog #: 9177315
Dimensions: 100 x 4.6mm
Particle Size: 3µm
Pore Size: 100Å
Inj.: 10µL
Sample: 531.1 Carbamate Pesticide Calibration Mix (cat.# 32273)
Conc.: 100µg/mL each
Solvent: methanol
Mobile Phase: A: 90:10 water:methanol + 10mM ammonium formate
 B: 10:90 acetonitrile:methanol + 10mM ammonium formate
 90:10 A:B to 10:90 A:B from 0-15 min.
Flow: 1mL/min. (0.75mL/min. to UV, 0.25mL/min. to MS)
Temp.: ambient

MS Conditions:
Det.: Micromass ZMD
Mode: ESI+
Capillary V: 3.50
Extractor: 4.0
Ion Energy: 0.4
Multiplier: 650
Source Temp.: 100°C
Desolv. Temp.: 250°C
Gas Flow: 490 L/hr.

Compound	Ion	Cone V
1. aldicarb sulfone	223.3	25V
2. aldicarb sulfoxide	207.3	18V
3. oxamyl	237.2*	10V
4. methomyl	163.2	15V
5. 3-hydroxycarbofuran	238.3	15V
6. aldicarb	191.2	8V
7. propoxur	210.2	18V
8. carbofuran	222.3	22V
9. carbaryl	202.2	18V
10. methiocarb	226.3	19V

*Ammonium adduct; others [M+H]⁺ ions.

Figure 3 — LC/MS analysis of carbamates in less than 20 minutes, using an Ultra Carbamate column.

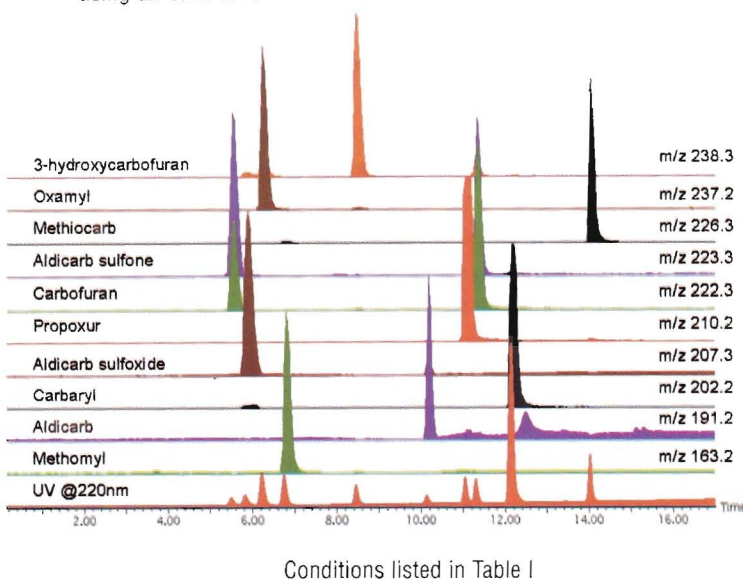


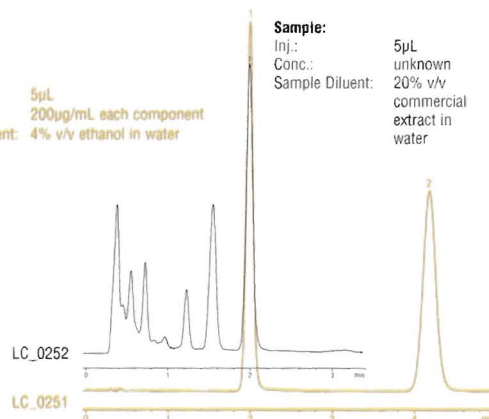
Figure 4 — Fast, highly selective analysis of vanillin/ethyl vanillin and vanilla bean extract on a PinnacleTM DB C18 column.

Peak List:	Ret. Time (min.)
1. vanillin	2.00
1. vanillin	2.00
2. ethyl vanillin	4.20

Column: PinnacleTM DB C18
Catalog #: 9414555
Dimensions: 50 x 4.6mm
Particle Size: 5µm
Pore Size: 140Å
Conditions:
Mobile Phase: A: 0.2% v/v conc. phosphoric acid in water
 B: methanol
 Isocratic: 80%A: 20%B
Flow: 2mL/min
Temp.: 27°C
Det: UV @ 254nm

Sample:
Inj.: 5µL
Conc.: 200µg/mL each component
Sample Diluent: 4% v/v ethanol in water

Sample:
Inj.: 5µL
Conc.: unknown
Sample Diluent: 20% v/v commercial extract in water



3µm Fast LC Cartridges

Description	Length	2.1mm ID	4.0mm ID
Ultra C18 Fast LC Cartridge	30mm	91743320	91743340
Ultra Aqueous C18 Fast LC Cartridge	30mm	91783320	91783340
Ultra Cyano Fast LC Cartridge	30mm	91063320	91063340
Ultra PFP Fast LC Cartridge	30mm	91763320	91763340

Fast LC Cartridge Holder

Description	qty.	cat.#
Fast LC Cartridge Holder	ea.	25298

Fast LC Development Kits

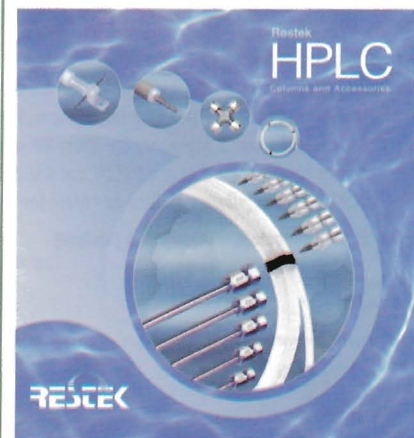
Four Fast LC Cartridges (Ultra C18, Ultra Aqueous C18, Ultra Cyano, Ultra PFP), Fast LC Cartridge Holder.

Description	qty.	cat.#
Fast LC Development Kit—30 x 2.1mm	kit	25296
Fast LC Development Kit—30 x 4.0mm	kit	25297

Additional HPLC Columns

Description	Dimensions	cat.#
Ultra Carbamate, 3µm	50mm x 4.6mm ID	9177355
Ultra Carbamate, 3µm	100mm x 4.6mm ID	9177315
Pinnacle TM DB C18, 5µm	50mm x 4.6mm ID	9414555

Request our 2003 HPLC minicatalog
 Lit. Cat.# 59241A



New Reference Materials

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

Organophosphorus Pesticides Mix

- ✓ High concentration mix.
- ✓ Includes all US EPA Method 8270 organophosphorus pesticide (OPP) target compounds.
- ✓ Enhanced stability—prepared in methanol-free methylene chloride.

This new mix complements our 8270 MegaMix™ (cat.#31686), Appendix IX Mix #1 (cat.#31625), and Appendix IX Mix #2 (cat.#31806), which do not include OPPs.

Organophosphorus Pesticide Mix, 8270/Appendix IX

dimethoate	fenphur	sulfotepp
disulfoton	methyl parathion	O,O,O-triethylphosphorothioate
ethyl parathion	phorate	zinphos (thionazine)

2,000µg/mL in methylene chloride, 1mL/ampul

Each	5-pk.	10-pk.
32419	32419-510	—
	w/data pack	
32419-500	32419-520	32519

Carbon Number Distribution Marker Standard For Texas Method 1005 Rev. 03 and Method 1006

- ✓ Includes the minimum required aliphatic markers defining the carbon ranges of interest.
- ✓ Completes set of reference materials for TNRCC methods 1005 and 1006.*

TNRCC Method 1006 is used for determining the total petroleum hydrocarbon (TPH) mass within boiling point ranges of aliphatic fractions (C6-C35).

TNRCC 1006 Retention Time Marker Mix

n-hexane (C6)	n-decane (C10)	n-heneicosane (C21)
n-heptane (C7)	n-dodecane (C12)	n-octacosane (C28)
n-octane (C8)	n-hexadecane (C16)	n-pentatriacontane (C35)

200µg/mL in pentane, 1mL/ampul

Each	5-pk.	10-pk.
32814	32814-510	—
	w/data pack	
32814-500	32814-520	32914

European Pharmacopoeia/ICH Class 1 Mix

- ✓ Concentrations revised to the latest standards for EP Class 1 residual solvents.
- ✓ Dimethylsulfoxide:water solvent for better dispersion during preparation.

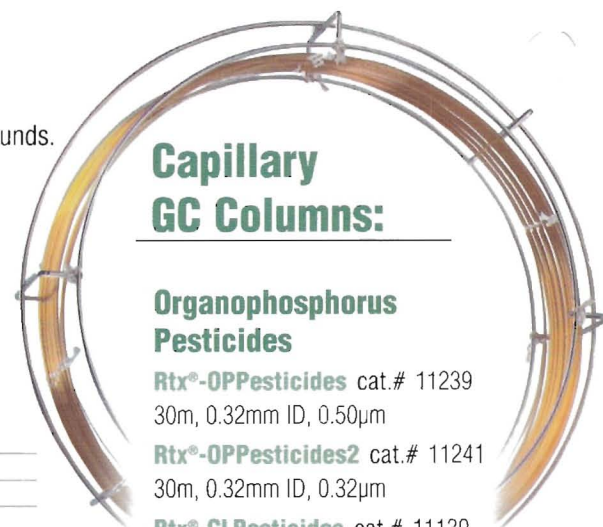
European Pharmacopoeia (EP) monographs now have legal status in 26 member countries. International Conference on Harmonization (ICH) guidelines for residual solvents are an international standard and have been adopted by the United States Pharmacopoeia. The revised concentrations for the components in European Pharmacopoeia/ICH Class 1 Mix meet the latest EP standards. We also offer EP/ICH Class 2 mixes of solvents that pose lesser health hazard (cat.#36229, cat.#36230, cat.#36231). Stabilwax® (cat.#10640) and Rtx®-1301 (G43) (cat.#16085) capillary columns are ideal for analyses of residual solvents.

European Pharmacopoeia/ICH Class 1 Mix (revised)

benzene	2µg/mL	1,1-dichloroethylene	8µg/mL
carbon tetrachloride	4	1,1,1-trichloroethane	10
1,2-dichloroethane	5		

In dimethylsulfoxide:water (90:10), 1mL/ampul

Each	5-pk.	10-pk.
36261	36261-510	—
	w/data pack	
36261-500	36261-520	36361



Capillary GC Columns:

Organophosphorus Pesticides

Rtx®-OPPesticides cat.# 11239

30m, 0.32mm ID, 0.50µm

Rtx®-OPPesticides2 cat.# 11241

30m, 0.32mm ID, 0.32µm

Rtx®-CLPesticides cat.# 11139

30m, 0.32mm ID, 0.50µm

TNRCC 1005 / 1006

Rtx®-5 cat.# 10223

30m, 0.25mm ID, 0.25µm

Rtx®-5 cat.# 10238

30m, 0.25mm ID, 0.50µm

Rtx®-5 cat.# 10253

30m, 0.25mm ID, 1.00µm

Residual Solvents

Rtx®-1301 (G43) cat.# 16085

30m, 0.53mm ID, 3.00µm

Stabilwax® cat.# 10640

30m, 0.53mm ID, 0.50µm

Semivolatiles

Rtx®-5 cat.# 10223

30m, 0.25mm ID, 0.25µm

Rtx®-5Sil MS cat.# 12723

30m, 0.25mm ID, 0.25µm

Rtx®-5MS cat.# 12623

30m, 0.25mm ID, 0.25µm

Volatiles

Rtx®-VMS cat.# 19916

60m, 0.25mm ID, 1.4µm

Rtx®-624 cat.# 10969

60m, 0.25mm ID, 1.40µm

For many more column choices, see our 2003 chromatography products catalog. If you don't have a copy, just ask!

* Additional Restek materials for TNRCC methods 1005 and 1006 include: TPH Locator Mix (cat.#31482), TX TPH Calibration Mix (cat.#31483), TX TPH Matrix Spike Mix (cat.#31484), Alternate Boiling Point/Carbon Number Distribution Marker Stock Standard (cat.#31639).

Resolve Complex Mixtures of Organophosphorus Pesticides, Using an Rtx®-CLPesticides GC Column and a New Restek Reference Mix

By Katia May, Ph.D., R&D Chemist, and Lydia Nolan, Environmental Innovations Chemist

- ✓ Fast, efficient analyses, using an Rtx®-CLPesticides column and flame photometric detection.
- ✓ New OPP reference mix corresponds to strict European criteria.
- ✓ Concentrations of mix components vary according to FPD response.

Organophosphorus pesticides (OPP) are widely used to protect fruits and vegetables from insects. Unfortunately, these toxic materials can accumulate in human fat tissue, potentially leading to death by respiratory depression.¹ In Europe, OPPs are considered a very serious risk to human health, and analysis of food products for these pesticides is important in quality control. OPPs also are strictly regulated in the United States. Policy in regard to pesticide residues in milk, eggs, meat, or poultry is stated in the Code of Federal Regulations.² Multi-residue methods in AOAC Official Methods of Analyses³ and the FDA Pesticide Analytical Manual⁴ are used to determine OPPs and organochlorine pesticides. Analytical procedures for OPPs usually involve GC with a selective detector, such as a flame photometric detector (FPD) or a nitrogen-phosphorous detector (NPD), to detect low ppb levels of target compounds. Use of an FPD in the phosphorous mode minimizes interference by materials that do not contain phosphorus.

Recently, our European customers asked us to develop a stable reference mix of target OPPs, with concentrations appropriate for analysis by GC/FPD. The components in our new European OPP Mix are especially important in quality control of milk, infant formulas, and baby foods. We include these in varied concentrations, according to the responses they elicit from an FPD. One of the OPPs, demeton, is a mixture of O- and S- isomers. We include demeton-S in the mix, and follow US EPA Method 8141B for quantifying this isomer. OPP compounds are photosensitive and are easily degraded during handling, storage, or analysis. When preparing and storing the new mix, we follow stringent measures to ensure prolonged stability.

Analyses of OPPs are challenging and time-consuming. Individual OPPs are difficult to identify because of coelutions and shifting retention times on different capillary phases. OPPs can degrade on reactive sites

in the chromatography system, so it is important that the injector be free of surface contaminants. The analysis usually requires high temperatures, and often causes bleed problems. Analysis time typically exceeds 40 minutes. Tributyl phosphate and triphenyl phosphate are recommended surrogates for GC/FPD (EPA Method 8141B).

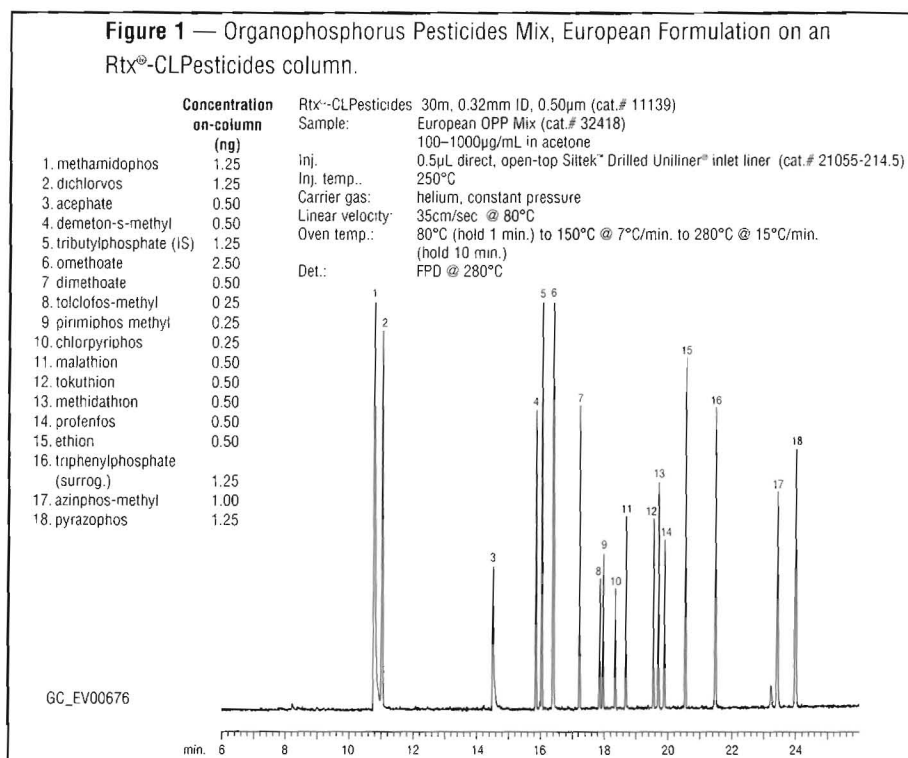
To meet the challenges of OPPs analysis, Restek chemists use an Rtx®-CLPesticides column. Rtx®-CLPesticides columns have a 330°C maximum operating temperature, superior inertness, and low bleed. Figure 1 shows excellent resolution of the European OPP Mix, obtained in less than 25 minutes. The 30m, 0.32mm ID, 0.50µm column is well suited to the split/splitless injection and FPD detection: all compounds, including the surrogates, are resolved. The high temperature stability of Rtx®-CLPesticide columns enables us to program the column to 330°C following each analysis, to bake out high molecular weight contaminants common in OPP-containing extracts. The ability to clean an Rtx®-CLPesticides column at high temperatures enables us to make more injections before replacing the column, compared to commonly used cyano phase columns.

Fast, efficient separations are an important goal in any analysis. In analyses of organophosphate pesticides, an Rtx®-CLPesticides column, and our new European OPP Mix, are important parts of attaining this goal.

References:

1. *Monitoring exposure of organophosphorus and/or carbamate insecticides* Saskatchewan Labor, Canada.
2. Code of Federal Regulations, 40 CFR sec. 180.6. Office of the Federal Register Archives and Records Administration.
3. Official Methods of Analysis 5th Ed., 1990, Section 970.52. Association of Official Analytical Chemists, AOAC International, Arlington, VA.
4. Pesticide Analytical Manual Vol.1, 3rd Ed., 1994, Section 304-11. U.S. Department of Health and Human Services, Food and Drug Administration

Figure 1 — Organophosphorus Pesticides Mix, European Formulation on an Rtx®-CLPesticides column.



Organophosphorus Pesticide Mix, European Formulation

(16 components)

acephate	200µg/mL
azinphos methyl(guthion)	400
chlorpyrifos	100
demeton-S-methyl	200
dichlorvos (DDVP)	500
dimethoate	200
ethion	200
malathion	200
methamidophos	500
methidathion	200
omethoate	1000
pirimiphos methyl	100
proflorfen	200
pyrazophos	500
tokuthion (prothiofos)	200
tolclofos-methyl	100

In methylene chloride, 1mL/ampul

Each	5-pk.	10-pk.
32418	32418-510	—
w/data pack		
32418-500	32418-520	32518

Minimize Adsorption of Active Analytes, Using a Drilled Uniliner® GC Inlet Liner

Now in Two Configurations, to Match Chromatographic Conditions

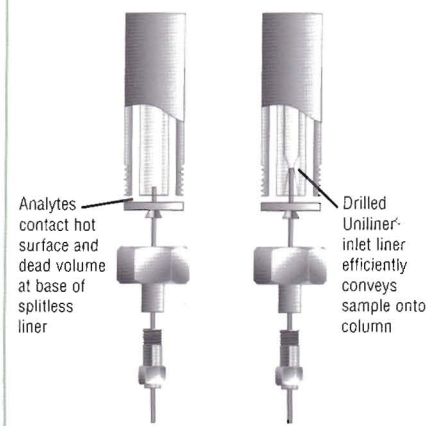
By Gary Slidsen, Innovations Team Manager

- ✓ Eliminate injector active sites and dead volume—minimize adsorption and discrimination.
- ✓ Use one configuration if analytes elute near the solvent peak.
- ✓ Use alternate configuration if analytes elute later than the solvent.

In sample injections into a hot splitless injection port liner, a typical 1 µL sample expands to a volume of hundreds of microliters.¹ The sample solvent vapor, and the analytes, fill the entire injector system. Analyte molecules come in contact with hot, active surfaces outside the injection port liner, and occupy the dead volume at the bottom of the injection port, below the inlet end of the column (Figure 1). In splitless injection mode, there is very little carrier gas flow in this area to carry the analytes back up to the column inlet. This situation is most noticeable with active compounds that degrade when they come in contact with active surfaces; recoveries can be significantly reduced. In addition, late-eluting compounds that do not readily vaporize are affected by injection port discrimination.

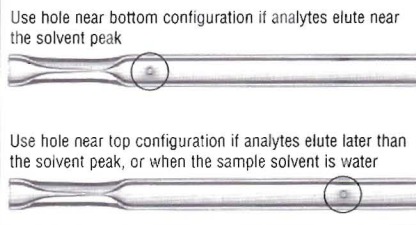
The innovative geometry of a Drilled Uniliner® inlet liner minimizes active sites in the sample pathway, and reduces injection port discrimination. The analytical column connects to the bottom of a Drilled Uniliner® inlet liner via a Press-Tight® seal (Figure 1), eliminating sample contact with any part of the injector below the column inlet. Recoveries of active analytes are significantly improved.² A hole in the side of the liner allows the injector to be operated in traditional split/splitless mode.

Figure 1 — Inlet liner geometry affects analyte recovery.



We now offer Drilled Uniliner® inlet liners in two configurations (Figure 2). The liner to use depends on the analysis, and how closely the early-eluting compounds elute to the solvent peak.

Figure 2 — Drilled Uniliner® inlet liners are available in two configurations. The hole allows the injector to be operated in split/splitless mode.

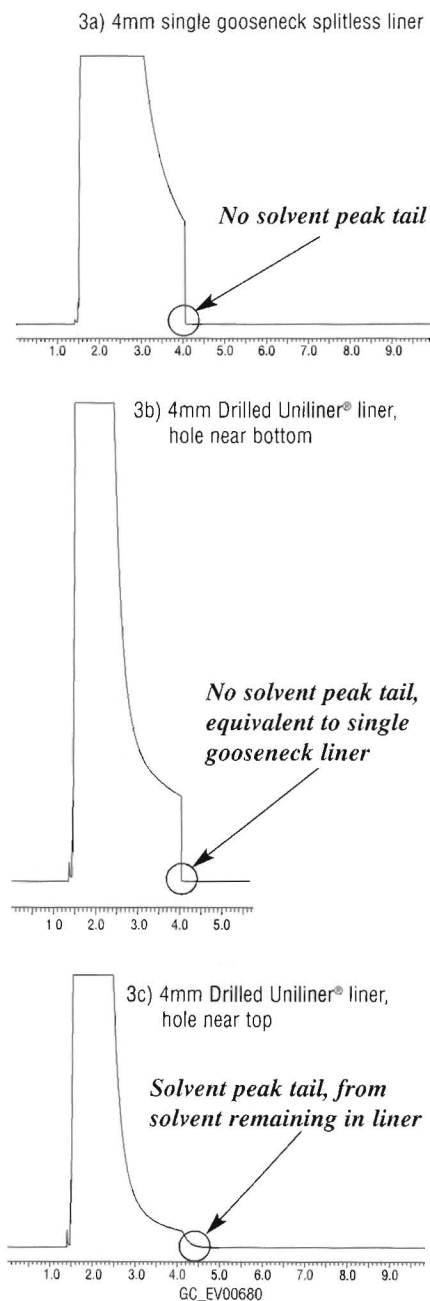


In flash on-column injection all of the solvent is transferred from the injector to the column, producing a substantial solvent peak tail. Splitless injection eliminates the solvent tail, because the injector goes into the split mode after the compounds of interest are transferred to the column, and all solvent remaining in the injection port is flushed out through the purge vent. The solvent peak ends abruptly, as shown in Figure 3a. Elimination of the solvent peak tail is an advantage to using the splitless injection technique when analyzing compounds that elute close to the solvent.

A Drilled Uniliner® inlet liner produces a distinctly different solvent peak shape than the single gooseneck splitless liner, as shown in Figure 3b and Figure 3c. The most noticeable difference is the peak width; the peak is considerably narrower than the peak from the single gooseneck liner. The position of the hole in the Drilled Uniliner® also affects solvent peak shape. A Drilled Uniliner® with the hole near the bottom produces a sharply ending solvent peak, similar to that from a single gooseneck liner (Figure 3b). This liner is a direct replacement for a splitless liner, and should be used when analytes elute closely behind the solvent.

Figure 3 — Solvent peak profiles from Drilled Uniliner® inlet liners and a splitless liner.

The position of the hole in a Drilled Uniliner® inlet liner affects solvent peak shape.



Rtx®- 5Sil MS 30m, 0.25 ID, 0.25 µm (cat.# 12723)
Sample: methylene chloride, PR grade
 0.5 µL, splitless (hold 2.5 min.)
Inj.: 4mm single gooseneck inlet liner (cat.# 20799)
 4mm Drilled Uniliner® inlet liner (cat.# 21055)
 4mm Drilled Uniliner® inlet liner (cat.# 20756)
Inj. temp.: 260°C
Carrier gas: helium, constant pressure
Linear velocity: 17 cm/sec. @ 50°C
Oven temp.: 50°C, isothermal
Det.: FID @ 330°C

Continued on page 13

Minimize Adsorption of Active Analytes...

Continued from page 12

Under the same conditions, a Drilled Uniliner® with the hole near the top produces a solvent peak with a small tail (Figure 3c). This is because solvent remaining within the liner, between the hole and the column entrance, is not swept out of the injection port when the injector goes into the split mode. Consequently, we recommend this liner for analyses in which the analytes would not be affected by a solvent tail, such as chlorinated pesticide analysis. A Drilled Uniliner® with the hole near the top will provide the best sensitivity, and is recommended when sensitivity is paramount. A Drilled Uniliner® with the hole near the top also has exhibited excellent reproducibility for analysis of glycols in water.

For accurate, reproducible, problem-free split/splitless injections, we recommend you use a Drilled Uniliner® inlet liner—and connect it to a Restek capillary GC column. 📌








References

1. *Operating Hints for Using Split/Splitless Injectors*
Restek Corporation, Bellefonte, PA, 36pp, 2002.
(Reference free on request: cat.# 59880A)
2. *Higher Responses for Chlorinated Pesticides, Using a Drilled Uniliner® GC Inlet Liner and Rtx®-CL Pesticides Columns*
Restek Corporation, Bellefonte, PA, 4pp, 2003.
(Reference free on request: cat.# 59487.)

Drilled Uniliner® Inlet Liners

Hole makes direct injection possible with EPC-equipped Agilent 6890 GCs!

all liners are deactivated

For Agilent 5890 & 6890 GCs (0.25/0.32/0.53mm ID columns)	ID*/OD & Length (mm)	Similar to Agilent	cat.# ea.	cat.# 5-pk.
 Drilled Uniliner® (hole on top)	4.0 ID 6.3 OD x 78.5	G1544-80730	21054	21055
 Siltek™ Drilled Uniliner® (hole on top)	4.0 ID 6.3 OD x 78.5	—	21054-214.1	21055-214.5
 Drilled Uniliner® (hole on bottom)	4.0 ID 6.3 OD x 78.5	G1544-80730	20756	20771
 Double Gooseneck Drilled Uniliner® (hole on top)	4.0 ID 6.3 OD x 78.5	G1544-80700	20508	20509
 Double Gooseneck Drilled Uniliner® (hole on bottom)	4.0 ID 6.3 OD x 78.5	G1544-80700	20954	20989
 Siltek™ 1mm Drilled Uniliner® (hole on top)	1.0 ID 6.3 OD x 78.5	—	21390-214.1	21391-214.5
For PerkinElmer GCs (0.32/0.53mm ID columns)	ID*/OD & Length (mm)	Similar to PE part#	cat.# ea.	cat.# 5-pk.
 Auto SYS Drilled Uniliner® (hole on top)	4.0 ID 6.2 OD x 92.1	—	20819	20822

*Nominal ID at syringe needle expulsion point.

Siltek™ Deactivation—The Next Generation of Surface Passivation

- Maximizes the inertness of the sample pathway.
- Minimizes breakdown.
- Low bleed.
- Thermally stable.
- "Clean and green"—manufactured without the use of harmful organic solvents.

Restek offers the next generation of deactivation. The Siltek™ deactivation process (patent pending) produces a highly inert glass surface, which features high temperature stability, extreme durability, and low bleed. Try Siltek™ liners, guard columns, wool, and connectors for better recovery of sample analytes.

For Siltek™ inlet liners, add the corresponding suffix number to the liner catalog number.

qty.	Siltek™		Siltek™ with Siltek™ wool		Siltek™ 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

New / Recent Literature

- ✓ Analysis of Volatile Organics - technical guide (lit. cat.# 59887A)
- ✓ Brominated Flame Retardants - applications note (lit. cat.# 59389B)
- ✓ Environmental Gas Standards - Fast Facts (lit. cat.# 59276A)
- ✓ EZ No-Vent™ GC/MS Connector - new product flyer (lit. cat.# 59498)
- ✓ Foods Flavors & Fragrances In-Review - abstracts of Restek publications (lit. cat.# 59489)
- ✓ High-Resolution Analyses of FAMES - applications note (lit. cat.# 59584A)
- ✓ HPLC minicatalog (lit. cat.# 59241A)
- ✓ Inlet Supplies - a handy guide to septa, liners, etc. (lit. cat.# 59893B)
- ✓ Pesticides (PCBs) / GC Racer - applications note (lit. cat.# 59457)
- ✓ Pinnacle™ DB HPLC Columns - new product flyer (lit. cat.# 59499)
- ✓ Sample Cylinder Technology - product flyer (lit. cat.# 59618A)
- ✓ STAR Service Rewards - new program: earn credit toward instrument service (lit. cat.# 59522)
- ✓ Vu2 Union™ Column Connector - new product flyer (lit. cat.# 59505)

HOT tech tip

Drilled Uniliner®

Use a Drilled Uniliner® inlet liner with the hole near the bottom if compounds of interest will be affected by a tailing solvent peak. Use a Drilled Uniliner® inlet liner with the hole near the top when compounds of interest elute away from the solvent peak, when sensitivity is critical, or when the sample solvent is water.

Analysis of Complex Semivolatiles Samples

Quantify 126 Semivolatile Compounds, Using an Rtx®-5Sil MS Capillary GC Column

By Gary Stidsen, Innovations Team Manager and Katia May, Ph.D., R&D Chemist

- ✓ Full complement of 126 EPA 8270 semivolatile/Appendix IX compounds in 3 mixes
- ✓ New 8270/Appendix IX Kit includes all 3 mixes
- ✓ New 32 component Appendix IX Mix

Appendix IX is a list of organic and inorganic Hazardous Constituents monitored in groundwater during compliance monitoring and corrective actions at RCRA-regulated hazardous waste treatment, storage, and disposal facilities. The organics usually are evaluated by following US EPA Method 8260 (volatiles), Method 8270 (semivolatiles), or Method 8080 (organochlorine pesticides).

Restek chemists determined the most commonly analyzed Appendix IX compounds, carefully reviewed the latest version of EPA Method 8270, and designed a new reference mix of 32 compounds—Appendix IX Mix #2—to meet current needs of environmental laboratories.

We formulated the new mix with the goal of preparing a product that is stable as well as useful. Appendix IX constituents include many classes of chemicals: polynuclear aromatic hydrocarbons (PAHs), phenols, chlorinated aromatic hydrocarbons, aldehydes, anilines, benzidines, insecticides. Unstable combinations of these compounds will produce chemical interactions—and flawed calibration data. Methylene chloride is a common solvent for semivolatile organics, but some grades of methylene chloride contain low concentrations of methanol as a stabilizer. Aldehydes (e.g., benzaldehyde) and chlorinated triazines (e.g., atrazine) can react with methanol; chlorinated triazines also react with water.

Consequently, we use affirmed methanol-free, water-free methylene chloride in formulating our mixes. We package the new mix in deactivated amber glass ampuls, to prevent reactions catalyzed by light.

Appendix IX Mix #2 is a highly useful complement to our 8270 MegaMix™ (76 compounds, cat.# 31686)

and Appendix IX Mix #1 (18 compounds, cat.# 31625). The 126 semivolatiles in these three mixes are separated on an Rtx®-5Sil MS column (cat.# 12723) (Figure 1, page 15). Because the PAHs elute at temperatures over 300°C, the analysis requires a column that will not bleed at high temperatures. Further, an inert column is important for the active compounds (e.g., pentachlorophenol, dinitrophenols). Rtx®-5Sil MS columns are widely used for analyzing various classes of semivolatiles, because they exhibit versatility, inertness, and low bleed at high temperature. The optimal combination of internal diameter and film thickness of a 30m, 0.25 mm ID, 0.25µm Rtx®-5Sil MS column make this the best choice for analyzing complex mixtures of semivolatiles. The Rtx®-5Sil MS column, in combination with our 8270 MegaMix™ mix, Appendix IX Mix #1, and new Appendix IX Mix #2, and our internal standards and surrogates for EPA Method 8270 and Appendix IX, make Restek the only place you need to look when you want columns and reference materials for semivolatiles analysis. 📄

8270 MegaMix™ (76 components)

acenaphthene	2,4-dinitrophenol
acenaphthylene	2,4-dinitrotoluene
aniline	2,6-dinitrotoluene
anthracene	di- <i>n</i> -butyl phthalate
azobenzene ¹	di- <i>n</i> -octyl phthalate
benzo(a)anthracene	diphenylamine ²
benzo(a)pyrene	fluorene
benzo(b)fluoranthene	fluoroanthene
benzo(g,h,i)perylene	hexachlorobenzene
benzo(k)fluoranthene	hexachlorobutadiene
benzyl alcohol	hexachlorocyclopentadiene
benzyl butyl phthalate	hexachloroethane
bis 2-ethylhexyl adipate	indeno(1,2,3- <i>cd</i>)pyrene
bis(2-chloroethoxy)methane	isophorone
bis(2-chloroethyl)ether	1-methylnaphthalene
bis(2-chloroisopropyl)ether	2-methylnaphthalene
bis(2-ethylhexyl)phthalate	2-methylphenol
4-bromophenyl phenyl ether	3-methylphenol*
carbazole	4-methylphenol*
4-chloroaniline	naphthalene
4-chloro-3-methylphenol	2-nitroaniline
2-chloronaphthalene	3-nitroaniline
2-chlorophenol	4-nitroaniline
4-chlorophenyl phenyl ether	nitrobenzene
chrysene	2-nitrophenol
dibenz(a,h)anthracene	4-nitrophenol
dibenzofuran	N-nitrosodimethylamine
1,2-dichlorobenzene	N-nitroso-di- <i>n</i> -propylamine
1,3-dichlorobenzene	pentachlorophenol
1,4-dichlorobenzene	phenanthrene
2,4-dichlorophenol	phenol
diethyl phthalate	pyrene
dimethyl phthalate	pyridine
2,4-dimethylphenol	2,3,4,6-tetrachlorophenol
1,2-dinitrobenzene	2,3,5,6-tetrachlorophenol
1,3-dinitrobenzene	1,2,4-trichlorobenzene
1,4-dinitrobenzene	2,4,5-trichlorophenol
4,6-dinitro-2-methylphenol	2,4,6-trichlorophenol

1,000µg/mL each (except where noted) in methylene chloride:benzene (75:25), 1mL/ampul

Each	5-pk.	10-pk.
31686	31686-510	—
w/data pack		
31686-500	31686-520	31786

*Concentration is 500µg/mL.

¹1,2-diphenylhydrazine (8270-listed analyte) decomposes to azobenzene (mix component)

²N-nitrosodiphenylamine (8270-listed analyte) decomposes to diphenylamine (mix component).

Ordering Information | Rtx®-5Sil MS column

30m, 0.25 mm ID, 0.25µm cat.# 12723

Appendix IX Mix #1 (18 components)

2-acetylaminofluorene
4-aminobiphenyl
p-dimethylaminoazobenzene
3,3'-dimethylbenzidine
 α,α' -dimethylphenethylamine (free base)
methapyrilene (free base)
1-naphthylamine
2-naphthylamine
5-nitro-*o*-toluidine
N-nitrosodibutylamine
N-nitrosodiethylamine
N-nitrosomethylethylamine
N-nitrosomorpholine
N-nitrosopiperidine
N-nitrosopyrrolidine
1,4-phenylenediamine
2-picoline
o-toluidine

2,000µg/mL each in methylene chloride, 1mL/ampul

Each	5-pk.	10-pk.
31625	31625-510	—
w/data pack		
31625-500	31625-520	31725

8270/Appendix IX Kit

31686: 8270 MegaMix™
31030: Benzidine Mix, EPA 605
31625: Appendix IX Mix #1
31806: Appendix IX Mix #2

Contains 1mL each of these mixtures.

Kit	Kit w/Data Pack
31815	31815-500

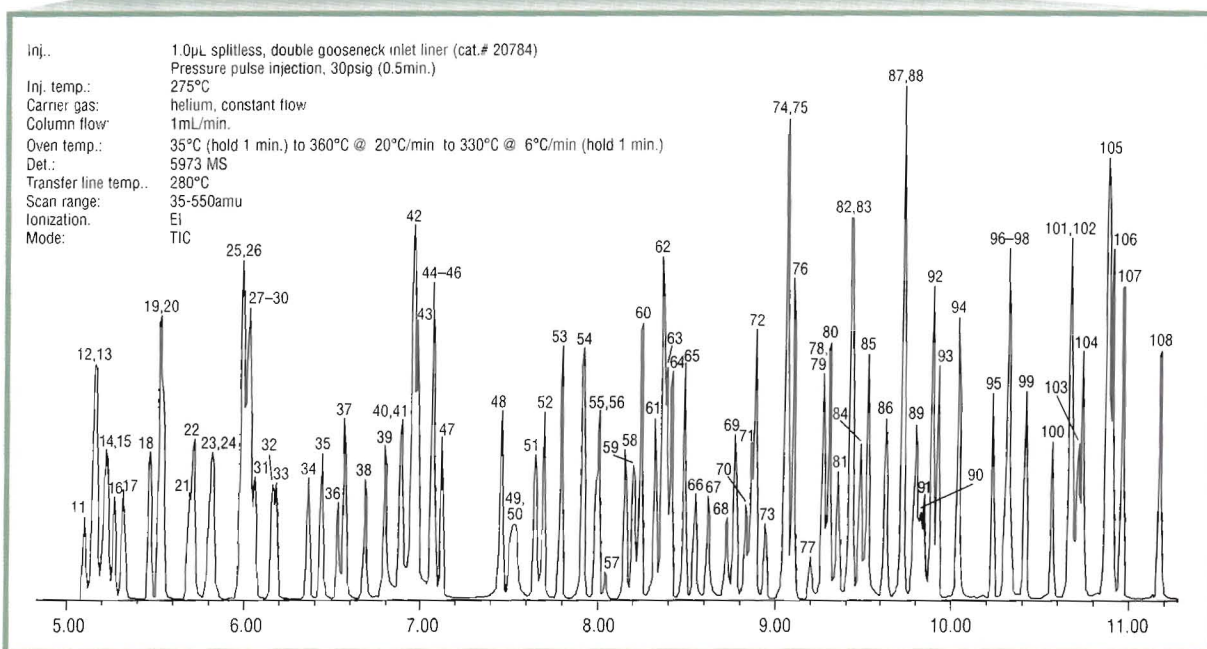
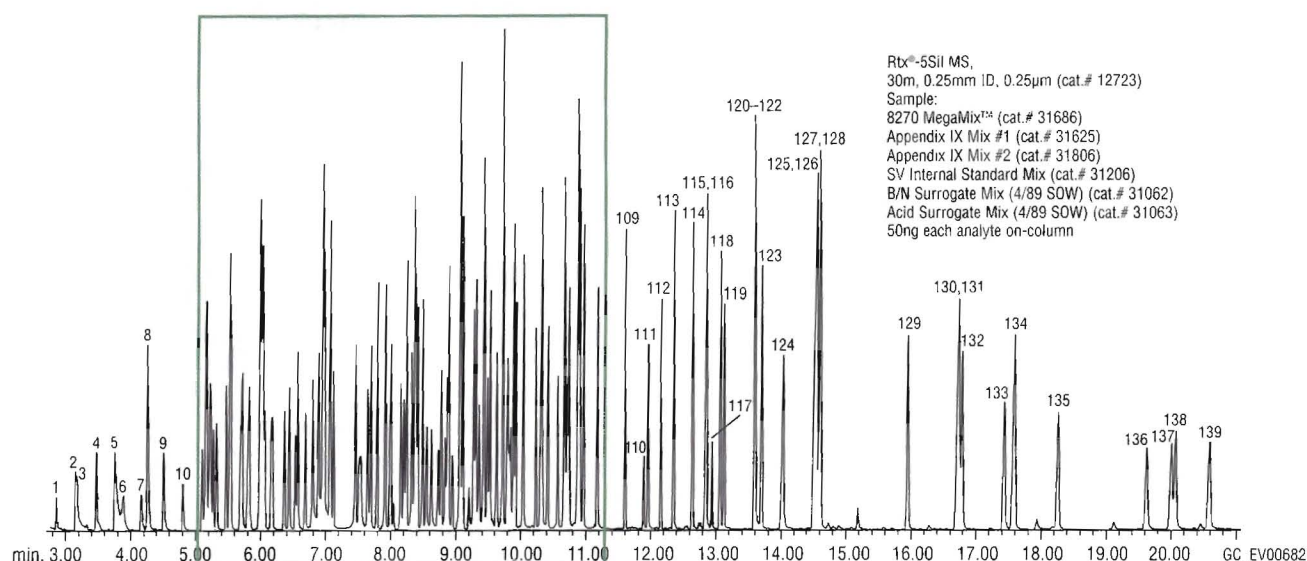
Appendix IX Mix #2 (32 components)

acetophenone	hexachloropropene
Aramite (2 isomers)	isodrin
atrazine	isosafrole (<i>cis</i> & <i>trans</i>)
benzaldehyde	kepone
biphenyl	methyl methanesulfonate
caprolactam (epsilon)	3-methylcholanthrene
chlorobenzilate	1,4-naphthoquinone
1-chloronaphthalene	4-nitroquinoline-N-oxide
diallate	pentachlorobenzene
dibenz(a,h)acridine	pentachloroethane
2,6-dichlorophenol	pentachloronitrobenzene
7,12-dimethylbenz(a)anthracene	phenacetin
1,4-dioxane	pronamide
diphenyl ether	safrrole
ethyl methacrylate	1,2,4,5-tetrachlorobenzene
ethyl methanesulfonate	1,3,5-trinitrobenzene

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

Each	5-pk.	10-pk.
31806	31806-510	—
w/data pack		
31806-500	31806-520	31906

Figure 1 — Resolve complex mixtures of semivolatiles with an inert, low-bleed column.







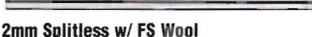
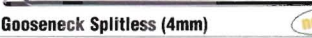




- | | | | | |
|-----------------------------------|--------------------------------|-------------------------------|---------------------------------|-------------------------------------|
| 1. 1,4-dioxane | 29. o-toluidine | 57. isosafrole (isomer) | 85. 2-naphthylamine | 113. fluoranthene |
| 2. pyridine | 30. 4-nitrosomorpholine | 58. 2,4,6-trichlorophenol | 86. diethyl phthalate | 114. pyrene |
| 3. N-nitrosodimethylamine | 31. hexachloroethane | 59. 2,4,5-trichlorophenol | 87. fluorene | 115. Aramite (isomer) |
| 4. ethyl methacrylate | 32. nitrobenzene-d5 (SS) | 60. 2-fluorobiphenyl (SS) | 88. 4-chlorophenyl phenyl ether | 116. p-terphenyl-d14 (SS) |
| 5. 2-picoline | 33. nitrobenzene | 61. safrole | 89. 2-methyl-5-nitroaniline | 117. Aramite (isomer) |
| 6. N-nitrosomethylmethanamine | 34. N-nitrosopiperidine | 62. biphenyl | 90. 4-nitroaniline | 118. dimethylaminooxobenzene |
| 7. methyl methanesulfonate | 35. isophorone | 63. 2-chloronaphthalene | 91. 4,6-dinitro-2-methylphenol | 119. dichlorobenzilate |
| 8. 2-fluorophenol (SS) | 36. 2-nitrophenol | 64. 1-chloronaphthalene | 92. diphenylamine | 120. 3,3-dimethylbenzidine |
| 9. N-nitrosodimethylamine | 37. 2,4-dimethylphenol | 65. diphenyl ether | 93. azobenzene | 121. butyl benzyl phthalate |
| 10. ethyl methanesulfonate | 38. bis(2-chloroethoxy)methane | 66. 2-nitroaniline | 94. 2,4,6-tribromophenol (SS) | 122. kepone |
| 11. benzaldehyde | 39. 2,4-dichlorophenol | 67. 1,4-naphthoquinone | 95. diallate | 123. bis(2-ethylhexyl)adipate |
| 12. phenol-d6 (SS) | 40. 1,2,4-trichlorobenzene | 68. 1,4-dinitrobenzene | 96. 1,3,5-trinitrobenzene | 124. 2-acetylaminofluorene |
| 13. phenol | 41. α,α-dimethylphenylamine | 69. dimethylphthalate | 97. phenacetin | 125. benzo(b)fluoranthene |
| 14. aniline | 42. naphthalene-d8 (IS) | 70. 1,3-dinitrobenzene | 98. 4-bromophenyl phenyl ether | 126. chrysene-d12 (IS) |
| 15. pentachloroethane | 43. naphthalene | 71. 2,6-dinitrotoluene | 99. hexachlorobenzene | 127. chrysene |
| 16. bis(2-chloroethyl)ether | 44. 2,6-dichlorophenol | 72. acenaphthylene | 100. atrazine | 128. bis(2-ethylhexyl)phthalate |
| 17. 2-chlorophenol | 45. 4-chloroaniline | 73. 1,2-dinitrobenzene | 101. 4-aminobiphenyl | 129. di-n-octyl phthalate |
| 18. 1,3-dichlorobenzene | 46. hexachloropropene | 74. 3-nitroaniline | 102. pentachlorophenol | 130. benzo(b)fluoranthene |
| 19. 1,4-dichlorobenzene-d4 (IS) | 47. hexachlorobutadiene | 75. acenaphthene-d10 (IS) | 103. pentachloronitrobenzene | 131. 7,12-dimethylbenz(a)anthracene |
| 20. 1,4-dichlorobenzene | 48. N-nitroso-n-butylamine | 76. acenaphthene | 104. propylamide | 132. benzo(k)fluoranthene |
| 21. benzyl alcohol | 49. 1,4-phenylenediamine | 77. 2,4-dinitrophenol | 105. phenanthrene-d10 (IS) | 133. benzo(a)pyrene |
| 22. 1,2-dichlorobenzene | 50. caprolactam | 78. pentachlorobenzene | 106. phenanthrene | 134. perylene-d12 (IS) |
| 23. 2-methylphenol | 51. 4-chloro-3-methylphenol | 79. 4-nitrophenol | 107. anthracene | 135. 3-methylcholanthrene |
| 24. bis(2-chloroisopropyl)ether | 52. isosafrole (isomer) | 80. dibenzofuran | 108. carbazole | 136. dibenz(a,j)acridine |
| 25. acetophenone | 53. 2-methylnaphthalene | 81. 2,4-dinitrotoluene | 109. di-n-butylphthalate | 137. indeno(1,2,3-cd)pyrene |
| 26. 4-methylphenol/3-methylphenol | 54. 1-methylnaphthalene | 82. 1-naphthalamine | 110. 4-nitroquinoline-1-oxide | 138. dibenz(a,h)anthracene |
| 27. N-nitroso-di-n-propylamine | 55. hexachlorocyclopentadiene | 83. 2,3,4,6-tetrachlorophenol | 111. methapyrilone | 139. benzo(ghi)perylene |
| 28. nitrosopyrrolidine | 56. 1,2,4,5-tetrachlorobenzene | 84. 2,3,5,6-tetrachlorophenol | 112. isodrin | |

Peak Performers

all liners are deactivated

By Donna Lidgett, GC Accessories Marketing Manager, and Brad Rightnour, Instrument Innovations Manager

Inlet liners for Varian 1177 GCs

	Benefits/ Uses:	ID*/OD & Length (mm)	Similar to Varian part #	ea.	cat.# 5-pk.
 4mm Split	universal	4.0 ID 6.3 OD x 78.5	39-26119-36	21045	21046
 4mm Split w/ FS Wool	universal	4.0 ID 6.3 OD x 78.5	39-26119-37	—	21079
 4mm Split Precision™ Liner w/FS Wool <i>new!</i>	dirty samples, trace samples	4.0 ID 6.3 OD x 78.5	—	20759	20762
 Laminar Cup Splitter <i>new!</i>	high MW compounds	4.0 ID 6.3 OD x 78.5	—	20765	20768
 2mm Splitless w/ FS Wool	trace samples <2µL	2.0 ID 6.5 OD x 78.5	39-26119-38	21045	21077
 Gooseneck Splitless (4mm) <i>new!</i>	trace samples <2µL	4.0 ID 6.5 OD x 78.5	39-26119-27	21896	21897
 Siltek™ Gooseneck Splitless (4mm) <i>new!</i>	trace samples <2µL	4.0 ID 6.5 OD x 78.5	—	21896-214.1	21897-214.5
 Gooseneck Splitless (4mm) w/ FS Wool <i>new!</i>	trace samples <2µL	4.0 ID 6.5 OD x 78.5	39-26119-36	21896-200.1	21897-200.5
 Siltek™ Gooseneck Splitless (4mm) w/ Siltek™ Glass Wool <i>new!</i>	trace samples <2µL	4.0 ID 6.5 OD x 78.5	—	21896-213.1	21897-213.5
 Double Gooseneck Splitless (4mm) <i>new!</i>	trace, active samples <2µL	4.0 ID 6.5 OD x 78.5	—	21891	21892

Graphite O-Rings for Varian 1177 and Agilent GCs







- Excellent thermal stability at injection port temperature up to 450°C!



Description	Max. temp.	Similar to Agilent part #	Restek cat.# 10-pk.	50-pk.
6.35mm ID Graphite O-rings for split liners	450°C	5180-4168	20296	20297
6.5mm ID Graphite O-rings for splitless liners	450°C	5180-4173	20298	20299

Precision™ Inlet Liners for Many GCs

- Wool maximizes vaporization and helps wipe the needle during injection.
- No guessing where the wool should be placed, easy to change.
- Wool stays in position during pressure pulses in the inlet and during injection.
- 100% polymeric deactivation ensures inertness.
- Similar to FocusLiner™ liners.

	Benefits/Uses:	ID*/OD & Length (mm)	ea.	cat.# 5-pk.	25-pk.
 Agilent 4mm Split Precision™ Liner	dirty samples, trace samples	4.0 ID 6.3 OD x 78.5	21022	21023	20979
 PerkinElmer Auto SYS Split Precision™ Liner	dirty samples, trace samples	4.0 ID 6.2 OD x 92.1	21026	21027	—
 Shimadzu 17A Split Precision™ Liner	dirty samples, trace samples	3.5 ID 5.0 OD x 95	21020	21021	—
 Thermo Finnigan 5mm Split Precision™ Liner	dirty samples, trace samples	5.0 ID 8.0 OD x 105	21028	21029	—
 Varian 1075/1077 Split Precision™ Liner	dirty samples, active samples	4.0 ID 6.3 OD x 72	21030	21031	—
 Varian 1078/1079 Split Precision™ Liner	dirty samples, trace samples	3.4 ID 5.0 OD x 54	21024	21025	—



Viton® O-Rings For Agilent and PE AutoSys

- Fit split (6.3mm OD) or splitless (6.5mm OD) liners.
- Maximum temperature 350°.

Description	Similar to Agilent part #	qty.	cat.#
Viton® O-rings for Agilent and PE	5180-4182	25-pk.	20377



new!

O-Rings for Apex Liners

Description	qty.	cat.#
Viton® O-rings for APEX liners	25-pk.	22067

new!



Inlet Liner Seals for TRACE™ 2000 GCs: PTV

Description	qty.	cat.#
Inlet Liner Seals	2-pk.	21392

Graphite Sealing Ring and Washer for 8000 and TRACE™ Series GC Inlet Liners

(Similar to Thermo Finnigan part # 290-03406)

Description	qty.	cat.#
Graphite Sealing Ring and Washer	ea.	21898
Graphite Sealing Rings and Washers	2-pk.	21899



new!

Liner Seals for CIS4 and PTV

Description	qty.	cat.#
Liner Seals for CIS4 and PTV	5-pk.	22684

new!



Liner Seals for Varian 1078/1079

Description	qty.	cat.#
5mm Liner Seals for Varian 1078/1079 GCs	10-pk.	22683

Replacement Nickel Reaction Tubes

- Pretreated for maximum sensitivity.
- Quality-controlled for reliability.
- Available for various models.



To replace these instrument part numbers:

Order these
Restek part numbers:

ELCD Model #	Tremetrics	Varian	PerkinElmer	Shimadzu	O.I. Analytical	qty.	cat.#
Hall 700A	115439-0003	00-996724-14	0330-2675	—	—	2-pk.	21580
Hall 1000	117459-0003	00-997625-12	N660-1072	220-90435-00	—	2-pk.	21581
O.I. 4420	—	—	—	—	183780	2-pk.	21582

Moisture Control By-Pass Line for Tekmar Instruments

- Increase response for ketones, alcohols, and acetates.
- Silcosteel® tubing for increased inertness.
- Suitable for US EPA Methods 8260, 524.2, and OLM4.1.
- Easily attaches in minutes.



Description	qty.	cat.#
Moisture Control By-Pass Line for Tekmar 3000 Purge & Trap	ea.	21035
Moisture Control By-Pass Line for Tekmar 3100 Purge & Trap	ea.	21109

New!

Replacement FID Jets

Capillary Adaptable Jet for Agilent 5890/6890/6850 GCs (0.011-inch ID tip)

(Similar to Agilent part # 19244-80560.)



Description	qty.	cat.#	qty.	cat.#
Standard	ea.	20670	3-pk.	20671
High-Performance Silcosteel®	ea.	20672	3-pk.	20673

Capillary Dedicated Jet for Agilent 6890/6850 GCs

(Similar to Agilent part # G1531-80560.)



Description	qty.	cat.#	qty.	cat.#
Standard	ea.	21621	3-pk.	21682
High-Performance Silcosteel®	ea.	21620	3-pk.	21683

Capillary Jet for Agilent 5880 GCs

(Similar to Agilent part # 19301-80500.)



Description	qty.	cat.#
Standard	ea.	21637
High-Performance Silcosteel®	ea.	21638

Packed Column Jets for Agilent 5890/6890/6850 GCs

0.018-Inch ID

(Similar to Agilent part # 18710-20119.)

Description	qty.	cat.#	qty.	cat.#
Standard	ea.	21694	3-pk.	21695
High-Performance Silcosteel®	ea.	21696	3-pk.	21697

0.030-Inch ID

(Similar to Agilent part # 18789-80070.)

Description	qty.	cat.#	qty.	cat.#
Standard	ea.	21688	3-pk.	21689
High-Performance Silcosteel®	ea.	21686	3-pk.	21687

Cleaned ELCD Transfer Lines

Restek's ELCD Teflon® transfer line tubing is stringently cleaned with an HCl solution to remove any contaminants, then is rinsed with methanol.

Conveniently offered in five 6.5-inch precut pieces that directly interface the nickel reaction tube and conductivity cell. Fits Tracor, Tremetrics, O.I., and many other ELCDs.



Description	qty.	cat.#
Teflon® Transfer Lines for ELCDs (five 6.5-inch lines)	5-pk.	20121

Fritted Purge-and-Trap Spargers

- For Tekmar 2000, 3000 and 3100.
- Available in 5 and 25mL sizes.
- Uniform frits ensure maximum purge efficiency.

These spargers provide maximum purge efficiency for water samples.* Manufactured to tight tolerances to ensure a leak-tight seal.

*Not recommended for wastewater samples—frit may become plugged.



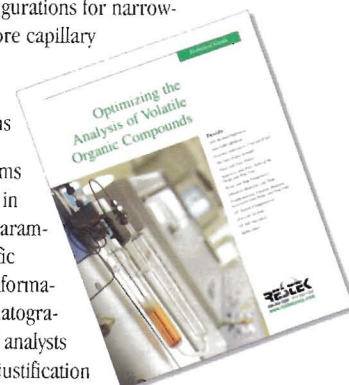
Description	qty.	cat.#
5mL Fritted Sparger, 1/2-inch mount	ea.	21150
25mL Fritted Sparger, 1/2-inch mount	ea.	21151

Optimizing the Analysis of Volatile Organic Compounds

Our newly updated technical guide is a concise, thorough overview to analyzing volatile organics in environmental samples:

- ✓ Purge and trap theory - adsorbents and traps - troubleshooting
- ✓ GC system configurations for narrow-bore or wide-bore capillary columns
- ✓ Optimizing detection systems

Many chromatograms show how changes in chromatographic parameters achieve specific goals. Invaluable information for new chromatographers; experienced analysts can find ideas and justification for updating methodology. 72 pages.



Free on request - ask for lit. cat.# 59887A, or visit our website.

Sulfinert™-Treated Sample Cylinders and Valves

Durable, Inert Storage for Active Analytes

By Gary Barone, Metals Passivation Marketing Manager, and Donna Lidgett, Air Products Marketing Manager

- ✓ Inert sample storage containers now available from stock.
- ✓ No adsorption of active compounds at low ppb concentrations.
- ✓ Stable, flexible surface deactivation will not crack or flake.

Whether you monitor hydrocarbons in refinery streams or reactive compounds in chemical reaction vessels, our Sulfinert™-treated sample cylinders and cylinder valves will help you achieve maximum accuracy in your results. These inert containers ensure the stability of sulfur compounds and other active analytes during storage and transport from the field to the laboratory.

Sulfinert™-treated sample cylinders combine the inertness of glass with the strength of stainless steel, making them ideal for analyses of active compounds. Restek's exclusive Sulfinert™ process creates a thin, silica-like layer on the stainless steel surface. Even at trace levels, sulfur compounds and other active molecules can be collected and stored in these cylinders with no significant loss. Effectively incorporated into

the steel surface, the Sulfinert™ layer cannot chip, flake, or rinse off - even under stringent sampling, transport, or cleaning conditions.

All sample-contacting surfaces in our Sulfinert™-treated sample cylinder valves are equally inert, making these components ideally compatible with Sulfinert™-treated sample cylinders.

Sulfinert™-treated gas sampling apparatus is ideal for applications that demand only inert surfaces contact the sample, such as sampling natural gas streams or testing beverage-grade carbon dioxide. For other Sulfinert™-treated sample pathway components, refer to our current general catalog, or contact our Technical Service group or your Restek representative.

Sulfinert™-Treated Sample Cylinders

- Sizes from 75cc to 2250cc
- Durable 316 stainless steel
- 1/4" female NPT threads on both ends
- D.O.T. rated to 1800psi at room temperature

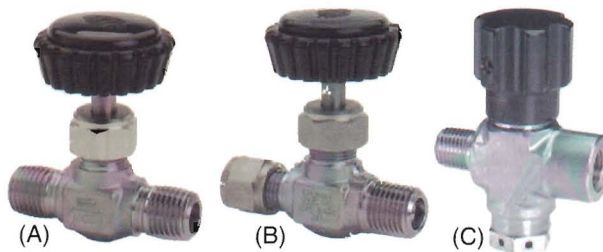


Sulfinert™-Treated Sample Cylinders

Size	qty.	cat.#
75cc	ea.	24130
150cc	ea.	24131
300cc	ea.	24132
500cc	ea.	24133
1000cc	ea.	24134
2250cc	ea.	21394

Sulfinert™-Treated Sample Cylinder Valves

- Maximum operating pressure: 5000psig
- Temperature range for KEL-F® stem tip: -20°F to 250°F (-29°C to 121°C)



Sulfinert™ Sample Cylinder Valves

Description	qty.	cat.#
(A) 1/4" NPT Exit, KEL-F® Stem Tip	ea.	24127
(B) 1/4" Compression Exit, KEL-F® Stem Tip	ea.	24128
(C) 1/4" Female NPT Outlet (built-in rupture disc)	ea.	21395

Sulfinert™ Welded 304 Grade Stainless Steel Tubing

ID	OD	cat.#	5-24 ft.	25-199 ft.	200-399 ft.	>400 ft.
0.011" (0.28mm)	0.022" (0.56mm)	22500				
0.021" (0.53mm)	0.029" (0.74mm)	22501				
0.010" (0.25mm)	1/16" (1.59mm)	22502				
0.020" (0.51mm)	1/8" (1.59mm)	22503				
0.030" (0.76mm)	1/4" (1.59mm)	22504				
0.040" (1.02mm)	1/2" (1.59mm)	22505				
0.085" (2.16mm)	1/2" (3.18mm)*	22506				
0.210" (5.33mm)	1/2" (6.35mm)*	22507				

*0.020" wall thickness

Sulfinert™ Seamless 316 Grade Stainless Steel Tubing

ID	OD	cat.#	5-24 ft.	25-199 ft.	200-399 ft.	>400 ft.
0.055" (1.40mm)	1/8" (3.18mm)**	22508				
0.180" (4.57mm)	1/2" (6.35mm)**	22509				

**0.035" wall thickness



For Sulfinert™-treated fittings, refer to our general catalog.

Ensure a Leak-Tight Seal the First Time, Every Time

Reliable, Leak-Tight Sealing with Vespel® Ring Inlet Seals*

By Donna Lidgett, GC Accessories Marketing Manager

- ✓ End problems associated with leaks at the inlet seal.
- ✓ Prevent wear or damage to the critical seal.
- ✓ Try Vespel® Ring Inlet Seals, free.

In Agilent split/splitless injection ports, the inlet seal sits at the base of the injector (Figure 1). Dirt, non-volatile residue, septum fragments, and other debris can accumulate on the surface of the seal and skew the linearity of your analyses. The only way to maintain optimum performance is to change the inlet seal frequently. Each time you change the inlet seal you must check the connection and ensure the seal is leak-tight, to prevent column oxidation and other problems associated with leaks.

Herein is a problem. It can be difficult to make and maintain a good seal with a conventional, metal, inlet disk. The metal-to-metal seal dictates that you apply considerable torque to the reducing nut but, based on our tests, this does not ensure a leak-tight seal. And, even if the seal is good initially, metal-to-metal seals are prone to leak over the course of


several oven temperature cycles, allowing oxygen and water vapor to enter the system. This can oxidize the phase in the capillary column, affect chromatogram baselines, and/or create other difficulties, causing expense and downtime. Potentially a worse problem, frequent making and breaking of the metal-to-metal seal ultimately could wear or damage the surface of the critical seal on the bottom of the injector body.

For years, Restek has offered replacement inlet seals for Agilent 5890, 6890, and 6850 split/splitless injection ports. The design and construction of our inlet seals prolong column lifetime - because oxygen is less likely to leak into the carrier gas - and reduce baseline noise from high-sensitivity detectors (e.g., ECDs and MSDs). To lessen breakdown and adsorption of active compounds, we offer inert

gold-plated and Silcosteel®-treated inlet seals, as well as stainless steel seals.

Yet, we had not entirely eliminated the problem of leaks. Now, Restek's instrument innovations team has re-engineered the inlet seal to address this issue. The solution, the Vespel® Ring Inlet Seal, is a high-quality stainless steel seal with a soft, easy-sealing Vespel® ring embedded into its face, eliminating the unreliable metal-to-metal seal. While ensuring a leak-tight seal, the Vespel® ring cannot harm the critical seal, and is outside the sample flowpath. Inlet maintenance becomes worry-free!

The Vespel® Ring Inlet Seal is designed to hold its seal, even after repeated temperature cycles, without retightening the reducing nut. To determine the differences between conventional inlet seals and Vespel® Ring Inlet Seals, we compared the leak rate for several inlet seals of each type across a range of torque, using a high sensitivity helium leak detector. Figure 2 shows Vespel® Ring Inlet Seals performed exceptionally at all levels, but especially well at lower torque.

Like our conventional inlet seals, Vespel® Ring Inlet Seals are available in stainless steel, gold-plated, or with Silcosteel® treatment. Use the stainless steel seals for analyses of nonactive compounds. To reduce breakdown and adsorption of active compounds, use gold-plated or Silcosteel®-treated seals. The gold surface offers better inertness than stainless steel; Silcosteel® treatment produces inertness similar to that of fused silica tubing. 

Free Vespel® Ring Inlet Seals!

Are you using conventional inlet seals, but want to try

Vespel® Ring Inlet Seals?

Purchase a 10-pack of our

conventional inlet seals and we'll

include a 2-pack of Vespel® Ring

Inlet Seals, free. Use the special

catalog numbers below.

Hurry-

Sept.30 is the last day to take advantage of this offer!

Ordering Information | Inlet Seals Special Offer!

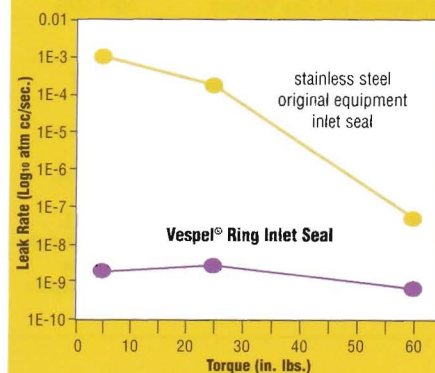
Order a 10-pack of our conventional metal inlet seals, receive a 2-pack of Vespel® Ring Inlet Seals, Free!



Inlet Seal	Qty.	cat.#	Price
0.8mm stainless steel	10 + 2*	21316-425	
0.8mm gold-plated	10 + 2	21318-425	
0.8mm Silcosteel®-treated	10 + 2	21320-425	
1.2mm stainless steel	10 + 2	20391-425	
1.2mm gold-plated	10 + 2	21306-425	
1.2mm Silcosteel®	10 + 2	21308-425	

*10 conventional metal inlet seals, 2 Vespel® Ring Inlet Seals.

Figure 2 — The Vespel® Ring Inlet Seal achieves a leak-tight seal even at low torque, reducing the chance of leak-related problems.



*Patent pending.

Vespel® Ring Inlet Seals

FREE
Vespel® Ring Inlet Seals.
See Page 19.

- Low torque, soft seal, reduces wear, prevents damage at critical seal: no unexpected downtime
- Leak-tight connections, for greater sensitivity (less detector noise) and longer column life (no phase oxidation)



Vespel® Ring Inlet Seals are available in three finishes: gold-plated, Silcosteel®-treated, or stainless steel.

Vespel® Ring Inlet Seals with Washers for Agilent 5890/6890/6850 GCs

0.8mm ID Vespel® Ring Inlet Seal	2-pk.	10-pk.
Gold-Plated	21562	21563
Silcosteel®	21564	21565
Stainless Steel	21560	21561
1.2mm ID Vespel® Ring Inlet Seal	2-pk.	10-pk.
Gold-Plated	21568	21569
Silcosteel®	21570	21571
Stainless Steel	21566	21567

Note: All seals include washers.

Replacement Inlet Seals for Agilent GCs

- Special grade of stainless steel that is softer and deforms more easily, ensuring a leak-free seal.
- Increases column lifetime because oxygen cannot permeate into the carrier gas.
- Reduced noise benefits high-sensitivity detectors (e.g., ECDs, MSDs).
- Silcosteel® seal offers the inertness of glass.
- All seals include washers.

Single-Column Installation, 0.8mm Opening*		0.25/0.32mm ID Dual-Column Installation, 1.2mm Opening		0.53mm ID Dual-Column Installation, 1/8-inch Opening	
2-pk.	10-pk.	2-pk.	10-pk.	2-pk.	10-pk.
Stainless Steel Inlet Seal					
21315	21316	20390	20391	20392	20393
Gold-Plated Inlet Seal					
21317	21318	21305	21306	—	—
Silcosteel® Inlet Seal					
21319	21320	21307	21308	—	—

*0.8mm ID stainless steel inlet seal is equivalent to Agilent part #18740-20880. 0.8mm ID gold-plated inlet seal is equivalent to Agilent part #18740-20885.

Note: The 1.2mm inlet seal is recommended for use with Vespel®/graphite ferrules or when installing two columns using a two-hole ferrule. The 0.8mm inlet seal is recommended for use with graphite ferrules and single capillary column installation.



Restek inlet seals feature a **super-smooth surface** for better chromatography!

Replacement Inlet Seal Washers

Description	Similar to Agilent part #	qty.	cat.#
Replacement Inlet Seal Washers	5061-5869	15-pk.	21710



Lit. Cat. # 59523-INT

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