

Minimizing Breakdown of Chlorinated Pesticides Using Siltek™-Deactivated GC Accessories

Gas chromatographic (GC) analysis of chlorinated pesticides presents unique challenges to environmental laboratories because these compounds often are at trace levels and susceptible to decomposition. Some analyses, such as the US Environmental Protection Agency (EPA) Methods 8081 and 608, have stringent breakdown and reproducibility criteria. Breakdown occurs when a compound decomposes into related compounds, generally because a thermal or chemical reaction has occurred. Two compounds notorious for exhibiting breakdown are endrin, which breaks down into endrin aldehyde and endrin ketone, and DDT, which breaks down into DDE and DDD. The source of breakdown can be aged samples and standards, the GC column or, most commonly, active sites in the GC injection port. Routine maintenance of the injection port, prevention of sample flashback, and thorough deactivation of the inlet liner and GC columns are essential to minimize compound breakdown.

We chose a pesticide analysis to compare Siltek™-deactivated products against undeactivated products. To evaluate inlet liner effects on endrin and DDT breakdown, an HP 5890 GC equipped with an Rtx®-CLPesticides2 column and an electron capture detector (ECD) was used. A 50pg/μL standard of tetrachloro-*m*-

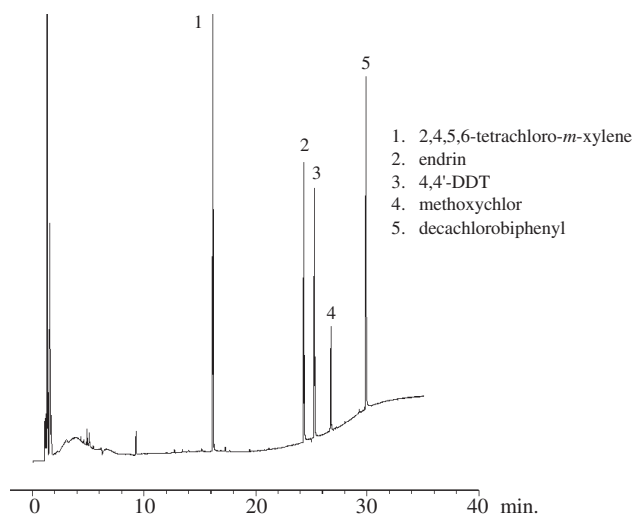
xylene, endrin, 4,4'-DDT, methoxychlor, and decachlorobiphenyl was injected directly onto the column and onto several different liners. The area of the breakdown products was then measured. Helium was used as the carrier gas and the following oven program was used: 120°C (hold 1 min.), to 300°C at 9°C/min. (hold 10 min.). The injector was set at 250°C and the ECD at 300°C.

To measure the column (i.e., "system") breakdown, an on-column injection was made. This eliminated the effects of the injection port. Using this technique, endrin breakdown was 1% and DDT breakdown was below detection limits (Figure 1).

A sample was then introduced by direct injection into an untreated glass Uniliner® sleeve. The advantage of using a Uniliner® sleeve for a direct injection is that the GC column forms a press-tight seal with the liner, allowing the vaporized sample to deposit onto the column with minimal injection port contact. Deactivation is critical for this technique because a direct injection maximizes contact of the sample vapor with the liner. The injection resulted in 62% endrin breakdown with no DDT breakdown (Figure 2).

Figure 1

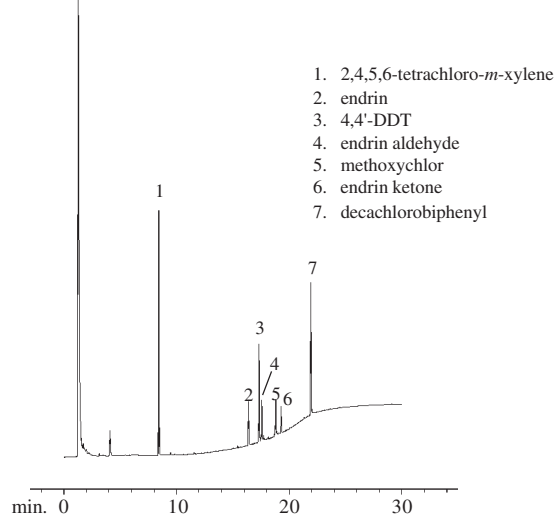
An on-column injection demonstrates system breakdown of less than 1% for endrin and DDT using a Siltek™-deactivated inlet liner.



30m, 0.53mm ID, 0.42μm Rtx®-CLPesticides2 (cat.# 11340).
Inj.: 1μL of 50pg/μL standard. **Oven temp.:** 40°C (hold 1 min.) to 300°C @ 9°C/min. (hold 10 min.); **Inj. temp.:** 250°C;
Det.: ECD, 300°C; **Carrier gas:** helium.

Figure 2

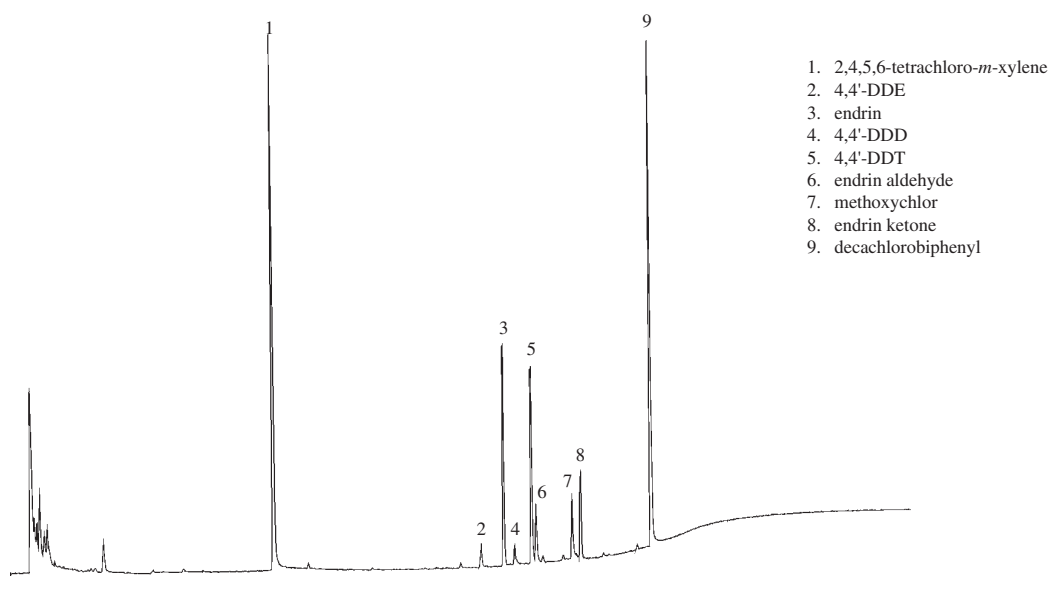
A chromatographic system that is inadequately deactivated will cause poor linearity, poor reproducibility, as demonstrated by 62% endrin breakdown.



30m, 0.53mm ID, 0.42μm Rtx®-CLPesticides2 (cat.# 11340).
Inj.: 1μL of 50pg/μL standard. **Oven temp.:** 120°C (hold 1 min.) to 300°C @ 9°C/min. (hold 10 min.); **Inj. temp.:** 250°C;
Det.: ECD, 300°C; **Carrier gas:** helium.

Figure 3

Untreated metal liners and injection port surfaces will cause high levels of endrin and DDT breakdown.



30m, 0.53mm ID, 0.42µm Rtx®-CLPesticides2 (cat.# 11340). **On-column conc.:** 50ppb; **Oven temp.:** 120°C (hold 1 min.) to 300°C @ 9°C/min. (hold 10 min.); **Inj./det. temp.:** 250°C/300°C; **Purge:** on 0.75 min.; **Carrier gas:** helium, 33cm/sec.

To compare the effects caused by hot metal surfaces, a splitless injection was made into an untreated stainless steel sleeve. Because the splitless sleeve does not form a press-tight seal with the analytical column, the sample vapor is less restricted and is free to contact the metal disk located at the bottom of the HP injection port, as well as the injection port body. Endrin breakdown (40%) was less than in the untreated glass liner, but DDT breakdown (20%) was significant (Figure 3).

As a final comparison, the standard mixture was injected via direct injection into a Uniliner® sleeve that was processed with Siltek™ deactivation (Figure 4). Endrin breakdown measured less than 1% on the Uniliner® sleeve that had been deactivated using the Siltek™ deactivation process. DDT breakdown again was below detection limits and, therefore, insignificant. A completely deactivated system is most effective for analyzing US EPA Method 8081A samples on the same HP system used for the previous injections (Figure 5).

Several conclusions can be drawn from the results of this series of injections. It appears that endrin is more prone to break down on glass surfaces than metal, and DDT is more prone to break down on metal surfaces. In addition, direct injection reduces contact between the sample and the metal injection port. And,

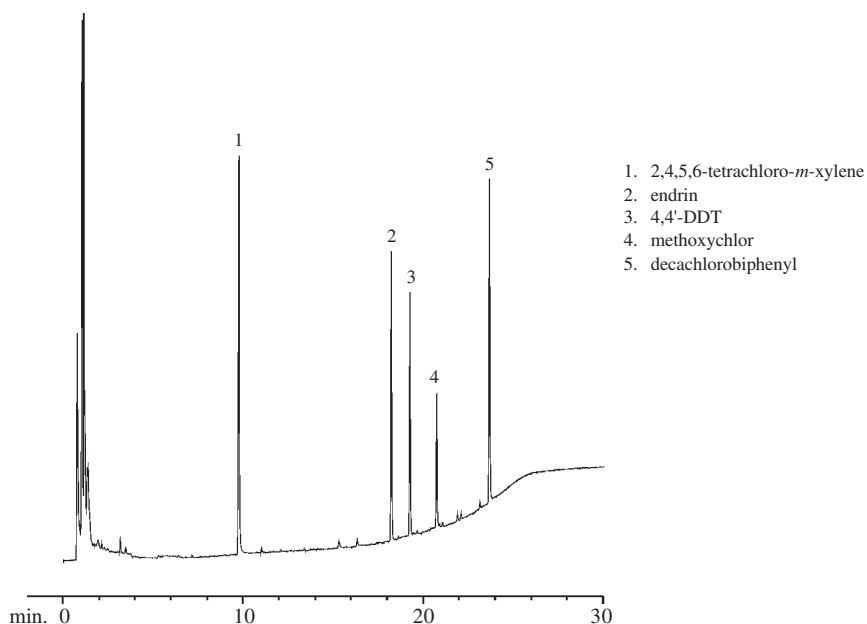
most importantly, careful deactivation of glass sleeves is crucial for minimizing endrin breakdown. Restek's Siltek™ deactivation yields a minimal endrin breakdown of 1%!

Our research demonstrates that a direct injection into a Siltek™-deactivated Uniliner® sleeve provides the best protection against problematic breakdown that occurs in the injection port when analyzing chlorinated pesticides. For a complete, highly inert pathway to analyze these compounds, Restek also offers analytical columns for chlorinated pesticide analysis (Rtx®-CLPesticides and Rtx®-CLPesticides2 columns) and Siltek™-deactivated guard columns.

**For more information on Siltek™—
the next generation of deactivation,
please request our Siltek™ Benefits
brochure (cat.# 59803).**

Figure 4

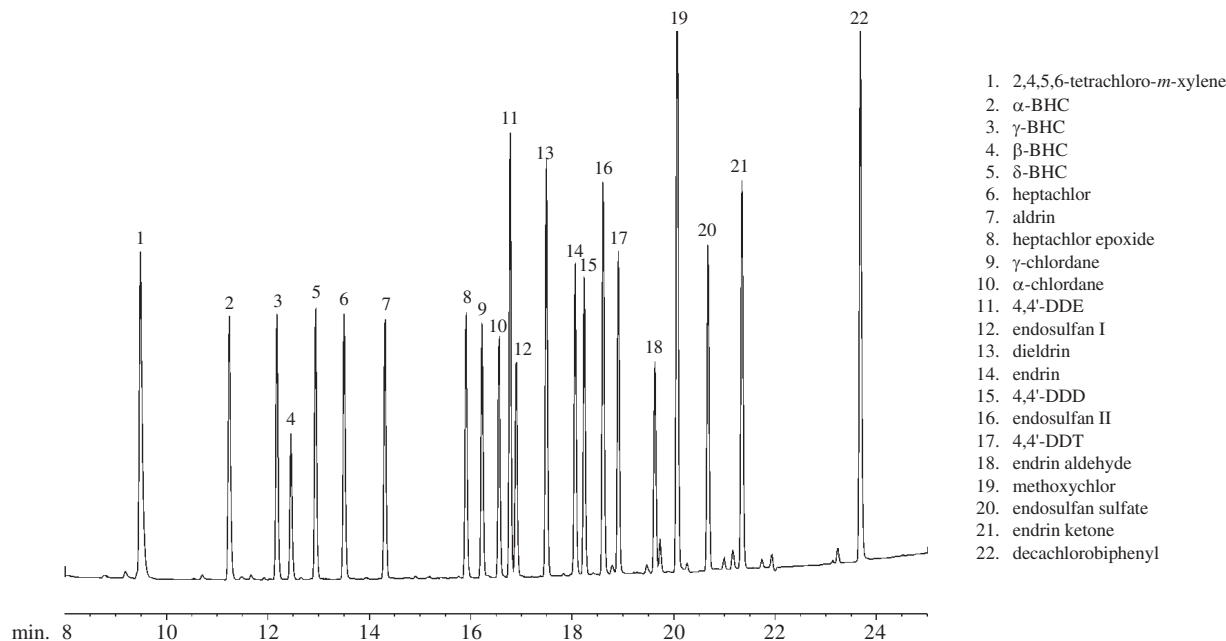
Siltek™-deactivated Uniliner® inlet liners result in less than 1% endrin breakdown and undetectable DDT breakdown.



30m, 0.53mm ID, 0.42µm Rtx®-CLPesticides2 (cat.# 11340). **Inj.:** 1µL of 50pg/µL standard. **Oven temp.:** 120°C (hold 1 min.) to 300°C @ 9°C/min. (hold 10 min.); **Inj. temp.:** 250°C; **ECD temp.:** 300°C; **Carrier gas:** helium.

Figure 5

A completely deactivated GC system shows excellent resolution of the complete list of the chlorinated pesticides in US EPA Method 8081A.



30m, 0.32mm ID, 0.5µm Rtx®-CLPesticides (cat.# 11139) with a 5m, 0.32mm ID Siltek™-deactivated guard column (cat.# 10027) and a Siltek™-deactivated gooseneck liner (cat.# 20798-214.1). **On-column conc.:** 16-160pg; **Oven temp.:** 120°C (hold 1 min.) to 300°C @ 9°C/min. (hold 10 min.); **Inj. temp.:** 250°C, splitless (hold for 0.75 min.); **ECD temp.:** 300°C with anode purge; **Carrier gas:** helium, 31cm/sec.

Product Listing

Rtx®-CLPesticides Columns

ID	df (µm)	Stable to	15m	30m
0.25mm	0.25	340°C	11120	11123
0.32mm	0.50	340°C	11136	11139
0.53mm	0.50	340°C	11137	11140
ID	df (µm)	Stable to	10m	20m
0.18mm	0.18	340°C	42101	42102

Rtx®-CLPesticides Column Kits

These kits include both a CLPesticides and CLPesticides2 column, a Universal Angled 'Y' Press-Tight® Connector, and a 5m guard column. (Note: Columns are not preconnected in these kits.)

Description	cat.#
0.53mm ID Rtx®-CLPesticides Kit	11197
0.32mm ID Rtx®-CLPesticides Kit	11198
0.25mm ID Rtx®-CLPesticides Kit	11199

Organochlorine Pesticide Mix AB #2

aldrin	8µg/mL	dieldrin	16µg/mL
α-BHC	8	endosulfan I	8
β-BHC	8	endosulfan II	16
δ-BHC	8	endosulfan sulfate	16
γ-BHC (lindane)	8	endrin	16
α-chlordane	8	endrin aldehyde	16
γ-chlordane	8	endrin ketone	16
4,4'-DDD	16	heptachlor	8
4,4'-DDE	16	heptachlor epoxide (B)	8
4,4'-DDT	16	methoxychlor	80

in hexane/toluene (1:1), 1mL/ampul.

	each	5-pack	10-pack
	32292	32292-510	
w/data pack	32292-500	32292-520	32392

Organochlorine Pesticide Mix C #2

chlorobenzilate	32µg/mL
diallate (cis & trans)	80
1,2-dibromo-3-chloropropane	8
hexachlorobenzene	8
hexachlorocyclopentadiene	8
isodrin	8

in hexane/toluene (1:1), 1mL/ampul.

	each	5-pack	10-pack
	32295	32295-510	
w/data pack	32295-500	32295-520	32395

Rtx®-CLPesticides2 Columns

ID	df (µm)	Stable to	15m	30m
0.25mm	0.20	340°C	11320	11323
0.32mm	0.25	340°C	11321	11324
0.53mm	0.42	340°C	11337	11340
ID	df (µm)	Stable to	10m	20m
0.18mm	0.14	340°C	42301	42302

Siltek™-Deactivated Guard Columns

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

Siltek™-Deactivated Press-Tight® Connectors

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

For other Siltek™-deactivated Press-Tight® connectors, add suffix "-266" to the catalog number.

Siltek™-Deactivated Inlet Liners

Siltek™	Siltek™ with Siltek™-deact. wool	Siltek™ with CarboFrit™	qty.
-214.1	-213.1	-216.1	each
-214.5	-213.5	-216.5	5-pk.
-214.25	-213.25	-216.25	25-pk.

For Siltek™-deactivated liners, add the corresponding suffix number to the liner's catalog number.

Siltek™-Deactivated Borosilicate Wool

qty.	cat.#
10 grams	21100

For more information on Siltek™—the next generation of deactivation, please request our Siltek™ Benefits brochure (cat.# 59803).

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Siltek™ Deactivation

HRMalytic Chromatography
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RESTEK

Siltek

deactivation

from

RESTEK

The Next Generation of Surface Deactivation

- ✓ Maximizes the inertness of sample pathway
- ✓ Minimizes breakdown and bleed
- ✓ Thermally stable



What is Siltek™ Deactivation?

The Siltek™ process (patent pending) produces a highly inert glass surface that features high-temperature stability, extreme durability, and virtually no bleed.

Siltek™ deactivation is not susceptible to cleavage or formation of active silanols like traditional deactivations can be; and, therefore, greatly reduce bleed, breakdown, and adsorption of active components.

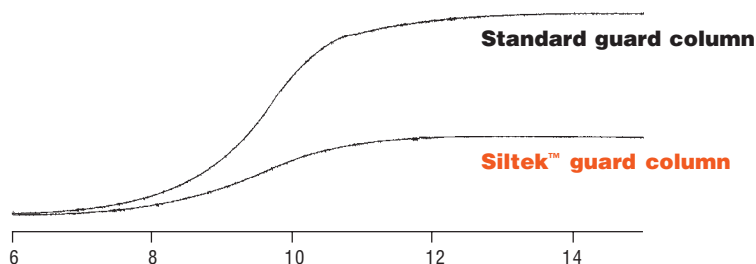
Lower Limits of Detection for High Molecular Weight Compounds

Traditional deactivated surfaces thermally degrade at the elevated temperatures used in GC analysis. As the temperature increases, so does the rate of thermal degradation of the column phase, which is reflected by an increase in the baseline of a detection system. This undesirable phenomena, called bleed, can interfere with the accurate quantitation of analytes. Although deactivated guard columns are not coated with stationary phase, their surface treatment can still show a measurable bleed level.

Siltek™ deactivation, however, results in extremely low bleed levels at elevated temperatures. A Siltek™ guard column has 60% less bleed than a standard deactivated guard column (Figure 1). Lower bleed translates to lower limits of detection for high molecular weight compounds. Better deactivation provides better analytical results!

Figure 1

An expanded bleed plot shows the Siltek™ guard column exhibits 60% less bleed than the standard deactivated guard column at 330°C.



LOW BLEED

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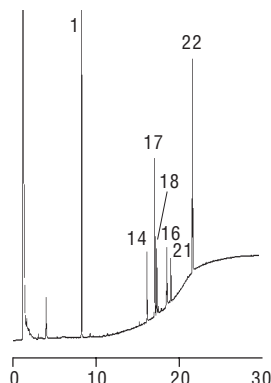
HRMalytic Chromatography Products '08
TECH nology



Figure 2

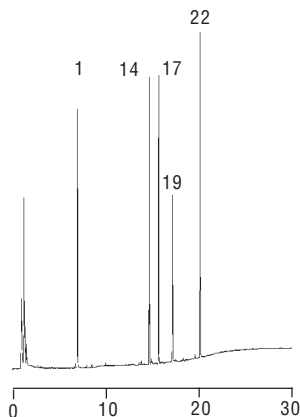
a) Before

A chromatographic system that is inadequately deactivated will cause poor linearity, a loss of reproducibility, and costly analytical downtime.



b) After

Siltek™-deactivated Uniliner® inlet liners result in less than 1% endrin breakdown, and undetectable DDT and methoxychlor breakdown.



Conditions for Figure 2

30m, 0.53mm ID, 0.42µm Rtx-CLPesticides2 (cat.#11340) with open-top Siltek™ Uniliner® w/o wool (cat.# 20843-214.1)

Inj.: 1µL of 50pg/µL standard of tetrachloro-meta-xylene (IS), endrin, 4,4'-DDT, methoxychlor, and decachlorobiphenyl (IS); **Oven temp.:** 120°C (hold 1 min.) to 300°C @ 9°C/min. (hold 10 min.)

Inj. temp.: 250°C; **Det.:** ECD, 300°C
Carrier gas: helium

INERTNESS

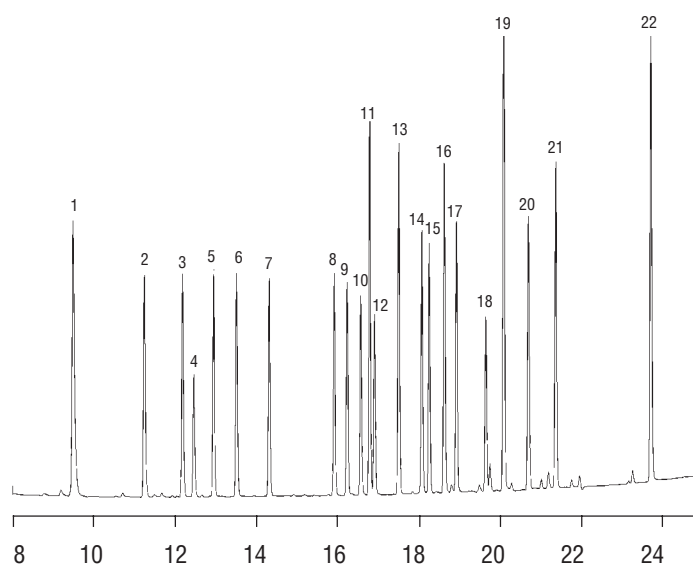
Enhanced Recovery of Trace-Level Chlorinated Pesticides

US Environmental Protection Agency (EPA) Method 8081A is a challenging analysis that requires gas chromatographic (GC) separation and detection of chlorinated pesticides in low ppb levels. Three compounds listed in the 8081A Method—endrin, DDT, and methoxychlor—are highly susceptible to breakdown on a variety of active surfaces, making accurate analysis difficult. A typical configuration for this analysis includes a direct injection sleeve and a guard column connected to one or two analytical columns via a press-tight connector. This entire chromatographic system needs to be optimized to prevent breakdown and ensure accurate results.

In Figure 2a, an on-column analyte concentration of 50ppb shows 62% endrin breakdown on an inadequately deactivated liner, as indicated by the integrated decomposition products of endrin aldehyde (peak 18) and endrin ketone (peak 21). Use of a Siltek™ inlet liner results in less than 1% endrin breakdown, and undetectable DDT and methoxychlor breakdown (Figure 2b). A completely deactivated GC system shows unsurpassed response and resolution of the complete list of 8081A analytes using a Siltek™ liner, Siltek™ Press-Tight® connector, Siltek™ guard column, and an Rtx®-CLPesticides analytical column (Figure 3).

Figure 3

A completely deactivated GC system shows excellent resolution of the complete list of US EPA Method 8081A analytes at very low levels.



Peak List for Figures 2 and 3

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

Conditions for Figure 3

30m, 0.32mm ID, 0.5µm (cat.# 11139) Rtx®-CLPesticides with a 5m, 0.32mm ID Siltek™ guard column (cat.# 10027) and a Siltek™ gooseneck liner (cat.# 20798-214.1)

On-column conc.: 16-160pg

Oven temp.: 120°C (hold 1 min.) to 300°C @ 9°C/min. (hold 10 min.)

Inj. temp.: 250°C, splitless (hold for 0.75 min.)

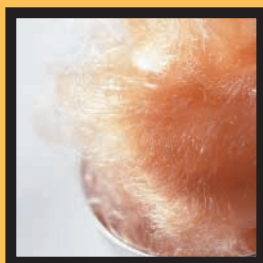
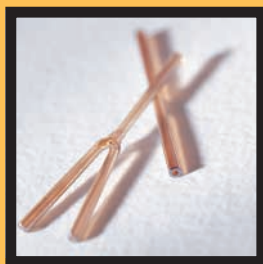
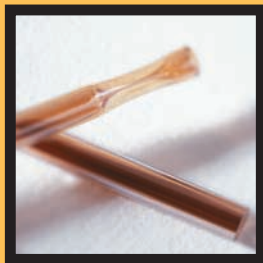
Det.: ECD, 300°C with anode purge
Carrier gas: helium, 31cm/sec.

Restek trademarks: Siltek, CarboFrit, Press-Tight, Uniliner, Rtx, and the Restek logo.

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Siltek™ Inlet Liners

For Siltek™ inlet liners, add the corresponding suffix number to your Restek 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	-213.5	addl. cost	-216.25	addl. cost

Siltek™ Press-Tight® Connectors

Type	Ea.	3-Pk.	5-Pk.	25-Pk.	100-Pk.
straight	—	—	20480	20449	20481
angled	—	—	20482	20483	20484
“Y”	20485	20486	—	—	—
angled “Y”	20487	20469	—	—	—

Siltek™ Borosilicate Wool

Qty.	cat.#
10 g	21100

Siltek™ Guard Columns

Nominal ID	Nominal OD	5-Meter	10-Meter
0.25mm	0.37 ±0.04mm	10026	10036
0.28mm	0.37 ±0.04mm	10016	10017
0.32mm	0.45 ±0.04mm	10027	10037
0.45mm	0.69 ±0.05mm	10018	10019
0.53mm	0.69 ±0.05mm	10028	10038

Rtx®-CLPesticides Column Kits

Kits include a universal angled “Y” Siltek™ Press-Tight® connector, 5m Siltek™ guard column, and columns listed.

Nominal ID	cat.#
30m, 0.53mm ID, 0.50µm Rtx®-CLPesticides column	11197
30m, 0.53mm ID, 0.42µm Rtx®-CLPesticides2 column	
30m, 0.32mm ID, 0.50µm Rtx®-CLPesticides column	11198
30m, 0.32mm ID, 0.25µm Rtx®-CLPesticides2 column	
30m, 0.25mm ID, 0.25µm Rtx®-CLPesticides column	11199
30m, 0.25mm ID, 0.20µm Rtx®-CLPesticides2 column	

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Restek Performance Coatings

Application Guide

If you have any questions about your application, contact us (800-356-1688 or 814-353-1300) or visit us online at www.restekcoatings.com

	Silcosteel®	Sulfinert®	Siltek®	Silcosteel®-AC	Silcosteel®-CR	Silcosteel®-UHV
Analytical equipment transfer tubing	x	x	x			
Automotive exhaust testing	x	x	x			
Beverage-grade CO ₂ testing		x	x			
Coking application (jet fuels, automotive fuels, petrochemical)				x		
Environmental sampling		x	x			
High-vacuum environments						x
Hydrochloric acid-containing streams					x	
Liquid propane gas	x	x	x			
Moisture control environments			x		x	x
Natural gas testing	x	x	x			
Nitric acid-containing streams					x	
NO _x monitoring	x	x	x			
Odorant testing		x	x			
Seawater environments					x	
Semi-conductor gas transfer			x		x	
SO _x monitoring	x	x	x			
Stack gas monitoring		x	x		x	
Sulfur dioxide		x	x			
Sulfurs in petroleum streams (levels above 1ppm)	x	x	x			
Sulfurs in petroleum streams (levels below 1ppm)		x	x			

For details on substrate preferences for treatment, request lit. cat.# 59929.



**Restek
Performance
Coatings**

did you **know?**

Restek offers custom treatment for tubing, fittings, and many system components. For details, contact us or visit us online at www.restekcoatings.com.



Top: electropolished finish, surface roughness average number: 5-10.
Bottom: conventional finish, surface roughness average number: approx. 23-27.

Performance-Treated Stock Products

**Tubing, Fittings, Sample Cylinders, and More
In Stock for Immediate Shipment**

The Family of Restek Performance Coatings

This is a brief description of Restek treatment properties. For more information, request brochure 59493, or contact our Technical Service staff at 800-356-1688 or 814-353-1300, ext. 4, or visit our website.

Silcosteel®	A general-purpose passivation layer for steel and stainless steel. U.S. patent 6,511,760.
Silcosteel®-AC	Dramatically reduces carbon buildup on stainless steel components. U.S. patent 6,444,326.
Silcosteel®-CR	A corrosion resistant layer that increases the lifetime of system components in acidic environments containing hydrochloric acid, nitric acid, sulfuric acid, or seawater. Patent pending.
Silcosteel®-UHV	Greatly reduces outgassing from components of ultra-high vacuum systems. Patent pending.
Siltek®	The ultimate passivation for treated components, from glass to high nickel alloys of steel. U.S. patent 6,444,326.
Sulfinert®	A required treatment for metal components when analyzing for parts-per-billion levels of organo-sulfur compounds. U.S. patent 6,444,326.

Tubing

Restek sets the standard in tubing for analytical and process applications. Complete your system with treated fittings and valves for an inert, corrosion-resistant pathway.

The extremely inert Siltek®/Sulfinert® surface is ideal in applications such as sulfurs or automotive exhaust testing, stack gas sampling, process monitoring, or in any other application in which a representative sample must be transferred without loss.

In systems used to transfer hydrochloric, nitric, sulfuric, or other acids, or seawater, Silcosteel®-CR treated electropolished stainless steel tubing will last longer and require less maintenance. In tests, Silcosteel®-CR treated stainless steel was very well protected from pitting and crevice corrosion, compared to bare steel. For information about Silcosteel®-CR treated metal's performance in corrosive environments, request lit. cat.# 59956.

Electropolished Tubing

Siltek®/Sulfinert®-Treated Electropolished Tubing

ID	OD	cat.#	5-24 ft.	25-99 ft.	100-299 ft.	>300 ft.
0.085"	1/8"	22538				
0.180"	1/4"	22539				

Silcosteel®-CR-Treated Electropolished Tubing

ID	OD	cat.#	5-24 ft.	25-99 ft.	100-299 ft.	>300 ft.
0.085"	1/8"	22536				
0.180"	1/4"	22537				

Frequently Asked Questions About Treated Tubing

Siltek® and Sulfinert®: What's the Difference?

From a performance standpoint, there is no difference. Siltek® is the name for the deposition process used to create the Sulfinert® surface layer. When we developed the Siltek® process, the application that showed the greatest benefit, among many we investigated, was the storage and transfer of low ppb level active sulfur compounds, such as hydrogen sulfide and the mercaptans. Because there was (and continues to be) demand for a reliable surface treatment for this application, we used the name Sulfinert® to describe products created through this new process.

How tightly can treated tubing be bent?

Treated tubing can be bent into curves with a bend radius greater than 1 inch for 1/16-inch OD tubing, 2 inches for 1/8-inch OD tubing, or 4 inches for 1/4-inch OD tubing. The treatment layer will remain intact as long as the tubing isn't stretched dramatically.***

Can compression fittings be used without crushing the treatment layer?

Yes. The layer is thin and permeates the fitting surface. It compresses with minimal damage.

How can treated tubing be cut?

Cut treated tubing with conventional tubing cutters (see tools in this flyer). The thin layer cleaves, leaving a clean break.

Why use Sulfinert® or Silcosteel® treatment instead of Teflon® coating?

Sulfinert® and Silcosteel® layers are non-polymeric, so they do not exhibit the problems associated with gas permeability. Teflon® coating often flakes off the surface, while the Sulfinert® or Silcosteel® layer is tightly integrated into the substrate lattice. Teflon® coating is limited to 280°C, while Silcosteel® treated stainless steel tubing and fittings can be used to 600°C.

Is treated tubing similar to glass-lined tubing (GLT™)?

No. Sulfinert® and Silcosteel® treated tubing is flexible and can be bent without heating. Also, the Sulfinert® or Silcosteel® layer is highly inert, unlike impure glass.

304 Grade Stainless Steel Tubing

Coiled Siltek®/Sulfinert®-Treated Welded/Drawn 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)	1/16" (1.59mm)	22503				
0.030" (0.76mm)	1/16" (1.59mm)	22504				
0.040" (1.02mm)	1/16" (1.59mm)	22505				
0.085" (2.16mm)	1/8" (3.18mm)*	22506				
0.210" (5.33mm)	1/4" (6.35mm)*	22507				

Coiled Silcosteel®-Treated Welded/Drawn 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)	20590				
0.021" (0.53mm)	0.029" (0.74mm)	20591				
0.010" (0.25mm)	1/16" (1.59mm)	20592				
0.020" (0.51mm)	1/16" (1.59mm)	20593				
0.030" (0.76mm)	1/16" (1.59mm)	20594				
0.040" (1.02mm)	1/16" (1.59mm)	20595				
0.085" (2.16mm)	1/8" (3.18mm)*	20596				
0.210" (5.33mm)	1/4" (6.35mm)*	20597				

316 Grade Stainless Steel Tubing

Coiled Siltek®/Sulfinert®-Treated 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)	1/4" (6.35mm)**	22509				

Coiled Silcosteel®-Treated 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)**	20598				
0.180" (4.57mm)	1/4" (6.35mm)**	20599				

Coiled Silcosteel®-CR -Treated Seamless 316L 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)**	22896				
0.180" (4.57mm)	1/4" (6.35mm)**	22897				

Straight Silcosteel®-Treated Tubing

18" (457mm) Length

ID	OD	qty.	cat.#
0.085" (2.16mm)	1/8" (3.18mm)	ea.	20575
0.085" (2.16mm)	1/8" (3.18mm)	5-pk.	20576
0.210" (5.33mm)	1/4" (6.35mm)	ea.	20577
0.210" (5.33mm)	1/4" (6.35mm)	5-pk.	20578

Silcosteel®-Treated Dual-Stage and Single-Stage Regulators

- All stainless steel wetted components Silcosteel®-treated to eliminate surface activity.
- Increase repeatability and consistency

Outlet pressure: 0 to 100psig
Outlet gauge: 30" - 0 to 200psig

Inlet gauge: 0 to 4000psig
Outlet assembly: diaphragm valve, 1/4" tube fitting

Description	qty.	cat.#
Single-Stage Silcosteel® Regulator	ea.	21361
Dual-Stage Silcosteel® Regulator	ea.	21360

*0.020" wall thickness

**0.035" wall thickness

***If tight bends are necessary, use a treated elbow union or bend untreated tubing and send it to Restek for custom treatment.

†Silcosteel®-treated and siloxane-deactivated. For Silcosteel® treatment only, add-279 to the cat.#.



Hydroguard™ Tubing

Silcosteel® Treated Hydroguard™ Tubing

ID	OD	cat.#	5-24 ft.	25-199 ft.	200-399 ft.	>400 ft.
0.010" (0.25mm)	1/16" (1.59mm)	22497				
0.020" (0.51mm)	1/16" (1.59mm)	22496				
0.030" (0.76mm)	1/16" (1.59mm)	22495				
0.040" (1.02mm)	1/16" (1.59mm)	22494				
0.085" (2.16mm)	1/8" (3.18mm)*	22493				
0.210" (5.33mm)	1/4" (6.35mm)*	22492				

Silcosteel® Treated Hydroguard™ 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)**	22491				
0.180" (4.57mm)	1/4" (6.35mm)**	22490				

Silcosteel® Treated Hydroguard™ Electropolished Tubing

ID	OD	cat.#	5-24 ft.	25-99 ft.	100-299 ft.	>300 ft.
0.085"	1/8"	22489				
0.180"	1/4"	22488				

Tubing Tools

SSI TC-20 Tube Cutting Machine

- Cuts 1/16", 1/8" and 1/4" tubing with inside diameters as small as 0.008".
- Handy dressing tool on the swing arm removes burrs and reams tubing.
- Voltage selectable 110–120/220–240 volts, 50–60Hz.*

Description	qty.	cat.#
SSI Tubing Cutter Machine	ea.	23029
SSI Replacement Cutting Wheels	3-pk.	23030

1/16-Inch Tubing Cutter

- Produces square, smooth cuts in 1/16-inch tubing.
- Eliminates tubing distortion.
- Replaceable cutting wheel.

Description	qty.	cat.#
1/16" Tubing Cutter	ea.	20192
Replacement Cutting Wheels	3-pk.	20185

Ridgid™ Tubing Cutter

- Excellent for cutting 1/8" or 1/4-inch metal tubing.
- Compact size is ideal for tight spaces.
- Replaceable cutting wheel.

Description	qty.	cat.#
Ridgid™ Tubing Cutter for 1/8" or 1/4" metal tubing	ea.	23011
Replacement Cutting Wheels	2-pk.	23012

Tubing Reamer

- Removes burrs from 1/4" or 1/8-inch stainless steel tubing.
- Non-slip safety design.

Description	qty.	cat.#
Tubing Reamer	ea.	20134

Tubing Bender

- Bends 1/8-inch, 3/16-inch, or 1/4-inch tubing.
- Accurate left-hand, right-hand, or offset bends.

Description	qty.	cat.#
Tubing Bender	ea.	23009

1/16-Inch Tubing Cutting Pliers

- Ideal for cutting 1/16-inch tubing.
- Cuts quickly, reducing distortion.

Description	qty.	cat.#
1/16" Tubing Cutting Pliers	ea.	20193

*Unit shipped set for 110–120 operating voltage. Switch to 220–240 volts by using alternate fuse and power cord (included).

Hydroguard™ tubing

Hydroguard™ deactivation creates a high-density surface that is not readily attacked by aggressive hydrolysis.

please note

An extra charge is applied for cutting tubing, calculated from the total number of pieces produced for each line item:














Siltek®/Sulfinert®, Silcosteel®, and Silcosteel®-CR Treated Fittings from Swagelok® and Parker

- Full line of treated $\frac{1}{16}$ " , $\frac{1}{8}$ " and $\frac{1}{4}$ " fittings.
- Siltek®/Sulfinert® treatment ensures ultimate inertness.
- Silcosteel®-CR treatment enhances corrosion resistance by 10X, or more.
- Custom treatment available for any fitting, or for other system parts.



Treated Fittings from Swagelok®

Fitting Type	Size	Swagelok® #	qty.	Siltek®/Sulfinert® cat.#	qty.	Silcosteel®-CR cat.#
	$\frac{1}{16}$ "	SS-100-6	ea.	22540	ea.	22575
	$\frac{1}{8}$ "	SS-200-6	ea.	22541	ea.	22576
	$\frac{1}{4}$ "	SS-400-6	ea.	22542	ea.	22577
	$\frac{1}{16}$ "	SS-100-3	ea.	22543	ea.	22578
	$\frac{1}{8}$ "	SS-200-3	ea.	22544	ea.	22579
	$\frac{1}{4}$ "	SS-400-3	ea.	22545	ea.	22580
	$\frac{1}{8}$ " to $\frac{1}{16}$ "	SS-200-6-1	ea.	22546	ea.	22581
	$\frac{1}{4}$ " to $\frac{1}{16}$ "	SS-400-6-1	ea.	22547	ea.	22582
	$\frac{1}{4}$ " to $\frac{1}{8}$ "	SS-400-6-2	ea.	22548	ea.	22583
	$\frac{1}{8}$ "	SS-200-9	ea.	22549	ea.	22584
	$\frac{1}{4}$ "	SS-400-9	ea.	22550	ea.	22585
	$\frac{1}{16}$ "	SS-100-P	ea.	22572	ea.	22619
	$\frac{1}{8}$ "	SS-200-P	ea.	22573	ea.	22620
	$\frac{1}{4}$ "	SS-400-P	ea.	22574	ea.	22597
	$\frac{1}{8}$ "	SS-200-4	ea.	22551	ea.	22586
	$\frac{1}{4}$ "	SS-400-4	ea.	22552	ea.	22587
	$\frac{1}{8}$ " tube to $\frac{1}{16}$ "	SS-100-R-2	ea.	22553	ea.	22588
	$\frac{1}{4}$ " tube to $\frac{1}{16}$ "	SS-100-R-4	ea.	22554	ea.	22589
	$\frac{1}{8}$ " tube to $\frac{1}{4}$ "	SS-400-R-2	ea.	22555	ea.	22590
	$\frac{1}{4}$ " tube to $\frac{1}{8}$ "	SS-200-R-4	ea.	22556	ea.	22591
	$\frac{1}{8}$ "	SS-201-PC	ea.	22557	ea.	22592
	$\frac{1}{4}$ "	SS-401-PC	ea.	22558	ea.	22593
	$\frac{1}{8}$ " tube to $\frac{1}{4}$ "	SS-401-PC-2	ea.	22559	ea.	22594
	$\frac{1}{4}$ " to $\frac{1}{8}$ " NPT	SS-200-1-2	ea.	22561	ea.	22595
	$\frac{1}{4}$ " to $\frac{1}{4}$ " NPT	SS-400-1-4	ea.	22562	ea.	22596
	$\frac{1}{16}$ " to $\frac{1}{8}$ " NPT	SS-100-1-2	ea.	22563	ea.	22610
	$\frac{1}{8}$ " to $\frac{1}{4}$ " NPT	SS-200-1-4	ea.	22564	ea.	22611
	$\frac{1}{4}$ " to $\frac{1}{8}$ " NPT	SS-400-1-2	ea.	22565	ea.	22612
	$\frac{1}{4}$ " to $\frac{1}{8}$ " NPT	SS-200-7-2	ea.	22566	ea.	22613
	$\frac{1}{4}$ " to $\frac{1}{4}$ " NPT	SS-400-7-4	ea.	22567	ea.	22614
	$\frac{1}{4}$ " to $\frac{1}{8}$ " NPT	SS-400-7-2	ea.	22568	ea.	22615
	$\frac{1}{8}$ " to $\frac{1}{4}$ " NPT	SS-200-7-4	ea.	22569	ea.	22616
	$\frac{1}{8}$ "	SS-200-61	ea.	22570	ea.	22617
	$\frac{1}{4}$ "	SS-400-61	ea.	22571	ea.	22618

please **note**

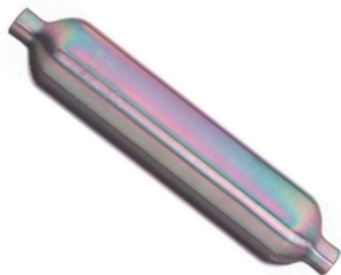
Nuts and ferrules are not treated unless requested (custom parts). Nuts and ferrules normally are not in contact with samples, and thus do not require treatment.

Treated Fittings from Parker

Fitting Type	Size	Siltek®/Sulfinert®		Silcosteel®		Silcosteel®-CR	
		qty.	cat.#	qty.	cat.#	qty.	cat.#
 Union	1/16"	ea.	22520	ea.	20510	ea.	22863
	1/8"	ea.	22521	ea.	20511	ea.	22864
	1/4"	ea.	22522	ea.	20512	ea.	22865
 Tee	1/16"	ea.	22526	ea.	20513	ea.	22866
	1/8"	ea.	22527	ea.	20514	ea.	22867
	1/4"	ea.	22528	ea.	20515	ea.	22868
 Reducing Union	1/8" to 1/16"	ea.	22523	ea.	20519	ea.	22869
	1/4" to 1/16"	ea.	22524	ea.	20520	ea.	22870
	1/4" to 1/8"	ea.	22525	ea.	20521	ea.	22871
 Elbow	1/16"	—	—	—	—	ea.	22874
	1/8"	ea.	22530	ea.	20517	ea.	22875
	1/4"	ea.	22531	ea.	20518	ea.	22876
 Plug	1/16"	ea.	21539	ea.	21518	ea.	22877
	1/8"	ea.	21540	ea.	21519	ea.	22878
	1/4"	ea.	21541	ea.	21520	ea.	22879
 Cross	1/8"	ea.	21542	ea.	21521	ea.	22872
	1/4"	ea.	21543	ea.	21522	ea.	22873
 Tube End Reducer	1/8" tube to 1/16"	ea.	21544	ea.	21523	ea.	22880
	1/4" tube to 1/16"	ea.	21545	ea.	21524	ea.	22881
	1/8" tube to 1/4"	ea.	21546	ea.	21525	ea.	22882
	1/4" tube to 1/8"	ea.	21547	ea.	21526	ea.	22883
 Port Connector	1/8"	ea.	21548	ea.	21527	ea.	22884
	1/4"	ea.	21549	ea.	21528	ea.	22885
	1/8" tube to 1/4"	ea.	21550	ea.	21529	ea.	22886
 Male Connector	1/8" to 1/8" NPT	ea.	21551	ea.	21530	ea.	22887
	1/4" to 1/4" NPT	ea.	21552	ea.	21531	ea.	22888
	1/16" to 1/8" NPT	ea.	21553	ea.	21532	ea.	22889
	1/8" to 1/4" NPT	ea.	21554	ea.	21533	ea.	22890
	1/4" to 1/8" NPT	ea.	21555	ea.	21534	ea.	22891
 Female Connector	1/8" to 1/8" NPT	ea.	21556	ea.	21535	ea.	22892
	1/4" to 1/4" NPT	ea.	21557	ea.	21536	ea.	22893
	1/4" to 1/8" NPT	ea.	21558	ea.	21537	ea.	22894
	1/8" to 1/4" NPT	ea.	21559	ea.	21538	ea.	22895
 VICI Valco Zero Dead Volume Tee	1/16"	ea.	22534	ea.	20581	—	—
	1/8"	ea.	22535	ea.	20583	—	—
 VICI Valco Zero Dead Volume Union	1/16"	ea.	22532	ea.	20580	—	—
	1/8"	ea.	22533	ea.	20582	—	—
 Plug Valve	1/8"	ea.	21586	ea.	21576	—	—
	1/4"	ea.	21587	ea.	21577	—	—
 Ball Valve	1/8"	ea.	21588	ea.	21578	—	—
	1/4"	ea.	21589	ea.	21579	—	—

Sample Cylinders, Valves, and Loops

Sulfinert®-treated gas sampling equipment is ideal for applications that demand only inert surfaces contact the sample, such as sampling natural gas or testing beverage-grade carbon dioxide. Sulfinert®-treated cylinders ensure sulfur compounds or other active compounds will be stable during transport from the field to the laboratory.



**Restek
Performance
Coatings**

Restek trademarks:
HydriGuard, Silcosteel,
Siltek, Sulfinert, the RPC
logo. Other trademarks:
Kel-F (3M co.), Rigid
(Rigid, Inc.), Swagelok
(Swagelok Co.)

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Sulfinert®-Treated Sample Cylinders

- Stable storage of low concentrations of sulfur compounds.
- Made from 316 stainless steel, 1/4" female NPT threads on both ends.
- D.O.T. rated to 1800psi at room temperature.

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

Sulfinert®-Treated Hoke® Sample Cylinder Valves

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

Sulfinert®-Treated Swagelok® Rupture Disc Tee

Description	qty.	cat.#
Sulfinert® Rupture Disc Tee (1/4" NPT connections)	ea.	21396
Replacement Rupture Disc (not Sulfinert®-treated)	ea.	24298

Sulfinert®-Treated Gas Sampling Valves

(1/16" fittings, 0.40mm port diameter; "W Type" valve)

Description	qty.	cat.#
Sulfinert® Gas Sampling Valve; 4-Port	ea.	20584
Sulfinert® Gas Sampling Valve; 6-Port	ea.	20585
Sulfinert® Gas Sampling Valve; 10-Port	ea.	20586

Replacement Rotors

Description	qty.	cat.#
Replacement Rotor for 4-Port Sulfinert® Gas Sampling Valve	ea.	20587
Replacement Rotor for 6-Port Sulfinert® Gas Sampling Valve	ea.	20588
Replacement Rotor for 10-Port Sulfinert® Gas Sampling Valve	ea.	20589

Sulfinert®-Treated Gas Sample Loops

(1/16" fittings, for "W Type" valves)

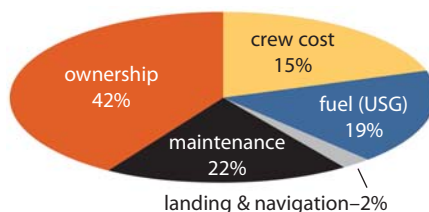
Size	qty.	cat.#
5µL	ea.	22840
10µL	ea.	22841
20µL	ea.	22842
25µL	ea.	22843
50µL	ea.	22844
100µL	ea.	22845
250µL	ea.	22846
500µL	ea.	22847
1cc	ea.	22848
2cc	ea.	22849
5cc	ea.	22850

Improve Engine & Process Performance with Silcosteel®-AC Surface Treatment

Reduce coking up to 8-fold, using Silcosteel®-AC treated components

High performance engines continue to push the envelope of efficiency and power. In order to maintain high efficiency and low emissions, these engines are designed to operate at higher temperatures. Whether the engine is a commercial aircraft CFM56, a diesel generator set, or a long haul truck engine, proper engine maintenance is crucial to continued fuel-efficient operation and long engine life. A typical aircraft engine maintenance program can represent as much as 22% of an airline's operating budget (Figure 1).¹

Figure 1 Engine maintenance can represent almost one quarter of an airline's operating budget.¹



An important contributor to high maintenance costs is carbon fouling, or coking—a buildup of carbon-based deposits on or in combustion engine components or process systems. Aircraft maintenance personnel are discovering significant coking in fuel lines, oil lines, and nozzles. Coking has been responsible for engine failures, shortened maintenance cycles, and unplanned repairs. Diesel engine manufacturers have determined that coking on pistons is a contributor to shortened engine life and costly rebuilds (Figure 2).²

Figure 2 A Silcosteel®-AC-treated piston (left) shows dramatically less coke buildup than an untreated diesel piston (right).²



Studies have shown that coking occurs when fuels or oils are exposed to temperatures over 200°C, and increases significantly at temperatures over 400°C. Frequently, exposure to high temperature occurs after the engine is shut down, when there is no coolant flow to carry away excess heat.³

Significantly reduce plant maintenance costs associated with downtime

Plant costs as a result of coking can be significant. Below are estimated manufacturing costs due to coke buildup:

- A one-hour delay in an 800,000 tpy ethylene plant can cost \$50,000
- An LDPE unit producing 250,000 tpy can sustain a production loss of \$36,000/hour
- A 250,000 tpy EBSM styrene plant stands to lose \$33,000/hour
- Even for a 200,000 tpy anti-freeze grade production process, loss can amount to \$3,600/hour

Reduce coke formation 8-fold with Silcosteel®-AC surface treatment

There are 4 types of coke buildup: pyrolytic (gas-solid deposition), spherulitic (gas-liquid-solid deposition), carbides, and filamentous. The latter type causes the most concern. At elevated temperatures, dissolved oxygen in the fuel can oxidize fuel components, and exposed metal surfaces can catalyze fuel into carbon filaments that grow on the surfaces. Although by weight only 10% of total carbon coking, filamentous coking is the most troublesome because, as the filaments grow, fuel or oil flow becomes obstructed. Eventually, this causes inefficient operation, or engine damage.

By passivating coking-susceptible surfaces with an inert, amorphous, high temperature-tolerant silicon layer, Silcosteel®-AC surface treatment greatly retards the catalytic coking process. The silicon layer is a barrier to the catalytic action that creates filamentous coking. Studies at The Pennsylvania State University and at Wright-Patterson Air Force Base have shown that Silcosteel®-AC treatment reduces carbon fouling on stainless steel up to 8-fold (Figure 3).^{4,5}

A Silcosteel®-AC-treated surface not only prevents the formation of filamentous coke, it

Increase efficiency, protect equipment

Silcosteel®-AC treatment adds value to your process:

- Longer component lifetimes.
- Decreased maintenance costs.
- Higher thermal efficiency.
- Will withstand temperatures to 550°C.
- Apply to existing equipment.



Restek Performance Coatings

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www.restekcoatings.com

simplifies removal of other types of coke that typically bind to a heated surface (Figure 4). Studies have shown that carbon deposits can be removed from a Silcosteel®-AC treated surface simply by sonicating the surface in common solvents, thus dramatically simplifying maintenance procedures and extending maintenance cycles.⁵

Apply Silcosteel®-AC treatment to engine components susceptible to coking

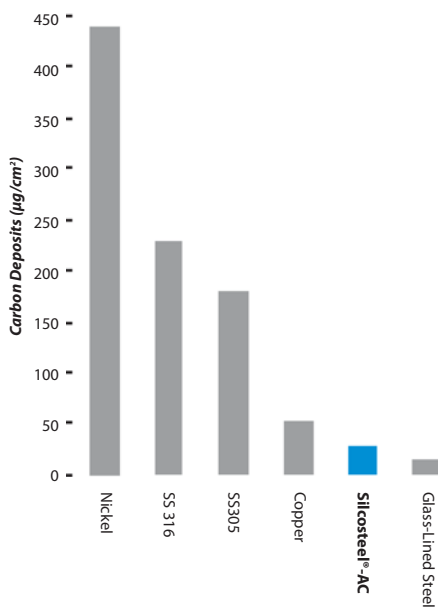
A Silcosteel®-AC layer can be applied to new or existing engine components. Silcosteel®-AC is a chemical vapor-deposited (CVD) layer, designed specifically to reduce coking of steel, stainless steel, specialty alloys, and aluminum. The unique

non-line-of-sight CVD process produces a flexible, amorphous silicon layer that diffuses into the metal lattice and conforms to the most intricate surface, while maintaining high dimensional tolerances. A Silcosteel®-AC layer will deform with the metal surface, allowing radius bends in tubing, or leak-free seals, even at the most demanding temperatures.

Silcosteel®-AC treatment extends maintenance cycles for engines while maintaining high dimensional tolerances, high temperature capability, and leak-free conditions, making it an ideal treatment for:

- fuel injection nozzles
- fuel and oil lines
- jet engine nozzles
- pistons
- EGR valves
- valves
- turbine shafts
- heat exchangers

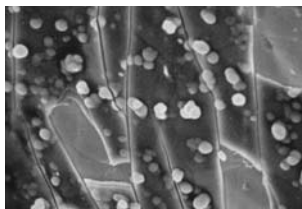
Figure 3 Silcosteel®-AC treatment reduces coking up to 8-fold.⁵



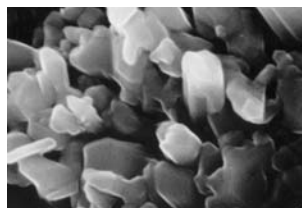
Contact us! Restek will treat your **tubing, fittings, and more** with Silcosteel®-AC.



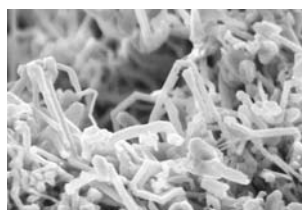
Figure 4 Carbon deposit from JP-8 fuel on various types of tubing (500°C, 500psi, 1cc/min. flow rate).



Silcosteel®-AC



304 Stainless Steel



Competitor A

In Summary

Test data show that Silcosteel®-AC treatment is highly effective in reducing catalytic coking, by as much as a factor of 8. Because Silcosteel®-AC treatment can be applied to existing components, maintenance cycles can be extended without significant re-engineering. Silcosteel®-AC treatment is a proprietary (U.S. patent 6,444,326), custom service, offered exclusively by Restek Performance Coatings. To learn more about how Silcosteel®-AC treatment can reduce coking in your engine fleet, visit Restek Performance Coatings on the web at www.restekcoatings.com or contact our technical service group at 800-356-1688, ext. 4.

References

1. Steinetz, B., R. Hendricks, J. Munson, *Advanced Seal Technology Role in Meeting Next Generation Turbine Engine Goals* NASA/TM-1998-206961; National Aeronautics and Space Administration, Cleveland, OH; Allison Engine Company, Indianapolis, IN (1998).
2. Perez, J., A. Boehman, *Penn State Multi-Discipline Tribology Group and Energy Institute Studies The Pennsylvania State University*, University Park, PA (1998).
3. Oil Coking EMAL-TT7-1201, ExxonMobil Corporation (2001).
4. Jones, E.G., W. Balster, W. Rubey, *Fouling of Stainless Steel and Silcosteel Surfaces During Aviation-Fuel Autoxidation Systems Research Laboratories, Inc.*, Dayton, OH; University of Dayton Research Institute, Dayton, OH (1995).
5. Altin, O., S. Eser, *Analysis of Solid Deposits from Thermal Stressing of a JP-8 Fuel on Different Surfaces in a Flow Reactor* Ind. Eng. Chem. Res. 40: 596-603 (2001).



for more **info**

Learn more about our precisely applied, highly durable surface treatment, Silcosteel®-AC: request information packet 59047.



Restek Performance Coatings

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Lit. Cat.# 580024

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Restek trademarks:
Silcosteel, the RPC logo.

Restek Surface Treatments

We offer many surface treatments that enhance performance in many applications:

Silcosteel®	A general-purpose passivation layer for steel and stainless steel. U.S. patent 6,511,760.
Silcosteel®-AC	Dramatically reduces carbon buildup on stainless steel components. U.S. patent 6,444,326.
Silcosteel®-CR	A corrosion resistant layer that increases the lifetime of system components in acidic environments containing hydrochloric acid, nitric acid, sulfuric acid, or seawater. Patent pending.
Silcosteel®-UHV	Greatly reduces outgassing from components of ultra-high vacuum systems. Recognized as one of the 100 most technologically significant products by <i>R&D</i> magazine. Patent pending.
Siltek™	The ultimate passivation for treated components, from glass to high nickel alloys of steel. U.S. patent 6,444,326.
Sulfinit®	A required treatment for metal components when analyzing for parts-per-billion levels of organo-sulfur compounds. U.S. patent 6,444,326.

Fast, Sensitive LC/MS/MS Analysis of Paraquat and Diquat

Using an API 3200™ Mass Spectrometer and an Ultra Quat HPLC Column

Houssain El Aribi, Ph.D., LC/MS Product and Application Specialist, MDS SCIEX*, Becky Wittrig, Ph.D., HPLC Product Manager, C. Vernon Bartlett, HPLC R&D Scientist, and Julie Kowalski, Innovations Team Chemist, Restek Corporation

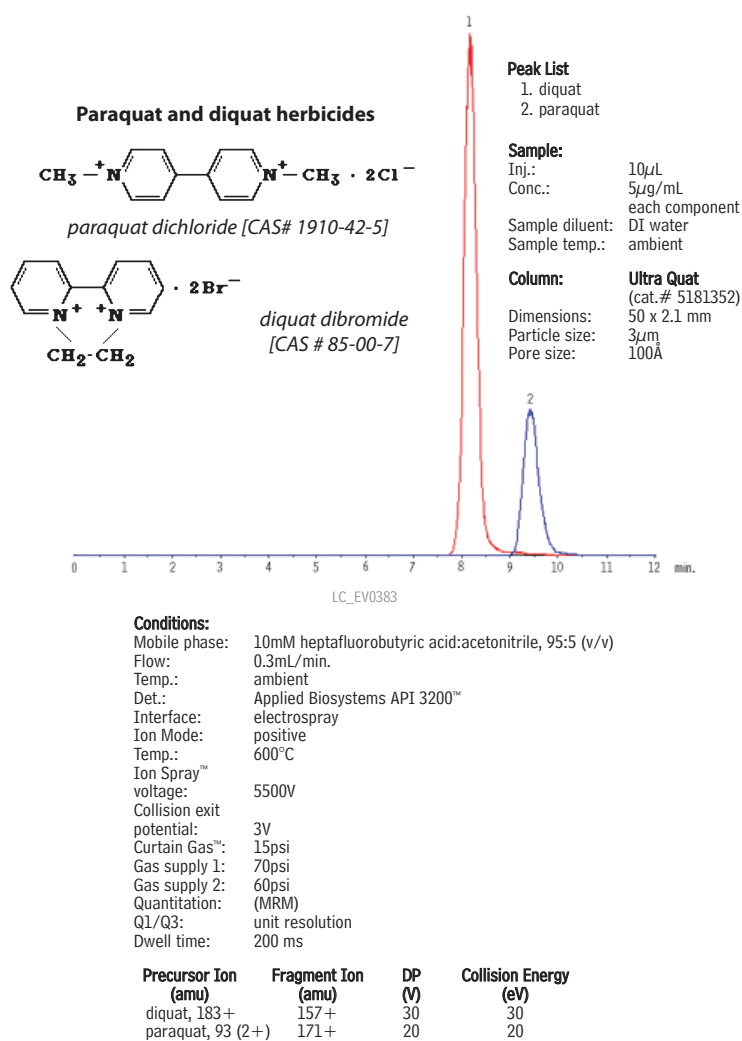
- Complete resolution of paraquat & diquat – with a simple, isocratic mobile phase!
- Superior sensitivity—5ppb paraquat or 0.1ppb diquat—without preconcentration.
- Significantly faster than conventional methodologies.

Restek chemists designed the Ultra Quat HPLC column specifically for analyses of quaternary amine compounds. This unique column makes possible a simple HPLC/UV analysis for paraquat and diquat¹ – a significant improvement over alternative methodologies. Now, in collaboration with scientists at MDS Sciex, we have developed a fast, highly sensitive LC/MS method for analyzing these challenging target compounds.

Charged quaternary amines, such as paraquat and diquat, exhibit little or no retention on C18 or other alkyl stationary phases. In our HPLC/UV procedure, our Ultra Quat mobile phase modifier (Ultra Quat Reagent Solution, cat.# 32441) increases the interactions between paraquat and diquat and the Ultra Quat stationary phase, providing the necessary retention and resolution. For compatibility with MS detection, however, we needed a volatile mobile phase additive. Low concentrations of heptafluorobutyric acid (HFBA) effectively shield the positive charges of paraquat and diquat, increasing interactions between the quaternary amines and the Ultra Quat stationary phase.

Figure 1 shows the excellent separation of paraquat and diquat, at a concentration of 5µg/mL each in water, achieved by using an API 3200™ mass spectrometer. We used multiple reaction monitoring (MRM) – a standard technique for quantitative LC/MS/MS – for this application. In MRM, pairs of target precursor ions and unique fragment ions are used for quick and accurate identification of target species. Collision induced

Figure 1 Fast, sensitive LC/MS/MS analysis of paraquat and diquat, using an API 3200™ mass spectrometer and an Ultra Quat HPLC column.



*Data courtesy of Houssain El Aribi, Ph.D., LC/MS Product and Application Specialist, MDS SCIEX, 71 Four Valley Drive, Concord, Ontario, Canada, L4K 4V8

Table 1 MRM transitions and MS conditions used to generate CID spectra for paraquat and diquat.

Precursor Ion (m/z)	Fragment Ions (m/z)	DP (V)	Collision Energy (eV)
Paraquat [$M^{2+} - H^+$] 185	170a 169b	40	30
Paraquat-d8 [$M^{2+} - D^+$] 193 (int. std.)	178a	40	30
Diquat [$M^{2+} - H^+$] 183	157a 168b	35	30
Diquat-d4 [$M^{2+} - D^+$] 186 (int. std.)	158a	35	30

Figure 2 CID spectra for paraquat⁺ at CE = 25eV.

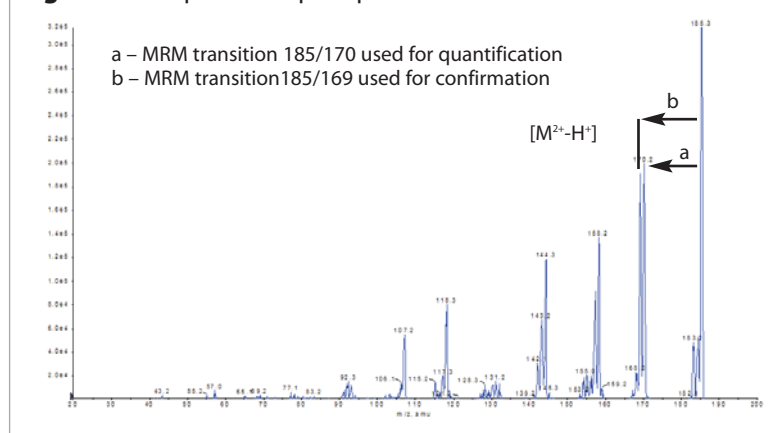
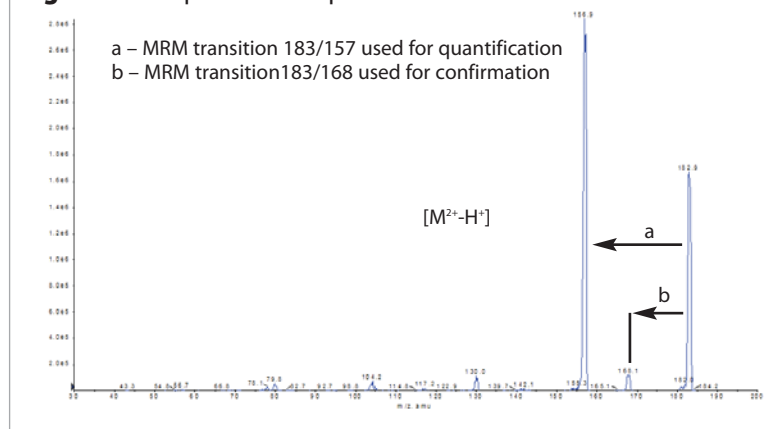


Figure 3 CID spectra for diquat⁺ at CE = 25eV.



free literature

Simple, Sensitive HPLC/UV Analysis for Paraquat and Diquat Using High-Recovery Solid Phase Extraction and an Ultra Quat HPLC Column

These highly charged quaternary amines are poorly retained on alkyl stationary phases. Using only acetonitrile, water, and a solvation-blocking reagent, our separation system alters the interactions among analyte, mobile phase, and stationary phase, and promotes solubility of the analytes in the stationary phase. In our system, the detection limit is 6ppb for either herbicide, and the analysis is completed in less than 10 minutes. An optimized solid phase extraction cartridge concentrates the herbicides for the analysis. **lit. cat.# 580006**

Environmental HPLC: Applications-Columns-Reference Materials

Restek HPLC columns support environmental HPLC applications with rapid analysis times and effective analyte resolution. Sample turn-around can be 50% faster, or more, than with alternative columns. In addition, we prepare analytical reference materials and sample clean-up products for these methods. Applications in this publication include polyaromatic hydrocarbons, carbamates, phenoxyacid herbicides, explosives, carbonyls, and paraquat/diquat. **lit. cat.# 59741A**

dissociation (CID) is used to generate the fragment ions. CID spectra for paraquat and diquat are shown in Figures 2 and 3. This approach has been used in many pharmaceutical and environmental applications, to generate unmatched limits of detection or quantification, precision, and accuracy. For accurate quantification, we used paraquat-d8 and diquat-d4 as internal standards (Table 1), to compensate for matrix effects and to correct for random and systematic errors in separation and detection.

For triplicate injections of 8 concentrations of analytes in deionized water and in lake water, from 5µg/100mL to 100µg/100mL for paraquat and from 0.1µg/100mL to 100µg/100mL for diquat, correlation coefficients for calibration curves were >0.995, using a linear fit and 1/x weighting factor. These results indicate that quantification can be performed with good linearity and sensitivity. Minimum detection limits (MDL) for the method, for paraquat and diquat in deionized water, were 5µg/L and 0.1µg/L, respectively.

LC/MS is a powerful tool for analyses of challenging environmental contaminants. In LC/MS analyses of paraquat and diquat, the combination of an Applied Biosystems API 3200™ mass spectrometer and an Ultra Quat HPLC column ensures fast, sensitive, and accurate results.

Reference

1. *Simple, Sensitive HPLC/UV Analysis for Paraquat and Diquat, Using High-Recovery Solid Phase Extraction and an Ultra Quat HPLC Column* Applications Note 580006, Restek Corporation, Feb. 2006. Reference available from Restek on request.

Ultra Quat Columns & Guard Cartridges

5µm Column, 4.6mm	cat. #
150mm	9181565
150mm (with Trident™ Inlet Fitting)	9181565-700
Ultra Quat Guard Cartridges	
10 x 2.1mm	918150212
10 x 4.0mm	918150210
20 x 2.1mm	918150222
20 x 4.0mm	918150220

Paraquat & Diquat Calibration Mix

diquat dibromide	paraquat dichloride
1,000µg/mL each in water, 1mL/ampul	
cat. # 32437 (ea.)	

free literature

HPLC Essentials

Genuine Restek Replacement Parts will keep your Agilent, Beckman, Hitachi, PerkinElmer, Shimadzu, Thermo Separation Products, or Waters system running smoothly and chromatography sharp. Restek parts equal or exceed the performance of original components. **lit. cat.# 59012A**



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Greatly improve purity & corrosion resistance

Silcosteel®-CR treatment is designed to:

- Improve process purity by reducing ion contamination in process tools.
- Eliminate moisture contamination in gas delivery systems.
- Improve corrosion resistance in process gas delivery systems, without the use of super alloys.



Restek Performance Coatings

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Silcosteel®-CR Surface Treatment

Improve Corrosion Resistance by Tenfold or More in Semiconductor Processes

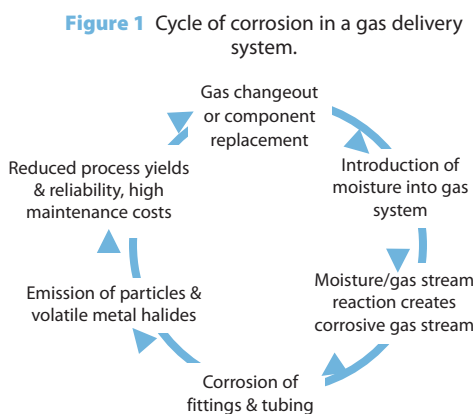
Semiconductor manufacturers face unique challenges in today's manufacturing environment. Market pressures for increased productivity, increased reliability, and improved production yields are greater than ever, while material and operating cost pressures continue to rise.

Key challenges to improved reliability in future chip designs are:¹

- ion contamination/process purity
- poor gas purity
- equipment reliability
- rising operating costs
- process corrosion/contamination

Process corrosion costs the US semiconductor industry over \$1.2B per year through manufacturing losses and increased maintenance costs.^{2,3} One contributor to poor reliability and high cost is the corrosion of gas distribution systems. Studies have shown that 68% of contamination issues in CMOS processes are traceable to the gas distribution system.⁴

Figure 1 outlines the cycle of corrosion in gas distribution systems:⁴



Adding to the challenge, facility material costs are increasing rapidly, due to higher commodity prices and reduced availability of stainless steel, nickel, and super alloys such as Hastelloy® C22™.

Corrosion resistant silicon coatings

Corrosion-resistant, high-purity silicon coatings from Restek Performance Coatings can improve the corrosion performance of stainless steels by an order of

magnitude, or more. Silcosteel®-CR is a proprietary (patent pending) multilayer silicon CVD coating delivering an order of magnitude improvement in corrosion resistance to a wide range of corrosive environments. Silcosteel®-CR maintains high system purity, demonstrates extreme heat capability, and exhibits leak-tight system performance when applied to steel, stainless steel, and alloy systems.

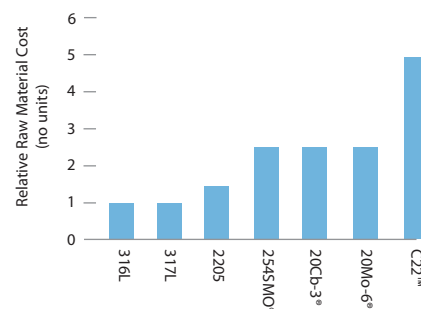
The unique non-line-of-sight CVD process produces a high purity, flexible amorphous silicon layer, diffused into the base metal lattice. The layer will conform to the most intricate surface while maintaining high dimensional tolerances. The Silcosteel®-CR layer will deform with tubing surfaces, allowing leak-free seals or radius bends.

Table I (reverse) shows compatibility of Silcosteel®-CR treatment with common chemicals used in the semiconductor industry.⁵

Improve reliability while reducing costs

316L gas delivery systems exposed to corrosive environments typically are replaced within 5 years of installation. Substituting a high performance alloy for 316L stainless steel can increase the cost of the system by as much as five-fold (Figure 2).⁴

Figure 2 High performance alloys substantially increase the cost of a gas delivery system.



By improving the corrosion resistance of 316L stainless steel by up to 10x, Silcosteel®-CR treatment reduces costly maintenance and yield failures due to system corrosion. Figure 3 compares the cost

of Silcosteel®-CR treatment versus Hastelloy C22™ construction in a typical gas delivery system. Silcosteel®-CR treatment demonstrates significant life cycle cost savings, compared to unprotected stainless steel or stainless steel alloys.

Figure 3 Silcosteel®-CR significantly lowers the life cycle cost of stainless steel or alloys (US dollars).

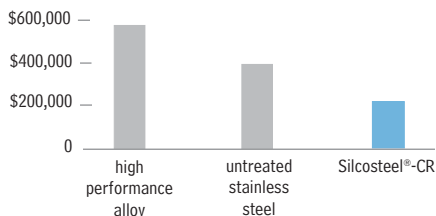


Table I Silcosteel®-CR treatment is compatible with many chemicals used in the semiconductor industry.

Chemical		Compatibility Rating		
		Excellent	Good	Poor
2-Propanol	C ₃ H ₈ O	●		
Acetic Acid	C ₂ H ₄ O ₂	●		
Acetone	C ₃ H ₆ O	●		
Ammonia	NH ₃		●	
Ammonium Fluoride	NH ₄ F			●
Ammonium Hydroxide	NH ₄ OH		●	
Argon	Ar	●		
Arsine	AsH ₃	●		
Boron Tribromide	BBr ₃	●		
Boron Trichloride	BCl ₃	●		
Carbon Dioxide	CO ₂	●		
Carbon Tetrafluoride	CF ₄	●		
Chlorine	Cl ₂	●		
Dichloromethane (methylene chloride)	CH ₂ Cl ₂	●		
Disilane	Si ₂ H ₆	●		
Helium	He	●		
Hexafluoroethane	C ₂ F ₆	●		
Hexamethyldisilazane HMDS	C ₆ H ₁₉ Si ₂ N	●		
Hydrochloric Acid	HCl	●		
Hydrofluoric Acid	HF			●
Hydrogen	H ₂	●		
Hydrogen Bromide	HBr		●	
Hydrogen Peroxide	H ₂ O ₂		●	
Methanol	CH ₃ OH	●		
Nitric Acid	HNO ₃	●		
Nitrogen	N ₂	●		
Nitrogen Trifluoride	NF ₃			●
n-Methyl 2-Pyrrolidone	C ₅ H ₉ NO	●		
Octafluorocyclobutane	C ₄ F ₈	●		
Oxygen	O ₂	●		
Ozone	O ₃	●		
Phosphine	PH ₃	●		
Phosphoric Acid	H ₃ PO ₄	●		
Phosphorus Oxychloride	POCl ₃		●	
Potassium Hydroxide	KOH			●
Silane	SiH ₄	●		
Sulfur Hexafluoride	SF ₆		●	
Sulfuric Acid	H ₂ SO ₄			●
Tungsten Hexafluoride	WF ₆		●	
Water	H ₂ O	●		
DI Water	H ₂ O			●

Restek Performance Coatings

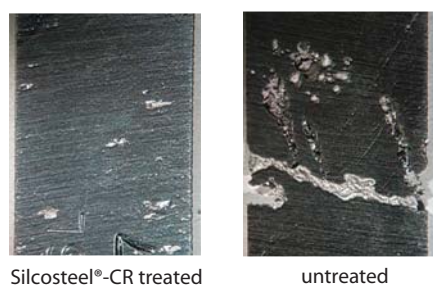
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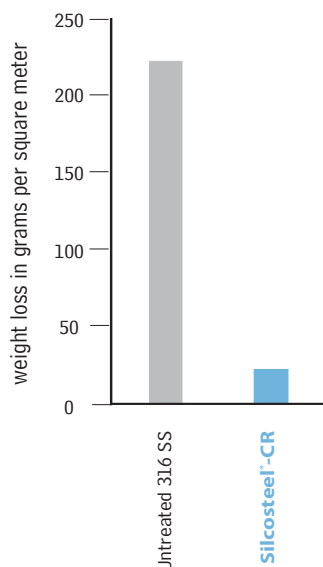
Independent laboratory testing: Silcosteel®-CR improves corrosion resistance by up to 10X over untreated 316 stainless steel

Corrosion testing of Silcosteel®-CR treated 316L stainless steel vs. uncoated 316L stainless steel, shows corrosion of the coated stainless steel is reduced by an order of magnitude, as measured by weight loss (per ASTM G 48, Method B, 72-hour ferric chloride pitting and crevice corrosion testing⁶) (Figure 4).

Figure 4 316L stainless steel shows significant crevice corrosion; a Silcosteel®-CR treated coupon shows only minor pitting (ASTM G 48, Method B).



Silcosteel®-CR treated stainless steel outperforms uncoated metal by an order of magnitude (ASTM G 48, Method B).



for more info

Learn more about our precisely applied, highly durable surface treatment, Silcosteel®-CR: request information packet 59048.

Independent laboratory testing: Cyclic polarization electrochemical tests per ASTM G61 show Silcosteel®-CR treated 316L stainless steel outperforms untreated 316L stainless steel by up to 50x⁶

Figure 5 compares pitting potentials and corrosion rates for Silcosteel®-CR treated and untreated 316L stainless steel in various chloride solutions. Results show Silcosteel®-CR treated coupons exhibit a 10x to 50x reduction in corrosion!

Figure 5 Silcosteel®-CR treated 316L stainless steel exhibits a 10–50x reduction in corrosion (per ASTM G61).

Breakdown or pitting potential, E_b , in millivolts.

Neutral Solution	Silcosteel®-CR	Bare Steel
100ppm chloride	> 3000	674
3000ppm chloride	1460	370
5000ppm chloride	1590	285
Acidic Solution (1N H₂SO₄)		
100ppm chloride	1128	580
3000ppm chloride	927	370
5000ppm chloride	983	563

Corrosion of Silcosteel®-CR treated 316L stainless steel versus bare stainless steel at 3000ppm Cl⁻ concentration.

Neutral Solution	Silcosteel®-CR	Bare Steel
Corrosion Rate, mpy	0.0009	0.04
Breakdown Potential, E_b	1460	370
50X Improvement!		
Acidic Solution (1N H₂SO₄)		
Corrosion Rate, mpy	0.05	0.83
Breakdown Potential, E_b	927	37
10X Improvement!		

Summary

Test data show that Silcosteel®-CR delivers an order of magnitude improvement in corrosion resistance in semiconductor applications. Silcosteel®-CR improves purity and saves money by reducing corrosion related system maintenance and by reducing yield failures caused ion contamination and moisture in process streams.



Silcosteel®-CR treatment can be applied to existing process components, so process equipment life can be extended without significant re-engineering. We offer Silcosteel®-CR treated Swagelok® and Parker tubing and fittings from stock.

Custom treatment is available for process-specific components.

To learn more about how Silcosteel®-CR treatment can improve the corrosion performance of your process system, visit Restek Performance Coatings at www.restekcoatings.com/semicon or contact our technical service group at 814-353-1300 or 800-356-1688, ext. 4.

Silcosteel®-CR Treated Swagelok® Fittings

- Full line of treated 1/16", 1/8", and 1/4" fittings.
- Silcosteel®-CR treatment enhances corrosion resistance by 10X, or more.
- Custom treatment available for any Swagelok® fitting, or other system parts.

Fitting Type	Size	Swagelok® #	Silcosteel®-CR Treated	
			qty.	cat.#
 Union	1/16"	SS-100-6	ea.	22575
	1/8"	SS-200-6	ea.	22576
	1/4"	SS-400-6	ea.	22577
 Tee	1/16"	SS-100-3	ea.	22578
	1/8"	SS-200-3	ea.	22579
	1/4"	SS-400-3	ea.	22580
 Reducing Union	1/8" to 1/16"	SS-200-6-1	ea.	22581
	1/4" to 1/16"	SS-400-6-1	ea.	22582
	1/4" to 1/8"	SS-400-6-2	ea.	22583
 Elbow	1/8"	SS-200-9	ea.	22584
	1/4"	SS-400-9	ea.	22585
 Plug	1/16"	SS-100-P	ea.	22619
	1/8"	SS-200-P	ea.	22620
	1/4"	SS-400-P	ea.	22597
 Cross	1/8"	SS-200-4	ea.	22586
	1/4"	SS-400-4	ea.	22587
 Tube End Reducer	1/8" tube to 1/16"	SS-100-R-2	ea.	22588
	1/4" tube to 1/16"	SS-100-R-4	ea.	22589
	1/8" tube to 1/4"	SS-400-R-2	ea.	22590
	1/4" tube to 1/8"	SS-200-R-4	ea.	22591
 Port Connector	1/8"	SS-201-PC	ea.	22592
	1/4"	SS-401-PC	ea.	22593
	1/8" tube to 1/4"	SS-401-PC-2	ea.	22594
 Male Connector	1/8" to 1/8" NPT	SS-200-1-2	ea.	22595
	1/4" to 1/4" NPT	SS-400-1-4	ea.	22596
	1/16" to 1/8" NPT	SS-100-1-2	ea.	22610
	1/8" to 1/4" NPT	SS-200-1-4	ea.	22611
	1/4" to 1/8" NPT	SS-400-1-2	ea.	22612
 Female Connector	1/8" to 1/8" NPT	SS-200-7-2	ea.	22613
	1/4" to 1/4" NPT	SS-400-7-4	ea.	22614
	1/8" to 1/8" NPT	SS-400-7-2	ea.	22615
	1/8" to 1/4" NPT	SS-200-7-4	ea.	22616
 Bulkhead Union	1/8"	SS-200-61	ea.	22617
	1/4"	SS-400-61	ea.	22618

References

1. Factory Integration Committee; "International Technology Roadmap for Semiconductors 2005 Edition"; The International Technology Roadmap for Semiconductors (ITRS). 2005
2. Committee on Cost of Corrosion in Japan, "Survey of Corrosion Cost in Japan"; Japan Society of Corrosion Engineering, Tokyo, Japan; Japan Association of Corrosion Control, Tokyo, Japan; National Research Institute for Metals, 2001
3. Bureau of Industry and Security; "Semiconductor Materials 1997"; U.S. Department of Commerce. 1997
4. Vininski, Joseph; Lawrence, David; Torres, Robert; Diede, Ehrich; Daniels, Mia; "Corrosion Resistance of Cost Effective Alternative Materials for Semiconductor Gas Distribution Systems"; Matheson Tri-Gas, Longmont, CO; Diede Precision Welding, Longmont, CO; Sherwood, Harsco Corporation, Washington, PA. 2002
5. North American Gases Committee; Semi F79-0703 "Guideline for Gas Compatibility with Silicon used in Gas Distribution Components"; Semi.org. 2003
6. Zamanzadeh, Mehrooz; Bayer, George; Rhodes Geoffrey; Smith, David; Higgins, Martin; "Laboratory Corrosion Testing of a Chemical Vapor Deposited Amorphous Silicon Coating"; Matco Associates, Inc. Pittsburgh, PA; Restek Corporation, Bellefonte, PA. 2005

Tubing

Restek sets the standard in tubing for analytical and process applications. Complete your system with treated fittings and valves for an inert, corrosion-resistant pathway.



Top: electropolished finish, surface roughness average number: 5-10.

Bottom: conventional finish, surface roughness average number: approx. 23-27.

Silcosteel®-CR Treated Coiled Electropolished 316L Grade Stainless Steel Tubing

- Exceptional inertness.
- Improved reliability and reproducibility; longer lifetime.
- Use with treated fittings for the most inert sample pathway available.

ID	OD	cat.#
0.085"	1/8"	22536
0.180"	3/4"	22537

Silcosteel®-CR Treated Coiled 316L Grade Stainless Steel Tubing

ID	OD	cat.#
0.055" (1.40mm)	1/8" (3.18mm)*	22896
0.180" (4.57mm)	1/4" (6.35mm)*	22897

Silcosteel®-CR Treated Straight Seamless 316L Grade Stainless Steel Tubing

6 foot Length

ID	OD	qty.	cat.#
0.055" (1.40mm)	1/8" (3.18mm)*	ea.	22898
0.180" (4.57mm)	1/4" (6.35mm)*	ea.	22899
0.277" (7.04mm)	3/8" (9.52mm)**	ea.	22900

*0.035" wall thickness

**0.049" wall thickness



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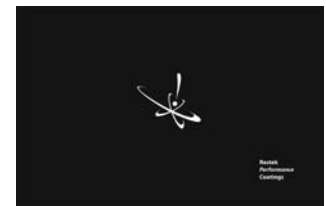
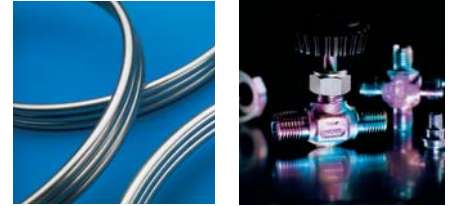
Silcosteel®-CR Treated Parker Fittings

If you do not see everything you need, contact us for information on custom coating services.

Fitting Type	Similar to Parker #	Size	Silcosteel®-CR Treated qty.	cat. #
	1SC1	1/16" N	ea.	22863
	1SC1	1/8" N	ea.	22864
	4SC4	1/4" N	ea.	22865
	1ET1	1/16" N	ea.	22866
	2ET2	1/8" N	ea.	22867
	4ET4	1/4" N	ea.	22868
	2RU1	1/8" to 1/16" N	ea.	22869
	4RU1	1/4" to 1/16" N	ea.	22870
	4RU2	1/4" to 1/8" N	ea.	22871
	1EE1	1/16" N	ea.	22874
	2EE2	1/8" N	ea.	22875
	4EE4	1/4" N	ea.	22876
	1BLP1	1/16" N	ea.	22877
	2BLP2	1/8" N	ea.	22878
	4BLP4	1/4" N	ea.	22879
	2ECR2	1/8" N	ea.	22872
	4ECR4	1/4" N	ea.	22873
	2TUR1	1/8" tube to 1/16" N	ea.	22880
	4TUR1	1/4" tube to 1/16" N	ea.	22881
	2TUR4	1/8" tube to 1/4" N	ea.	22882
	4TUR2	1/4" tube to 1/8" N	ea.	22883
	2PC2	1/8" N	ea.	22884
	4PC4	1/4" N	ea.	22885
	2PC4	1/8" tube to 1/4" N	ea.	22886
	2MSC2N	1/8" to 1/8" NPT	ea.	22887
	4MSC4N	1/4" to 1/4" NPT	ea.	22888
	1MSC2N	1/16" to 1/8" NPT	ea.	22889
	2MSC4N	1/8" to 1/4" NPT	ea.	22890
	4MSC2N	1/4" to 1/8" NPT	ea.	22891
	2FSC2N	1/8" to 1/8" NPT	ea.	22892
	4FSC4N	1/4" to 1/4" NPT	ea.	22893
	4FSC2N	1/4" to 1/8" NPT	ea.	22894
	2FSC4N	1/8" to 1/4" NPT	ea.	22895

Please note: Nuts and ferrules are not treated unless requested (custom parts). Nuts and ferrules normally are not in contact with samples, and thus do not require coating.

Contact us!
Restek will treat your
**tubing, fittings, & custom
process components**
with Silcosteel®-CR.



free literature

Learn more about our
precisely applied, highly
durable surface treatments:
request our brochure lit.
cat.# 59493.

Questions?

Our Coatings Experts are here to help.
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Gary Barone at 800-356-1688, ext 2135
David Smith at 800-356-1688, ext 2154

Restek trademarks: Silcosteel, Siltek, the RPC logo. Other
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Harsco Corporation); Hastelloy, C22 (Haynes International,
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Lit. Cat.# 580099

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Restek Surface Treatments

We offer many surface treatments that enhance performance in many applications:

- Silcosteel®** A general-purpose passivation layer for steel and stainless steel. U.S. patent 6,511,760.
- Silcosteel®-AC** Dramatically reduces carbon buildup on stainless steel components. U.S. patent 6,444,326.
- Silcosteel®-CR** A corrosion resistant layer that increases the lifetime of system components in acidic environments containing hydrochloric acid, nitric acid, sulfuric acid, or seawater. Patent pending.
- Silcosteel®-UHV** Greatly reduces outgassing from components of ultra-high vacuum systems. Recognized as one of the 100 most technologically significant products by R&D magazine. Patent pending.
- Siltek™** The ultimate passivation for treated components, from glass to high nickel alloys of steel. U.S. patent 6,444,326.
- Sulfinit®** A required treatment for metal components when analyzing for parts-per-billion levels of organo-sulfur compounds. U.S. patent 6,444,326.

Extend Process Component Lifetime and Enhance Durability

Restek surface treatments improve sampling and transfer component performance

- **Economical**—Lower cost than specialty alloys, more durable than traditional stainless steels.
- **Versatile**—Suitable in a variety of environments and temperature ranges.
- **Simple**—Can be applied to existing equipment; stock tubing and fittings available.

When corrosion and surface activity are a concern, solutions must be engineered using special alloys or surface treatments. The Restek Performance Coatings group offers a family of surface treatments that address reactivity and corrosion concerns over a wide spectrum of applications. Table 1 lists applications in which Siltek®/Sulfinert® treatment of sample pathway components prevents adsorption of active compounds, thereby contributing toward reliable and accurate information, or in which Silcosteel®-CR treatment greatly reduces corrosion.

sample to the analytical instrument. Always use deactivated tubing for applications involving active compounds. For special requirements, ensure maximum inertness and minimal surface area by applying the deactivating treatment to electropolished tubing. Figure 1 shows the detector signal curves for 500ppbv of methyl mercaptan, an active sulfur compound, in a gas stream passing through a variety of tubing substrates.¹ Siltek®/Sulfinert® treated tubing reduces uptake by orders of magnitude, relative to untreated tubing.

Restek surface treatments are:

Silcosteel®—A general-purpose passivation layer for steel and stainless steel. U.S. patent 6,511,760.

Silcosteel®-AC—Dramatically reduces carbon buildup on stainless steel components. U.S. patent 6,444,326.

Silcosteel®-CR—A corrosion resistant layer that increases the lifetime of system components in acidic environments containing hydrochloric acid, nitric acid, or seawater. US patent 7,070,833.

Silcosteel®-UHV—Greatly reduces outgassing from components of ultra-high vacuum systems. US patent 7,070,833.

Siltek®—The ultimate passivation for treated components, from glass to high nickel alloys of steel. U.S. patent 6,444,326.

Sulfinert®—A required treatment for metal components when analyzing for parts-per-billion levels of organo-sulfur compounds. U.S. patent 6,444,326.

This outline of system components and considerations will help in evaluating the usefulness of surface treatments for analytical and process reliability.

Tubing used for sampling

Adsorption problems in sample pathways often can be traced to the tubing used to transfer the

Figure 1 Sulfinert® treated electropolished seamless stainless steel tubing (red) does not adsorb methyl mercaptan (500ppbv). Blue-untreated electropolished tubing; violet-raw tubing.

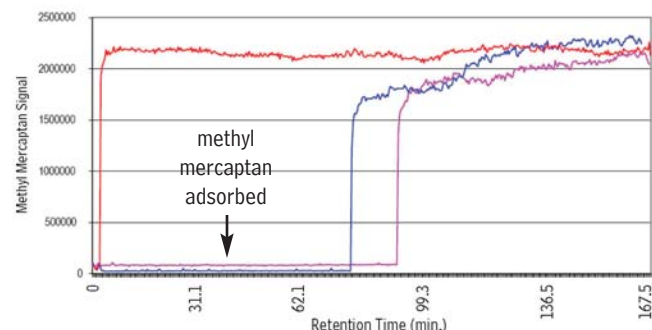


Table 1 Applications in which Restek treated sample pathway components minimize corrosion** or prevent adsorption of active compounds*.

Sulfur compounds in:*

automotive exhaust
beverage grade CO₂
diesel fuels
environmental samples
ethylene
gasoline
liquefied petroleum gas
natural gas (odorants)
propylene
stack gas emissions
wines and beers

Nitric oxide (NOx) compounds in:*

automotive exhaust
stack gas emissions

Mercury compounds in:*

crude oil
environmental samples
exhaust
stack gas emissions from coal fired electric power plants

Corrosive environments:**

hydrochloric acid
hydrogen peroxide
seawater

Moisture hold-up in high purity sampling lines**

sample systems
gas delivery systems
process systems

*Siltek®/Sulfinert® treatment.

**Silcosteel®-CR treatment.



Restek Performance Coatings

[†]Note that with any corrosive stream, regular inspections are needed to confirm there are no leaks or breakthroughs.

Tubing used in corrosive environments

In corrosive environments, Silcosteel®-CR treated tubing is an excellent alternative to expensive alloys. Silcosteel®-CR treatment extends the lifetime of the tubing, reducing the frequency of preventive maintenance and helping to ensure the purity of the process or sample stream. Silcosteel®-CR improves corrosion resistance by up to 10X over untreated 316L stainless steel, per ASTM Method G48, Method B (Figure 2).

Figure 2 Silcosteel®-CR treated 316L stainless steel coupons show no crevice corrosion and only slight pitting corrosion after 72-hour exposure to ferric chloride; untreated coupons exhibit severe crevice corrosion (per ASTM Method G48, Method B).



Silcosteel®-CR treated

untreated

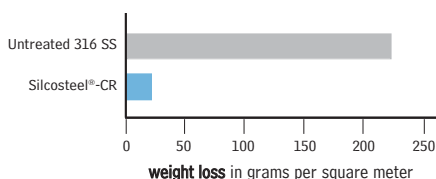
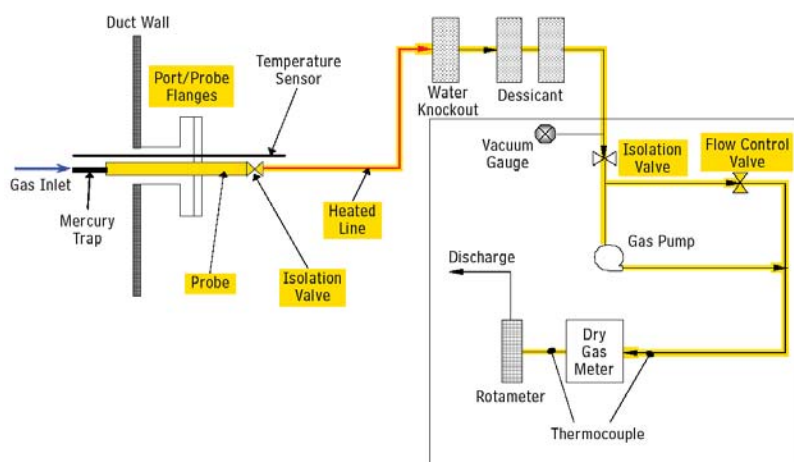


Figure 4 Highlighted components of a mercury sampling train,² and all tubing in the system, can be Siltek®/Sulfinert® treated.



Siltek® and Sulfinert®: What's the Difference?

Siltek® is the name for our patented deposition process. When we developed the Siltek® process, the application that showed the greatest benefit, among many we investigated, was the storage and transfer of low ppb level active sulfur compounds, such as hydrogen sulfide and mercaptans. Because there was (and continues to be) demand for a reliable surface treatment for this application, we use the name Sulfinert® to describe Siltek® treated products created specifically for this purpose.

Figure 3 shows the results of a 4000-hour salt spray test on Silcosteel®-CR treated 316L stainless steel and untreated 316L stainless steel. The Silcosteel®-CR treated material exhibited virtually no change.

Figure 3 Silcosteel®-CR treated 316L stainless steel coupons show no sign of attack after 4000-hour salt spray exposure, per ASTM B117.



Silcosteel®-CR treated

untreated

Fittings

Connections can be a source of adsorption and sample loss, and there is benefit to using Restek surface treatment on many of these components. For example, in corrosive environments, Silcosteel®-CR treatment will extend the useful life of system fittings, as it will for tubing. We offer extensive lines of treated Swagelok® and Parker fittings, in sizes from 1/16" to 3/8".

Valves

The sample flow path through a valve can be tortuous, prolonging contact between the sample stream and the valve components. Restek surface treatments have been applied to many valve geometries, to eliminate adsorption to bodies, stems, diaphragms, or other components.

Filters

Frits and other filtering devices trap particles and prevent them from entering the analytical instrument, but they also very effectively adsorb active components in sample streams. Their large surface areas can increase sample/system contact by orders of magnitude. Siltek®/Sulfinert® treatment of frits and filters creates an inert flowpath. Our chemical vapor deposition technology ensures the treatment penetrates even the smallest pores in sintered metal frits.

Sample Vessel Equipment

When samples are taken from a process stream and are transported to the laboratory for evaluation, it is critical to use Restek treated sampling containers, to prevent active components from adsorbing to vessel, valve, or outage tube surfaces. We offer a complete line of high pressure sampling equipment for sampling applications involving liquefied petroleum gases, ethylene, natural gas, or propylene.

Probes

Sampling probes are used in a variety of applications, including sampling natural gas or other process streams (Figure 4). An untreated probe contributes to the active surface area in the system, and this should be considered when identifying potential adsorption sites during active stream transfer.

Heated Lines

A heated "trace line" consists of standard grade or electropolished tubing that has been insulated and bundled with heating devices to ensure the sample is transferred at a consistent temperature. Often, samples are transferred at temperatures greater than 150°C, to prevent condensation of moisture in the line. Such lines are used in many gas stacks and other remote sampling points at which a sample is transported through the outdoor environment. Active compounds in the sample quickly can be adsorbed onto the hot tubing. Restek surface treatment prevents adsorption of active compounds.

Summary

Surface treatments from the Restek Performance Coatings group prevent corrosion or adsorption of active compounds in process systems, and always should be considered in applications in which corrosive or active streams are to be sampled, transferred, or analyzed.

To determine if a Restek surface treatment can be applied to your system, contact our Technical Service department at 800-356-1688, ext. 4, or visit us at www.restekcoatings.com/OTC.

for more info

For more information about Restek performance coatings, request lit. cat. # 59493, or visit us at www.restekcoatings.com/OTC

References

- ¹Relative Response Time of True Tube™ when Measuring Moisture Content in a Sample Stream Test Report, Haritec Scientific & Engineering Support, Calgary, Alberta, Canada, may 2004. Reference courtesy of O'Brien Canada. Reference available on request from Restek.
- ²Proposed Method 324. Determination of Vapor Phase Flue Gas Mercury Emissions from Stationary Sources Using Dry Sorbent Trap Sampling. United States Environmental Protection Agency. Washington, D.C. p. 5.

Siltek®/Sulfinert® Treated and Silcosteel®-CR Treated Swagelok® Fittings

- Full line of treated $\frac{1}{16}$ ", $\frac{1}{8}$ ", $\frac{1}{4}$ ", and $\frac{3}{8}$ " fittings.
- Siltek®/Sulfinert® 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.

Fitting Type	Size	Siltek®/Sulfinert® Treated	Silcosteel®-CR Treated
		cat. #	cat. #
	$\frac{1}{16}$ "	22540	22575
	$\frac{1}{8}$ "	22541	22576
	$\frac{1}{4}$ "	22542	22577
	$\frac{3}{8}$ "	22909	22904
	$\frac{1}{16}$ "	22543	22578
	$\frac{1}{8}$ "	22544	22579
	$\frac{1}{4}$ "	22545	22580
	$\frac{3}{8}$ "	22910	22905
	$\frac{1}{8}$ " to $\frac{1}{16}$ "	22546	22581
	$\frac{1}{4}$ " to $\frac{1}{16}$ "	22547	22582
	$\frac{1}{4}$ " to $\frac{1}{8}$ "	22548	22583
	$\frac{3}{8}$ " to $\frac{1}{4}$ "	22911	22906
	$\frac{1}{8}$ "	22549	22584
	$\frac{1}{4}$ "	22550	22585
	$\frac{1}{16}$ "	22572	22619
	$\frac{1}{8}$ "	22573	22620
	$\frac{1}{4}$ "	22574	22597
	$\frac{1}{8}$ "	22551	22586
	$\frac{1}{4}$ "	22552	22587
	$\frac{1}{8}$ " tube to $\frac{1}{16}$ "	22553	22588
	$\frac{1}{4}$ " tube to $\frac{1}{16}$ "	22554	22589
	$\frac{1}{8}$ " tube to $\frac{1}{4}$ "	22555	22590
	$\frac{1}{4}$ " tube to $\frac{1}{8}$ "	22556	22591
	$\frac{1}{8}$ "	22557	22592
	$\frac{1}{4}$ "	22558	22593
	$\frac{1}{8}$ " tube to $\frac{1}{4}$ "	22559	22594
	$\frac{1}{8}$ " to $\frac{1}{8}$ " NPT	22561	22595
	$\frac{1}{4}$ " to $\frac{1}{4}$ " NPT	22562	22596
	$\frac{1}{16}$ " to $\frac{1}{8}$ " NPT	22563	22610
	$\frac{1}{8}$ " to $\frac{1}{4}$ " NPT	22564	22611
	$\frac{1}{4}$ " to $\frac{1}{8}$ " NPT	22565	22612
	$\frac{3}{8}$ " to $\frac{3}{8}$ " NPT	22912	22907
	$\frac{3}{8}$ " to $\frac{1}{4}$ " NPT	22913	22908
	$\frac{1}{8}$ " to $\frac{1}{8}$ " NPT	22566	22613
	$\frac{1}{4}$ " to $\frac{1}{4}$ " NPT	22567	22614
	$\frac{1}{4}$ " to $\frac{1}{8}$ " NPT	22568	22615
	$\frac{1}{8}$ " to $\frac{1}{4}$ " NPT	22569	22616
	$\frac{1}{8}$ "	22570	22617
	$\frac{1}{4}$ "	22571	22618

Sulfinert® Treated Sample Cylinders



- Stable storage of samples containing ppb levels of sulfur compounds.
- D.O.T. rated to 1800psi at room temperature.

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

Sulfinert® Treated Alta-Robbins Sample Cylinder Valves



- All wetted parts Sulfinert® treated for inertness.
- Compatible with Sulfinert® treated Swagelok® sample cylinders.
- Large, durable, Kel-F® seat ensures leak-free operation.

Description	qty.	cat. #
$\frac{1}{4}$ " NPT Exit	ea.	21400
$\frac{1}{4}$ " Compression Exit	ea.	21401
$\frac{1}{4}$ " NPT with Dip Tube*	ea.	21402
$\frac{1}{4}$ " NPT with 2850psi Rupture Disk	ea.	21403

*Specify dip tube length or % outage when ordering (maximum length = 5.25" / 13.3cm)

Siltek® Treated Filters



Siltek® 2µm frit filter



Siltek® 7µm in-line filter

Description	qty.	cat. #
Siltek® 2µm Frit Filter	3-pk.	24171
Siltek® 7µm In-Line Filter	ea.	24265

Siltek®/Sulfinert® Treated & Silcosteel®-Treated Parker Plug & Ball Valves



Fitting Type	Size	Siltek®/Sulfinert®	Silcosteel®
		cat. #	cat. #
Plug Valve	$\frac{1}{8}$ "	21586	21576
	$\frac{1}{4}$ "	21587	21577
Ball Valve	$\frac{1}{8}$ "	21588	21578
	$\frac{1}{4}$ "	21589	21579



Restek Performance Coatings

www.restekcoatings.com/OTC

simply the best

Siltek®/Sulfinert®- and Silcosteel®-treated electropolished tubing is the best tubing choice when purity, inertness, or reproducibility are concerns.



Top: electropolished finish, surface roughness average number: 5-10. Bottom: conventional finish, surface roughness average number: 23-27.



Restek offers handy **tapes, tools, and accessories** to make installing and maintaining your tubing system easier. Request lit. cat.# or visit us online.



Restek Performance Coatings

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Restek trademarks: Silcosteel, Siltek, Sulfinert, the RPC logo. Other trademarks: Kel-F (3M Co.); Swagelok (Swagelok Co.); TrueTube (O'Brien Corp.).

Treated Electropolished Tubing

- Exceptional inertness.
- Improved reliability and reproducibility; longer lifetime.
- Use with treated fittings for the most inert sample pathway available.



Siltek®/Sulfinert® Treated Coiled Electropolished 316L Grade Stainless Steel Tubing

ID	OD	cat.#	5-24 ft.	25-99 ft.	100-299 ft.	> 300 ft.
0.085" (2.16mm)	1/8" (3.18mm)	22538				
0.180" (4.57mm)	1/4" (6.35mm)	22539				

Silcosteel®-CR Treated Coiled Electropolished 316L Grade Stainless Steel Tubing

ID	OD	cat.#	5-24 ft.	25-99 ft.	100-299 ft.	> 300 ft.
0.085" (2.16mm)	1/8" (3.18mm)	22536				
0.180" (4.57mm)	1/4" (6.35mm)	22537				

Treated Electropolished Tubing

Siltek®/Sulfinert® Treated Coiled 316L 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)	1/4" (6.35mm)	22509				
0.277" (7.04mm)	3/8" (9.52mm)	22914				

Silcosteel®-CR Treated Coiled 316L 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)	22896				
0.180" (4.57mm)	1/4" (6.35mm)	22897				
0.277" (7.04mm)	3/8" (9.52mm)	22915				

Siltek®/Sulfinert® Treated Straight Seamless 316L Grade Stainless Steel Tubing

6 foot Length

ID	OD	qty.	cat.#
0.055" (1.40mm)	1/8" (3.18mm)	ea.	22901
0.180" (4.57mm)	1/4" (6.35mm)	ea.	22902
0.277" (7.04mm)	3/8" (9.52mm)	ea.	22903

Silcosteel®-CR Treated Straight Seamless 316L Grade Stainless Steel Tubing

6 foot Length

ID	OD	qty.	cat.#
0.055" (1.40mm)	1/8" (3.18mm)	ea.	22898
0.180" (4.57mm)	1/4" (6.35mm)	ea.	22899
0.277" (7.04mm)	3/8" (9.52mm)	ea.	22900

Siltek®/Sulfinert® Treated Straight Seamless 304 Grade Stainless Steel Tubing

- Ideal for adsorbent traps, thermal desorption tubes, transfer lines, and instrument interfaces.
- Easily cut to specific lengths using a standard tubing cutter.
- Available in individual 18"/457mm pieces or in economical 5-packs.

18" (457mm) Length

ID	OD	qty.	cat.#
0.085" (2.16mm)	1/8" (3.18mm)*	ea.	20575
0.085" (2.16mm)	1/8" (3.18mm)*	5-pk.	20576
0.210" (5.33mm)	1/4" (6.35mm)*	ea.	20577
0.210" (5.33mm)	1/4" (6.35mm)*	5-pk.	20578

Restek Performance Coatings

Driving Innovation

Restek's patented surface treatments are:

- Corrosion resistant
- Chemically inert
- Barriers for coking and fouling
- Beautiful



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RESTEK



**Restek
Performance
Coatings**

Driving Innovation

Restek's patented surface treatments are:

- Corrosion resistant
- Chemically inert
- Barriers for coking and fouling
- Beautiful

As needs for improved performance of system components increase, surface coatings often are an effective solution. Restek's Performance Coatings Division specializes in innovative surface treatments for steel, stainless steel, alloys, glass, ceramics, and other materials.

The Restek Performance Coatings family of surface treatments includes:

- **Silcosteel®**—A general purpose passivation layer for steel and stainless steel. US Patent 6,511,760.
- **Siltek®**—The ultimate passivation of treated surfaces, from glass to high nickel alloys of steel. US Patent 6,444,326.
- **Silcosteel®-AC**—Dramatically reduces carbon buildup on stainless steel components. US Patent 6,444,326.
- **Silcosteel®-CR**—A corrosion resistant layer that increases the life-time of system components in acidic environments containing hydrochloric acid, nitric acid, or seawater. US Patent 7,070,833.
- **Silcosteel®-UHV**—Greatly reduces outgassing from components of ultra-high vacuum systems. US Patent 7,070,833.
- **Sulfinert®**—A required treatment for metal components when analyzing for parts-per-billion levels of organo-sulfur compounds. US Patent 6,444,326.

Who benefits from using Restek Performance Coatings?

Makers of scientific instruments have used Restek surface treatments since the mid 90s, improving their machines' abilities to detect chemicals at concentrations as low as a few parts per trillion – less than a drop of chemical in an olympic-sized swimming pool of water! Equipment for detecting explosives often is treated with a Restek performance coating to assure that incredibly low levels of dangerous materials can be detected, thus improving safety for all.

Out-of-this-world uses for Restek's treatments have involved air sampling systems in space shuttles and the space station, and equipment on Rover missions to Mars and comet probes. Even the Huygens probe, which landed on Titan, one of Saturn's moons, has Restek-treated components, to ensure reliable performance from delicate sensing systems.

Now, engine manufacturers are evaluating one of our newest performance coatings for reducing carbon buildup in injectors and for increasing the lifetimes of turbocharger housings.

For a free sample, visit
www.restekcoatings.com/sample



Restek Performance Coatings

Driving Innovation

*Want to know if Restek
Performance Coatings can
help you? Call or visit
www.restekcoatings.com*

Restek's patented surface
treatments are:

- Corrosion resistant
- Chemically inert
- Barriers for coking and fouling
- Beautiful

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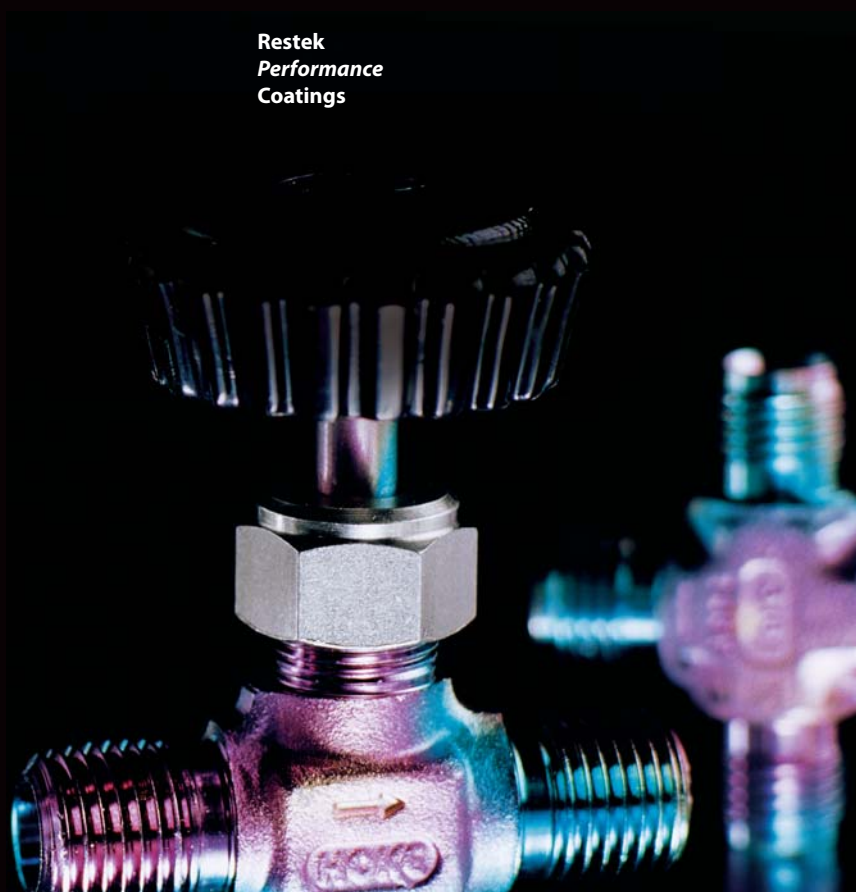
www.restekcoatings.com/sample

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RESTEK



Gas Analysis in a Refinery Environment



During the distillation and cracking processes at an oil refinery, many gases are produced as by- products.

This article is to explain which gases are produced, what the gases are used for and which columns to use to analyze these products.

Use this article to help understand where the gases are coming from and what they are used for. The column recommendations are guidelines and based on existing methodology.

Refinery Process Map

```
graph LR; CO[Crude Oil] --> AD[Atmospheric Distillation]; CO --> VD[Vacuum Distillation]; AD --> GP[Gas Plant]; AD --> H[Hydrocracker]; AD --> CC1[Catalytic Cracker]; AD --> G[Gasoline]; AD --> K[Kerosene]; AD --> D[Diesel]; AD --> N1[Naphtha]; AD --> HO[Heating Oil]; VD --> CC2[Catalytic Cracker]; VD --> SE[Solvent Extraction]; VD --> A[Asphalt]; CC1 --> H; CC2 --> NK[Naphtha, Kerosene]; SE --> LWG[Lube oil, Wax, Grease]; GP --> LPG[LPG, Refinery Gas, Petrochemical feedstock];
```

The diagram illustrates the refinery process map, showing the flow of materials from Crude Oil to various petroleum products. The process begins with Crude Oil, which is fed into two main distillation units: Atmospheric Distillation and Vacuum Distillation. Atmospheric Distillation produces Gasoline, Kerosene, Diesel, Naphtha, and Heating Oil. It also feeds into a Gas Plant and a Hydrocracker. The Gas Plant produces LPG, Refinery Gas, and Petrochemical feedstock. The Hydrocracker produces Gasoline, Kerosene, and Diesel. The Vacuum Distillation unit feeds into a Catalytic Cracker and a Solvent Extraction unit. The Catalytic Cracker produces Naphtha and Heating Oil. The Solvent Extraction unit produces Lube oil, Wax, Grease, and Asphalt. The Catalytic Cracker also feeds into the Hydrocracker.

Crude Oil (Grey box) feeds into **Atmospheric Distillation** (Green box) and **Vacuum Distillation** (Green box).

Atmospheric Distillation feeds into **Gas Plant** (Green box) and **Hydrocracker** (Red box). It also produces **Gasoline** (Yellow box), **Kerosene** (Yellow box), **Diesel** (Yellow box), **Naphtha** (Yellow box), and **Heating Oil** (Yellow box).

Gas Plant produces **LPG, Refinery Gas, Petrochemical feedstock** (Yellow box).

Hydrocracker produces **Gasoline** (Yellow box), **Kerosene** (Yellow box), and **Diesel** (Yellow box).

Vacuum Distillation feeds into **Catalytic Cracker** (Red box) and **Solvent Extraction** (Red box). It also produces **Naphtha** (Yellow box) and **Heating Oil** (Yellow box).

Catalytic Cracker (from Vacuum Distillation) produces **Naphtha** (Yellow box) and **Heating Oil** (Yellow box). It also feeds into **Hydrocracker**.

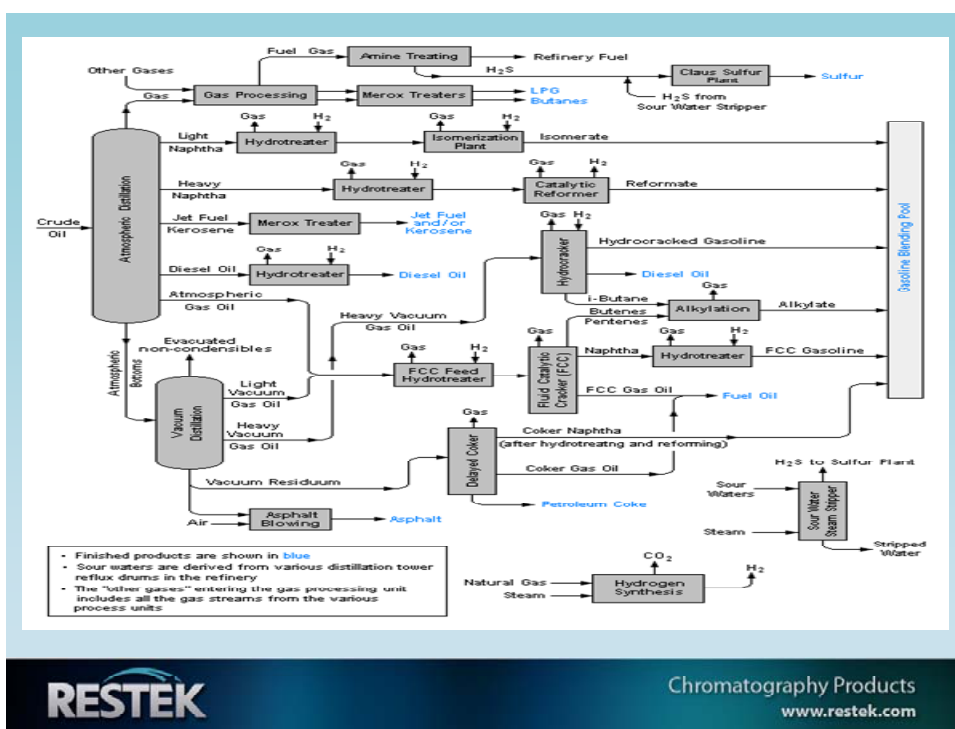
Solvent Extraction produces **Lube oil, Wax, Grease** (Yellow box) and **Asphalt** (Yellow box).

Catalytic Cracker (from Atmospheric Distillation) produces **Naphtha** (Yellow box) and **Heating Oil** (Yellow box).

Products (Yellow boxes): **Gasoline**, **Kerosene**, **Diesel**, **Naphtha**, **Heating Oil**, **LPG, Refinery Gas, Petrochemical feedstock**, **Naphtha, Kerosene**, **Lube oil, Wax, Grease**, **Asphalt**.

Process Units (Colored boxes): **Crude Oil** (Grey), **Atmospheric Distillation** (Green), **Vacuum Distillation** (Green), **Gas Plant** (Green), **Hydrocracker** (Red), **Catalytic Cracker** (Red), **Solvent Extraction** (Red).

RESTEK Chromatography Products www.restek.com



Refinery Gas

This is the first product coming from a crude distillation unit.

Refinery Gas is a mix of the following gases: Methane (CH₄), Ethane (C₂H₆), Ethylene (C₂H₄), Propane (C₃H₈), Propylene (C₃H₆), iso-Butane (C₄H₁₀), n-Butane (C₄H₁₀), various Butenes (C₄H₈), Carbon monoxide (CO), Carbon dioxide (CO₂), Hydrogen Sulfide (H₂S), Hydrogen (H₂), Oxygen (O₂), Nitrogen (N₂) and in some cases Helium (He).

Use:

Refinery Gas has a variety of purposes:

- 1- Re-introduction into the atmospheric distillation unit to produce more light naphtha for gasoline production.
- 2- Fuel gas for various units within the refinery.
- 3- Feedstock for petrochemical processes.

Analysis:

Refinery Gas must be analyzed to determine the efficiency of the distillation unit of a refinery. In most cases refinery gas is analyzed according to UOP 539 or ASTM D1946 (GC with packed or wide bore columns).

Recommended columns:

Al₂O₃/Na₂SO₄ for the analysis of the hydrocarbons.

Molsieve 5A for the analysis of CO, H₂, O₂, N₂ (and He, but with different carrier gas).

Q-BOND for the analysis of CO₂ and H₂S.

Most gases are purified from distillation of crude oil or from naphtha.

Some refineries have the facilities to derive individual gases from refinery gas.

The purified gases are then used as feedstock for (petro)chemical processes.

Some of these gases are:

Hydrogen

Use: Feed for refinery hydrotreater to increase refinery efficiency. Semiconductor industry

Analysis: impurities (such as C1, C2, CO, CO₂) in hydrogen.

Recommended column: Q-BOND

Ethane

Use: Feedstock for the production of ethylene, ethanol.

Analysis: impurities (C1, C2, C3, C4) in ethane.

Recommended column: Al₂O₃/KCl

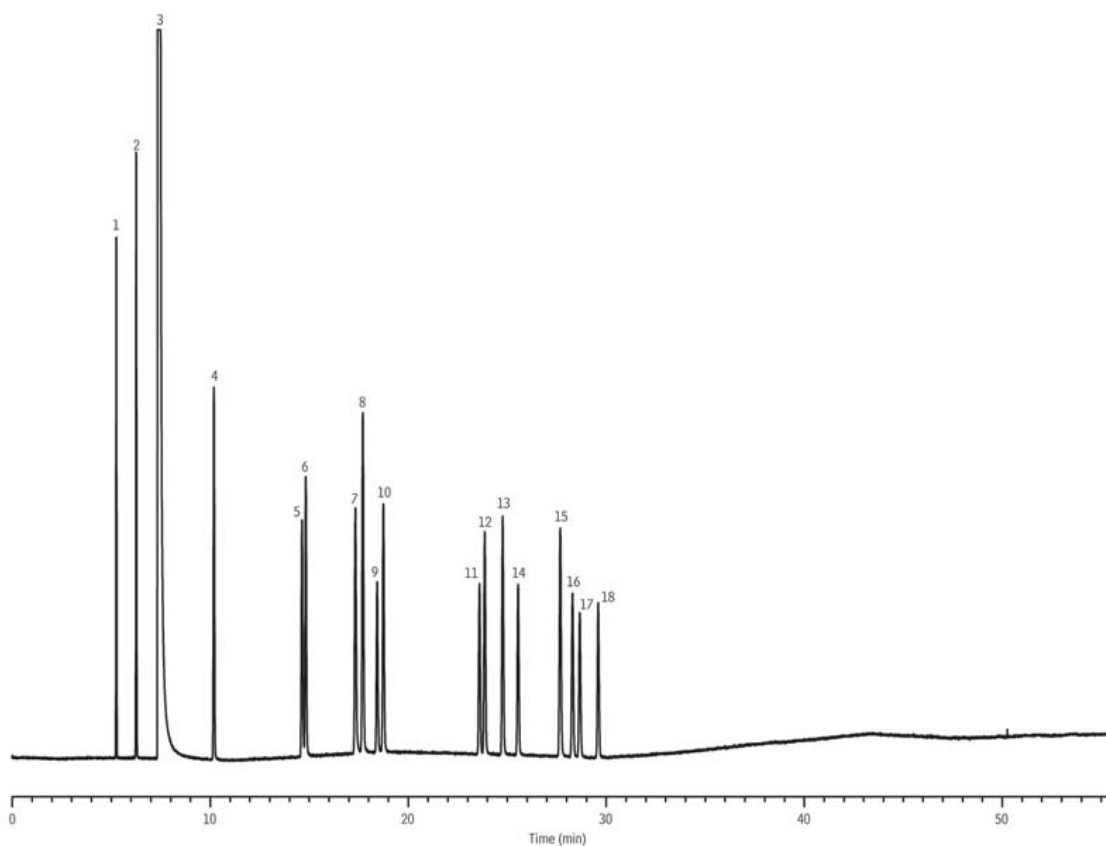
See chromatogram under ethylene

Ethylene

Use: Feedstock for the production of polyethylene (soft plastics).

Analysis: impurities (C1, C2, C3, C4) in ethylene.

Recommended column: Al₂O₃/KCl + Rtx-1 (ASTM D6159)



Peak List

1. methane 2. ethane 3. ethylene 4. propane 5. cyclopropane 6. propylene 7. acetylene
8. isobutane 9. propadiene 10 n-butane 11. trans-2-butene 12. 1-butene 13. isobutylene
14. cis-2-butene 15. isopentane 16. methyl acetylene 17. n-pentane 18. 1,3-butadiene

Column: Rt®-Alumina BOND/KCl, 50m, 0.53mm ID, 10.0µm (cat.# 19760) in series with Rtx®-1, 30m, 0.53mm ID, 5.0µm (cat.# 10179), connected using a Universal Press-Tight® Connector (cat.# 20401)

Sample: ethylene and C1-C5 hydrocarbons

Inj.: 1µL split, 60mL/min. split vent flow rate

2mm splitless liner (cat.# 20712)

Inj. temp.: 200°C

Carrier gas: helium, constant pressure (8.0psi, 55.2kPa)

Linear velocity: 25.4cm/sec. @ 35°C

Oven temp.: 35°C (hold 2 min.) to 190°C @ 4°C/min. (hold 15 min.)

(conditions as per ASTM D6159-97)

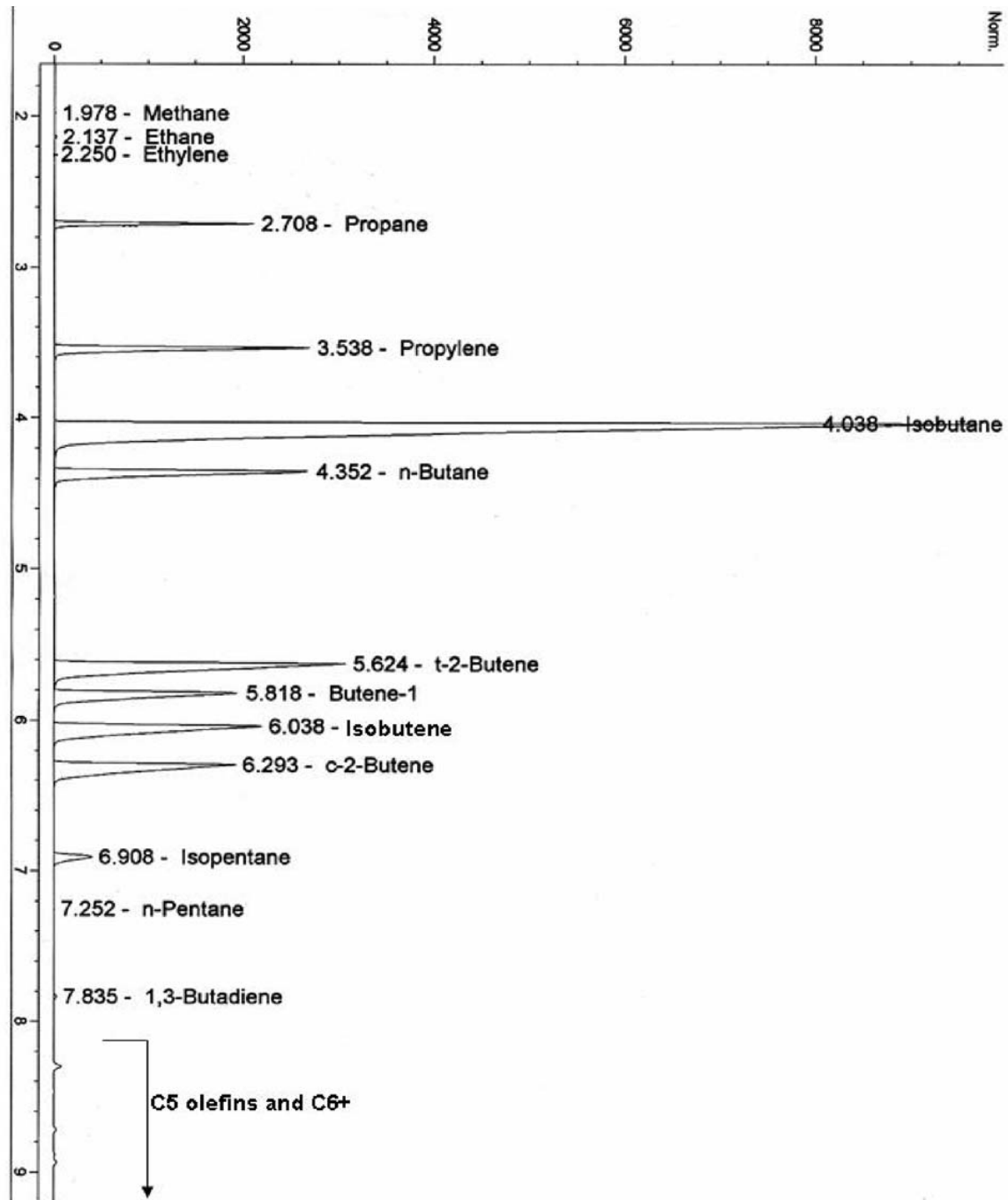
Det.: FID @ 200°C

Propane

Use: Heating gas and fuel gas.

Analysis: impurities (C2, C3, C4) in propane.

Recommended column: Al₂O₃/Na₂SO₄ (ASTM D2163)

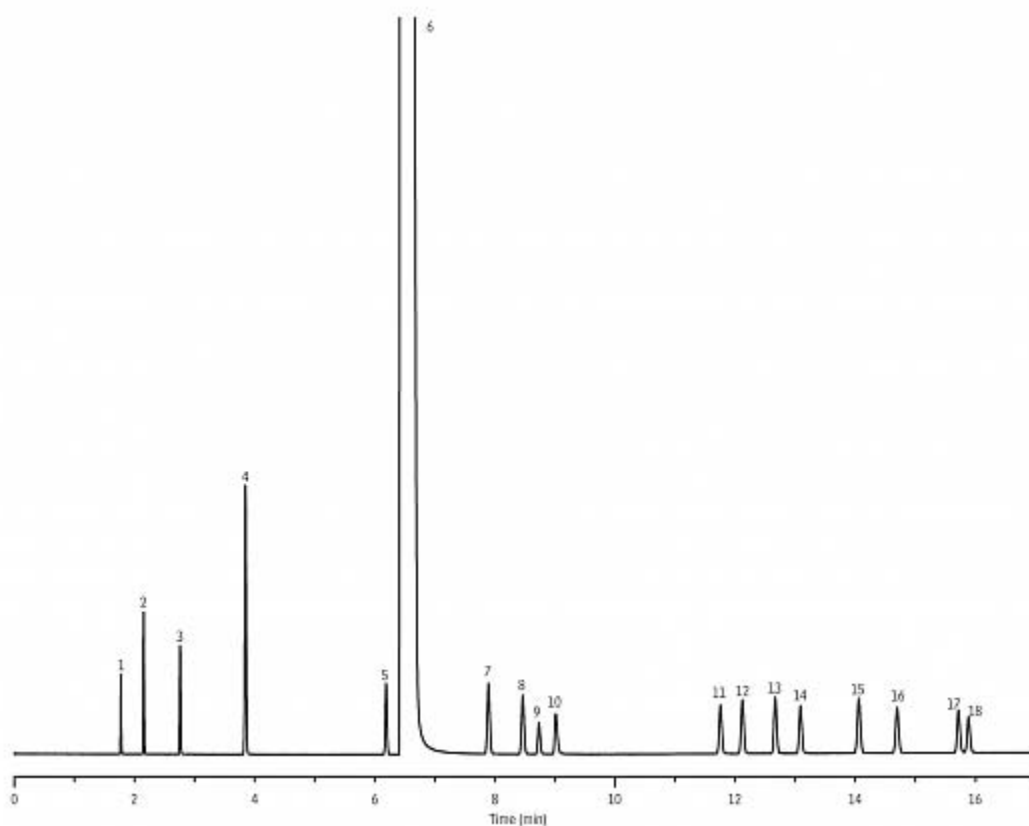


Propylene

Use: Feedstock for the production of polypropylene (hard plastics).

Analysis: impurities (C2, C3, C4) in propylene.

Recommended column: Al₂O₃/Na₂SO₄ (ASTM D2712)



Peak List

1. methane 2. ethane 3. ethylene 4. propane 5. cyclopropane 6. propylene 7. isobutane
8. n-butane 9. propadiene 10. acetylene 11. trans-2-butene 12. 1-butene 13. isobutylene
14. cis-2-butene 15. isopentane 16. n-pentane 17. 1,3-butadiene 18. methyl acetylene

Column: Rt®-Alumina BOND/Na₂SO₄, 50m, 0.53mm ID, 10.0µm (cat.# 19756)

Sample: propylene and C1-C5 hydrocarbons

Inj.: 10µL split, 35mL/min. split vent flow rate

2mm splitless liner (cat.# 20712)

Inj. temp.: 200°C

Carrier gas: helium, constant pressure (10.0psi, 68.9kPa)

Linear velocity: 47cm/sec. @ 50°C

Oven temp.: 50°C to 150°C @ 6°C/min.

Det.: FID @ 200°C

Liquefied Petroleum Gas (LPG)

LPG is derived from distillation of crude oil. LPG is a mix of propane and butane.

Use: Refrigeration gas, fuel gas for cars and fuel gas for appliances.

Analysis: impurities (C2, C3, C4, C5+) in LPG.

Recommended column: Al₂O₃/Na₂SO₄ (ASTM D2163)

See chromatogram under propane

Butane

Butane is a by-product of the distillation process and is present in refinery gas.

Use: Feedstock for the production of chemicals, refrigerant, additive for gasoline (winter gasoline) and fuel gas (camping gas).

Analysis: impurities (C2, C3, C4, C5+) in butane.

Recommended column: Al₂O₃/Na₂SO₄ (ASTM D2163)

See chromatogram under propane

1-Butene, 2-Butene, isobutylene and 1,3-Butadiene

1-Butene, 2-butene and isobutylene are by-products of cracking processes and are present in refinery gas. Butenes are used to produce 1,3-butadiene. 1,3-Butadiene is an important component for the production of synthetic rubber.

Use: Feedstock for the production of chemicals, plastics (ABS [Acrylonitrile-Butadiene-Styrene]). Isobutylene is used for the production of MTBE and iso-octane which are additives for gasoline (octane boosters).

Analysis: impurities (C3, C4, C5+) in butenes.

Recommended column: packed as per ASTM D2593 or Al₂O₃/KCl.

Chromatogram will follow.

Jan Pijpelink

September 2010

Solvent Analysis Using USP <467>: Procedure A

Residual Solvents on Rxi-624SilMS(G43): (6%cyanopropylphenyl / 94%dimethylpolysiloxane)

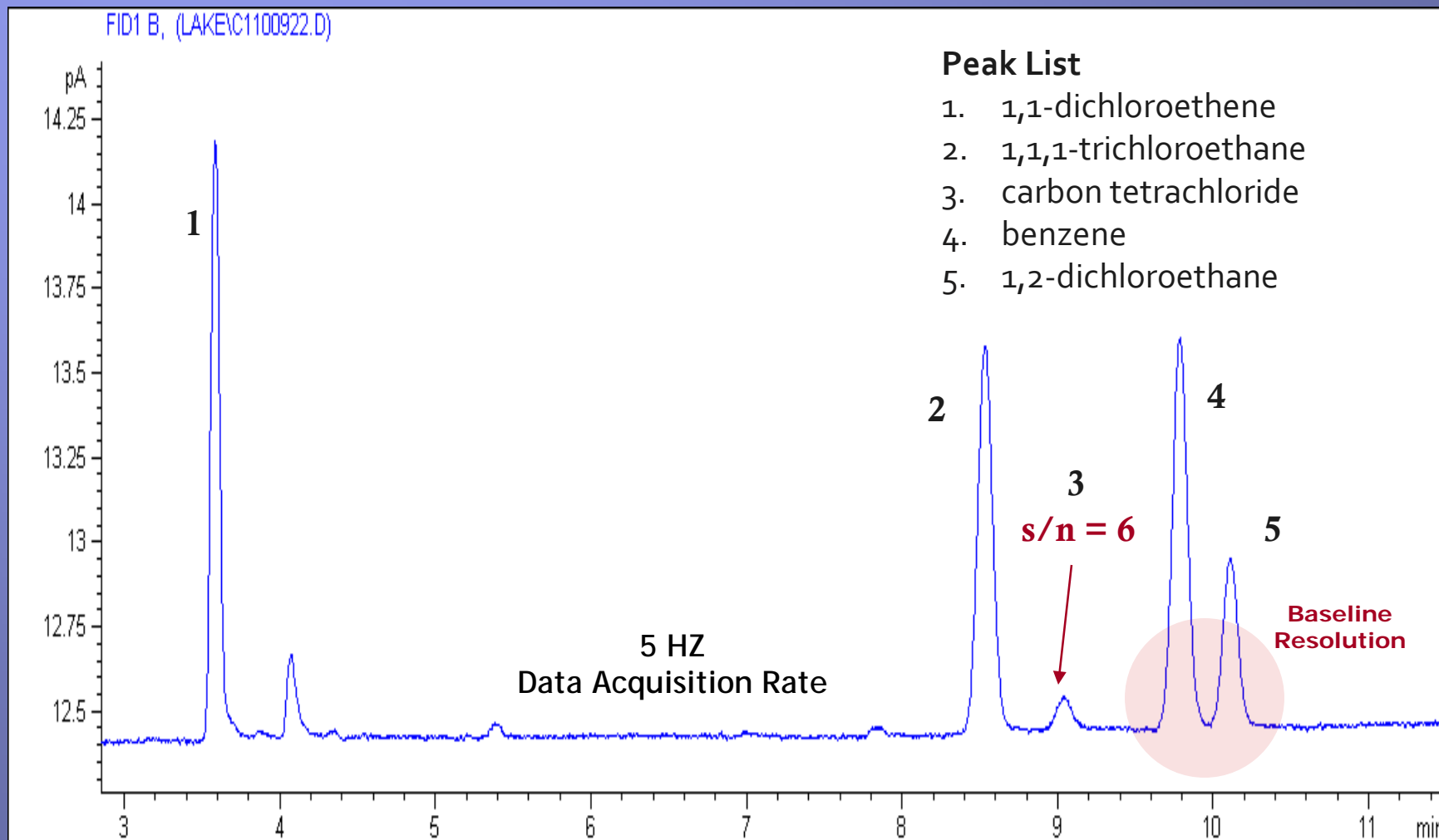
GC Conditions:

Instrument	Agilent 6890
Column:	Rxi-624SilMS 30m, 0.32 ID, 1.8µm (cat. # 13870)
Sample:	USP<467> Standard Solutions (cat#. 36279) in 20 ml headspace vial
Inj.:	Headspace injection (split ratio 5:1), 1mm Split liner IP Deactivated (cat. # 20972)
Inj. temp.:	140°C
Carrier gas:	helium, constant flow
Flow rate:	2.16 ml/min, 35.3 cm/sec
Oven temp.:	40°C for 20 minutes, to 240°C @ 10°C/minute, hold for 20 minutes
Det.:	FID @ 250°C

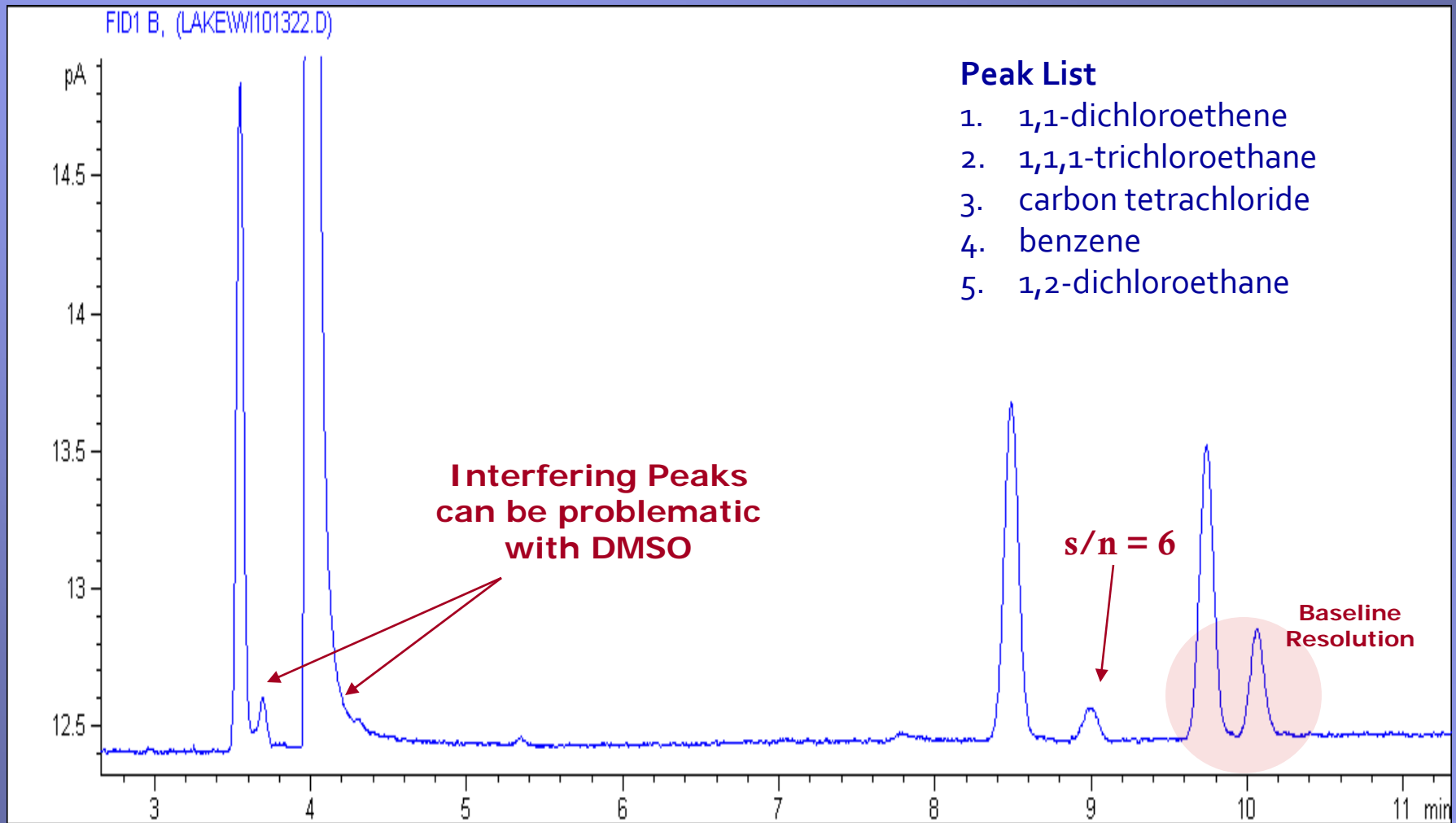
Headspace Conditions:

Instrument:	Tekmar HT3
Transfer Line Temp.:	110°C
Valve Oven Temp.:	110°C
Sample Temp.:	80°C
Sample Equil. Time:	60 min.
Vial Pressure:	10 psi
Pressurize Time:	0.5 min.
Loop Fill Pressure:	5 psi
Loop Fill Time:	0.1 min.
Loop Equilibration Time:	0.05 min
Inject Time:	1.00 min.
Inject Volume:	1 ml

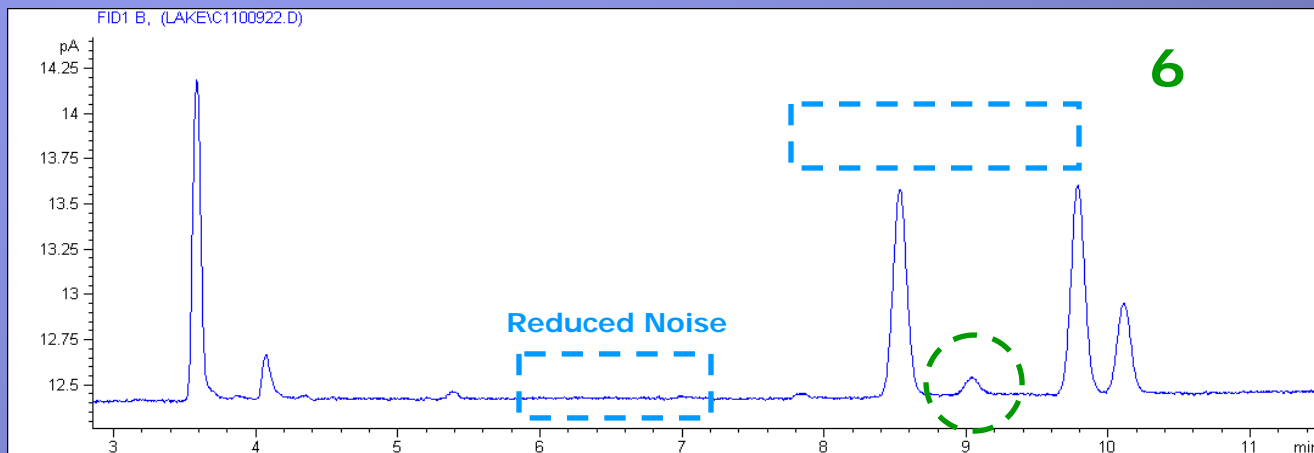
USP <467> Water –Soluble Articles Procedure A – Class 1



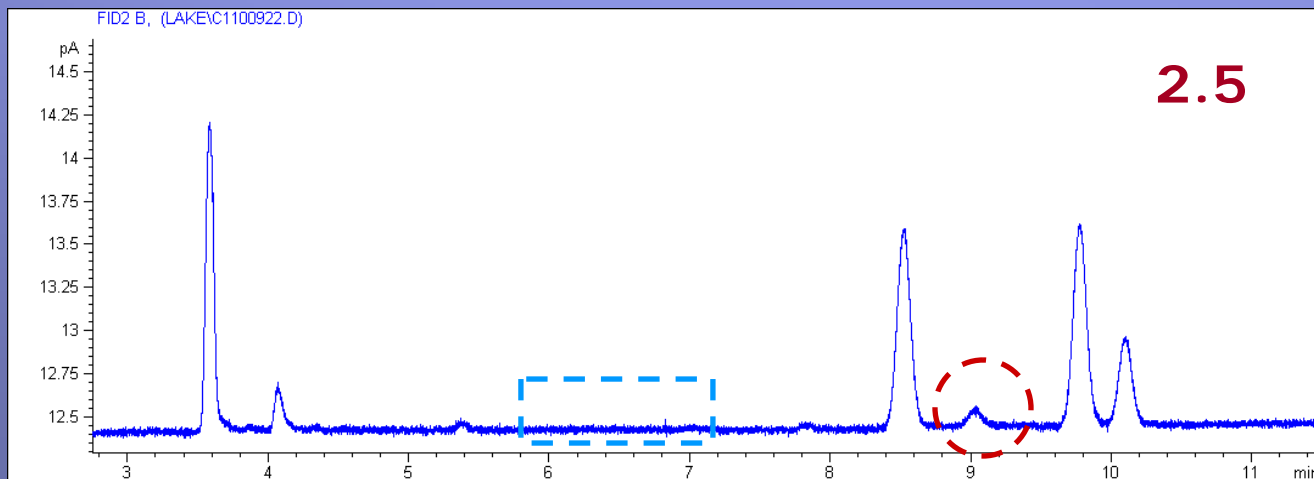
USP <467> Water –Insoluble Articles Procedure A – Class 1



Sensitivity for Class 1 Solvents - Adjusting the Data Acquisition Rate

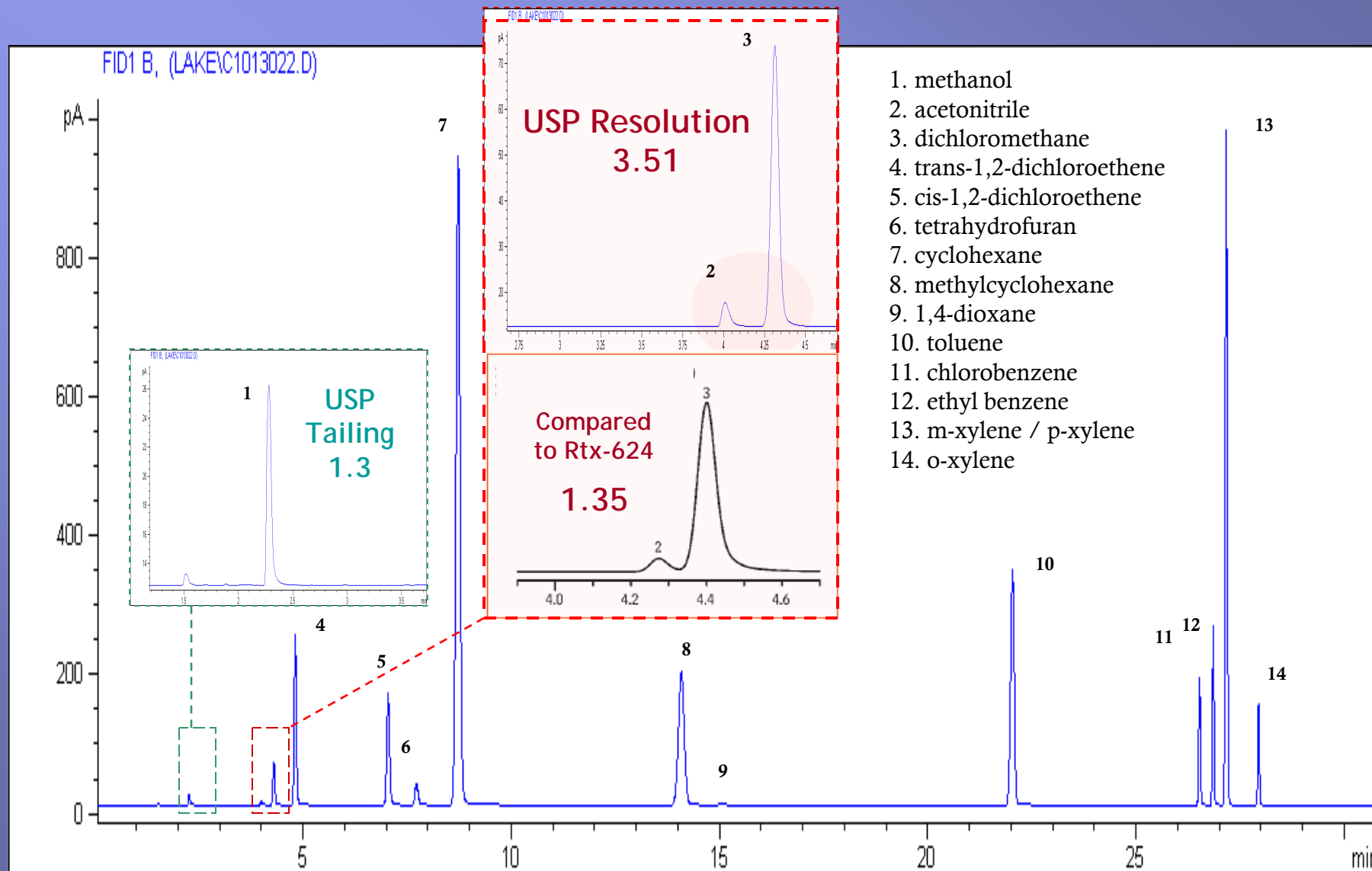


- 5:1 Split
- 5 HZ Data Acquisition Rate

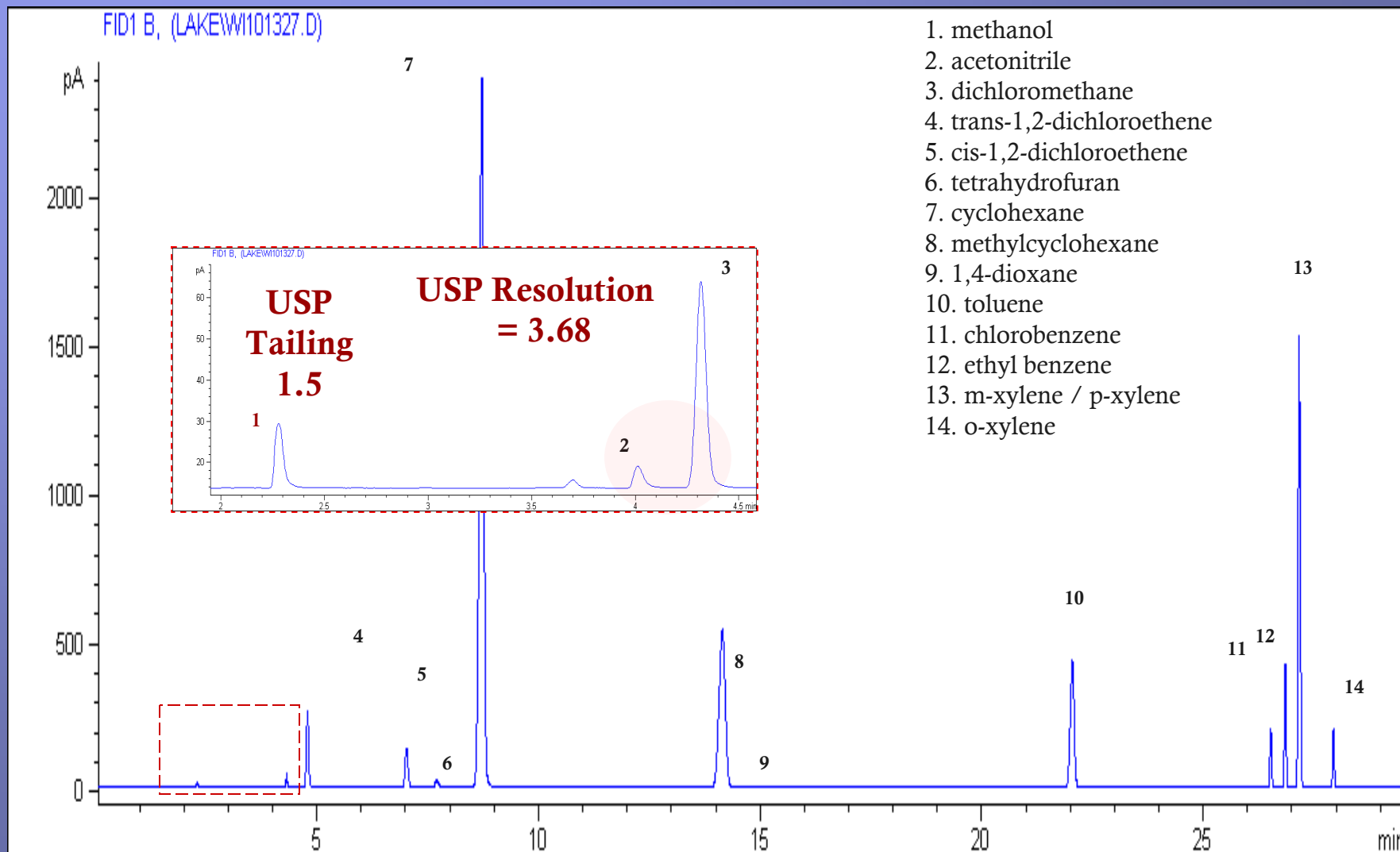


- 5:1 Split
- 50 HZ Data Acquisition Rate

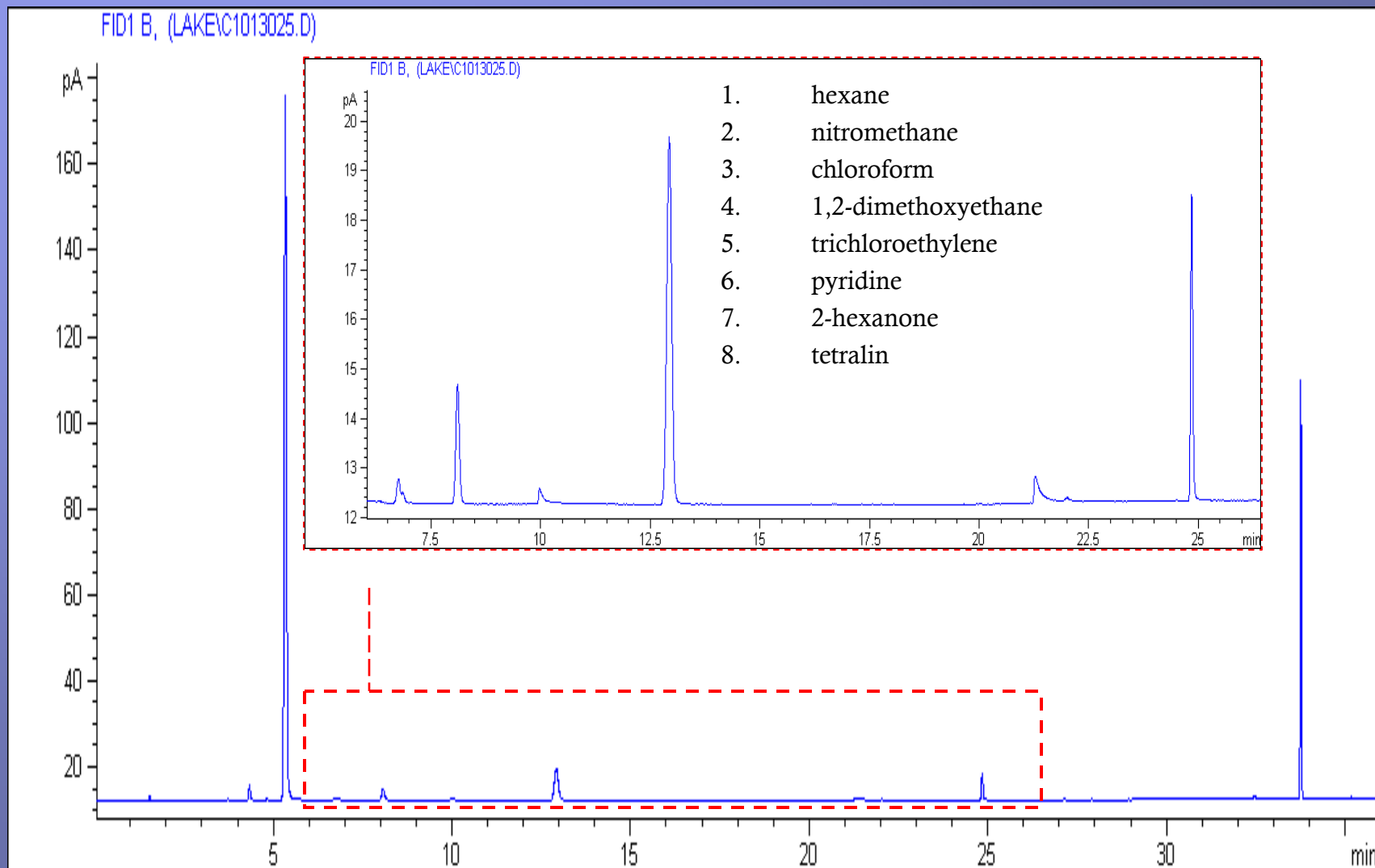
USP <467> Water –Soluble Articles Procedure A – Class 2 Mix A



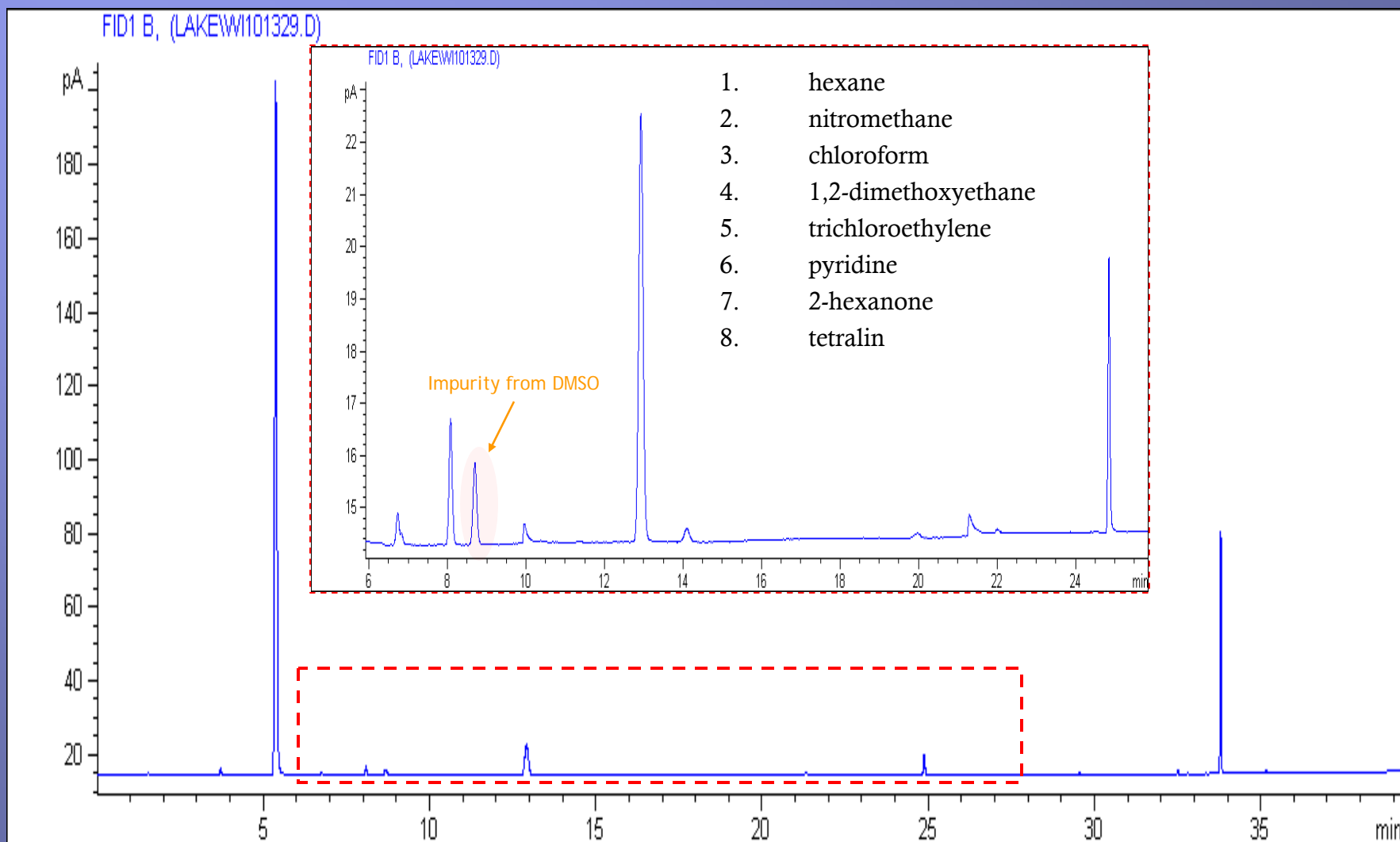
USP <467> Water –Insoluble Articles Procedure A – Class 2 Mix A



USP <467> Water –Soluble Articles Procedure A – Class 2 Mix B



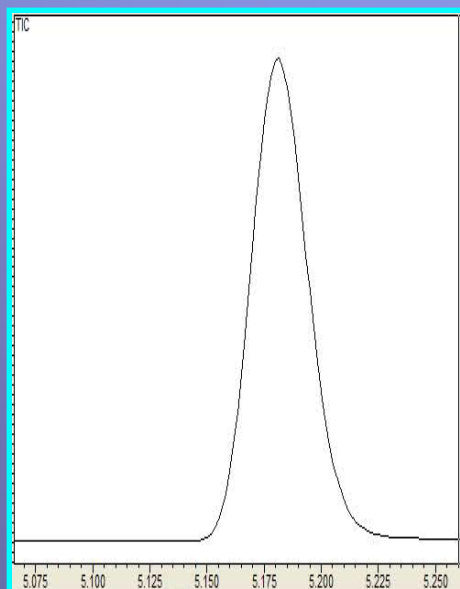
USP <467> Water –Insoluble Articles Procedure A – Class 2 Mix B



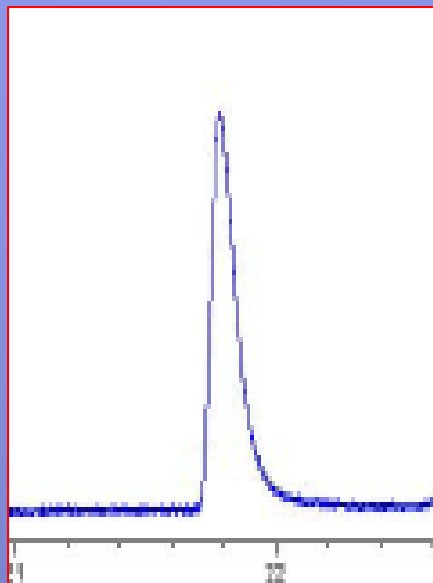
USP <467> Water –Soluble Articles Procedure A – Pyridine

- Deactivation is required along entire sample pathway
- Deactivated metal transfer lines can be source of activity

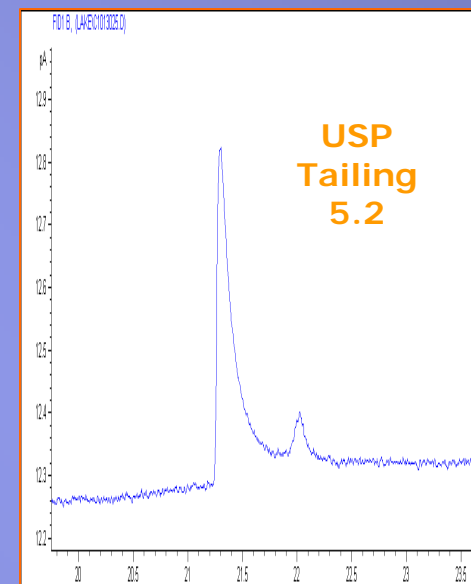
Liquid
Injection



Syringe HS
Injection



Transfer Line
HS Injection
110 C



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Cat. #	Tubing OD (in/mm)	Tubing ID (in/mm)	Maximum Temperature (° C)*	Minimum Suggested Bend		Maximum Operating Pressure (psig/kPa)
				Radius (in/cm)	Diameter (in/cm)	
22903; 22914	³ / ₈ / 9.53	0.277 / 7.04	450	6 / 15.2	12 / 30.5	4,800 / 33,094
22509; 22539; 22902	¹ / ₄ / 6.35	0.180 / 4.57	450	4 / 10.2	8 / 20.3	3,300 / 22,752
22507	¹ / ₄ / 6.35	0.210 / 5.33	450	4 / 10.2	8 / 20.3	2,200 / 15,168
22506; 22538	¹ / ₈ / 3.18	0.085 / 2.16	450	2 / 5.1	4 / 10.2	6,100 / 42,058
22508; 22901	¹ / ₈ / 3.18	0.055 / 1.40	450	2 / 5.1	4 / 10.2	10,900 / 75,152
22505	¹ / ₁₆ / 1.59	0.040 / 1.02	450	1 / 2.5	2 / 5.1	4,800 / 33,094
22504	¹ / ₁₆ / 1.59	0.030 / 0.76	450	1 / 2.5	2 / 5.1	8,100 / 55,847
22503	¹ / ₁₆ / 1.59	0.020 / 0.51	450	1 / 2.5	2 / 5.1	10,300 / 71,015
22502	¹ / ₁₆ / 1.59	0.010 / 0.25	450	1 / 2.5	2 / 5.1	14,000 / 96,526
22501	0.029 / 0.74	0.021 / 0.53	450	1 / 2.5	2 / 5.1	6,400 / 44,126
22500	0.022 / 0.56	0.011 / 0.28	450	1 / 2.5	2 / 5.1	11,250 / 77,566

*In an inert (oxygen-free) atmosphere.

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Handling: Handle the Siltek®/Sulfinert® tubing as you would any stainless steel tubing. Take precautions to avoid sharp bends or bends tighter than the minimum suggested bending radius. Any bend sharper than those listed may cause the tubing to stretch, potentially creating active sites as the coating layer density decreases. Additionally, we recommend passing a burst of nitrogen or clean compressed air through the tubing (at approximately 50 psi/340 kPa) to prevent damage from any particles released during the stress of bending. Once the tubing has been flushed and put into service, additional particle generation will not occur.

Cutting: Cut the tubing ends with a standard metal tubing cutter. Point the tubing end down when cutting or reaming to prevent metal filings from depositing inside the bore. Always flush tubing sections after cutting and end-cleaning to ensure the removal of metal or coating particles generated during cutting.

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[lit. cat.# EVFL1192](#) (1.54mb PDF)



Analysis of Explosives by Liquid Chromatography

< Application Note: Added May 2009

Ultra II Aromax and Ultra C8 columns were determined to provide better separations for the routine analysis of explosives by LC than conventional phases.

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Reduce Acetonitrile Dependence by Analyzing Polycyclic Aromatic Hydrocarbons with Methanol-Based Mobile Phase

< Application Note: Added May 2009

Switching to a methanol-based mobile phase for polycyclic aromatic hydrocarbon analysis—using the method shown here—is an effective way to save money by reducing acetonitrile consumption.

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Thermal Desorption Tubes:

Versatile Air Sampling for a Wide Range of Applications

< [Flyer](#)

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FEATURED LITERATURE

Ultra II™ LC Columns: The Column Line Designed for Optimal Chromatography on ANY LC System, Based on Highly Inert Restek Silica

Ultra II™ is the first LC column line specifically designed for universal application and completely scalable chromatography, from conventional to ultra-high pressure systems. Available in a wide range of phases, including traditional and unique chemistries.

[lit. cat.# GNTS1177](#) (393kb PDF)



Resolution Evolution: Biphenyl—Next Generation of Phenyl Columns

Biphenyl columns provide both high hydrophobic retention and aromatic selectivity in the same column. Orthogonal separations can be achieved with simple mobile phase changes, giving markedly better separations for a wide variety of molecules.

[lit. cat.# GNFL1096](#) (523kb PDF)



Residual Solvent Analysis: Complete Solutions for Residual Solvent Testing

This 12-page reference includes a review of headspace fundamentals, the revised USP <467> method (July, 2008), chromatography for Procedures A, B, and C, and technical tips for optimization. Guidance on fast, effect method development is given.



» [Click here for more pharmaceutical literature.](#)

Featured Articles

Improve Pass Rates for Residual Solvents by USP <467> Using the new Rxi®-624SiI MS GC Column

Not all G43 columns are equivalent. New Rxi®-624SiI MS columns reliably produce improved resolution and sensitivity, increasing system suitability pass rates and ensuring more productive laboratory time.

[Find out more](#)



Achieve Faster LC on Any System Using Ultra II™ Columns

Significant savings can be obtained without the costly upgrade to UHPLC. This famotidine example illustrates how a 90% reduction in analysis time and solvent volume resulted from strategic LC column choices.

[Find out more](#)



Two Options for Analyzing Potential Genotoxic Impurities

Laboratory needs for analyzing PGIs in API vary. Here we developed both a fast analysis of sulfonate esters on the Rxi®-5SiI MS column, and a comprehensive method for both sulfonate esters and alkyl halides on the Rtx®-200 column.

[Find out more](#)



Explaining the Small Particle Advantage: Faster Sample Throughput on a 1.9µm Pinnacle™ DB column

Here we demonstrate the importance of stationary phase choice in UHPLC separations. By optimizing selectivity for your analytes of interest faster separations can be achieved without compromising resolution.

[Find out more](#)



Acetonitrile Shortage: Short-Term & Long-Term Solutions

Resources to assist analytical laboratories in coping with the limited availability of acetonitrile. Ways to reduce solvent consumption, shorten analysis times, and switch to alternative mobile phases.

[Find out more](#)

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Clinical/Forensic/Toxicology Solutions

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» Featured Resources



Featured Products

Ultra II® Biphenyl HPLC Columns

- Easily convert to LC/MS/MS testing with Ultra II® columns.
- Unique Biphenyl phase allows for selective analysis of difficult-to-resolve compounds.
- Improved hydrophobic retention reduces matrix interferences compared to competitor phenyl-based columns.

[Special Offer!](#) | [More Info](#)



Rxi®-5SiI MS GC Columns

- Low bleed column ideal for GC/MS and trace level analyses.
- Excellent inertness, improves accuracy for active compounds.
- Longer column lifetime saves costs and reduces downtime.

[Products](#) | [More Info](#)



Syringe Filters (with luer lock inlet)

- Variety of filter types, porosities, and diameters.
- Color coded for easy identification.
- Polypropylene housing.
- Reusable storage container.
- Quantity break pricing, for greater savings.

[Products](#) | [More Info](#)



Forensic Drug Screen Mixes

- **Test mixture** and **internal standard** available.
- Rigorous quality controls and full data packs available ONLINE!

[Products](#)



2.0mL Autosampler Vial Convenience Kits

- Vials packaged in a clear-lid tray. Preassembled caps with septa packaged separately in a plastic bag.
- Black polypropylene open-hole caps and 8mm red PTFE/silicone septa, 0.065".



Products

Survival Kits for HPLC

- Contain a wide range of tubing, fittings, and tools necessary to set up and maintain your HPLC system.
- Available in **stainless steel** or **PEEK™**.

Stainless Steel | PEEK™



For more products and applications for clinical/forensic analyses, please use the links to the right.

Featured Resources

LC/MS in Forensic Toxicology: Selecting a Killer LC Column (62 minutes)

Speakers: Becky Wittrig, Global HPLC Specialist, & Amanda Rigdon, Clinical/Forensics Applications Chemist | [View Webinar \(Windows Media file\)](#)



LC/MS/MS Analysis of Diuretics in Urine: Proper Column Choice Takes Matrix out of the Equation

< Added October 2009

Ultra II® Biphenyl columns improve the accuracy of diuretics analysis in urine by separating target diuretics from isobaric matrix interferences. Fast, reliable separation can be achieved for compounds that coelute on phenyl hexyl columns.

[Find out more](#)



Reduce Downtime and Cost of Materials with Rugged Rxi®-5Sil MS GC Columns

New Rxi®-5Sil MS columns produce consistent results for amphetamine—even after 400 injections of derivatizing reagent—resulting in less time and money spent on column maintenance and replacement.

[Find out more](#)



Ultra II® LC Columns: The Column Line Designed for Optimal Chromatography on ANY LC System, Based on Highly Inert Restek Silica

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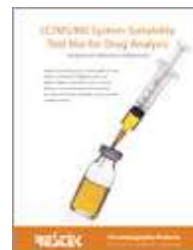
the same column. [Abstracts Only for more details ask! or see Restek website www.restek.com](#)
changes, giving markedly better separations for a wide variety of molecules.
[lit. cat.# GNFL1096](#) (523kb PDF)

LC/MS/MS System Suitability Test Mix for Drug Analysis

Analytical Reference Materials

Ensure proper LC/MS/MS system performance by analyzing a system suitability mix on a regular basis. This mix contains compounds covering a wide range of masses and polarities, and a simple test is used to evaluate the entire analytical system.

[lit. cat.# CFTS1002](#) (160kb PDF)



High Sensitivity EtG and EtS Method Reduces Costs and Analysis Time

A new LC method for analyzing ethanol metabolites using ion-pairing provides higher retention, faster analysis times, and improved MS sensitivity for EtG and EtS, compared to conventional methods.

[Find out more](#)



5 Minute Analysis of Vitamin D in Serum by LC/MS/MS

Conventional techniques for vitamin D analysis often lack adequate sensitivity, specificity, and speed. This LC/MS/MS assay results in highly symmetric peaks that elute in just 5 minutes.

[Find out more](#)



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Petrochemical Solutions

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Featured Products

MXT®-1HT SimDist Columns

- Stable up to 430°C—lowest bleed for longest column lifetime.
- Reliably meet all ASTM D6352 and D7500 specifications.
- 100% dimethyl polysiloxane phase allows easy comparisons to historical data.

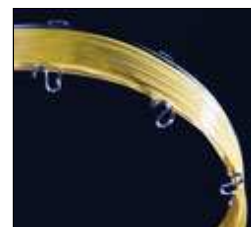
[Products](#) | [More Info](#)



Restek PLOT Columns

- New bonding process minimizes particle release, reducing column blockage and protecting instrument parts.
- More consistent flow means stable retention times in Deans and related flow switching techniques.
- Outstanding peak symmetry improves impurity analysis for gases, solvents, and hydrocarbons.

[Special Offer!](#) | [More Info](#)



Rtx®-1PONA GC Columns

- Application-specific columns.
- Meet ASTM and CGSB requirements for [detailed hydrocarbon analysis](#).

[Products](#) | [More Info](#)



PIANO & PONA VI Mixes

- PIANO blends: used for calibrating complex hydrocarbon analyses.
- PONA-VI: prepared to provide nearly every component that may be encountered in feedstock and finished gasolines.



Sulfinert® Treated Sample Cylinders & Valves

- Stable storage of sulfur and mercury at ppb levels.
- Inert coating doesn't flake; more durable than Teflon®.

[Products](#) | [More Info](#)



Restek Electronic Leak Detector

- Protect your data and analytical column by leak checking.
- Ergonomic, hand-held design with rugged side grips for added durability.
- Detectable gases: helium, nitrogen, argon, carbon dioxide, hydrogen.

[Products](#) | [More Info](#)



For more products and applications for petrochemical analyses, please use the links to the right.

Featured Literature

New Solutions for Your Petro Analyses

< Flyer: Updated December 2009

Chromatograms, technical tips, and products developed specifically for petrochemical testing. Detailed recommendations for simulated distillation, PLOT column applications, DHA, D3606, biodiesel, permanent gases and hydrocarbons.

[lit. cat.# PCFL1195A](#) (786kb PDF)



Stabilized GC PLOT Columns

< Flyer: Added October 2009

New bonded PLOT columns from Restek offer significantly reduced particle release, which extends column lifetime and gives highly reproducible retention times. This flyer illustrates improved flow and chromatography for various gases and solvents.

[lit. cat.# PCFL1163A](#) (413kb PDF)



Increase Productivity: Get More Runs from Your SimDist Setup Using Next Generation MXT®-1HT Columns

< Flyer: Added October 2009

New MXT®-1HT SimDist GC columns are shown to outperform competitors, allowing more productive D6352 analyses. Low bleed levels ensure accurate data and longer column lifetime. High efficiency improves resolution, assuring more samples can be run within method specifications.

[lit. cat.# PCFL1201](#) (348kb PDF)



17 Minute D2712 Analysis of Impurities in Propylene Using PLOT Columns

< Application Note: Added October 2009

When analyzing hydrocarbon impurities in propylene by ASTM D2712, using an Rt®-Alumina BOND Na₂SO₄ PLOT column instead of a packed column setup provides the greatest degree of resolution in the least amount of time.

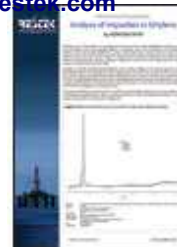
[lit. cat.# PCAN1202](#) (120kb PDF)



< Application Note: Added August 2009

When testing for impurities in ethylene using ASTM D6159-97, the combination of an Rt®-Alumina BOND column coupled to an Rtx®-1 column provides the best resolution of the most common hydrocarbon contaminants.

lit. cat.# PCAN1174 (176kb PDF)



» **Click here for more petrochemical literature.**

Featured Articles

Accurately Quantify Methanol and Ethanol in E85 Biofuel by D5501 with New Rtx®-DHA-150 Column

Content previously published in Petro Industry News

< Added November 2009

Improve D5501 analysis of ethanol biofuel with Rtx®-DHA-150 columns. Reliably separate methanol and isobutane in just 20 minutes, with excellent symmetry for both target alcohols.

Find out more.



New PLOT Column Technology Stabilizes Flow and Improves Analysis of Light Hydrocarbons, Solvents, and Permanent Gases

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Find out more.



Tighten Control of Distillation Processes with the New MXT®-1HT Sim Dist Column

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Find out more.



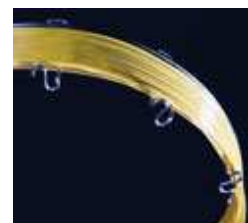
Advances in Porous Layer Open Tubular Columns

Content previously published in International Laboratory

< Added October 2009

Jaap de Zeeuw discusses recent advances in PLOT column technology in an *International Laboratory* article. New stabilization technology minimizes particle release, assuring more consistent flow and better performance for a number of applications.

Find out more (4.4mb pdf)



New D3606 Column Set Outperforms TCEP Columns for Benzene Analysis

Content previously published in Petro Industry News

< Added August 2009

Restek's new D3606 column set outperforms TCEP columns for gasoline testing.



[Find out more](#)

Higher DHA Sample Throughput for PONA Analysis: Options for Helium and Hydrogen

Content previously published in Petro Industry News

< Added August 2009

Rtx®-1 PONA columns are highly stable and can be run with helium or hydrogen under accelerated conditions. Restek has developed a new DHA method using Rtx®-1 PONA columns with hydrogen that can double refinery sample throughput.



[Find out more](#)

Stable Sulfur & Mercury Sampling in Refineries

Using Siltek® and Sulfinert® Surface Treated Components

Refinery and natural gas samples often contain trace amounts of sulfur- and mercury-containing compounds, which can interfere with reactions, poison catalysts in petrochemical processes, and damage equipment. Because these compounds quickly react with stainless steel surfaces, accurate determination of these compounds is impossible when samples are collected and stored in untreated sample cylinders. Restek's Siltek® and Sulfinert® passivation techniques bond an inert layer into the surface of stainless steel, preventing active compounds from reacting with or adsorbing to the steel.

Got Sulfur?



[Find out more.](#)

Eliminate Column Breakage in High Temperature Biodiesel Analysis

Fused silica columns traditionally have been used for analyzing glycerin in biodiesel, but metal columns offer significant performance advantages. How can analysts determine which column is best for their lab? Here we compare fused silica and metal column performance for total glycerin analysis of biodiesel and offer guidelines for column selection.



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Restek Technical Articles



EDITORIAL

Further Editorials, by Dr. Konrad Grob

< Added September, 2009

Collected from the Restek *Advantage*, thirteen thought-provoking essays offering insight into sample vaporization processes in gas chromatography, important splitless optimization concepts, and food for thought on lab practices, education, and food safety.

[Find out more](#)

Unraveling Scent Signals to Protect African Wild Dogs

< Added May, 2009

Dr. Peter Apps discusses how gas chromatography is being used to help protect endangered African wild dogs from conflicts with humans in Botswana.

[Find out more](#)

Analysis of Brominated Flame Retardants by Liquid Chromatography Mass Spectrometry

Dr. Chris Marvin, of Environment Canada, discusses the challenges of analyzing brominated flame retardants, such as polybrominated diphenyl ethers, by LC/MS.

[Find out more](#)

Achieving Faster GC

Numerous articles have been published on faster methods for gas chromatography (GC), yet uncertainty remains on how best to speed up separations. Here, Dr. Hans-Gerd Janssen clarifies the confusion surrounding fast GC and recommends a strategic approach based on 3 steps: 1) minimizing resolution to a value just sufficient, 2) maximizing the selectivity of the chromatographic system, and 3) implementing a method that reduces analysis time while holding resolution constant.

[Find out more](#)

Quality Control in Metabolomics

Metabolites are found in different concentrations in complex biological matrices and are very difficult to extract without compromising their structural integrity and relative abundances. Quality control in metabolomics means more than just taking care of chromatographic or mass spectrometry parameters. This article by Oliver Fiehn examines quality control as an attitude towards gaining reliable data, rather than an automatic procedure implemented in instrument software.

[Find out more](#)

Using Guard Columns and Retention Gaps in GC (Part 2)

Guard columns & retention gaps are used widely in gas chromatography (GC) but the differences between them are not always understood. Part 2 of this two-part editorial by Jaap de Zeeuw discusses guard columns & introduces a new segment coating technology that allows retention gaps & guard columns to be built directly in the same piece of tubing as the analytical column.

[Find out more.](#)

Using Guard Columns and Retention Gaps in GC (Part 1)

Guard columns & retention gaps are used widely in gas chromatography (GC) but the differences between them are not always understood. Part 1 of this two-part editorial by Jaap de Zeeuw reviews the use of retention gaps & discusses critical factors affecting performance. This sets the background for Part 2, which details guard columns & introduces a new segment coating technology that allows retention gaps & guard columns to be built directly in the same piece of tubing as the analytical column.

[Find out more.](#)

Retention Cross-over Phenomenon in Gas Chromatography

Dr. Werner Engewald discusses the phenomenon of cross-over, or changes in elution order following modification of the GC temperature program. This effect has been observed for decades but the physio-chemical background still is not well understood. In this article Dr. Engewald explores the theory and potential explanations for the cross-over phenomenon.

[Find out more.](#)

Restek: A Company of Owners

By Paul Silvis, Restek Founder & former Head Coach

In this editorial, founder and former CEO Paul Silvis explains some of the reasons for Restek's success as a provider of chromatography columns and supplies. Restek will continue to be successful because, as an employee-owned company, we hold our future in our own hands. Customers will benefit because we can continue to respond to their ideas for the products and services they need to make their work easier.

[Find out more.](#)

Sample Preparation Techniques Used for Gas Chromatography

Guest Editorial by Robert L. Grob, Ph.D.

Sample preparation principles and techniques for gas chromatography are reviewed. Techniques include: static headspace, dynamic headspace, solid phase extraction and microextraction, distillation, stir bar sorptive extraction, Soxhlet, accelerated solvent extraction, pressurized liquid extraction, subcritical water extraction, microwave assisted extraction, ultrasonic extraction, and supercritical fluid extraction.

[Find out more.](#)

Comprehensive 2D Gas Chromatography — Making GC Separations Work Harder

Guest editor Dr. Phil Marriott tells us the three primary contributions ascribed to GCxGC are greater separation capacity, greater sensitivity, and a data presentation that permits identification of related compounds based on the molecular properties that control retention. The most significant advantage is separation power: to be able to resolve many more compounds immediately enables a much more complete 'picture' of the composition of a sample.

[Find out more.](#)

Preventive Maintenance for GC

Professor Jennings explains the consequences of ignoring those enclosures included with a new column, and offers simple, proven, preventive maintenance options that help avoid downtime.

[Find out more.](#)

The "Replacement" Column, A Recurring Problem in Gas Chromatography

In his first contribution to the Restek Advantage Professor Walter Jennings discusses why analysts often encounter problems when replacing a capillary GC column, and provides a solution.

[Find out more.](#)

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PETROCHEMICAL

Accurately Quantify Methanol and Ethanol in E85 Biofuel by D5501 with New Rtx®-DHA-150 Column

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[Find out more](#)

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[Find out more](#)

Stable Sulfur & Mercury Sampling in Refineries

Using Siltek® and Sulfinert® Surface Treated Components

Refinery and natural gas samples often contain trace amounts of sulfur- and mercury-containing compounds, which can interfere with reactions, poison catalysts in petrochemical processes, and damage equipment. Because these compounds quickly react with stainless steel surfaces, accurate determination of these compounds is impossible when samples are collected and stored in untreated sample cylinders. Restek's Siltek® and Sulfinert® passivation techniques bond an inert layer into the surface of stainless steel, preventing active compounds from reacting with or adsorbing to the steel.

[Find out more.](#)

Eliminate Column Breakage in High Temperature Biodiesel Analysis

Using metal columns to analyze glycerin in biodiesel offer significant performance advantages compared to fused silica columns, as shown in this evaluation.

[Find out more.](#)

How Good is Your PONA Column?

Data-Based Decisions Help Simplify the Choice

We evaluated our 100 meter x 0.25mm ID x 0.5df PONA column and equivalent columns from four other vendors, following ASTM D-6730 methodology (hydrogen carrier gas). Data and chromatograms presented here show that only the Restek PONA column performed to method specifications admirably. Column efficiency exceeded specification.

[Find out more.](#)

Parker ChromGas® Hydrogen Generators

Relative to helium as the GC carrier gas, hydrogen from a gas generator reduces gas costs, cuts analysis time by 50%, and reduces temperatures needed for eluting analytes — which increases column lifetime.

[Find out more.](#)

High Temp. Stability Problem Solved with New Metal Columns

Analysis of Total Glycerides in Biodiesel Oils by ASTM D-6584 Using the New MXT®-Biodiesel TG Capillary Column

The high temperatures required for biodiesel analysis by gas chromatography present a considerable challenge to analytical columns. Fused silica columns, even those rated for high-temperature tolerance, breakdown relatively quickly. Restek's new MXT®-Biodiesel columns are more stable up to 430°C and offer excellent chromatography for glycerides. These columns are available in two configurations: factory-coupled to a 0.53mm retention gap, or with a built-in, leak-proof Integra-Gap™ retention gap.

[Find out more.](#)

Fast, Accurate FAMES Analyses of Biodiesel Fuel

Using a Stabilwax® Capillary GC Column

As biodiesel fuel continues to stimulate interest worldwide as an energy source, several gas chromatographic methods have been developed to determine the quality of B100 fuel. Here we show excellent peak symmetry, resolution, and reproducibility for determining the fatty acid methyl ester (FAME) and linolenic acid methyl ester content in B100 biodiesel fuel, using European standard method EN 14103 on a Stabilwax® fused silica GC column.

[Find out more.](#)

Separate Argon from Oxygen Above Ambient Temperatures

Using an Rt-Msieve™ 5A PLOT Column

A Restek PLOT column can be your best solution for difficult separations of gaseous analytes. Rt-Msieve™ 5A PLOT columns offer fast, efficient separation of argon/oxygen, hydrogen/helium, and other permanent gases, including permanent gases in refinery or natural gas. You can make difficult separations without subambient temperatures, e.g.: separate oxygen from argon to baseline in approximately 4 minutes.

[Find out more.](#)

Biodiesel Analysis by European Methodology

Exceptional Peak Symmetry, Using an Rtx®-Biodiesel GC Column

Glycerin is a notoriously difficult challenge in GC, particularly at the levels involved in biodiesel oil analysis, but an Rtx®-Biodiesel column provides a symmetric peak that makes quantification easier and more reliable. The column performs well at elevated temperatures: peaks for glycerin and glycerides exhibit minimal tailing, and bleed is low at 370°C, as specified in European method DIN EN14105.

[Find out more.](#)

Analyze Biodiesel Oil for Glycerin

Using Restek's Robust Rtx®-Biodiesel Capillary GC Column

We challenged our Rtx®-Biodiesel column with analysis for glycerin in biodiesel according to method ASTM D-6584-00. Excellent linearity was established for glycerin, triolein, monolein, and diolein, with r² values exceeding the method criteria for all compounds. Mono-, di-, and triglycerides resolved well from other compounds in B100 biodiesel oil. Column performance was strong at high temperatures, with low bleed even at 380°C. An Alumaseal™ connector and guard column were used to extend column life.

[Find out more.](#)

GC Analysis of Total Reduced Sulfurs at ppbv Levels

Using an Rxi™-1ms Column and Sulfur Chemiluminescence Detection

Ultra-low bleed and exceptional inertness assure complete separation of sulfur compounds (hydrogen sulfide, carbonyl sulfide, dimethyl sulfide, mercaptans) on our new column, with excellent peak shapes and reliable quantification at ppbv levels. A Sulfinert® treated sampling/transfer system assures no adsorption losses of these very reactive compounds.

[Find out more.](#)

Sulfinert®-Treated Sample Cylinders Store Active Sulfur Compounds at ppb Levels

Recovery of a 17ppbv test standard of hydrogen sulfide exceeded 85% after 54 hours in a Sulfinert®-treated cylinder; recoveries of methyl mercaptan, ethyl mercaptan, carbonyl sulfide, and dimethyl disulfide exceeded 90%. A Sulfinert®-treated sampling/transfer system can assure accurate sulfur content data for natural gas, beverage-grade carbon dioxide, or other samples.

[Find out more.](#)

Analyze Hydrocarbons on OPN/Res-Sil™ C Bonded GC Packing

In process GC analyses, this material offers unique selectivity for the difficult-to-separate saturated and unsaturated C4 hydrocarbons, eluting *cis*-2-butene before 1,3-butadiene. Innovative bonding chemistry assures batch-to-batch reproducibility, excellent thermal stability, and long column life.

[Find out more.](#)

Res-Sil™ C Packings for Analyses of Light Hydrocarbons

n-Octane on Res-Sil™ C packing provides excellent, reproducible separations of volatile hydrocarbons in petroleum products, including the difficult-to-separate saturated and unsaturated C4 compounds. An OPN on Res-Sil™ C column separates C1-C5 hydrocarbons in half the time required by alternative columns.

[Find out more.](#)

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CLINICAL/FORENSICS

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< Added July 2009

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[Find out more](#)

5 Minute Analysis of Vitamin D in Serum by LC/MS/MS

< Added May 2009

Conventional techniques for vitamin D analysis often lack adequate sensitivity, specificity, and speed. This LC/MS/MS assay results in highly symmetric peaks that elute in just 5 minutes.

[Find out more](#)

Fast Screening and Confirmation of Gamma-Hydroxybutyrate (GHB) in Urine

< Added February 2009

The headspace (HS) analysis of gamma-hydroxybutyrate (GHB) described here reduces contamination and eliminates time-consuming derivatization. Confirmation testing using an Rtx®-5MS column, provides definitive results in less than 7 minutes.

[Find out more](#)

Assure LC/MS/MS System Performance and Increase Sample Throughput

Using a System Suitability Test Mix for Drug Analysis

Restek and Applied Biosystems have developed a system suitability mix specifically for drug testing that contains compounds covering a wide range of molecular weights, polarities, and retention times. This mix is designed to verify system performance and identify problems. Data are automatically compared to expected results by Cliquant® Drug Screen & Quant Software. Use this mix to assure system performance, improve data quality, increase sample throughput, and simplify troubleshooting.

Rapid Separation of Human Sex Hormones in Biological Samples

Using the JASCO X-LC System

This application note describes a 6.1 min method for identifying a mixture of 8 sex hormones using Jasco X-LC. The compounds are separated by a gradient elution of water and acetonitrile on a Restek 1.9µm Pinnacle DB Biphenyl column.

Find out more at www.jascoinc.com

Accurate, Reproducible Amphetamines Analysis

Clean Up Procedure Improves Chromatography and Reduces Maintenance

Analyzing amphetamines by GC/MS can be challenging whether they are derivatized or underivatized. Here we evaluate the effects of several sample pretreatment methods. The resulting method reported here produces symmetric peaks while reducing the amount of contamination that can enter the GC system. This method ensures accurate area count reproducibility, a clean GC system, and a stable baseline, even for GC/MS work.

Find out more.

Fast, Sensitive Analysis of Benzodiazepines by LC/MS/MS

Quantify an Order of Magnitude below Typical Methods

An LC/MS/MS method for benzodiazepines was developed and offers several advantages over other techniques: minimal sample preparation, fast analysis times, multiple reaction monitoring transitions for quantification and confirmation, and sensitivity down to 0.10-10ng/mL. This method uses the Allure® PFP Propyl stationary phase, which retains compounds long enough to minimize matrix interferences and chromatographically separate compounds that share the same precursor ion.

Find out more.

Simplify and Speed Up Opiates Analysis

Using LC/MS/MS & an Allure® PFP Propyl HPLC Column

The analysis of opiates typically requires derivatization when using gas chromatography/mass spectrometry (GC/MS), which leads to longer sample preparation time. An alternative liquid chromatography tandem mass spectrometry (LC/MS/MS) method presented here eliminates sample derivatization and offers fast analysis times, resulting in increased sample throughput. In addition, the Allure® PFP Propyl column used here produces baseline resolution for compounds that have very similar mass spectra.

Find out more.

Why Derivatize?

Improve GC Separations with Derivatization

Derivatizing compounds is often necessary to obtain acceptable, reproducible results. Here we review reasons for derivatization and the three basic types of derivatization reactions for gas chromatography: silylation, acylation, and alkylation. An example procedure for derivatizing hormones, including chromatography, is given.

Find out more.

Reliably Confirm Cannabinoids by GC/MS

Using a 12m x 0.20mm ID 0.33µm Rxi®-5ms Column

Screening for evidence of marijuana use is typically done using an immunoassay method to detect derivatives in urine, but confirmation of positive results requires GC/MS. Here we describe a GC/MS method, using an Rxi®-5ms column, that resolves all major cannabinoid metabolites to baseline and exhibits very low bleed, even at 300°C. We also prolonged column life by baking at 340°C to remove derivatization by-products.

Find out more.

Fast Screening and Confirmation for Gamma-Hydroxybutyrate (GHB)

Using Restek Columns in Headspace GC or GC/MS Systems

We adapted Rtx®-BAC1 and Rtx®-BAC2 columns, with their proven performance in blood alcohol analysis, to a screening procedure for GHB, followed by confirmation and quantification on a highly inert Rxi®-5ms column. Use of a system and column already in use for blood alcohol analysis eliminates the need for additional equipment, reduces system maintenance, and allows rapid and reliable screening, confirmation, and quantification.

Find out more.

Drugs of Abuse Analytical Reference Materials

These exempted materials include amphetamine and methamphetamine, barbiturates, benzodiazepines, cannabidiol and cannabinol, cocaine/cocaine metabolites, methadone/methadone metabolites, opiates/opiate metabolites, and other drugs, a range of blood alcohol standards from 0.010g/dl to 0.4g/dl, and a blood alcohol resolution control standard.

Find out more about:

[Exempted Drug of Abuse Reference Materials](#)

[Blood Alcohol Standards](#)

[Blood Alcohol Mix Resolution Control Standard](#)

Rapid Analysis of Steroid Hormones by GC/MS

Using the New Rxi®-1ms Column

GC/MS analysis of urinary steroid hormones is a demanding application, and the Rxi®-1ms column meets the requirements for low bleed and inertness better than any column we have tested. We analyzed a variety of derivatized steroid sex hormones in less than 25 minutes, with excellent resolution and symmetric peaks. At 300°C or above, bleed from the Rxi®-1ms column was negligible.

[Find out more.](#)

GC Inlet Liner Deactivations for Basic Drug Analysis

Basic drugs can interact with active sites on the surface of the inlet liner, reducing responses. The combination of a base-deactivated liner and a base-deactivated Rtx®-5Amine column ensures the greatest responses in analyses for these compounds.

[Find out more.](#)

Sensitive GC/MS Analysis for Drugs of Abuse

An Rxi®-5ms column will resolve acidic/neutral or free basic drugs under one set of conditions. There is no interference from column bleed — not even at 330°C. This is one of the first published applications for our new family of Rxi® columns.

[Find out more.](#)

Rapid, Sensitive HPLC/TOF-MS Analysis for Cocaine

A high-organic mobile phase and an Allure™ PFP Propyl column offers adequate retention, short analysis times, and excellent sensitivity for cocaine and cocaine metabolites, without mobile phase modifiers. Target compounds are eluted within 3 minutes, with excellent sensitivity at 5.0pg on-column.

[Find out more.](#)

Want more? Click here to view Clinical/Forensic Literature

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Analyze Haloacetic Acids in Under 13 Minutes with Rtx®-CLPesticides Columns

< Added September, 2009

Sample throughput for haloacetic acids in drinking water can be increased significantly using Rtx®-CLPesticides/Rtx®-CLPesticides2 columns. Target HAAs were fully resolved in under 13 minutes.

[Find out more](#)

New Wool Ensures More Accurate Semivolatiles Analyses

< Added September, 2009

New Semivolatiles Wool liners are designed specifically for semivolatiles analysis and result in more accurate results at lower levels, compared to similar products.

[Find out more](#)

3-Fold Faster Polybrominated Diphenyl Ether (PBDE) Short Column Method

< Added August, 2009

Sample throughput for PBDE analysis can be significantly increased using a 15m Rtx®-1614 column. Excellent responses and peak shapes are obtained for all congeners, including BDE-209, in just 20 mi

New Column Option for Reliable LC Separation of Explosives

< Added May, 2009

Ultra II Aromax and Ultra C8 columns were determined to provide better separations for the routine analysis of explosives by LC than conventional phases.

[Find out more](#)

Reduce Acetonitrile Use by Analyzing PAHs with Methanol-Based Mobile Phase

< Added April, 2009

Switching to a methanol based mobile phase for polycyclic aromatic hydrocarbon analysis—using the method shown here—is an effective way to save money by reducing acetonitrile consumption.

[Find out more](#)

Detect Down to 10pg with Sensitive SIM GC/MS Multiresidue Method

As labs operate in an extremely competitive market, the demand for more sensitive multiresidue pesticide methods is increasing. Here we demonstrate linearity down to 10pg on-column for a wide range of pesticides differing in volatility, compound class, and degree of activity. The inertness of the Rxi®-5Sil MS column ensures linear performance and more accurate low level quantification for multiresidue pesticide methods.

[Find out more](#)

PTV On-Column Liner Gives You Two Inlets in One

Programmable temperature vaporization inlets are versatile, yet normally do not accommodate on-column injection. Now, using a PTV On-Column liner, the capabilities of PTV can be expanded to include true on-column injections.

[Find out more](#)

Isomer-Specific Analysis and Large Volume Sampling of Estrogens and their Conjugates in Water Samples

Estrogens and conjugates, including estradiol sulfates and estradiol glucuronides, were separated and detection limits were lowered using an Allure AK column and an LC/MS/MS system. Initial results from large volume sample testing are also reported.

[Download](#) (1.09 MB PDF)

One Stop Shop for EPA Method 535

Reliably Analyze Acetamide Herbicide Degradates by LC/MS/MS

An optimized EPA Method 535 procedure offers superior sensitivity for the ethanesulfonic acid (ESA) and oxanilic acid (OA) degradates of chloroacetanilide herbicides alachlor, acetochlor, and metolachlor. Alachlor ESA and acetochlor ESA isomers are reliably resolved, and the procedure is simplified with a full line of Method 535 products, including reference standards, solid phase extraction cartridges, and HPLC columns.

[Find out more](#)

Reliable Quantification of Brominated Flame Retardants by GC/MS

Using a New Rtx®-1614 Column for PBDE Analysis

The new Rtx®-1614 column is ideal for analyzing polybrominated diphenyl ethers (PBDEs) according to EPA Method 1614 due to its selectivity, sensitivity, and inertness. Data show this column meets the method requirements for resolution of critical pairs, tailing factors, and retention. Congeners 49 and 71 are fully resolved and a greater response for BDE-209 is seen. Optimized conditions can improve performance.

[Find out more](#)

Increase Polycyclic Aromatic Hydrocarbon Sample Throughput

With UHPLC and HPLC Column Options

Here we analyze polycyclic (polynuclear) aromatic hydrocarbons (PAHs) from the US EPA, European Union (EU), and Portugal lists by UHPLC and HPLC. Procedures shown use two optimized stationary phases (Pinnacle™ DB PAH and Pinnacle™ II PAH) and provide 3.5 to 6 minute analyses, allowing labs to achieve significantly faster sample throughput.

[Find out more](#)

Characterizing All 136 Tetra- to Octachlorinated Dioxins and Furans

Using the Rtx®-Dioxin2 Column

The Rtx®-Dioxin2 column has a unique selectivity for dioxins and furans, including specificity for 2,3,7,8-

ABSTRACTS Only - for more details ask! or see Restek - www.restek.com
TCDD and 2,3,7,8-PCDF. Here we characterize an 13b tetra- through octachlorine dioxins and furans and define all possible coelutions. While commonly used cyanopropyl columns are limited by a low maximum operating temperature of 240°C, the Rtx®-Dioxin2 column is stable up to 340°C, extending column lifetime and improving the analyses of dioxins and furans.

[Find out more](#)

Enhancing Air Monitoring Methods with Thermal Desorption

The use of carbon disulfide (CS₂) extraction as an air monitoring method for vapor-phase organic compounds (VOCs) is fundamentally limited with respect to detection limits. Thermal desorption (TD) is a complementary gas extraction technique whereby sorbent tubes are heated in a flow of carrier gas. Trapped vapors desorb from the sample tubes into the gas stream and are transferred into the GC/MS analyzer. Here, we summarize the key advantages of thermal desorption versus solvent extraction.

[Find out more.](#)

13 Minute Chlorophenoxyacid Herbicides Analysis

On New Rtx®-CLPesticides & Rtx®-CLPesticides2 Columns

The Rtx®-CLPesticides and Rtx®-CLPesticides2 column pair is an excellent choice for chlorophenoxyacid herbicide analysis. Now, with an optimized film thickness for the 0.32mm ID version, this difficult analysis can be made in less than 13 minutes on both the primary and confirmation columns. Near baseline resolution is achieved for all analytes except for bentazon/picloram on the Rtx®-CLPesticides column; however, this pair is fully resolved on the Rtx®-CLPesticides2.

[Find out more.](#)

Accurately Quantify PAHs Down to 5pg On-Column

GC/MS SIM Analysis with the New Rxi®-5Sil MS Column

Semivolatiles methods, such as EPA Method 8270, place stringent demands on gas chromatography (GC) columns. Here we demonstrate the performance of Rxi®-5Sil MS columns for semivolatiles analysis in terms of bleed, efficiency, and activity. Excellent sensitivity and resolution are seen, even for difficult PAHs such as benzo(b)fluoranthene & benzo(k)fluoranthene, and indeno(1,2,3-cd)pyrene and dibenzo(a,h)anthracene. Both basic and acidic compounds show good response even at low levels.

[Find out more.](#)

Fast, Accurate Semivolatiles Analysis!

Using New Rxi®-5Sil MS GC Columns

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[Find out more.](#)

Complete Resolution of 13 Difficult Carbonyls

Using the New Allure® AK HPLC Column

The new Allure® AK HPLC column was developed specifically for the analysis of aldehydes and ketones, including the 13 carbonyl compounds specified in the California Air Resources Board (CARB) Method 1004. The data shown in this article demonstrate excellent resolution, even of buteraldehyde and methyl ethyl ketone (MEK), in less than 12 minutes using a 200mm Allure® AK HPLC column.

[Find out more.](#)

Faster Organochlorine Pesticide Sample Throughput

On New Rtx®-CLPesticides & Rtx®-CLPesticides2 Columns

Increasing sample throughput is an effective way to reduce operating costs for environmental labs. Here we introduce new film thicknesses for the Rtx®-CLPesticide and Rtx®-CLPesticide2 GC columns, optimized for complete separations and short analysis times. Using these new columns, all US EPA Method 8081 organochlorine pesticides are resolved in <9 min. We also show complete separation of these compounds in <5 min. using these columns and a Gerstel MACH column heating system.

[Find out more.](#)

Resolving the Benzo(j)fluoranthene Challenge

Separate New PAHs Quickly Using the Rxi®-17 GC Column

Polynuclear aromatic hydrocarbons are a significant, and wide-spread, source of pollution. The US EPA mandates testing of the 16 PAHs they designate as most hazardous; the target list in other countries is expanding and includes new compounds that are difficult to separate. Here we demonstrate the ability of

the Rxi®-17 column to effectively resolve dibenzo-pyrene isomers, as well as to separate benzo(j) fluoranthene from benzo(b)fluoranthene and benzo(k)fluoranthene.

[Find out more.](#)

Choosing a Liner for Semivolatiles Analysis

Liner choice is a critical decision in semivolatiles analysis. Liners containing wool packing are recommended to minimize molecular weight discrimination. Attributes of different types of liners, including the Drilled Uniliner, are discussed.

[Find out more.](#)

8-Minute Dual Column Analysis of Organochlorine Pesticides

Using Rtx®-CLPesticides / Rtx®-CLPesticides2 Columns

Unique selectivities make the Rtx®-CLPesticides / Rtx®-CLPesticides2 column pair an excellent choice for analyzing pesticides by US EPA Method 8081, or equivalent methods. A 0.53mm ID guard column allows sample injection onto high-efficiency 20m x 0.18mm ID thin film columns, for baseline resolution in greatly reduced analysis time. Sharp, symmetric peaks help assure reliable quantification data.

[Find out more.](#)

Superior Chromatography for Semivolatile Organics

Using the Rtx®-5Sil MS Capillary GC Column

Combining an optimized stationary phase and deactivation that assures unsurpassed inertness and excellent responses for active analytes, Rtx®-5Sil MS columns address the challenging demands of semivolatiles analyses. Phenyl rings in the polymer backbone stiffen the siloxane chain, ensuring thermal stability and reducing bleed. Selectivity is similar to that of conventional 5% diphenyl phases, but improved, e.g.: separation of isomers benzo(b)- and benzo(k)fluoranthene is increased.

[Find out more.](#)

High Throughput of Semivolatiles Samples by GC/MS

Using a 20m x 0.18mm x 0.30µm Rxi®-5ms Column

We developed the 20m x 0.18mm x 0.30µm Rxi®-5ms column to balance the demand for shorter analysis times with the need to maintain both column capacity and column efficiency. Here we establish conditions for eluting more than 90 semivolatiles, including 7 surrogates and 6 internal standards, in less than 12 minutes. Benzo(b) and benzo(k)fluoranthene were resolved well and sample throughput was improved by 75%. This highly inert, low bleed column is ideal for GC/MS analysis.

[Find out more.](#)

Resolving Benzo(j)fluoranthene from Other PAHs

Using a Pinnacle™ II PAH Column

Nineteen polycyclic aromatic hydrocarbons (PAHs), including benzo(b) and benzo(j)fluoranthene, were fully resolved using a Pinnacle™ II PAH column. Greater sensitivity was achieved by coupling UV and fluorescence detection. This HPLC method offers improved resolution compared to standard GC techniques.

[Find out more.](#)

Rxi®-1ms Capillary GC Column

For Low Level GC/MS Analyses

Our new, nonpolar, 100% dimethyl polysiloxane Rxi®-1ms column offers the same superior inertness, ultra-low bleed, and excellent batch to batch reproducibility exhibited by our Rxi®-5ms column. We analyzed a complex mixture of semivolatile analytes, including both acidic and basic compounds, at levels as low as 0.5ng on column. The selectivity, analyte breakdown, peak symmetry, and bleed results shown here are strong recommendations for the new column.

[Find out more.](#)

Low-Level GC/MS for Semivolatiles in Drinking Water

Excellent Responses at 10ng On Column, Using an Rxi®-5ms Column

Using this new column, resolution and peak shapes for 88 semivolatile compounds commonly analyzed in drinking water are exceptionally good at 10ng each on column. Because the Rxi®-5ms column performs well with analytes in a diverse range of chemical classes, we highly recommend it for analyzing complex mixtures of semivolatiles.

[Find out more.](#)

Fast, Sensitive LC/MS/MS Analysis of Paraquat and Diquat

Using an API 3200™ Mass Spectrometer and an Ultra Quat HPLC Column



Developed through collaboration with scientists at AB/MS-Sciex, this analysis allows complete resolution of paraquat and diquat with a simple, isocratic mobile phase. It is significantly faster than conventional methodologies and, with detection limits of 5ppb for paraquat or 0.1ppb for diquat, sensitivity is superior — without preconcentration.

[Find out more.](#)

Analytical Reference Materials for Semivolatile Pollutants

Drinking Water: US EPA Method 525.2

Listed reference mixes include organochlorine pesticides, organonitrogen pesticides, organophosphorus pesticides, PCB congeners, internal standards, surrogates, a performance check mix, and more.

[Find out more.](#)

Excellent Responses in GC/MS Analysis of Semivolatiles

The newest members of our new line of Rxi® columns, Rxi®-1ms columns, offer the same outstanding inertness, ultra-low bleed, and batch-to-batch reproducibility as our Rxi®-5ms columns. Rxi®-1ms columns provide excellent selectivity and symmetric peaks for the diverse chemicals that can make up a semivolatiles sample.

[Find out more.](#)

Analysis of Semivolatile Organics

Exceptional inertness and ultra-low bleed enable an Rxi®-5ms column to resolve sub-1ng quantities of acidic or basic analytes under a single set of conditions. In this example analysis, an Rxi®-5ms column separated 93 target analytes in US EPA Method 8270D in less than 18 minutes.

[Find out more.](#)

Monitoring Petroleum Hydrocarbons by Solid Phase Extraction/GC

New manufacturing processes for our Massachusetts TPH solid phase extraction cartridges reduce extractable contaminants almost to blank levels, and assure more reliable fractionation of aliphatics from aromatics. Large, uniform lots of silica reduce the frequency of verifying fractionation results.

[Find out more.](#)

Reference Mix of Canadian Drinking Water Volatiles

This mix includes all 19 volatile compounds on the Canadian Drinking Water List. We recommend using an Rtx®-VMS column for the analysis, to assure sharp peaks for early eluters and resolution of the heavier compounds.

[Find out more.](#)

A 12-Minute Analysis for Volatiles

An Rtx®-VMS column provides rapid, baseline resolution of most volatile analytes in the CLP OLM 04.1 analysis for groundwaters or drinking waters from Superfund sites. A particularly challenging stipulation of the method, 90% resolution of the gaseous components, is easily attained.

[Find out more.](#)

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FOODS, FLAVORS, & FRAGRANCES

Comprehensive Pesticide Residue Analysis by LC/MS/MS

< Added May, 2009

Analysis of pesticide residues in foods is complicated by the large number of target compounds. LC/MS/MS analysis using an Aqueous C18 column provides more comprehensive results than GC alone.

[Find out more](#)

Meet New Requirements for Melamine Analysis at 1µg/g in Infant Formula

< Updated April, 2009

The recent establishment of a 1µg/g safety threshold for melamine in infant foods has led to an immediate need for more sensitive methods. Here we established GC/MS conditions for highly

reproducible analyses and evaluated the effectiveness of both solvent-based and matrix-matched standards. Using this method, melamine and cyanuric acid were reliably detected at and below 1µg/g in infant formula.

[Find out more](#)

Prepare Samples in Half the Time

Using a Fraction of the Solvent with dSPE

Simplify and speed up sample preparation with Restek dispersive SPE tubes! Here we show the extraction and clean-up of pesticide residues from olive oil samples — twice as fast as gel permeation chromatography (GPC), with only a fraction of the solvent required for conventional solid phase extraction (SPE).

[Find out more](#)

Prevent Fraud with Simple Analysis of Cholesterol and Glycerides

Estimating cholesterol in food products is complicated, but often is part of the authentication testing of label claims regarding egg content. The method shown here simplifies fraud detection by incorporating glyceride testing. Easy comparison of the chromatographic profiles of egg and egg product (pasta) samples can be made using an Rtx®-65TG column, which is specifically tested to assure excellent separations and a reliable performance for glycerides.

[Find out more](#)

Fast, Simple Sample Cleanup

Using QuEChERS SPE Tubes

Quick, Easy, Cheap, Effective, Rugged, and Safe, the QuEChERS ("catchers") method for extracting pesticides from food is based on USDA research and employs a novel dispersive solid phase extraction cleanup (dSPE). QuEChERS methods are convenient, rugged methods that simplify extract cleanup, reduce material costs, and improve sample throughput. Here we demonstrate the effectiveness of QuEChERS sample cleanup using a multiresidue analysis of pesticides on strawberries.

[Find out more.](#)

Rapid Screening Method for Carbamates in Orange Oil

Using an Ultra Carbamate HPLC Column

EPA Method 531.1 addresses the analysis of carbamate pesticides in water, but not in more complex matrices, which often contain interferences and require time-consuming sample preparation. We developed an easy, accurate screening method for carbamates in a complex matrix using an Ultra Carbamate HPLC column in conjunction with the Leco Unique TOF- MS. This method requires no sample preparation and provides fast analysis times, significantly increasing sample throughput.

[Find out more](#)

Using Thermal Desorption to Enhance Aroma Profiling by GC/MS

Lower Detection Limits with Latest Technology

Thermal desorption offers an automatic, high-sensitivity alternative to conventional liquid extraction methods for aroma profiling by GC/MS. It allows vapor profile constituents to be cleanly separated from the sample matrix and often facilitates selective purging of volatile interferences. This ensures that the vapor profile analyzed is most representative of the aroma perceived by consumers and that key compounds can be identified and measured at the lowest levels possible.

[Find out more](#)

High Sensitivity Melamine GC/MS Analysis of Cat Food

Modified Conditions Save Costs and Reduce Maintenance

Melamine contamination was implicated in a large pet food recall that occurred in 2007 when animals died after eating contaminated pet food. Here, a modified GC/MS method, based on an FDA method, was used to analyze for melamine & related compounds cyanuric acid, ammelide, and ammeline in dry cat food. Analytes were easily identified by retention time matching and mass spectra.

[Find out more.](#)

Rapid Characterization of Garlic Volatiles—No Sample Prep Requires!

Using Headspace GC/MS and an Rxi®-5ms Capillary Column

Chromatographic methods for garlic and garlic powder are used by the food and dietary supplement industries to monitor product quality. Here we present a headspace gas chromatography mass spectrometry (HS GC/MS) method for garlic flavor and odor components using an Rxi®-5ms column. This method eliminates sample preparation making the bench work simple and fast. The experimental set-up is ideal for both screening analysis and low-level trace analysis.

Simple, Reliable HPLC Analyses of Organic Acids

Using Water-Compatible Allure® or Ultra C18 Columns

Commonly used organic acid methods (e.g. AOAC method 986.13) depend on reversed phase HPLC and C18 columns, however these columns are vulnerable to phase collapse when used with the aqueous mobile phases necessary for optimal organic acid analysis. Restek's Ultra Aqueous C18, Allure® Aqueous C18, and Allure® Organic Acids columns all withstand phase collapse and resolve organic acids in a 100% aqueous mobile phase, compared to a conventional C18 column which shows a complete loss of retention.

Find out more.

Analysis of Nitrofurans in Honey

Using LC/MS/MS and an Ultra C18 Column

Nitrofurans are a class of veterinary antibiotics used to increase growth rate and prevent or treat disease in animals. Determining levels of nitrofurans in animal tissue, or even products such as honey, is important in studying drug resistance and allergies in humans. The Ultra C18 HPLC column is an excellent choice for LC/MS/MS analysis of nitrofurans at low levels in complex matrices such as honey. Here we show excellent sensitivity, resolution, and peak shape at trace levels.

Find out more.

Evaluating Undiluted Essential Oils

Essential oils are complex natural products containing many components across a wide concentration range. This complexity makes their analysis especially challenging. Many methods involve sample dilution to prevent syringes from clogging but this is not always necessary and can compromise analytical quality, especially for less abundant compounds near the solvent peak. Here we provide steps for optimizing your method to allow essential oils to be analyzed without dilution.

Find out more.

Monitor Antioxidants in Tea Extract

Using an Ultra Aqueous C18 HPLC Column and Unique® TOFMS

An Ultra Aqueous C18 column enables you to use the conditions most effective for this analysis: gradient elution in high aqueous mobile phases. The C18 chains will not collapse in the presence of a high water content. Use this chromatographic system to extract data for specific compounds of interest and to manually inspect spectra for phenolic glycosides, esters of phenolic acid, or other compounds.

Find out more.

Robust 9-Minute GC Analysis of Cholesterol

Excellent Sample Throughput with an Rxi™-5ms Column

Conditions are established for analyzing both derivatized and underivatized cholesterol on a highly inert Rxi™-5ms column. Methods described include both an isothermal analysis for use when interferences are minimal, but sample throughput is critical, and a temperature program for use when separation of analytes from contaminants or interfering compounds is the primary concern. Results for both derivatized and underivatized samples were highly reproducible.

Find out more.

Rapid, Reproducible HPLC Analysis for Flavonoids in Cocoa

Using a Leco Unique® LC-TOFMS System and an Ultra Aqueous C18 Column

We separated flavonoids in cacao or cocoa powder samples and returned conditions to the initial mobile phase composition in 15 minutes. For compounds common to both samples, retention times were equal to within 0.01 seconds. Flavonoid marker compound profiles for 38%, 49%, and 65% cacao were easily distinguished.

Find out more.

80% Faster GC/MS Analysis of Essential Oils

A 10-meter, 0.10mm ID, 0.10µm film Rtx®-5 column reduces analysis time for bergamot oil or patchouli oil by 80%, for five-fold greater sample throughput and sharply reduced cost per analysis. Sample resolution is unchanged for bergamot oil and is slightly improved for patchouli oil.

Find out more.

trans Fat: Resolving cis and trans FAME Isomers by GC

The highly polar Rt-2560 stationary phase has the selectivity needed for resolving cis and trans FAME isomers to comply with US FDA food labeling guidelines. Restek reference materials will help you

accurately characterize your materials.

[Find out more.](#)

Detecting Illegal Dyes in Foods: Identify Four Sudan Dyes in One HPLC Analysis

Using an Ultra Aqueous C18 column, a simple, isocratic mobile phase, and detection at two UV wavelengths (488nm for Sudan I and II and 520nm for Sudan III and IV), the four dyes are separated and identified in approximately 20 minutes.

[Find out more.](#)

Simple HPLC Analysis for Sudan Dyes

Sudan dyes are illegal as food additives according to the US FDA and the EU. A reversed phase HPLC separation of Sudan I, Sudan II, Sudan III, and Sudan IV (Scarlet Red) is simple, yet efficient, requiring only a simple mobile phase, isocratic elution, and detection at two wavelengths. An Ultra Aqueous C18 column provides the selectivity needed to assure the separation.

[Find out more.](#)

Malachite Green and Leucomalachite Green Analysis

Illegal use of malachite green (MG), an inexpensive fungicide, can allow MG to enter water cycles, where it is easily absorbed by fish tissue, and thus enters the human food supply. Reversed phase HPLC often is used to analyze for MG and its stored metabolite, leucomalachite green. Methods that facilitate detection of both compounds are discussed.

[Find out more.](#)

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PHARMACEUTICAL

Improve Pass Rates for Residual Solvents by USP <467>

Using the new Rxi®-624Sil MS GC Column

< Added October 2009

Not all G43 columns are equivalent. New Rxi®-624Sil MS columns reliably produce improved resolution and sensitivity, increasing system suitability pass rates and ensuring more productive laboratory time.

[Find out more](#)

Achieve Faster Analyses on Any HPLC System Using Ultra II™ Columns

< Added July 2009

Significant savings can be obtained without the costly upgrade to UHPLC. This famotidine example illustrates how a 90% reduction in analysis time and solvent volume resulted from strategic HPLC column choices.

[Find out more.](#)

Column Choice: A Critical Factor for Successful UHPLC Integration

< Added April 2009

Column choice is a critical factor in successfully transferring methods between UHPLC and HPLC. Here, we discuss the column qualities that contribute to the successful integration of UHPLC technology.

[Find out more.](#)

Novel Column Chemistry—High Impact, Low Cost Technology

< Added April 2009

Novel column chemistries are a simple change in an already budgeted consumable that can lead to optimized and more reliable methods—giving a fast return on a minimal investment.

[Find out more.](#)

Beyond C18 — Increase Retention of Hydrophilic Compounds Using Biphenyl Columns

The Pinnacle® DB Biphenyl column offers enhanced retention and alternate selectivity for aromatic unsaturated, a retention of su (C18) columns



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A 10-meter, 0.10mm ID, 0.10µm film Rtx®-5 column reduces analysis time for bergamot oil or patchouli oil by 80%, for five-fold greater sample throughput and sharply reduced cost per analysis. Sample resolution is unchanged for bergamot oil and is slightly improved for patchouli oil.

[Find out more.](#)

trans Fat: Resolving cis and trans FAME Isomers by GC

The highly polar Rt-2560 stationary phase has the selectivity needed for resolving cis and trans FAME isomers to comply with US FDA food labeling guidelines. Restek reference materials will help you

ABSTRACTS Only - for more details ask! or see Restek - www.restek.com
faster separations. The small particle sizes used in UHPLC improve efficiency; however selectivity is still the most important factor affecting compound resolution. Here we demonstrate the importance of stationary phase choice in UHPLC separations. By optimizing selectivity for your analytes of interest, faster separations can be achieved without compromising resolution.

[Find out more.](#)

Choosing the Correct Liner for Headspace Injections

Pass System Suitability Requirements with a Smaller Bore Liner

For headspace applications involving a transfer line, a smaller bore liner (preferably 1 mm) can improve system suitability pass rates. This lower liner volume decreases band broadening and allows quicker sample transfer by increasing the linear velocity through the inlet.

[Find out more.](#)

Simplifying Column Selection for ICH Residual Solvents

Using a Retention Time Index for Fast and Accurate OVI Separations

To make column selection for residual solvents easy, Restek has benchmarked the ICH Class 1, 2 and 3 residual solvents on our most popular OVI columns.

[Find out more.](#)

Separating NSAIDs through Aromatic Selectivity

Improve Retention by Using an Allure® Biphenyl HPLC Column

Non-steroidal anti-inflammatory drugs (NSAIDs) are typically separated on C18 phases. Separations on our Allure® Biphenyl HPLC column are based on pi-pi interactions, resulting in optimized retention and selectivity. Increased retention requires higher organic content in the mobile phase, increasing desolvation efficiency in LC/MS. Simple mobile phase changes enhance selectivity, making this column a great alternative to conventional phenyl phase columns, especially in method development.

[Find out more.](#)

Assaying Local Anesthetics by GC/FID

Optimizing System Suitability, Using an Rxi™-5ms Column

An Rxi™-5ms column and a wool-packed inlet liner provide the stability and inertness needed for these basic, active analytes. Chromatography from a six-replicate system suitability analysis was well within normal acceptance criteria. USP tailing factors were approximately 1.00 for all analytes; retention times and area responses were very stable.

[Find out more.](#)

Optimized RP-HPLC Analysis of Hydroxybenzoic Acids

An Ultra Aqueous C18 Column Provides the Best Retention of Polar and Weakly Polar Compounds

Among hydroxybenzoic acids, hydroxyl groups on the benzene ring vary by position and number, creating differences in overall polarity and solubility. The unique bonding chemistry of the Ultra Aqueous C18 phase assures high resolving power, the best separations across a broad range of analyte polarity, and compatibility with 100% aqueous mobile phases.

[Find out more.](#)

8-Minute GC Analysis of Residual Solvents

Single-injection, dual-column detection/confirmation assay is feasible for regulated solvents in pharmaceutical products, but no temperature program provides sufficient resolution on both columns. Using a Restek G43/G16 column pair and independent temperature programs in a Gerstel MACH column heating system, we analyzed and confirmed 23 Class 2 solvents in 8 minutes.

[Find out more.](#)

Simple, Optimized HPLC Analysis of Catecholamines

An Allure™ PFP Propyl column exhibits the retention needed to resolve these active, basic compounds, without derivatization or ion-pairing agents. Selectivity can be adjusted simply by changing the organic modifier in the mostly aqueous mobile phase.

[Find out more.](#)

RP-HPLC Analysis of Selective Serotonin Reuptake Inhibitors

Two Restek columns provide good retention, selectivity, and peak shape for SSRIs, without ion-pairing chromatography. Choose an Allure™ Basix column and neutral pH conditions, or an Ultra PFP column and acidic conditions — either will improve performance for these basic compounds, relative to alkyl phases.

[Find out more.](#)

Developing a Simple, Rugged HPLC Assay for Tetracyclines

Overall, three columns provide excellent repeatability in a simple analysis: Allure™ PFP Propyl, Ultra C18, and Allure™ Biphenyl. An Allure™ Biphenyl column employs π - π bonding with the ring structures of the tetracycline molecules to ensure good capacity, high selectivity, and the most symmetric peaks.

[Find out more.](#)

Using π - π Interactions to Enhance Selectivity for Unsaturated Compounds

The Allure™ Biphenyl HPLC Column

Relative to phases that separate via hydrophobic or polar interactions, the Allure™ Biphenyl stationary phase offers better retention, selectivity, and efficiency, when analyzing compounds with differences in the numbers and locations of unsaturated bonds in the hydrocarbon ring structure.

[Find out more.](#)

Want more? Click here to view Pharmaceutical Literature

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AIR SAMPLING

New Market Opportunities for VOC Air Sampling Labs

< Added May, 2009

VOC testing laboratories can expand into new markets using existing air sampling canisters and thermal desorption tubes, due to the broad applicability of these techniques.

[Find out more](#)

Early Detection of Structural Mold with SilcoCan™ Air Sampling Canisters

Early detection of structural mold is critically important to protecting human health and property values. Restek SilcoCan™ canisters allow low levels of microbial volatile organic compounds (MVOCs) to be detected in air samples before mold can be seen, providing an opportunity for structural repair and safer living conditions. The inertness of these canisters provides an exceptional storage environment, particularly for polar and high boiling point compounds.

[Find out more.](#)

Sampling Volatile Organic Compounds in Air

Restek Sampling Equipment Helps Assure Accurate Data

TO-Can™ air sampling canisters are electropolished and extensively cleaned, to provide a high-quality, passivated surface for improved stability of analytes listed in USEPA Method TO-15 (ambient air monitoring). For reactive compounds, such as sulfur-containing components, SilcoCan™ canisters are your best choice — our exclusive Siltek® surface treatment ensures exceptional inertness and maximum sample stability, even for 1-20ppb sulfur compounds.

[Find out more.](#)

Enhancing Air Monitoring Methods with Thermal Desorption

The use of carbon disulfide extraction as an air monitoring method for vapor-phase organic compounds (VOCs) is fundamentally limited. Thermal desorption is a complementary gas extraction technique whereby sorbent tubes are heated in a flow of carrier gas. Here, we summarize the key advantages of thermal desorption versus solvent extraction.

[Find out more](#)

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SAMPLE PREPARATION

Superior Fractionation of Extractable Petroleum Hydrocarbons

Get More Accurate Results Using Restek SPE Tubes

The Massachusetts Dept. of Environmental Protection's "Method for the Determination of Extractable Petroleum Hydrocarbons" is a method commonly used for underground storage tank testing. Commercially available SPE tubes are convenient, but vary in quality and consistency. Here we show that Restek's EPH SPE tubes have the highest silica activity and lowest overall level of coextractables among the tubes tested. These characteristics translate into more reliable and reproducible results.

[Find out more.](#)

Faster Extraction and Cleanup of Pesticide Residue Samples

With QuEChERS Products

If you are frustrated by the time and cost involved with pesticide sample cleanup, we suggest you try the simple and economical QuEChERS method. Follow this approach to remove sugars, lipids, organic acids, sterols, proteins, pigments, and excess water, any of which often are present. To make your work even simpler, we offer QuEChERS extraction products in a variety of standard sizes and formats, and custom products by request.

[Find out more.](#)

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BIOANALYTICAL

Reduce Downtime with Robust Lipidomics Method

Labs can save days of downtime by using an Rxi®-5ms column in assays similar to this high-throughput test method for cholesterol and low-level sterol metabolites. Here, extremely reproducible results were obtained using an Rxi®-5ms column, which gave highly consistent separations — even after 10,000 injections. Consistent performance and long column lifetimes increase productivity by reducing downtime associated with column changes and revalidation.

[Find out more](#)

Easily Resolve Oxytocin PEGylation Reaction Products

Using Viva Wide Pore HPLC Columns

Viva Wide Pore HPLC columns are ideal for the separation of large molecules, as target analytes can enter the larger pores and access more of the surface area. Here we demonstrate the added retentive power of these columns, using the PEGylation of oxytocin as an example. Separation of these large, closely related compounds demonstrates the suitability of Viva Wide Pore columns for monitoring PEGylation reactions, and other large molecule applications.

[Find out more](#)

Improve Characterization of Complex Protein Digests

A Viva C18 wide pore HPLC column resolves a tryptic digest of bovine serum albumin primarily into 1-2 peptide peaks, versus peaks of 3 or more peptides typically provided by conventional C18 columns. This superior resolution helps ensure more reliable identification of peptides in complex mixtures.

[Find out more.](#)

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RESTEK PERFORMANCE COATINGS

Sulfinert® Treated Systems Preserve ppb Levels of Active Sulfur Compounds

Many volatile sulfur compounds adsorb strongly to the metal surfaces encountered during sampling, transfer, and storage. This adsorption can cause falsely low sample results and also prolong analysis

ABSTRACTS Only - for more details ask or see Restek www.restek.com
cycle times. Data shown here demonstrate the effectiveness of Sulfinert® treatment of system components. Sulfinert® treatment reduces adsorption, resulting in more accurate quantitation of sulfur compounds and reduced cycle times.

[Find out more.](#)

Assure Accurate Sampling and Reliable Sample Purity

Restek Sampling System Treatments Prevent Adsorption, Protect Components

Siltek®/Sulfinert® surface treatments improve component performance by significantly reducing corrosion and adsorption problems in the sampling and sample transfer pathways. These treatments improve sampling accuracy, increase component lifetime, and cost less than super alloys. Treatments can be applied to cylinders, valves, fittings, tubing and more, and demonstrably improve detection of low-level sulfur, nitric oxide, and mercury compounds in a wide variety of applications and industries.

[Find out more.](#)

Prevent Mercury Loss During Transport and Storage

Use Siltek® Surface Treatment on Steel Components

As concerns about mercury in the environment grow, new regulations and testing requirements emerge. To ensure accurate results, sample storage and transfer systems must be inert to elemental mercury. Here we demonstrate that Siltek® treatment provides an unreactive surface compared to stainless steel. Data shown demonstrate that Siltek® treatment of sampling systems will improve analytical accuracy. Siltek® treatment is available on many stock items and custom components can be treated upon request.

[Find out more.](#)

Protect Sample Integrity and Prolong Sampling System Lifetime

Using Hydroguard™ Deactivated/Silcosteel® Treated Tubing

Tubing deactivated with Hydroguard™ and treated with Silcosteel® is preferred for situations in which water vaporization is encountered, such as in purge and trap systems. Hydroguard's™ unique deactivation chemistry creates an outer surface that prevents water vapor from contacting the Silcosteel® treated stainless steel surface below. This protected inert surface allows active analytes to pass through the tubing without adsorbing to the surface.

[Find out more.](#)

Extend Process Component Lifetime and Enhance Durability

Restek Surface Treatments Improve Sampling and Transfer Component Performance

In sampling or process stream pathways, Siltek®/Sulfinert® treated tubing reduces uptake of active (e.g., sulfur) compounds by orders of magnitude, relative to untreated tubing, for reliable data about stream composition. Silcosteel®-CR treated tubing improves corrosion resistance by up to 10X over untreated tubing, reducing the need for maintenance and helping to ensure the purity of the sample or process stream.

[Find out more.](#)

Superior Protection Against Corrosion: Silcosteel®-CR

Treated Fittings and Tubing

Silcosteel®-CR treatment is highly effective protection for stainless steel exposed to hydrochloric acid, nitric acid, or marine environments: in independent tests, Silcosteel®-CR treatment upgraded the corrosion resistance of 300-grade stainless steel by an order of magnitude. Now, electropolished stainless steel tubing and a wide selection of world-renowned Swagelok® fittings are available with Silcosteel®-CR treatment, from stock. Custom treatment of system components also is available.

[Find out more.](#)

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GENERAL INTEREST

How Much Sensitivity is Needed in a Leak Detector?

< Added, September 2009

Restek's Electronic Leak Detector is sensitive enough to find leaks below instrument pressure decay test



[Find out more](#)

How to Understand and Deal with Overloading in GC

Content previously published in Separation Science

< Added, June 2009

Overloading GC columns affects peak symmetry and can cause coelutions and retention time shifts. This article provides tips on diagnosing and correcting overloading problems.

[Find out more](#) (241kb pdf)

Minimizing Decomposition of Components during GC Analysis

Content previously published in Separation Science

< Added, June 2009

Many compounds are susceptible to thermal degradation. This article explains how to diagnose and reduce analyte decomposition in both the GC inlet and column.

[Find out more](#) (1.3mb pdf)

Dual Vespel® Ring Inlet Seals

Washerless, Leak-Tight Seals for Agilent GCs

< Added, May 2009

Restek's Dual Vespel® Ring inlet seal gives you a better seal with fewer parts. Data show that the soft Vespel® material has a much lower leak rate than a metal seal. Also, since less torque is required for installation, user variability is reduced.

[Find out more](#)

Troubleshooting the Acetonitrile Shortage

< Added, March 2009

The current acetonitrile shortage has labs scrambling to adjust to limited supplies and increased costs. Here we discuss short- and long-term strategies to reduce acetonitrile consumption, including method development based on alternative solvents.

[Find out more](#)

Reducing Column Internal Diameter (HPLC)

Scaling down column size is simple to do and can help reduce solvent use. Here is an easy-to-follow example that teaches you how to reduce column internal diameter.

[Find out more](#)

Under Pressure?

Reduce System Stress by Backflushing Your HPLC Column

High pump pressures can be caused by heavily retained impurities building up in the head of the analytical column. Such contamination can cause poor chromatography, usually in the form of broad, split, or misshapen peaks, and ultimately can compromise results. Backflushing a contaminated analytical column, using the procedure outlined here, can help restore column performance and reduce pump pressure and system strain.

[Find out more](#)

Selecting the Right HPLC Guard Column

Understanding the significant factors that affect HPLC guard column performance can help you protect your analytical column and save money by extending analytical column lifetime. Here we review available options in packings, dimensions, cartridge holders, and filters to help you select the best guard column system for your application.

[Find out more.](#)

The Forgotten Septum

How to Correctly Diagnose the Source of Bleed Contamination

Septum bleed is generally attributed to the injection port septum; however, the vial cap septum also can be a source. Bleed contamination from any septum can cause interfering peaks and lead to inaccurate results, so it is important to correctly identify the source and understand how to eliminate or minimize bleed level. Here we discuss how to diagnose the source of the bleed and review considerations that can reduce the amount of contamination.

[Find out more.](#)

Warm-up Before You Run

Why Conditioning Your Inlet Parts After Maintenance Is Good Practice

Background noise in a gas chromatography system can be eliminated by conditioning the system prior to sample analysis. In this article, we discuss warm-up procedures and use liners and liner installation to demonstrate the importance of conditioning the system to remove background peaks. Investing a little time in warming-up the system pays big dividends by preventing costly coelutions and avoidable reanalyses.

[Find out more.](#)

Affected by the Helium Shortage?

Switch Your GC Carrier Gas to Hydrogen

Faced with helium shortages and prices that continue to soar upwards like a runaway party balloon? Consider switching to hydrogen as your carrier gas. High-quality hydrogen is readily available from either high-pressure cylinders or hydrogen generators. It is cost-effective and provides shorter analysis times (by half if running isothermally) than helium and many times yields better separations.

[Find out more.](#)

How to Maximize Column Oven Accuracy and Stability

Tips & Techniques for Long-term Instrument Performance

Simple tips and techniques are presented to improve the accuracy and precision of your data by keeping your column oven at peak performance. Details on reducing variation around the oven set point through calibration and maintenance are given.

[Find out more.](#)

Get Connected!

Do you need to connect a GC analytical column to a guard column or transfer line? Or repair a broken column? How about connecting two columns for primary and confirmation analysis from a single injection? Restek's extensive selection of GC connectors makes all of these connections possible. Here we review differences among our connectors and answer some frequently asked questions about our popular Press-Tight® connectors.

[Find out more.](#)

Considerations for Adapting an HPLC Method for MS Detection

Most HPLC methods can be coupled with mass spectral detection provided appropriate attention is given to pump capabilities, column diameter, and system plumbing, and to sample matrix and mobile phase composition. Here we discuss these considerations and provide tips on adapting your method to include mass spectral detection using either electrospray ionization or atmospheric pressure chemical ionization.

[Find out more.](#)

Using Micropacked Columns

Micropacked columns are 1-2 meter, 0.75-1.0mm ID packed stainless steel columns with performance characteristics intermediate between conventional packed columns and capillary columns. They are inexpensive, very durable, and easy to install and operate. They have a wide range of applications, but are especially useful for analyses of gas mixes, including sulfur compounds or light hydrocarbons, for which a packed column is needed to obtain baseline separations of sample components.

[Find out more.](#)

Restek's Knowledgeable Technical Support

Real People, Real Time and Real Results for YOU!

Restek's Technical Support group includes more than 64 individuals with extensive experience in chemistry, chromatography, engineering, and related fields. When you call Restek, you have access to the combined expertise of everyone in this group. With more than 110 international distributors and dealers in 81 countries, we can understand and respond to your lab's unique challenges whether you are in North America, South America, Africa, Asia, Europe, the Pacific Rim or elsewhere.

[Find out more.](#)

Commonly Asked GC Questions

The Restek Chromatography Information Services Group answers hundreds of questions each month. The answers provided here deal with inquiries about guard column chemistry, column temperature limits, ghost peaks in GC/MS analyses, pesticides breakdown on cyano-phase columns, and column cage options.

[Find out more.](#)

How to Condition a New Capillary GC Column

Proper conditioning is essential for optimal performance from a capillary GC column, but inexperienced

chromatographers might not know the proper procedures for installing and conditioning a new column. Here, we summarize our recommendations for installation and conditioning procedures.

[Find out more.](#)

Leak Checking a GC System

Analysts should use an electronic leak detector when installing a new column or fitting, changing a cylinder, or troubleshooting the system. The portable, reliable, easy-to-use Restek Electronic Leak Detector reveals minute leaks without contaminating the system.

[Find out more.](#)

Preventing Septum Problems

Handy tips and tools for choosing the right septum for your application and instrument. Includes an overview of common septum problems including coring and bleed. Guidelines help you avoid extraneous peaks and optimize your system's performance.

[Find out more.](#)

How Hot is Your Septum?

Inlet design, including placement of the heating element, differs among manufacturers and as a result the temperature at the septum differs from the actual set point and the degree of this difference varies among manufacturers. Septa brands, however, are given a single maximum operating temperature. Here we demonstrate the temperature gradients within inlets for several popular GC models and discuss the pros and cons of hotter and cooler inlets.

[Find out more.](#)

Supplies for Agilent Instrument Injection Ports

EZ Twist Top™ Split/Splitless Port for Agilent GCs

Using our unique EZ Twist Top™ Injection Port, Septum Nut Removal Tool, and Inlet Liner Removal Tool, you can reduce maintenance time and frustration, eliminate tangled gas lines that can lead to leaks, and avoid contact with hot surfaces. The gas lines are attached to the EZ Twist Top™ Shell Weldment, not to the weldment — they are under the GC cover and cannot interfere with routine injection port maintenance. Changing inlet liners becomes a quick and simple task.

[Find out more.](#)

Injection Port Maintenance with FastPack™ Inlet Kits

Regular injection port maintenance helps ensure the best results from your analyses, and helps minimize downtime. Each FastPack™ inlet kit includes all the parts you need to perform routine maintenance — inlet liner (choose from four styles), O-ring, inlet seal and inlet seal washer, and septum — in a sealed Mylar® bag.

[Find out more.](#)

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Restek Technical Literature

These publications are available in printed form or online, as downloadable pdf files.

[Find out more.](#)



Restek Technical Articles



EDITORIAL

Further Editorials, by Dr. Konrad Grob

< Added September, 2009

Collected from the Restek *Advantage*, thirteen thought-provoking essays offering insight into sample vaporization processes in gas chromatography, important splitless optimization concepts, and food for thought on lab practices, education, and food safety.

[Find out more](#)

Unraveling Scent Signals to Protect African Wild Dogs

< Added May, 2009

Dr. Peter Apps discusses how gas chromatography is being used to help protect endangered African wild dogs from conflicts with humans in Botswana.

[Find out more](#)

Analysis of Brominated Flame Retardants by Liquid Chromatography Mass Spectrometry

Dr. Chris Marvin, of Environment Canada, discusses the challenges of analyzing brominated flame retardants, such as polybrominated diphenyl ethers, by LC/MS.

[Find out more](#)

Achieving Faster GC

Numerous articles have been published on faster methods for gas chromatography (GC), yet uncertainty remains on how best to speed up separations. Here, Dr. Hans-Gerd Janssen clarifies the confusion surrounding fast GC and recommends a strategic approach based on 3 steps: 1) minimizing resolution to a value just sufficient, 2) maximizing the selectivity of the chromatographic system, and 3) implementing a method that reduces analysis time while holding resolution constant.

[Find out more](#)

Quality Control in Metabolomics

Metabolites are found in different concentrations in complex biological matrices and are very difficult to extract without compromising their structural integrity and relative abundances. Quality control in metabolomics means more than just taking care of chromatographic or mass spectrometry parameters. This article by Oliver Fiehn examines quality control as an attitude towards gaining reliable data, rather than an automatic procedure implemented in instrument software.

[Find out more](#)

Using Guard Columns and Retention Gaps in GC (Part 2)

Guard columns & retention gaps are used widely in gas chromatography (GC) but the differences between them are not always understood. Part 2 of this two-part editorial by Jaap de Zeeuw discusses guard columns & introduces a new segment coating technology that allows retention gaps & guard columns to be built directly in the same piece of tubing as the analytical column.

[Find out more.](#)

Using Guard Columns and Retention Gaps in GC (Part 1)

Guard columns & retention gaps are used widely in gas chromatography (GC) but the differences between them are not always understood. Part 1 of this two-part editorial by Jaap de Zeeuw reviews the use of retention gaps & discusses critical factors affecting performance. This sets the background for Part 2, which details guard columns & introduces a new segment coating technology that allows retention gaps & guard columns to be built directly in the same piece of tubing as the analytical column.

[Find out more.](#)

Retention Cross-over Phenomenon in Gas Chromatography

Can the Mystery Be Revealed?

Dr. Werner Engewald discusses the phenomenon of cross-over, or changes in elution order following modification of the GC temperature program. This effect has been observed for decades but the physio-chemical background still is not well understood. In this article Dr. Engewald explores the theory and potential explanations for the cross-over phenomenon.

[Find out more.](#)

Restek: A Company of Owners

By Paul Silvis, Restek Founder & former Head Coach

In this editorial, founder and former CEO Paul Silvis explains some of the reasons for Restek's success as a provider of chromatography columns and supplies. Restek will continue to be successful because, as an employee-owned company, we hold our future in our own hands. Customers will benefit because we can continue to respond to their ideas for the products and services they need to make their work easier.

[Find out more.](#)

Sample Preparation Techniques Used for Gas Chromatography

Guest Editorial by Robert L. Grob, Ph.D.

Sample preparation principles and techniques for gas chromatography are reviewed. Techniques include: static headspace, dynamic headspace, solid phase extraction and microextraction, distillation, stir bar sorptive extraction, Soxhlet, accelerated solvent extraction, pressurized liquid extraction, subcritical water extraction, microwave assisted extraction, ultrasonic extraction, and supercritical fluid extraction.

[Find out more.](#)

Comprehensive 2D Gas Chromatography — Making GC Separations Work Harder

Guest editor Dr. Phil Marriott tells us the three primary contributions ascribed to GCxGC are greater separation capacity, greater sensitivity, and a data presentation that permits identification of related compounds based on the molecular properties that control retention. The most significant advantage is separation power: to be able to resolve many more compounds immediately enables a much more complete 'picture' of the composition of a sample.

[Find out more.](#)

Preventive Maintenance for GC

Professor Jennings explains the consequences of ignoring those enclosures included with a new column, and offers simple, proven, preventive maintenance options that help avoid downtime.

[Find out more.](#)

The "Replacement" Column, A Recurring Problem in Gas Chromatography

In his first contribution to the Restek Advantage Professor Walter Jennings discusses why analysts often encounter problems when replacing a capillary GC column, and provides a solution.

[Find out more.](#)

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PETROCHEMICAL

Accurately Quantify Methanol and Ethanol in E85 Biofuel by D5501 with New Rtx®-DHA-150 Column

Content previously published in Petro Industry News

< Added November 2009

Improve D5501 analysis of ethanol biofuel with Rtx®-DHA-150 columns. Reliably separate methanol and isobutane in just 20 minutes, with excellent symmetry for both target alcohols.

[Find out more.](#)

New PLOT Column Technology Stabilizes Flow and Improves Analysis of Light Hydrocarbons, Solvents, and Permanent Gases

Content previously published in Petro Industry News

< Added November 2009

New PLOT columns offer significantly reduced particle release, extending column lifetime and assuring highly reproducible retention times column-to-column. Improved applications for porous polymer, molecular sieve, and alumina columns.

[Find out more.](#)

Tighten Control of Distillation Processes with the New MXT®-1HT Sim Dist Column

Content previously published in Petro Industry News

< Added November 2009

New MXT®-1HT SimDist GC columns outperform competitors, allowing more productive D6352 analyses. Here we demonstrate lower bleed levels and higher efficiency, improving resolution and assuring more samples can be run within method specifications.

[Find out more.](#)

Advances in Porous Layer Open Tubular Columns

Content previously published in International Laboratory

< Added October 2009

Jaap de Zeeuw discusses recent advances in PLOT column technology in an *International Laboratory* article. New stabilization technology minimizes particle release, assuring more consistent flow and better performance for a number of applications.

[Find out more](#) (4.4mb pdf)

Higher DHA Sample Throughput for PONA Analysis: Options for Helium and Hydrogen

Content previously published in Petro Industry News

< Added August 2009

Rtx®-1 PONA columns are highly stable and can be run with helium or hydrogen under accelerated conditions. Restek has developed a new DHA method using Rtx®-1 PONA columns with hydrogen that can double refinery sample throughput.

[Find out more](#)

New D3606 Column Set Outperforms TCEP Columns for Benzene Analysis

Content previously published in Petro Industry News

< Added August 2009

Restek's new D3606 column set outperforms TCEP columns for gasoline testing. The D3606 set has higher thermal stability and reliably resolves benzene from ethanol, resulting in more accurate quantitation.

[Find out more](#)

Stable Sulfur & Mercury Sampling in Refineries

Using Siltek® and Sulfinert® Surface Treated Components

Refinery and natural gas samples often contain trace amounts of sulfur- and mercury-containing compounds, which can interfere with reactions, poison catalysts in petrochemical processes, and damage equipment. Because these compounds quickly react with stainless steel surfaces, accurate determination of these compounds is impossible when samples are collected and stored in untreated sample cylinders. Restek's Siltek® and Sulfinert® passivation techniques bond an inert layer into the surface of stainless steel, preventing active compounds from reacting with or adsorbing to the steel.

[Find out more.](#)

Eliminate Column Breakage in High Temperature Biodiesel Analysis

Using metal columns to analyze glycerin in biodiesel offer significant performance advantages compared to fused silica columns, as shown in this evaluation.

[Find out more.](#)

How Good is Your PONA Column?

Data-Based Decisions Help Simplify the Choice

We evaluated our 100 meter x 0.25mm ID x 0.5df PONA column and equivalent columns from four other vendors, following ASTM D-6730 methodology (hydrogen carrier gas). Data and chromatograms presented here show that only the Restek PONA column performed to method specifications admirably. Column efficiency exceeded specification.

[Find out more.](#)

Parker ChromGas® Hydrogen Generators

Relative to helium as the GC carrier gas, hydrogen from a gas generator reduces gas costs, cuts analysis time by 50%, and reduces temperatures needed for eluting analytes — which increases column lifetime.

Parker ChromGas® hydrogen generators are safe, convenient, reliable, and easy to use.

[Find out more.](#)

High Temp. Stability Problem Solved with New Metal Columns

Analysis of Total Glycerides in Biodiesel Oils by ASTM D-6584 Using the New MXT®-Biodiesel TG Capillary Column

The high temperatures required for biodiesel analysis by gas chromatography present a considerable challenge to analytical columns. Fused silica columns, even those rated for high-temperature tolerance, breakdown relatively quickly. Restek's new MXT®-Biodiesel columns are more stable up to 430°C and offer excellent chromatography for glycerides. These columns are available in two configurations: factory-coupled to a 0.53mm retention gap, or with a built-in, leak-proof Integra-Gap™ retention gap.

[Find out more.](#)

Fast, Accurate FAMES Analyses of Biodiesel Fuel

Using a Stabilwax® Capillary GC Column

As biodiesel fuel continues to stimulate interest worldwide as an energy source, several gas chromatographic methods have been developed to determine the quality of B100 fuel. Here we show excellent peak symmetry, resolution, and reproducibility for determining the fatty acid methyl ester (FAME) and linolenic acid methyl ester content in B100 biodiesel fuel, using European standard method EN 14103 on a Stabilwax® fused silica GC column.

[Find out more.](#)

Separate Argon from Oxygen Above Ambient Temperatures

Using an Rt-Msieve™ 5A PLOT Column

A Restek PLOT column can be your best solution for difficult separations of gaseous analytes. Rt-Msieve™ 5A PLOT columns offer fast, efficient separation of argon/oxygen, hydrogen/helium, and other permanent gases, including permanent gases in refinery or natural gas. You can make difficult separations without subambient temperatures, e.g.: separate oxygen from argon to baseline in approximately 4 minutes.

[Find out more.](#)

Biodiesel Analysis by European Methodology

Exceptional Peak Symmetry, Using an Rtx®-Biodiesel GC Column

Glycerin is a notoriously difficult challenge in GC, particularly at the levels involved in biodiesel oil analysis, but an Rtx®-Biodiesel column provides a symmetric peak that makes quantification easier and more reliable. The column performs well at elevated temperatures: peaks for glycerin and glycerides exhibit minimal tailing, and bleed is low at 370°C, as specified in European method DIN EN14105.

[Find out more.](#)

Analyze Biodiesel Oil for Glycerin

Using Restek's Robust Rtx®-Biodiesel Capillary GC Column

We challenged our Rtx®-Biodiesel column with analysis for glycerin in biodiesel according to method ASTM D-6584-00. Excellent linearity was established for glycerin, triolein, monolein, and diolein, with r^2 values exceeding the method criteria for all compounds. Mono-, di-, and triglycerides resolved well from other compounds in B100 biodiesel oil. Column performance was strong at high temperatures, with low bleed even at 380°C. An Alumaseal™ connector and guard column were used to extend column life.

[Find out more.](#)

GC Analysis of Total Reduced Sulfurs at ppbv Levels

Using an Rxi™-1ms Column and Sulfur Chemiluminescence Detection

Ultra-low bleed and exceptional inertness assure complete separation of sulfur compounds (hydrogen sulfide, carbonyl sulfide, dimethyl sulfide, mercaptans) on our new column, with excellent peak shapes and reliable quantification at ppbv levels. A Sulfinert® treated sampling/transfer system assures no adsorption losses of these very reactive compounds.

[Find out more.](#)

Sulfinert®-Treated Sample Cylinders Store Active Sulfur Compounds at ppb Levels

Recovery of a 17ppbv test standard of hydrogen sulfide exceeded 85% after 54 hours in a Sulfinert®-treated cylinder; recoveries of methyl mercaptan, ethyl mercaptan, carbonyl sulfide, and dimethyl disulfide exceeded 90%. A Sulfinert®-treated sampling/transfer system can assure accurate sulfur content data for natural gas, beverage-grade carbon dioxide, or other samples.

[Find out more.](#)

Analyze Hydrocarbons on OPN/Res-Sil™ C Bonded GC Packing

In process GC analyses, this material offers unique selectivity for the difficult-to-separate saturated and unsaturated C4 hydrocarbons, eluting *cis*-2-butene before 1,3-butadiene. Innovative bonding chemistry assures batch-to-batch reproducibility, excellent thermal stability, and long column life.

[Find out more.](#)

Res-Sil™ C Packings for Analyses of Light Hydrocarbons

n-Octane on Res-Sil™ C packing provides excellent, reproducible separations of volatile hydrocarbons in petroleum products, including the difficult-to-separate saturated and unsaturated C4 compounds. An OPN on Res-Sil™ C column separates C1-C5 hydrocarbons in half the time required by alternative columns.

[Find out more.](#)

Want more? Click here to view Petrochemical Literature

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CLINICAL/FORENSICS

LC/MS/MS Analysis of Diuretics in Urine:

Proper Column Choice Takes Matrix out of the Equation

< Added October 2009

Ultra II™ Biphenyl columns improve the accuracy of diuretics analysis in urine by separating target diuretics from isobaric matrix interferences. Fast, reliable separation can be achieved for compounds that coelute on phenyl hexyl columns.

[Find out more](#)

Reduce Downtime and Cost of Materials with Rxi®-5Sil MS GC Columns

< Added July 2009

New Rxi®-5Sil MS columns produce consistent results for amphetamine—even after 400 injections of derivatizing reagent—resulting in less time and money spent on column maintenance and replacement.

[Find out more](#)

High Sensitivity EtG and EtS Method Reduces Costs and Analysis Time

< Added July 2009

A new LC method for analyzing ethanol metabolites using ion-pairing provides higher retention, faster analysis times, and improved MS sensitivity for EtG and EtS, compared to conventional methods.

[Find out more](#)

5 Minute Analysis of Vitamin D in Serum by LC/MS/MS

< Added May 2009

Conventional techniques for vitamin D analysis often lack adequate sensitivity, specificity, and speed. This LC/MS/MS assay results in highly symmetric peaks that elute in just 5 minutes.

[Find out more](#)

Fast Screening and Confirmation of Gamma-Hydroxybutyrate (GHB) in Urine

< Added February 2009

The headspace (HS) analysis of gamma-hydroxybutyrate (GHB) described here reduces contamination and eliminates time-consuming derivatization. Confirmation testing using an Rtx®-5MS column, provides definitive results in less than 7 minutes.

[Find out more](#)

Assure LC/MS/MS System Performance and Increase Sample Throughput

Using a System Suitability Test Mix for Drug Analysis

Restek and Applied Biosystems have developed a system suitability mix specifically for drug testing that contains compounds covering a wide range of molecular weights, polarities, and retention times. This mix is designed to verify system performance and identify problems. Data are automatically compared to expected results by Cliquid® Drug Screen & Quant Software. Use this mix to assure system performance, improve data quality, increase sample throughput, and simplify troubleshooting.

Find out more

Rapid Separation of Human Sex Hormones in Biological Samples

Using the JASCO X-LC System

This application note describes a 6.1 min method for identifying a mixture of 8 sex hormones using Jasco X-LC. The compounds are separated by a gradient elution of water and acetonitrile on a Restek 1.9µm Pinnacle DB Biphenyl column.

Find out more at www.jascoinc.com

Accurate, Reproducible Amphetamines Analysis

Clean Up Procedure Improves Chromatography and Reduces Maintenance

Analyzing amphetamines by GC/MS can be challenging whether they are derivatized or underivatized. Here we evaluate the effects of several sample pretreatment methods. The resulting method reported here produces symmetric peaks while reducing the amount of contamination that can enter the GC system. This method ensures accurate area count reproducibility, a clean GC system, and a stable baseline, even for GC/MS work.

Find out more.

Fast, Sensitive Analysis of Benzodiazepines by LC/MS/MS

Quantify an Order of Magnitude below Typical Methods

An LC/MS/MS method for benzodiazepines was developed and offers several advantages over other techniques: minimal sample preparation, fast analysis times, multiple reaction monitoring transitions for quantification and confirmation, and sensitivity down to 0.10-10ng/mL. This method uses the Allure® PFP Propyl stationary phase, which retains compounds long enough to minimize matrix interferences and chromatographically separate compounds that share the same precursor ion.

Find out more.

Simplify and Speed Up Opiates Analysis

Using LC/MS/MS & an Allure® PFP Propyl HPLC Column

The analysis of opiates typically requires derivatization when using gas chromatography/mass spectrometry (GC/MS), which leads to longer sample preparation time. An alternative liquid chromatography tandem mass spectrometry (LC/MS/MS) method presented here eliminates sample derivatization and offers fast analysis times, resulting in increased sample throughput. In addition, the Allure® PFP Propyl column used here produces baseline resolution for compounds that have very similar mass spectra.

Find out more.

Why Derivatize?

Improve GC Separations with Derivatization

Derivatizing compounds is often necessary to obtain acceptable, reproducible results. Here we review reasons for derivatization and the three basic types of derivatization reactions for gas chromatography: silylation, acylation, and alkylation. An example procedure for derivatizing hormones, including chromatography, is given.

Find out more.

Reliably Confirm Cannabinoids by GC/MS

Using a 12m x 0.20mm ID 0.33µm Rxi®-5ms Column

Screening for evidence of marijuana use is typically done using an immunoassay method to detect derivatives in urine, but confirmation of positive results requires GC/MS. Here we describe a GC/MS method, using an Rxi®-5ms column, that resolves all major cannabinoid metabolites to baseline and exhibits very low bleed, even at 300°C. We also prolonged column life by baking at 340°C to remove derivatization by-products.

Find out more.

Fast Screening and Confirmation for Gamma-Hydroxybutyrate (GHB)

Using Restek Columns in Headspace GC or GC/MS Systems

We adapted Rtx®-BAC1 and Rtx®-BAC2 columns, with their proven performance in blood alcohol analysis, to a screening procedure for GHB, followed by confirmation and quantification on a highly inert Rxi®-5ms column. Use of a system and column already in use for blood alcohol analysis eliminates the need for additional equipment, reduces system maintenance, and allows rapid and reliable screening, confirmation, and quantification.

Find out more.

Drugs of Abuse Analytical Reference Materials

These exempted materials include amphetamine and methamphetamine, barbiturates, benzodiazepines, cannabidiol and cannabinol, cocaine/cocaine metabolites, methadone/methadone metabolites, opiates/opiate metabolites, and other drugs, a range of blood alcohol standards from 0.010g/dl to 0.4g/dl, and a blood alcohol resolution control standard.

Find out more about:

[Exempted Drug of Abuse Reference Materials](#)

[Blood Alcohol Standards](#)

[Blood Alcohol Mix Resolution Control Standard](#)

Rapid Analysis of Steroid Hormones by GC/MS

Using the New Rxi®-1ms Column

GC/MS analysis of urinary steroid hormones is a demanding application, and the Rxi®-1ms column meets the requirements for low bleed and inertness better than any column we have tested. We analyzed a variety of derivatized steroid sex hormones in less than 25 minutes, with excellent resolution and symmetric peaks. At 300°C or above, bleed from the Rxi®-1ms column was negligible.

[Find out more.](#)

GC Inlet Liner Deactivations for Basic Drug Analysis

Basic drugs can interact with active sites on the surface of the inlet liner, reducing responses. The combination of a base-deactivated liner and a base-deactivated Rtx®-5Amine column ensures the greatest responses in analyses for these compounds.

[Find out more.](#)

Sensitive GC/MS Analysis for Drugs of Abuse

An Rxi®-5ms column will resolve acidic/neutral or free basic drugs under one set of conditions. There is no interference from column bleed — not even at 330°C. This is one of the first published applications for our new family of Rxi® columns.

[Find out more.](#)

Rapid, Sensitive HPLC/TOF-MS Analysis for Cocaine

A high-organic mobile phase and an Allure™ PFP Propyl column offers adequate retention, short analysis times, and excellent sensitivity for cocaine and cocaine metabolites, without mobile phase modifiers. Target compounds are eluted within 3 minutes, with excellent sensitivity at 5.0pg on-column.

[Find out more.](#)

Want more? Click here to view Clinical/Forensic Literature

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ENVIRONMENTAL

Analyze Haloacetic Acids in Under 13 Minutes with Rtx®-CLPesticides Columns

< Added September, 2009

Sample throughput for haloacetic acids in drinking water can be increased significantly using Rtx®-CLPesticides/Rtx®-CLPesticides2 columns. Target HAAs were fully resolved in under 13 minutes.

[Find out more](#)

New Wool Ensures More Accurate Semivolatiles Analyses

< Added September, 2009

New Semivolatiles Wool liners are designed specifically for semivolatiles analysis and result in more accurate results at lower levels, compared to similar products.

[Find out more](#)

3-Fold Faster Polybrominated Diphenyl Ether (PBDE) Short Column Method

< Added August, 2009

Sample throughput for PBDE analysis can be significantly increased using a 15m Rtx®-1614 column. Excellent responses and peak shapes are obtained for all congeners, including BDE-209, in just 20 minutes.

[Find out more](#)

New Column Option for Reliable LC Separation of Explosives

< Added May, 2009

Ultra II Aromax and Ultra C8 columns were determined to provide better separations for the routine analysis of explosives by LC than conventional phases.

[Find out more](#)

Reduce Acetonitrile Use by Analyzing PAHs with Methanol-Based Mobile Phase

< Added April, 2009

Switching to a methanol based mobile phase for polycyclic aromatic hydrocarbon analysis—using the method shown here—is an effective way to save money by reducing acetonitrile consumption.

[Find out more](#)

Detect Down to 10pg with Sensitive SIM GC/MS Multiresidue Method

As labs operate in an extremely competitive market, the demand for more sensitive multiresidue pesticide methods is increasing. Here we demonstrate linearity down to 10pg on-column for a wide range of pesticides differing in volatility, compound class, and degree of activity. The inertness of the Rxi®-5Sil MS column ensures linear performance and more accurate low level quantification for multiresidue pesticide methods.

[Find out more](#)

PTV On-Column Liner Gives You Two Inlets in One

Programmable temperature vaporization inlets are versatile, yet normally do not accommodate on-column injection. Now, using a PTV On-Column liner, the capabilities of PTV can be expanded to include true on-column injections.

[Find out more](#)

Isomer-Specific Analysis and Large Volume Sampling of Estrogens and their Conjugates in Water Samples

Estrogens and conjugates, including estradiol sulfates and estradiol glucuronides, were separated and detection limits were lowered using an Allure AK column and an LC/MS/MS system. Initial results from large volume sample testing are also reported.

[Download](#) (1.09 MB PDF)

One Stop Shop for EPA Method 535

Reliably Analyze Acetamide Herbicide Degradates by LC/MS/MS

An optimized EPA Method 535 procedure offers superior sensitivity for the ethanesulfonic acid (ESA) and oxanilic acid (OA) degradates of chloroacetanilide herbicides alachlor, acetochlor, and metolachlor. Alachlor ESA and acetochlor ESA isomers are reliably resolved, and the procedure is simplified with a full line of Method 535 products, including reference standards, solid phase extraction cartridges, and HPLC columns.

[Find out more](#)

Reliable Quantification of Brominated Flame Retardants by GC/MS

Using a New Rtx®-1614 Column for PBDE Analysis

The new Rtx®-1614 column is ideal for analyzing polybrominated diphenyl ethers (PBDEs) according to EPA Method 1614 due to its selectivity, sensitivity, and inertness. Data show this column meets the method requirements for resolution of critical pairs, tailing factors, and retention. Congeners 49 and 71 are fully resolved and a greater response for BDE-209 is seen. Optimized conditions can improve performance.

[Find out more](#)

Increase Polycyclic Aromatic Hydrocarbon Sample Throughput

With UHPLC and HPLC Column Options

Here we analyze polycyclic (polynuclear) aromatic hydrocarbons (PAHs) from the US EPA, European Union (EU), and Portugal lists by UHPLC and HPLC. Procedures shown use two optimized stationary phases (Pinnacle™ DB PAH and Pinnacle™ II PAH) and provide 3.5 to 6 minute analyses, allowing labs to achieve significantly faster sample throughput.

[Find out more](#)

Characterizing All 136 Tetra- to Octachlorinated Dioxins and Furans

Using the Rtx®-Dioxin2 Column

The Rtx®-Dioxin2 column has a unique selectivity for dioxins and furans, including specificity for 2,3,7,8-

TCDD and 2,3,7,8-TCDF. Here we characterize all 136 tetra- through octachlorine dioxins and furans and define all possible coelutions. While commonly used cyanopropyl columns are limited by a low maximum operating temperature of 240°C, the Rtx®-Dioxin2 column is stable up to 340°C, extending column lifetime and improving the analyses of dioxins and furans.

[Find out more.](#)

Enhancing Air Monitoring Methods with Thermal Desorption

The use of carbon disulfide (CS₂) extraction as an air monitoring method for vapor-phase organic compounds (VOCs) is fundamentally limited with respect to detection limits. Thermal desorption (TD) is a complementary gas extraction technique whereby sorbent tubes are heated in a flow of carrier gas. Trapped vapors desorb from the sample tubes into the gas stream and are transferred into the GC/MS analyzer. Here, we summarize the key advantages of thermal desorption versus solvent extraction.

[Find out more.](#)

13 Minute Chlorophenoxyacid Herbicides Analysis

On New Rtx®-CLPesticides & Rtx®-CLPesticides2 Columns

The Rtx®-CLPesticides and Rtx®-CLPesticides2 column pair is an excellent choice for chlorophenoxyacid herbicide analysis. Now, with an optimized film thickness for the 0.32mm ID version, this difficult analysis can be made in less than 13 minutes on both the primary and confirmation columns. Near baseline resolution is achieved for all analytes except for bentazon/picloram on the Rtx®-CLPesticides column; however, this pair is fully resolved on the Rtx®-CLPesticides2.

[Find out more.](#)

Accurately Quantify PAHs Down to 5pg On-Column

GC/MS SIM Analysis with the New Rxi®-5Sil MS Column

Semivolatiles methods, such as EPA Method 8270, place stringent demands on gas chromatography (GC) columns. Here we demonstrate the performance of Rxi®-5Sil MS columns for semivolatiles analysis in terms of bleed, efficiency, and activity. Excellent sensitivity and resolution are seen, even for difficult PAHs such as benzo(b)fluoranthene & benzo(k)fluoranthene, and indeno(1,2,3-cd)pyrene and dibenzo(a,h)anthracene. Both basic and acidic compounds show good response even at low levels.

[Find out more.](#)

Fast, Accurate Semivolatiles Analysis!

Using New Rxi®-5Sil MS GC Columns

Semivolatiles methods, such as EPA Method 8270, place stringent demands on gas chromatography (GC) columns. Here we evaluate the performance of Rxi®-5Sil MS columns for semivolatiles analysis in terms of bleed, efficiency, and activity. We demonstrate excellent sensitivity and resolution, even for difficult PAHs such as benzo(b)fluoranthene & benzo(k)fluoranthene, and indeno(1,2,3-cd)pyrene and dibenzo(a,h)anthracene. Both basic and acidic compounds show good response even at low levels.

[Find out more.](#)

Complete Resolution of 13 Difficult Carbonyls

Using the New Allure® AK HPLC Column

The new Allure® AK HPLC column was developed specifically for the analysis of aldehydes and ketones, including the 13 carbonyl compounds specified in the California Air Resources Board (CARB) Method 1004. The data shown in this article demonstrate excellent resolution, even of buteraldehyde and methyl ethyl ketone (MEK), in less than 12 minutes using a 200mm Allure® AK HPLC column.

[Find out more.](#)

Faster Organochlorine Pesticide Sample Throughput

On New Rtx®-CLPesticides & Rtx®-CLPesticides2 Columns

Increasing sample throughput is an effective way to reduce operating costs for environmental labs. Here we introduce new film thicknesses for the Rtx®-CLPesticide and Rtx®-CLPesticide2 GC columns, optimized for complete separations and short analysis times. Using these new columns, all US EPA Method 8081 organochlorine pesticides are resolved in <9 min. We also show complete separation of these compounds in <5 min. using these columns and a Gerstel MACH column heating system.

[Find out more.](#)

Resolving the Benzo(j)fluoranthene Challenge

Separate New PAHs Quickly Using the Rxi®-17 GC Column

Polynuclear aromatic hydrocarbons are a significant, and wide-spread, source of pollution. The US EPA mandates testing of the 16 PAHs they designate as most hazardous; the target list in other countries is expanding and includes new compounds that are difficult to separate. Here we demonstrate the ability of

the Rxi®-17 column to effectively resolve dibenzo pyrene isomers, as well as to separate benzo(j)fluoranthene from benzo(b)fluoranthene and benzo(k)fluoranthene.

[Find out more.](#)

Choosing a Liner for Semivolatiles Analysis

Liner choice is a critical decision in semivolatiles analysis. Liners containing wool packing are recommended to minimize molecular weight discrimination. Attributes of different types of liners, including the Drilled Uniliner, are discussed.

[Find out more.](#)

8-Minute Dual Column Analysis of Organochlorine Pesticides

Using Rtx®-CLPesticides / Rtx®-CLPesticides2 Columns

Unique selectivities make the Rtx®-CLPesticides / Rtx®-CLPesticides2 column pair an excellent choice for analyzing pesticides by US EPA Method 8081, or equivalent methods. A 0.53mm ID guard column allows sample injection onto high-efficiency 20m x 0.18mm ID thin film columns, for baseline resolution in greatly reduced analysis time. Sharp, symmetric peaks help assure reliable quantification data.

[Find out more.](#)

Superior Chromatography for Semivolatile Organics

Using the Rtx®-5Sil MS Capillary GC Column

Combining an optimized stationary phase and deactivation that assures unsurpassed inertness and excellent responses for active analytes, Rtx®-5Sil MS columns address the challenging demands of semivolatiles analyses. Phenyl rings in the polymer backbone stiffen the siloxane chain, ensuring thermal stability and reducing bleed. Selectivity is similar to that of conventional 5% diphenyl phases, but improved, e.g.: separation of isomers benzo(b)- and benzo(k)fluoranthene is increased.

[Find out more.](#)

High Throughput of Semivolatiles Samples by GC/MS

Using a 20m x 0.18mm x 0.30µm Rxi®-5ms Column

We developed the 20m x 0.18mm x 0.30µm Rxi®-5ms column to balance the demand for shorter analysis times with the need to maintain both column capacity and column efficiency. Here we establish conditions for eluting more than 90 semivolatiles, including 7 surrogates and 6 internal standards, in less than 12 minutes. Benzo(b) and benzo(k)fluoranthene were resolved well and sample throughput was improved by 75%. This highly inert, low bleed column is ideal for GC/MS analysis.

[Find out more.](#)

Resolving Benzo(j)fluoranthene from Other PAHs

Using a Pinnacle™ II PAH Column

Nineteen polycyclic aromatic hydrocarbons (PAHs), including benzo(b) and benzo(j)fluoranthene, were fully resolved using a Pinnacle™ II PAH column. Greater sensitivity was achieved by coupling UV and fluorescence detection. This HPLC method offers improved resolution compared to standard GC techniques.

[Find out more.](#)

Rxi®-1ms Capillary GC Column

For Low Level GC/MS Analyses

Our new, nonpolar, 100% dimethyl polysiloxane Rxi®-1ms column offers the same superior inertness, ultra-low bleed, and excellent batch to batch reproducibility exhibited by our Rxi®-5ms column. We analyzed a complex mixture of semivolatile analytes, including both acidic and basic compounds, at levels as low as 0.5ng on column. The selectivity, analyte breakdown, peak symmetry, and bleed results shown here are strong recommendations for the new column.

[Find out more.](#)

Low-Level GC/MS for Semivolatiles in Drinking Water

Excellent Responses at 10ng On Column, Using an Rxi®-5ms Column

Using this new column, resolution and peak shapes for 88 semivolatile compounds commonly analyzed in drinking water are exceptionally good at 10ng each on column. Because the Rxi®-5ms column performs well with analytes in a diverse range of chemical classes, we highly recommend it for analyzing complex mixtures of semivolatiles.

[Find out more.](#)

Fast, Sensitive LC/MS/MS Analysis of Paraquat and Diquat

Using an API 3200™ Mass Spectrometer and an Ultra Quat HPLC Column

Developed through collaboration with scientists at AB/MDS Sciex, this analysis allows complete resolution of paraquat and diquat with a simple, isocratic mobile phase. It is significantly faster than conventional methodologies and, with detection limits of 5ppb for paraquat or 0.1ppb for diquat, sensitivity is superior — without preconcentration.

[Find out more.](#)

Analytical Reference Materials for Semivolatile Pollutants

Drinking Water: US EPA Method 525.2

Listed reference mixes include organochlorine pesticides, organonitrogen pesticides, organophosphorus pesticides, PCB congeners, internal standards, surrogates, a performance check mix, and more.

[Find out more.](#)

Excellent Responses in GC/MS Analysis of Semivolatiles

The newest members of our new line of Rxi® columns, Rxi®-1ms columns, offer the same outstanding inertness, ultra-low bleed, and batch-to-batch reproducibility as our Rxi®-5ms columns. Rxi®-1ms columns provide excellent selectivity and symmetric peaks for the diverse chemicals that can make up a semivolatiles sample.

[Find out more.](#)

Analysis of Semivolatile Organics

Exceptional inertness and ultra-low bleed enable an Rxi®-5ms column to resolve sub-1ng quantities of acidic or basic analytes under a single set of conditions. In this example analysis, an Rxi®-5ms column separated 93 target analytes in US EPA Method 8270D in less than 18 minutes.

[Find out more.](#)

Monitoring Petroleum Hydrocarbons by Solid Phase Extraction/GC

New manufacturing processes for our Massachusetts TPH solid phase extraction cartridges reduce extractable contaminants almost to blank levels, and assure more reliable fractionation of aliphatics from aromatics. Large, uniform lots of silica reduce the frequency of verifying fractionation results.

[Find out more.](#)

Reference Mix of Canadian Drinking Water Volatiles

This mix includes all 19 volatile compounds on the Canadian Drinking Water List. We recommend using an Rtx®-VMS column for the analysis, to assure sharp peaks for early eluters and resolution of the heavier compounds.

[Find out more.](#)

A 12-Minute Analysis for Volatiles

An Rtx®-VMS column provides rapid, baseline resolution of most volatile analytes in the CLP OLM 04.1 analysis for groundwaters or drinking waters from Superfund sites. A particularly challenging stipulation of the method, 90% resolution of the gaseous components, is easily attained.

[Find out more.](#)

Want more? Click here to view Environmental Literature

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FOODS, FLAVORS, & FRAGRANCES

Comprehensive Pesticide Residue Analysis by LC/MS/MS

< Added May, 2009

Analysis of pesticide residues in foods is complicated by the large number of target compounds. LC/MS/MS analysis using an Aqueous C18 column provides more comprehensive results than GC alone.

[Find out more](#)

Meet New Requirements for Melamine Analysis at 1µg/g in Infant Formula

< Updated April, 2009

The recent establishment of a 1µg/g safety threshold for melamine in infant foods has led to an immediate need for more sensitive methods. Here we established GC/MS conditions for highly

reproducible analyses and evaluated the effectiveness of both solvent-based and matrix-matched standards. Using this method, melamine and cyanuric acid were reliably detected at and below 1µg/g in infant formula.

[Find out more](#)

Prepare Samples in Half the Time

Using a Fraction of the Solvent with dSPE

Simplify and speed up sample preparation with Restek dispersive SPE tubes! Here we show the extraction and clean-up of pesticide residues from olive oil samples — twice as fast as gel permeation chromatography (GPC), with only a fraction of the solvent required for conventional solid phase extraction (SPE).

[Find out more](#)

Prevent Fraud with Simple Analysis of Cholesterol and Glycerides

Estimating cholesterol in food products is complicated, but often is part of the authentication testing of label claims regarding egg content. The method shown here simplifies fraud detection by incorporating glyceride testing. Easy comparison of the chromatographic profiles of egg and egg product (pasta) samples can be made using an Rtx®-65TG column, which is specifically tested to assure excellent separations and a reliable performance for glycerides.

[Find out more](#)

Fast, Simple Sample Cleanup

Using QuEChERS SPE Tubes

Quick, Easy, Cheap, Effective, Rugged, and Safe, the QuEChERS ("catchers") method for extracting pesticides from food is based on USDA research and employs a novel dispersive solid phase extraction cleanup (dSPE). QuEChERS methods are convenient, rugged methods that simplify extract cleanup, reduce material costs, and improve sample throughput. Here we demonstrate the effectiveness of QuEChERS sample cleanup using a multiresidue analysis of pesticides on strawberries.

[Find out more.](#)

Rapid Screening Method for Carbamates in Orange Oil

Using an Ultra Carbamate HPLC Column

EPA Method 531.1 addresses the analysis of carbamate pesticides in water, but not in more complex matrices, which often contain interferences and require time-consuming sample preparation. We developed an easy, accurate screening method for carbamates in a complex matrix using an Ultra Carbamate HPLC column in conjunction with the Leco Unique TOF- MS. This method requires no sample preparation and provides fast analysis times, significantly increasing sample throughput.

[Find out more](#)

Using Thermal Desorption to Enhance Aroma Profiling by GC/MS

Lower Detection Limits with Latest Technology

Thermal desorption offers an automatic, high-sensitivity alternative to conventional liquid extraction methods for aroma profiling by GC/MS. It allows vapor profile constituents to be cleanly separated from the sample matrix and often facilitates selective purging of volatile interferences. This ensures that the vapor profile analyzed is most representative of the aroma perceived by consumers and that key compounds can be identified and measured at the lowest levels possible.

[Find out more](#)

High Sensitivity Melamine GC/MS Analysis of Cat Food

Modified Conditions Save Costs and Reduce Maintenance

Melamine contamination was implicated in a large pet food recall that occurred in 2007 when animals died after eating contaminated pet food. Here, a modified GC/MS method, based on an FDA method, was used to analyze for melamine & related compounds cyanuric acid, ammelide, and ammeline in dry cat food. Analytes were easily identified by retention time matching and mass spectra.

[Find out more.](#)

Rapid Characterization of Garlic Volatiles—No Sample Prep Requires!

Using Headspace GC/MS and an Rxi®-5ms Capillary Column

Chromatographic methods for garlic and garlic powder are used by the food and dietary supplement industries to monitor product quality. Here we present a headspace gas chromatography mass spectrometry (HS GC/MS) method for garlic flavor and odor components using an Rxi®-5ms column. This method eliminates sample preparation making the bench work simple and fast. The experimental set-up is ideal for both screening analysis and low-level trace analysis.

[Find out more.](#)

Simple, Reliable HPLC Analyses of Organic Acids

Using Water-Compatible Allure® or Ultra C18 Columns

Commonly used organic acid methods (e.g. AOAC method 986.13) depend on reversed phase HPLC and C18 columns, however these columns are vulnerable to phase collapse when used with the aqueous mobile phases necessary for optimal organic acid analysis. Restek's Ultra Aqueous C18, Allure® Aqueous C18, and Allure® Organic Acids columns all withstand phase collapse and resolve organic acids in a 100% aqueous mobile phase, compared to a conventional C18 column which shows a complete loss of retention.

[Find out more.](#)

Analysis of Nitrofurans in Honey

Using LC/MS/MS and an Ultra C18 Column

Nitrofurans are a class of veterinary antibiotics used to increase growth rate and prevent or treat disease in animals. Determining levels of nitrofurans in animal tissue, or even products such as honey, is important in studying drug resistance and allergies in humans. The Ultra C18 HPLC column is an excellent choice for LC/MS/MS analysis of nitrofurans at low levels in complex matrices such as honey. Here we show excellent sensitivity, resolution, and peak shape at trace levels.

[Find out more.](#)

Evaluating Undiluted Essential Oils

Essential oils are complex natural products containing many components across a wide concentration range. This complexity makes their analysis especially challenging. Many methods involve sample dilution to prevent syringes from clogging but this is not always necessary and can compromise analytical quality, especially for less abundant compounds near the solvent peak. Here we provide steps for optimizing your method to allow essential oils to be analyzed without dilution.

[Find out more.](#)

Monitor Antioxidants in Tea Extract

Using an Ultra Aqueous C18 HPLC Column and Unique® TOFMS

An Ultra Aqueous C18 column enables you to use the conditions most effective for this analysis: gradient elution in high aqueous mobile phases. The C18 chains will not collapse in the presence of a high water content. Use this chromatographic system to extract data for specific compounds of interest and to manually inspect spectra for phenolic glycosides, esters of phenolic acid, or other compounds.

[Find out more.](#)

Robust 9-Minute GC Analysis of Cholesterol

Excellent Sample Throughput with an Rxi™-5ms Column

Conditions are established for analyzing both derivatized and underivatized cholesterol on a highly inert Rxi™-5ms column. Methods described include both an isothermal analysis for use when interferences are minimal, but sample throughput is critical, and a temperature program for use when separation of analytes from contaminants or interfering compounds is the primary concern. Results for both derivatized and underivatized samples were highly reproducible.

[Find out more.](#)

Rapid, Reproducible HPLC Analysis for Flavonoids in Cocoa

Using a Leco Unique® LC-TOFMS System and an Ultra Aqueous C18 Column

We separated flavonoids in cacao or cocoa powder samples and returned conditions to the initial mobile phase composition in 15 minutes. For compounds common to both samples, retention times were equal to within 0.01 seconds. Flavonoid marker compound profiles for 38%, 49%, and 65% cacao were easily distinguished.

[Find out more.](#)

80% Faster GC/MS Analysis of Essential Oils

A 10-meter, 0.10mm ID, 0.10µm film Rtx®-5 column reduces analysis time for bergamot oil or patchouli oil by 80%, for five-fold greater sample throughput and sharply reduced cost per analysis. Sample resolution is unchanged for bergamot oil and is slightly improved for patchouli oil.

[Find out more.](#)

trans Fat: Resolving cis and trans FAME Isomers by GC

The highly polar Rt-2560 stationary phase has the selectivity needed for resolving cis and trans FAME isomers to comply with US FDA food labeling guidelines. Restek reference materials will help you

accurately characterize your materials.

[Find out more.](#)

Detecting Illegal Dyes in Foods: Identify Four Sudan Dyes in One HPLC Analysis

Using an Ultra Aqueous C18 column, a simple, isocratic mobile phase, and detection at two UV wavelengths (488nm for Sudan I and II and 520nm for Sudan III and IV), the four dyes are separated and identified in approximately 20 minutes.

[Find out more.](#)

Simple HPLC Analysis for Sudan Dyes

Sudan dyes are illegal as food additives according to the US FDA and the EU. A reversed phase HPLC separation of Sudan I, Sudan II, Sudan III, and Sudan IV (Scarlet Red) is simple, yet efficient, requiring only a simple mobile phase, isocratic elution, and detection at two wavelengths. An Ultra Aqueous C18 column provides the selectivity needed to assure the separation.

[Find out more.](#)

Malachite Green and Leucomalachite Green Analysis

Illegal use of malachite green (MG), an inexpensive fungicide, can allow MG to enter water cycles, where it is easily absorbed by fish tissue, and thus enters the human food supply. Reversed phase HPLC often is used to analyze for MG and its stored metabolite, leucomalachite green. Methods that facilitate detection of both compounds are discussed.

[Find out more.](#)

Want more? Click here to view Foods, Flavors, & Fragrances Literature

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PHARMACEUTICAL

Improve Pass Rates for Residual Solvents by USP <467>

Using the new Rxi®-624Sil MS GC Column

< Added October 2009

Not all G43 columns are equivalent. New Rxi®-624Sil MS columns reliably produce improved resolution and sensitivity, increasing system suitability pass rates and ensuring more productive laboratory time.

[Find out more](#)

Achieve Faster Analyses on Any HPLC System Using Ultra II™ Columns

< Added July 2009

Significant savings can be obtained without the costly upgrade to UHPLC. This famotidine example illustrates how a 90% reduction in analysis time and solvent volume resulted from strategic HPLC column choices.

[Find out more.](#)

Column Choice: A Critical Factor for Successful UHPLC Integration

< Added April 2009

Column choice is a critical factor in successfully transferring methods between UHPLC and HPLC. Here, we discuss the column qualities that contribute to the successful integration of UHPLC technology.

[Find out more.](#)

Novel Column Chemistry—High Impact, Low Cost Technology

< Added April 2009

Novel column chemistries are a simple change in an already budgeted consumable that can lead to optimized and more reliable methods—giving a fast return on a minimal investment.

[Find out more.](#)

Beyond C18 — Increase Retention of Hydrophilic Compounds Using Biphenyl Columns

The Pinnacle® DB Biphenyl column offers enhanced retention and alternate selectivity for aromatic, unsaturated, and sulfur-containing hydrophilic compounds. Here we demonstrate significantly greater retention of sulfone- and sulfoxide-containing drug probes, compared to phenyl, phenyl hexyl, and alkyl (C18) columns. Only the Biphenyl column, using pi-pi interactions, separated both test probes to $k' > 2$,

the level needed to ensure separation from unretained matrix contaminants.

[Find out more.](#)

Two Options for Analyzing Potential Genotoxic Impurities in Active Pharmaceutical Ingredients

Two options for the analysis of PGIs in API have been developed by Merck and Restek to meet different laboratory needs. The first option is a fast method for the analysis of sulfonate esters on the Rxi®-5Sil MS column. The second option is a comprehensive method for the analysis of both sulfonate esters and alkyl halides on the Rtx®-200 column. Both methods require very little sample preparation, which helps increase laboratory productivity.

[Find out more.](#)

How do intrinsically base-deactivated phases work?

Analyzing basic compounds can be somewhat troublesome on traditional alkyl stationary phases, namely conventional C18 columns. This is largely due to the interaction of analyte molecules with silanol groups present on the silica surface. To better understand the workings of silanol interactions, it is important to consider the composition of the support material. Silica is the most commonly used support in the production of HPLC columns, mainly because it is well-suited to high-pressure chromatographic separations, giving high efficiencies and good reproducibility. Silica offers bed and pressure stability and is highly porous, which ultimately gives rise to its large surface area, increased bonding capacity and high peak efficiencies. Silica also possesses widely-studied and effective bonding chemistries, making possible diverse analyte selectivities through a wide variety of bonded stationary phases.

[Find out more.](#)

Multi-task with an Ultra IBD Column

A Versatile Column with Many Applications

The Ultra IBD HPLC column addresses the inherent problems attributed to linear alkyl phases, providing excellent peak shape for basic compounds and heightened retention of hydrophilic compounds. Here we demonstrate the versatility of this polar embedded column, and its ability to overcome some of the common limitations of conventional C18 columns. The versatility of the Ultra IBD makes it an excellent tool for the practicing method developer.

[Find out more.](#)

Easy Transfer of HPLC Methods to UHPLC

Using Fully Scalable Pinnacle™ DB Columns

Ultra High Pressure Liquid Chromatography (UHPLC) is a rapidly growing technique that can provide faster analysis times. Scaling conventional HPLC methods down to UHPLC can be an effective way to take advantage of shorter run times and increase sample throughput. Here we review the factors that must be considered when scaling down an existing method. A sulfonamides method transfer is used as an example; chromatograms and formulas for all required calculations are included.

[Find out more.](#)

Explaining the Small Particle Advantage

Faster Sample Throughput on a 1.9µm Pinnacle™ DB column

Small particle HPLC columns can offer faster analysis times but only if the particle size distribution is tightly controlled. Restek's 1.9µm Pinnacle™ DB columns have tight, symmetric particle size distributions and contain no particles less than 1µm. Here we demonstrate how our stringent quality requirements translate into faster, more reproducible results compared to competitor columns. Greater column efficiency and reproducibility mean faster throughput and more consistent results.

[Find out more.](#)

Revised USP 467 Residual Solvent Method

Satisfy New Method Requirements with Restek Columns and Standards

The United States Pharmacopeia recently revised the general chapter on residual solvent analysis, USP <467>, to mirror the International Conference on Harmonization (ICH) guidelines for the identification, control and quantification of residual solvents. This revision, effective July 1, 2007, replaces previous methods that were not consistent with the ICH guidelines. Here we provide an overview, chromatograms, and technical tips for successfully running the new procedure.

[Find out more.](#)

Optimize Selectivity & Efficiency in UHPLC Separations

With More Stationary Phase Choices on 1.9µm Pinnacle™ DB HPLC Columns

Ultra-high pressure liquid chromatography (UHPLC) can significantly increase efficiency and produce

faster separations. The small particle sizes used in UHPLC improve efficiency; however selectivity is still the most important factor affecting compound resolution. Here we demonstrate the importance of stationary phase choice in UHPLC separations. By optimizing selectivity for your analytes of interest, faster separations can be achieved without compromising resolution.

[Find out more.](#)

Choosing the Correct Liner for Headspace Injections

Pass System Suitability Requirements with a Smaller Bore Liner

For headspace applications involving a transfer line, a smaller bore liner (preferably 1 mm) can improve system suitability pass rates. This lower liner volume decreases band broadening and allows quicker sample transfer by increasing the linear velocity through the inlet.

[Find out more.](#)

Simplifying Column Selection for ICH Residual Solvents

Using a Retention Time Index for Fast and Accurate OVI Separations

To make column selection for residual solvents easy, Restek has benchmarked the ICH Class 1, 2 and 3 residual solvents on our most popular OVI columns.

[Find out more.](#)

Separating NSAIDs through Aromatic Selectivity

Improve Retention by Using an Allure® Biphenyl HPLC Column

Non-steroidal anti-inflammatory drugs (NSAIDs) are typically separated on C18 phases. Separations on our Allure® Biphenyl HPLC column are based on pi-pi interactions, resulting in optimized retention and selectivity. Increased retention requires higher organic content in the mobile phase, increasing desolvation efficiency in LC/MS. Simple mobile phase changes enhance selectivity, making this column a great alternative to conventional phenyl phase columns, especially in method development.

[Find out more.](#)

Assaying Local Anesthetics by GC/FID

Optimizing System Suitability, Using an Rxi™-5ms Column

An Rxi™-5ms column and a wool-packed inlet liner provide the stability and inertness needed for these basic, active analytes. Chromatography from a six-replicate system suitability analysis was well within normal acceptance criteria. USP tailing factors were approximately 1.00 for all analytes; retention times and area responses were very stable.

[Find out more.](#)

Optimized RP-HPLC Analysis of Hydroxybenzoic Acids

An Ultra Aqueous C18 Column Provides the Best Retention of Polar and Weakly Polar Compounds

Among hydroxybenzoic acids, hydroxyl groups on the benzene ring vary by position and number, creating differences in overall polarity and solubility. The unique bonding chemistry of the Ultra Aqueous C18 phase assures high resolving power, the best separations across a broad range of analyte polarity, and compatibility with 100% aqueous mobile phases.

[Find out more.](#)

8-Minute GC Analysis of Residual Solvents

Single-injection, dual-column detection/confirmation assay is feasible for regulated solvents in pharmaceutical products, but no temperature program provides sufficient resolution on both columns. Using a Restek G43/G16 column pair and independent temperature programs in a Gerstel MACH column heating system, we analyzed and confirmed 23 Class 2 solvents in 8 minutes.

[Find out more.](#)

Simple, Optimized HPLC Analysis of Catecholamines

An Allure™ PFP Propyl column exhibits the retention needed to resolve these active, basic compounds, without derivatization or ion-pairing agents. Selectivity can be adjusted simply by changing the organic modifier in the mostly aqueous mobile phase.

[Find out more.](#)

RP-HPLC Analysis of Selective Serotonin Reuptake Inhibitors

Two Restek columns provide good retention, selectivity, and peak shape for SSRIs, without ion-pairing chromatography. Choose an Allure™ Basix column and neutral pH conditions, or an Ultra PFP column and acidic conditions — either will improve performance for these basic compounds, relative to alkyl phases.

[Find out more.](#)

Developing a Simple, Rugged HPLC Assay for Tetracyclines

Overall, three columns provide excellent repeatability in a simple analysis: Allure™ PFP Propyl, Ultra C18, and Allure™ Biphenyl. An Allure™ Biphenyl column employs π - π bonding with the ring structures of the tetracycline molecules to ensure good capacity, high selectivity, and the most symmetric peaks.

[Find out more.](#)

Using π - π Interactions to Enhance Selectivity for Unsaturated Compounds

The Allure™ Biphenyl HPLC Column

Relative to phases that separate via hydrophobic or polar interactions, the Allure™ Biphenyl stationary phase offers better retention, selectivity, and efficiency, when analyzing compounds with differences in the numbers and locations of unsaturated bonds in the hydrocarbon ring structure.

[Find out more.](#)

Want more? Click here to view Pharmaceutical Literature

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AIR SAMPLING

New Market Opportunities for VOC Air Sampling Labs

< Added May, 2009

VOC testing laboratories can expand into new markets using existing air sampling canisters and thermal desorption tubes, due to the broad applicability of these techniques.

[Find out more](#)

Early Detection of Structural Mold with SilcoCan™ Air Sampling Canisters

Early detection of structural mold is critically important to protecting human health and property values. Restek SilcoCan™ canisters allow low levels of microbial volatile organic compounds (MVOCs) to be detected in air samples before mold can be seen, providing an opportunity for structural repair and safer living conditions. The inertness of these canisters provides an exceptional storage environment, particularly for polar and high boiling point compounds.

[Find out more.](#)

Sampling Volatile Organic Compounds in Air

Restek Sampling Equipment Helps Assure Accurate Data

TO-Can™ air sampling canisters are electropolished and extensively cleaned, to provide a high-quality, passivated surface for improved stability of analytes listed in USEPA Method TO-15 (ambient air monitoring). For reactive compounds, such as sulfur-containing components, SilcoCan™ canisters are your best choice — our exclusive Siltek® surface treatment ensures exceptional inertness and maximum sample stability, even for 1-20ppb sulfur compounds.

[Find out more.](#)

Enhancing Air Monitoring Methods with Thermal Desorption

The use of carbon disulfide extraction as an air monitoring method for vapor-phase organic compounds (VOCs) is fundamentally limited. Thermal desorption is a complementary gas extraction technique whereby sorbent tubes are heated in a flow of carrier gas. Here, we summarize the key advantages of thermal desorption versus solvent extraction.

[Find out more](#)

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SAMPLE PREPARATION

Superior Fractionation of Extractable Petroleum Hydrocarbons

Get More Accurate Results Using Restek SPE Tubes

The Massachusetts Dept. of Environmental Protection's "Method for the Determination of Extractable Petroleum Hydrocarbons" is a method commonly used for underground storage tank testing. Commercially available SPE tubes are convenient, but vary in quality and consistency. Here we show that Restek's EPH SPE tubes have the highest silica activity and lowest overall level of coextractables among the tubes tested. These characteristics translate into more reliable and reproducible results.

[Find out more.](#)

Faster Extraction and Cleanup of Pesticide Residue Samples

With QuEChERS Products

If you are frustrated by the time and cost involved with pesticide sample cleanup, we suggest you try the simple and economical QuEChERS method. Follow this approach to remove sugars, lipids, organic acids, sterols, proteins, pigments, and excess water, any of which often are present. To make your work even simpler, we offer QuEChERS extraction products in a variety of standard sizes and formats, and custom products by request.

[Find out more.](#)

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BIOANALYTICAL

Reduce Downtime with Robust Lipidomics Method

Labs can save days of downtime by using an Rxi®-5ms column in assays similar to this high-throughput test method for cholesterol and low-level sterol metabolites. Here, extremely reproducible results were obtained using an Rxi®-5ms column, which gave highly consistent separations — even after 10,000 injections. Consistent performance and long column lifetimes increase productivity by reducing downtime associated with column changes and revalidation.

[Find out more](#)

Easily Resolve Oxytocin PEGylation Reaction Products

Using Viva Wide Pore HPLC Columns

Viva Wide Pore HPLC columns are ideal for the separation of large molecules, as target analytes can enter the larger pores and access more of the surface area. Here we demonstrate the added retentive power of these columns, using the PEGylation of oxytocin as an example. Separation of these large, closely related compounds demonstrates the suitability of Viva Wide Pore columns for monitoring PEGylation reactions, and other large molecule applications.

[Find out more](#)

Improve Characterization of Complex Protein Digests

A Viva C18 wide pore HPLC column resolves a tryptic digest of bovine serum albumin primarily into 1-2 peptide peaks, versus peaks of 3 or more peptides typically provided by conventional C18 columns. This superior resolution helps ensure more reliable identification of peptides in complex mixtures.

[Find out more.](#)

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RESTEK PERFORMANCE COATINGS

Sulfinert® Treated Systems Preserve ppb Levels of Active Sulfur Compounds

Many volatile sulfur compounds adsorb strongly to the metal surfaces encountered during sampling, transfer, and storage. This adsorption can cause falsely low sample results and also prolong analysis

cycle times. Data shown here demonstrate the effectiveness of Sulfinert® treatment of system components. Sulfinert® treatment reduces adsorption, resulting in more accurate quantitation of sulfur compounds and reduced cycle times.

[Find out more.](#)

Assure Accurate Sampling and Reliable Sample Purity

Restek Sampling System Treatments Prevent Adsorption, Protect Components

Siltek®/Sulfinert® surface treatments improve component performance by significantly reducing corrosion and adsorption problems in the sampling and sample transfer pathways. These treatments improve sampling accuracy, increase component lifetime, and cost less than super alloys. Treatments can be applied to cylinders, valves, fittings, tubing and more, and demonstrably improve detection of low-level sulfur, nitric oxide, and mercury compounds in a wide variety of applications and industries.

[Find out more.](#)

Prevent Mercury Loss During Transport and Storage

Use Siltek® Surface Treatment on Steel Components

As concerns about mercury in the environment grow, new regulations and testing requirements emerge. To ensure accurate results, sample storage and transfer systems must be inert to elemental mercury. Here we demonstrate that Siltek® treatment provides an unreactive surface compared to stainless steel. Data shown demonstrate that Siltek® treatment of sampling systems will improve analytical accuracy. Siltek® treatment is available on many stock items and custom components can be treated upon request.

[Find out more.](#)

Protect Sample Integrity and Prolong Sampling System Lifetime

Using Hydroguard™ Deactivated/Silcosteel® Treated Tubing

Tubing deactivated with Hydroguard™ and treated with Silcosteel® is preferred for situations in which water vaporization is encountered, such as in purge and trap systems. Hydroguard's™ unique deactivation chemistry creates an outer surface that prevents water vapor from contacting the Silcosteel® treated stainless steel surface below. This protected inert surface allows active analytes to pass through the tubing without adsorbing to the surface.

[Find out more.](#)

Extend Process Component Lifetime and Enhance Durability

Restek Surface Treatments Improve Sampling and Transfer Component Performance

In sampling or process stream pathways, Siltek®/Sulfinert® treated tubing reduces uptake of active (e.g., sulfur) compounds by orders of magnitude, relative to untreated tubing, for reliable data about stream composition. Silcosteel®-CR treated tubing improves corrosion resistance by up to 10X over untreated tubing, reducing the need for maintenance and helping to ensure the purity of the sample or process stream.

[Find out more.](#)

Superior Protection Against Corrosion: Silcosteel®-CR

Treated Fittings and Tubing

Silcosteel®-CR treatment is highly effective protection for stainless steel exposed to hydrochloric acid, nitric acid, or marine environments: in independent tests, Silcosteel®-CR treatment upgraded the corrosion resistance of 300-grade stainless steel by an order of magnitude. Now, electropolished stainless steel tubing and a wide selection of world-renowned Swagelok® fittings are available with Silcosteel®-CR treatment, from stock. Custom treatment of system components also is available.

[Find out more.](#)

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GENERAL INTEREST

How Much Sensitivity is Needed in a Leak Detector?

< Added, September 2009

Restek's Electronic Leak Detector is sensitive enough to find leaks below instrument pressure decay test

levels and is available at a fraction of the cost of other hand-held units.

[Find out more](#)

How to Understand and Deal with Overloading in GC

Content previously published in Separation Science

< Added, June 2009

Overloading GC columns affects peak symmetry and can cause coelutions and retention time shifts. This article provides tips on diagnosing and correcting overloading problems.

[Find out more](#) (241kb pdf)

Minimizing Decomposition of Components during GC Analysis

Content previously published in Separation Science

< Added, June 2009

Many compounds are susceptible to thermal degradation. This article explains how to diagnose and reduce analyte decomposition in both the GC inlet and column.

[Find out more](#) (1.3mb pdf)

Dual Vespel® Ring Inlet Seals

Washerless, Leak-Tight Seals for Agilent GCs

< Added, May 2009

Restek's Dual Vespel® Ring inlet seal gives you a better seal with fewer parts. Data show that the soft Vespel® material has a much lower leak rate than a metal seal. Also, since less torque is required for installation, user variability is reduced.

[Find out more](#)

Troubleshooting the Acetonitrile Shortage

< Added, March 2009

The current acetonitrile shortage has labs scrambling to adjust to limited supplies and increased costs. Here we discuss short- and long-term strategies to reduce acetonitrile consumption, including method development based on alternative solvents.

[Find out more](#)

Reducing Column Internal Diameter (HPLC)

Scaling down column size is simple to do and can help reduce solvent use. Here is an easy-to-follow example that teaches you how to reduce column internal diameter.

[Find out more](#)

Under Pressure?

Reduce System Stress by Backflushing Your HPLC Column

High pump pressures can be caused by heavily retained impurities building up in the head of the analytical column. Such contamination can cause poor chromatography, usually in the form of broad, split, or misshapen peaks, and ultimately can compromise results. Backflushing a contaminated analytical column, using the procedure outlined here, can help restore column performance and reduce pump pressure and system strain.

[Find out more](#)

Selecting the Right HPLC Guard Column

Understanding the significant factors that affect HPLC guard column performance can help you protect your analytical column and save money by extending analytical column lifetime. Here we review available options in packings, dimensions, cartridge holders, and filters to help you select the best guard column system for your application.

[Find out more.](#)

The Forgotten Septum

How to Correctly Diagnose the Source of Bleed Contamination

Septum bleed is generally attributed to the injection port septum; however, the vial cap septum also can be a source. Bleed contamination from any septum can cause interfering peaks and lead to inaccurate results, so it is important to correctly identify the source and understand how to eliminate or minimize bleed level. Here we discuss how to diagnose the source of the bleed and review considerations that can reduce the amount of contamination.

[Find out more.](#)

Warm-up Before You Run

Why Conditioning Your Inlet Parts After Maintenance Is Good Practice

Background noise in a gas chromatography system can be eliminated by conditioning the system prior to sample analysis. In this article, we discuss warm-up procedures and use liners and liner installation to demonstrate the importance of conditioning the system to remove background peaks. Investing a little time in warming-up the system pays big dividends by preventing costly coelutions and avoidable reanalyses.

[Find out more.](#)

Affected by the Helium Shortage?

Switch Your GC Carrier Gas to Hydrogen

Faced with helium shortages and prices that continue to soar upwards like a runaway party balloon? Consider switching to hydrogen as your carrier gas. High-quality hydrogen is readily available from either high-pressure cylinders or hydrogen generators. It is cost-effective and provides shorter analysis times (by half if running isothermally) than helium and many times yields better separations.

[Find out more.](#)

How to Maximize Column Oven Accuracy and Stability

Tips & Techniques for Long-term Instrument Performance

Simple tips and techniques are presented to improve the accuracy and precision of your data by keeping your column oven at peak performance. Details on reducing variation around the oven set point through calibration and maintenance are given.

[Find out more.](#)

Get Connected!

Do you need to connect a GC analytical column to a guard column or transfer line? Or repair a broken column? How about connecting two columns for primary and confirmation analysis from a single injection? Restek's extensive selection of GC connectors makes all of these connections possible. Here we review differences among our connectors and answer some frequently asked questions about our popular Press-Tight® connectors.

[Find out more.](#)

Considerations for Adapting an HPLC Method for MS Detection

Most HPLC methods can be coupled with mass spectral detection provided appropriate attention is given to pump capabilities, column diameter, and system plumbing, and to sample matrix and mobile phase composition. Here we discuss these considerations and provide tips on adapting your method to include mass spectral detection using either electrospray ionization or atmospheric pressure chemical ionization.

[Find out more.](#)

Using Micropacked Columns

Micropacked columns are 1-2 meter, 0.75-1.0mm ID packed stainless steel columns with performance characteristics intermediate between conventional packed columns and capillary columns. They are inexpensive, very durable, and easy to install and operate. They have a wide range of applications, but are especially useful for analyses of gas mixes, including sulfur compounds or light hydrocarbons, for which a packed column is needed to obtain baseline separations of sample components.

[Find out more.](#)

Restek's Knowledgeable Technical Support

Real People, Real Time and Real Results for YOU!

Restek's Technical Support group includes more than 64 individuals with extensive experience in chemistry, chromatography, engineering, and related fields. When you call Restek, you have access to the combined expertise of everyone in this group. With more than 110 international distributors and dealers in 81 countries, we can understand and respond to your lab's unique challenges whether you are in North America, South America, Africa, Asia, Europe, the Pacific Rim or elsewhere.

[Find out more.](#)

Commonly Asked GC Questions

The Restek Chromatography Information Services Group answers hundreds of questions each month. The answers provided here deal with inquiries about guard column chemistry, column temperature limits, ghost peaks in GC/MS analyses, pesticides breakdown on cyano-phase columns, and column cage options.

[Find out more.](#)

How to Condition a New Capillary GC Column

Proper conditioning is essential for optimal performance from a capillary GC column, but inexperienced

chromatographers might not know the proper procedures for installing and conditioning a new column. Here, we summarize our recommendations for installation and conditioning procedures.

[Find out more.](#)

Leak Checking a GC System

Analysts should use an electronic leak detector when installing a new column or fitting, changing a cylinder, or troubleshooting the system. The portable, reliable, easy-to-use Restek Electronic Leak Detector reveals minute leaks without contaminating the system.

[Find out more.](#)

Preventing Septum Problems

Handy tips and tools for choosing the right septum for your application and instrument. Includes an overview of common septum problems including coring and bleed. Guidelines help you avoid extraneous peaks and optimize your system's performance.

[Find out more.](#)

How Hot is Your Septum?

Inlet design, including placement of the heating element, differs among manufacturers and as a result the temperature at the septum differs from the actual set point and the degree of this difference varies among manufacturers. Septa brands, however, are given a single maximum operating temperature. Here we demonstrate the temperature gradients within inlets for several popular GC models and discuss the pros and cons of hotter and cooler inlets.

[Find out more.](#)

Supplies for Agilent Instrument Injection Ports

EZ Twist Top™ Split/Splitless Port for Agilent GCs

Using our unique EZ Twist Top™ Injection Port, Septum Nut Removal Tool, and Inlet Liner Removal Tool, you can reduce maintenance time and frustration, eliminate tangled gas lines that can lead to leaks, and avoid contact with hot surfaces. The gas lines are attached to the EZ Twist Top™ Shell Weldment, not to the weldment — they are under the GC cover and cannot interfere with routine injection port maintenance. Changing inlet liners becomes a quick and simple task.

[Find out more.](#)

Injection Port Maintenance with FastPack™ Inlet Kits

Regular injection port maintenance helps ensure the best results from your analyses, and helps minimize downtime. Each FastPack™ inlet kit includes all the parts you need to perform routine maintenance — inlet liner (choose from four styles), O-ring, inlet seal and inlet seal washer, and septum — in a sealed Mylar® bag.

[Find out more.](#)

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Restek Technical Literature

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