

# THE RESTEK

## ADVANTAGE

### *new!* Micropacked GC Columns

*Improve the Separation of Low Molecular Weight Compounds*

- Higher efficiency compared to packed columns.
- Larger sample capacity than PLOT columns.
- All columns tested for packing and flow consistency.
- Silcosteel® tubing and endplugs improve inertness.
- Columns to fit packed and capillary injection ports
- Available with HayeSep® N, Q, R, S and Molecular sieve 5A and 13X packings.

#### Good efficiency and sample capacity

Column options for analyzing low molecular weight compounds have been limited. Packed columns filled with porous polymer packings offer one alternative, but yield limited resolution. Porous Layer Open Tubular (PLOT) capillary columns offer increased resolution, but have limited capacity. Also, small particles from PLOT columns can fragment from the column and cause contamination of valves and detectors. Another alternative for the analysis of low molecular weight compounds is micropacked columns.

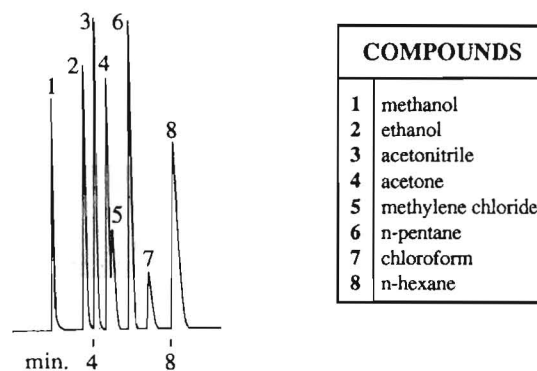
Micropacked columns offer features from both packed and capillary columns. Due to their narrow diameter, micropacked columns exhibit a greater efficiency than standard packed

columns. Micropacked columns offer much greater sample capacity than PLOT columns (1). Figure 1 shows a high concentration solvent mixture run by direct injection on a HayeSep® Q micropacked column. The symmetrical peak shape indicates no sample overloading even at these high concentrations.

#### Guaranteed packing

All columns are individually tested for packing weight and

**Figure 1 - HayeSep® Micropacked columns show excellent resolution and capacity.**



2m, 1mm ID HayeSep® Q Micropacked Column (cat.# 19107)  
 1ml direct injection of a neat solvent mixture  
 Oven temp.: 80° to 180°C @ 16°C/min. (hold 5 min.)  
 Inj. & det. temp.: 200°C Carrier gas: helium  
 Flow: 20ml/min. set @ 40°C  
 FID sensitivity: 512 x 10<sup>-11</sup> AFS

flow consistency. Variation in packing weight and density is limited to less than 5% between columns. This results in micropacked columns that give reproducible retention times run- after-run and column-to-column.

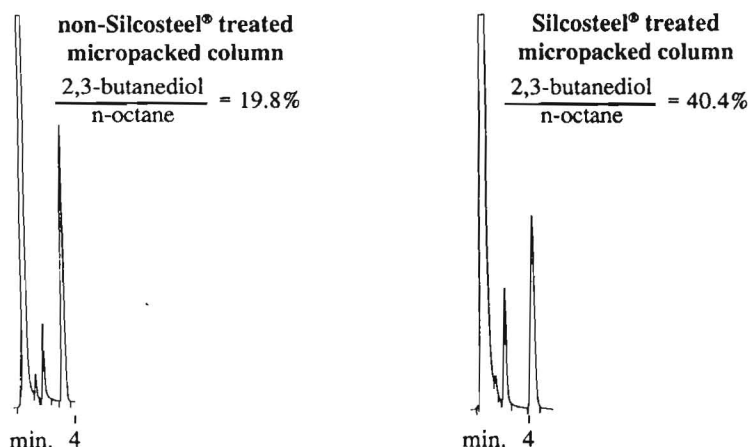
#### Silcosteel® process improves inertness

All micropacked columns are made with Silcosteel® tubing and deactivated to provide greater inertness. The Silcosteel® process deposits a thin layer of fused silica over the active metal surface. The endplugs are made from braided stainless steel that has also been treated using the Silcosteel® process to insure that the sample only contacts inert surfaces. To demonstrate this improved inertness, a Silcosteel® treated micropacked column was compared to a non-Silcosteel® column. A mixture containing 1000ppm of 2,3-butanediol and n-octane was run on both columns at 220°C isothermal. Active

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**Figure 2 - A Silcosteel treated micropacked column shows improved response of active compounds such as 2,3-butanediol.**



2m, 1mm ID HayeSep® Q Micropacked Column (cat.# 19017)  
 0.5ml direct injection of 1000ppm mix of 2,3-butanediol and n-octane in methylene chloride  
 Oven temp.: 220°C isothermal  
 Inj. & det. temp.: 250°C Carrier gas: helium  
 Flow: 20ml/min. set @ 40°C  
 FID sensitivity: 32 x 10<sup>-11</sup> AFS

compounds such as 2,3-butanediol will be adsorbed on untreated metal surfaces. Inert compounds such as n-octane do not exhibit adsorption. Therefore, the ratio of these components are a good indicator of column inertness. Figure 2 shows that the ratio of 2,3-butanediol to n-octane on the non-Silcosteel® treated column was only 19.8% and that the Silcosteel® treated micropacked column exhibited a ratio of 40.4%.

#### Micropacked columns fit packed and capillary injection ports

We have designed micropacked columns to fit both packed and capillary injection systems. The 1mm ID standard wall (1/16" OD) micropacked columns offer improved efficiency for packed column instruments without the expense of converting to capillary injection systems with no modifications. The 0.75mm ID thin wall (0.81mm OD) micropacked columns were designed to install directly into a capillary injector. Figure 3 shows a hydrocarbon mix run on a micropacked column using a split/splitless capillary injection system.

#### A wide range of porous polymer packings offered

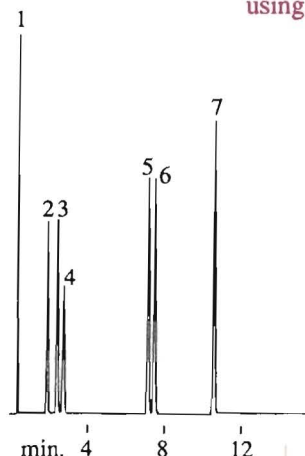
Micropacked columns are available in a wide range of HayeSep® porous polymer packing materials. HayeSep® materials were chosen since they go through extensive preparation to yield the greatest column to column reproducibility currently available for porous GC packings. These materials cover a wide range of polarities for most common applications. Table I shows the composition, maximum temperatures, and common applications of the HayeSep® packings offered.

**TABLE I**  
HayeSep® material properties

HayeSep® Material	Polymer Composition	Maximum Operating Temperature	Applications
N	DVB/EGDM	165°C	CO <sub>2</sub> , Water, & Acetylene
Q	DVB	275°C	Hydrocarbons & Sulfur gases
R	DVB/NV2P	250°C	Methyl esters & Formaldehyde
S	DVB/4VP	250°C	Alcohols & Nitriles

DVB= divinylbenzene      NV2P= N-vinyl-2-pyrrolidinone  
 4VP= 4-vinyl-pyridine      EGDM= ethyleneglycoldimethacrylate

**Figure 3 - A hydrocarbon mix can be analyzed with a split/splitless capillary injection system using a 2m X 0.75mm ID micropacked column.**



COMPOUNDS	
1	methane
2	ethylene
3	acetylene
4	ethane
5	propylene
6	propane
7	1-butene

2m, 0.75mm ID HayeSep® S Micropacked Column (cat.# 19011)  
 500ml split injection of a light hydrocarbon gas mixture  
 Oven temp.: 40°C (hold 3 min.) to 150°C @ 15°C/min. (hold 5 min.)  
 Inj. & det. temp.: 220°C Carrier gas: helium  
 Flow: 20ml/min. set @ 40°C  
 FID sensitivity: 32 x 10<sup>-11</sup> AFS  
 Split ratio: 10:1



## Two molecular sieve packings also available

Molecular sieve materials have shown a unique ability to separate permanent gases. Micropacked columns are available with either 5A or 13X molecular sieve packings. These two molecular sieve materials cover a wide range of permanent gas applications. Figure 4 show the analysis of permanent gases on a 13X micropacked column. At 40°C, all of the gases are separated in under 3 minutes.

**TABLE II**

### Molecular Sieve Properties

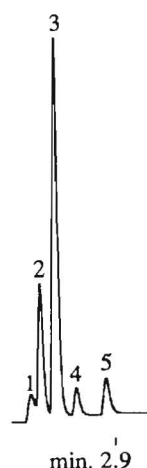
Material	Pore Size	Cation
5A	5A	Calcium
13X	10A	Sodium

Restek's new micropacked columns offer a unique mix of efficiency, sample capacity, and inertness. These columns provide the packed column user an improvement in separating efficiency. They offer the capillary chromatographer a less expensive alternative to PLOT columns for the separation of low molecular weight compounds. Micropacked columns also deliver improved sample capacity compared to PLOT columns. Available in a wide range of porous polymers and molecular sieves, these micropacked columns are ideal for the separation of low molecular weight compounds. ■

#### References

1) Tomas Herraiz, et. al., *Journal of Chromatography*, 388, pp. 325-333 (1987).

**Figure 4 - A 13X molecular sieve micropacked column can separate permanent gases in less than 3 minutes.**



COMPOUNDS	
1	hydrogen
2	oxygen
3	nitrogen
4	methane
5	carbon monoxide

2m, 1mm ID Molecular Sieve 13X Micropacked Column (cat.# 19005)  
 10ml direct injection of a permanent gas mixture (hydrogen spiked)  
 Oven temp.: 40°C isothermal  
 Inj./det. temp.: 150°C/100°C  
 Carrier gas: helium  
 Flow: 17ml/min. set @ 40°C  
 TCD filament temp.: 300°C

### Particle Sizes for Micropacked Columns

1mm ID	0.75mm ID
100/120 Mesh	120/140 Mesh

## Micropacked Column Product Listing

Hayesep® R Micropacked				
length	1mm ID		0.75mm ID	
1 meter	19012	\$75	19014	\$75
2 meter	19013	\$99	19015	\$99
Hayesep® Q Micropacked				
length	1mm ID		0.75mm ID	
1 meter	19016	\$75	19018	\$75
2 meter	19017	\$99	19019	\$99
Hayesep® N Micropacked				
length	1mm ID		0.75mm ID	
1 meter	19020	\$75	19022	\$75
2 meter	19021	\$99	19023	\$99
Hayesep® S Micropacked				
length	1mm ID		0.75mm ID	
1 meter	19008	\$75	19010	\$75
2 meter	19009	\$99	19011	\$99

5A Molecular Sieve Micropacked				
length	1mm ID		0.75mm ID	
1 meter	19000	\$75	19002	\$75
2 meter	19001	\$99	19003	\$99
13X Molecular Sieve Micropacked				
length	1mm ID		0.75mm ID	
1 meter	19004	\$75	19006	\$75
2 meter	19005	\$99	19007	\$99

**To order any Restek product,  
call 800-356-1688 (ext.3).**

# Analyze Sulfur Compounds in Petroleum Gases and Light Liquids

## Using Selective Sulfur Detection with our New, 4.0 $\mu$ m Rtx™-1.

The presence of trace organic sulfur compounds in petroleum products can have detrimental effects on the lifetime and performance of catalysts used in hydrocarbon processing. Furthermore, government agencies have scheduled changes to the specifications for total sulfur concentrations in Phase II gasoline to a maximum of 40 ppm. High resolution gas chromatography with sulfur specific detection provides a technique for quantitation of individual sulfur components in a wide range of petroleum products. By combining the amounts of the individual components, it is also possible to determine the total sulfur concentration in the sample.

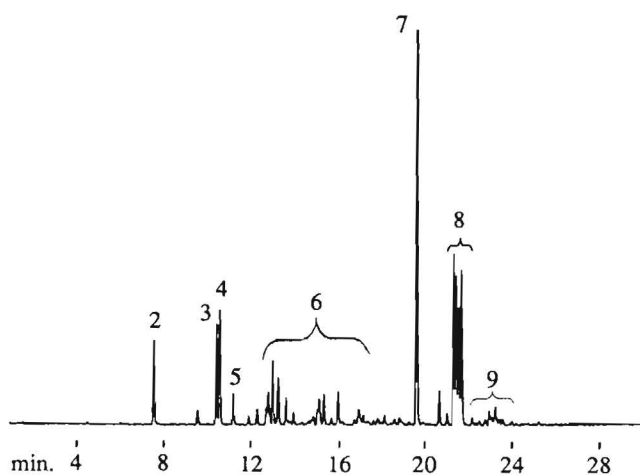
The American Society of Testing and Materials (ASTM) Committee D-2 on Petroleum products is evaluating a proposed test method<sup>1</sup> which utilizes a 30 meter x 0.32mm ID methyl silicone capillary column (Rtx™-1) and a sulfur specific detector (Sievers SCD). This method is applicable for measurement of individual sulfur compounds in hydrocarbon products that range from petroleum gases, to liquids with a final boiling point of 440°C. The advantage of this method compared to methods which determine a total sulfur concentration is that the system can be calibrated to report the composition and concentration of the organic sulfur components such as H<sub>2</sub>S, COS, mercaptans, thiophenes, benzothiophenes, sulfides and disulfides. This additional information may be useful in optimizing sulfur removal processes employed in hydrocarbon processing and gasoline refining.

Figure 1 shows a typical analysis of the sulfur components in gasoline using the Rtx™-1 column and the Sievers SCD. A new, thick film (4 $\mu$ m) column was selected for this method so that a single column can be used for a wide range of compounds from the more volatile sulfur gases to the higher molecular weight dimethylbenzothiophenes. This film thickness also increases the column capacity for the higher concentration hydrocarbons so that column overloading does not adversely effect the peak shape of the sulfur compounds.

It is also important that the column have low bleed to avoid a loss of sensitivity in the SCD from the buildup of silicone dioxide deposits on the reaction tube. Restek's 4 $\mu$ m Rtx™-1 column provides low bleed and does not degrade the sensitivity of sulfur specific detectors. Each column is preconditioned and individually tested using a temperature programmed QA test to ensure low bleed.

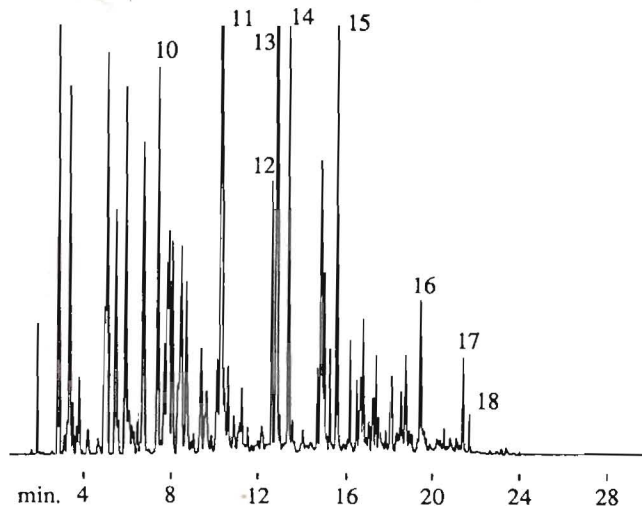
The Sievers detector can be operated for simultaneous detection of hydrocarbons and sulfur using a modified flame ionization detector. The chromatogram in Figure 2 shows the corresponding hydrocarbon response from the same gasoline analysis shown in Figure 1. The SCD is reported to be very sensitive and specific for organic sulfur compounds and does not have the quenching problems associated with flame photometric detectors<sup>2</sup>. Another detector suitable for the proposed ASTM test method is the HP 5921A Atomic Emis-

Figure 1 - 300ppm Total Sulfur in Gasoline by SCD



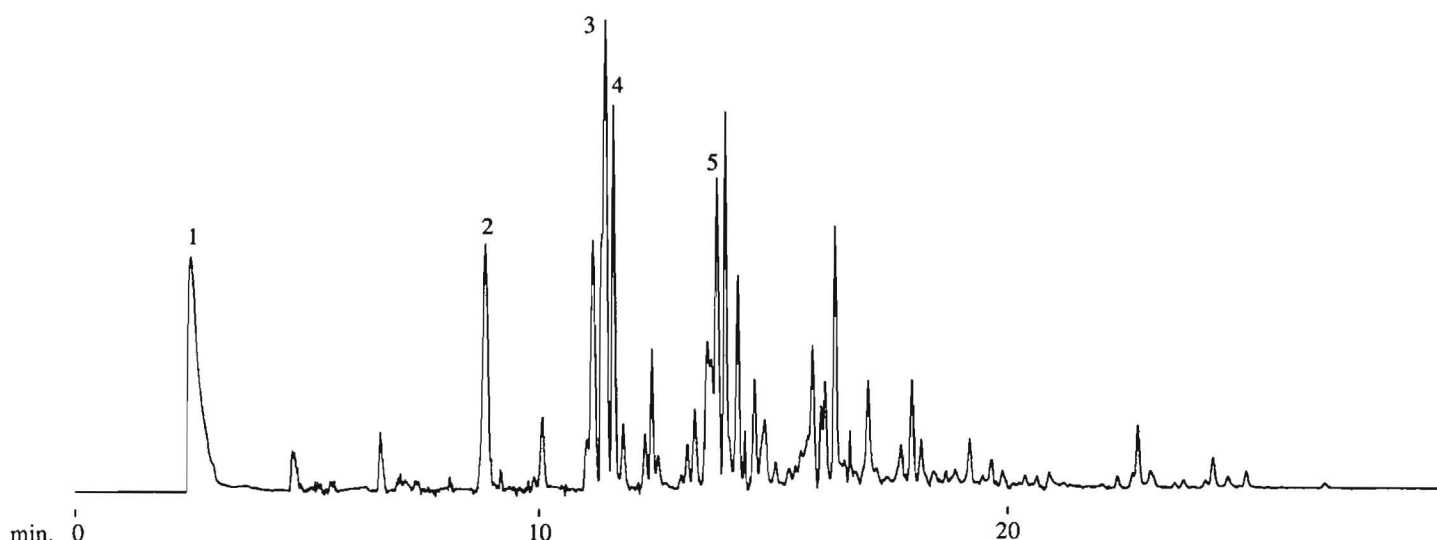
30m, 0.32mm ID, 4.0 $\mu$ m Rtx™-1 (cat.# 10198)  
1.0 $\mu$ l split injection of gasoline containing 300ppm total sulfur  
Oven temp.: 40°C (hold 3 min.) to 275°C @ 10°C/min. (hold 5 min.)  
Inj. & det. temp.: 275°C Carrier gas: helium  
Linear velocity: 70cm/sec. (2.5ml/min.)

Figure 2 - Hydrocarbons in Gasoline by FID





**Figure 3 - 500ppm Total Sulfur in Naphtha by AED**



30m, 0.32mm ID, 4.0µm Rtx™-1 (cat.# 10198)  
 1.0µl split injection of Naphtha containing 500ppm total sulfur  
 Oven temp.: 35°C to 275°C @ 10°C/min. (hold 5 min.)  
 Inj. & det. temp.: 275°C Carrier gas: helium  
 Linear velocity: 24cm/sec. (0.8ml/min.)

sion Detector (AED). By monitoring the 181 nm emission line of the AED<sup>3</sup>, a sulfur specific chromatogram is obtained. Figure 3 shows the analysis of a petroleum naphtha containing approximately 500ppm total sulfur using the Rtx™-1 column and an AED.

High resolution gas chromatography along with the detection capabilities of the SCD and AED detectors provides a powerful analytical technique for determining total sulfur and individual sulfur components in a variety of hydrocarbon products. The 4µm Rtx™-1 column offers the resolution, inertness, capacity, and low bleed needed to meet the requirements of the proposed ASTM test method. ■

#### References

1. ASTM Committee D-2 Proposed Standard Test Method for the Determination of Sulfur Compounds in Petroleum Gases and Light Liquids by Gas Chromatography and Chemiluminescence Detection.
2. S.E. Eckert-Tilotta, S.B. Hawthorne and D.J. Miller *Journal of Chromatography*, 591 (1992) 313-323
3. B. D. Quimby and P.C. Dryden, "Multielement Simulated Distillation with the HP 5921A Atomic Emission Detector", Hewlett Packard Application Note 228-205.

#### Peak List for Figures 1-3

COMPOUNDS	
1	hydrogen sulfide
2	thiophene
3	2-methylthiophene
4	3-methylthiophene
5	2-ethylthiophene
6	alkylthiophenes
7	benzothiophene
8	methylbenzothiophenes
9	dimethylbenzothiophenes
10	benzene
11	toluene
12	ethylbenzene
13	m & p-xylene
14	o-xylene
15	1,2,4-trimethylbenzene
16	naphthalene
17	1-methylnaphthalene
18	2-methylnaphthalene

#### Product Listing

30m, 0.32mm ID, 4.0µm Rtx™-1, cat.# 10198, \$425

# Rtx™-200, Methyl Trifluoropropyl

## Unique Selectivity Makes It Ideal for Many Analyses

- Excellent thermal stability • Low bleed with FIDs, ECDs, and MSDs • Ideal confirmational column •

Trifluoropropyl stationary phases have unique selectivity due to the electrophilic nature of the fluorine atom in the polymer backbone. This selectivity intensifies interactions with compounds that are electron rich such as ketones, nitro compounds, and Freon®s. This selectivity often resolves compounds that phenyl, cyano, and Carbowax® containing phases cannot.

While trifluoropropyls have been recognized for their unique selectivity, they have also suffered from low thermal stability, high bleed, poor inertness, and incomplete bonding of the stationary phase to the fused silica surface. Our trifluoropropyl polymer, the Rtx™-200, eliminates the common problems associated with typical trifluoropropyl phases. Because of the complete surface deactivation and high phase purity, inertness is exceptional, allowing highly active compounds to elute without tailing or adsorbing onto the column surface. Since the polymer is bonded to the surface and completely crosslinked, it can be solvent rinsed with a wide variety of solvents to clean sample residue from the polymer.

### Extended thermal stability & low bleed

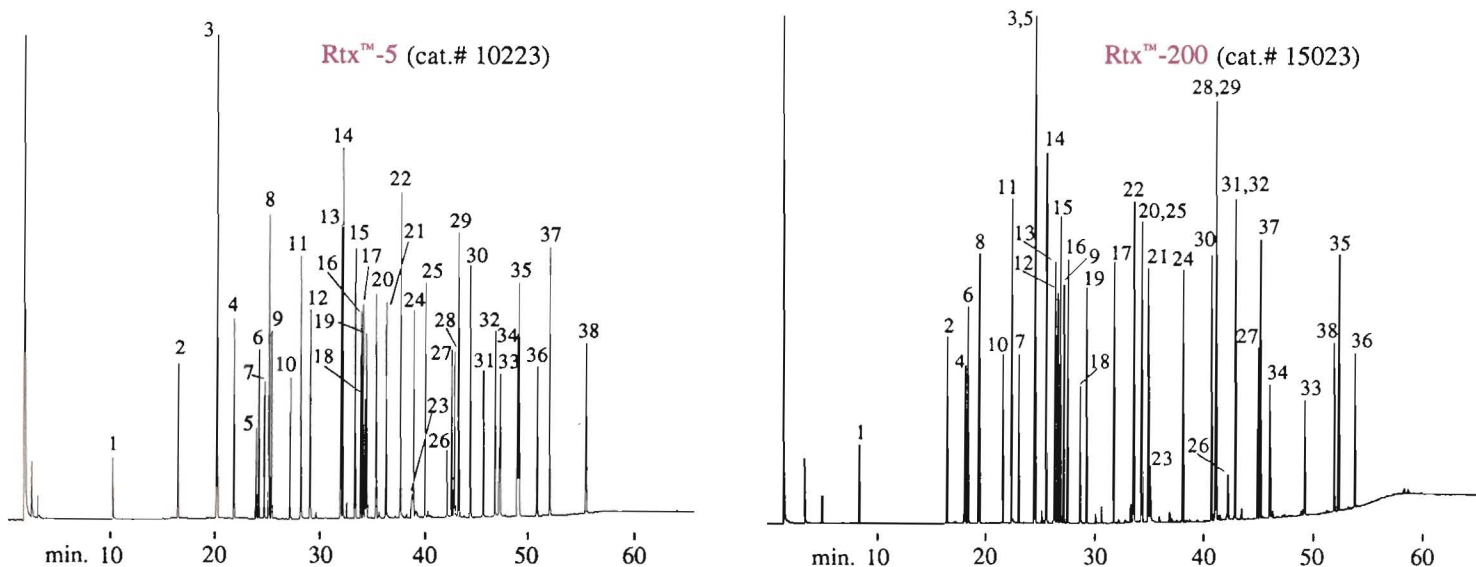
Rtx™-200's have the highest thermal stability of any commercially available trifluoropropyl phase. The fluorine groups on an Rtx™-200 would normally produce high bleed with an ECD. However, the crosslinking technology developed for this phase results in extremely low ECD bleed, even at high temperatures. The Rtx™-200 polymer is stable to 360°C, however, the useable upper temperature limit for thicker films has been decreased to temperatures that provide tolerable bleed for most detectors.

### Rtx™-200 can be used for a wide variety of applications

#### Toxicological analyses

Testing for the presence of drugs in biological fluids is a technique that is commonly used in drug overdose and drug abuse screening. The Rtx™-200 is an excellent column choice for toxicological analyses because of its selectivity for nucleophilic drugs. Compounds with electron donating groups, such as carbonyl, azo, and nitro, are preferentially retained on the Rtx™-200 when compared to compounds with similar base structures that do not contain these groups.

Figure 1 - Rtx™-200's unique selectivity improves specific separations of hard to resolve compounds.

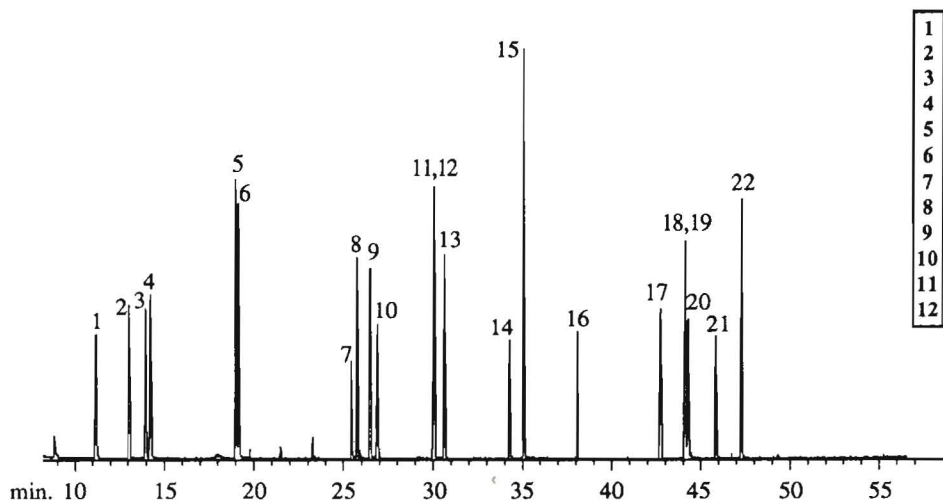


30m, 0.25mm ID, 0.25µm  
1.0µl split injection of 100µg/ml (2ng on-column)  
Oven temp.: 100°C to 320°C @ 4°C/min. (hold 10 min.)  
Inj./det. temp.: 225°C/300°C  
Carrier gas: helium  
Linear velocity: 30cm/sec. @ 100°C  
TSD sensitivity: 4 x 10<sup>-12</sup> AFS  
Split ratio: 50:1

1 benzocaine	9 chlorpheniramine	17 promazine	25 prazepam
2 cotinine	10 dextromethorphan	18 codeine	26 flurazepam
3 meperidine	11 methadone	19 morphine	27 haloperidol
4 caffeine	12 amitriptyline	20 diazepam	28 alprazolam
5 lidocaine	13 trimipramine	21 chlorpromazine	29 triazolam
6 phencyclidine	14 imipramine	22 chlorprothixene	30 thioridazine
7 doxylamine	15 medazepam	23 clobazam	31 verapamil
8 phenyltoloxamine	16 pentazocine	24 flunitrazepam	32 strychnine



**Figure 2 - The Rtx™-200 yields excellent separation of nitro-explosive compounds.**



1	2-nitrotoluene	13	2,3-dinitrotoluene
2	3-nitrotoluene	14	3,4-dinitrotoluene
3	4-nitrotoluene	15	3-nitrobiphenyl
4	2,3-diaminotoluene	16	2,4,6-trinitrotoluene
5	2,6-diaminotoluene	17	2,4,5-trinitrotoluene
6	2,4-diaminotoluene	18	4-amino-2,6-dinitrotoluene
7	1,4-dinitrobenzene	19	2,3,4-trinitrotoluene
8	2,6-dinitrotoluene	20	1,3-dinitronaphthalene
9	2-amino-6-nitrotoluene	21	2,6-diamino-4-nitrotoluene
10	1,3-dinitrobenzene	22	2-amino-4,6-dinitrotoluene
11	2,4-dinitrotoluene	23	2,2'-dinitrobiphenyl
12	2-amino-4-nitrotoluene		

30m, 0.25mm ID, 0.25µm, Rtx™-200 (cat.# 15023)  
 1.0µl splitless injection of 20ng/µl explosives  
**Oven temp.:** 80°C (hold 2 min.) to 260°C @ 3°C/min. (hold 2 min.)  
**Inj./det. temp.:** 280°C/300°C  
**Carrier gas:** helium  
**Linear velocity:** 20cm/sec. @ 80°C  
**Splitless hold time:** .6 min.  
**MSD Scan range:** 45-300

Figure 1 shows the analysis of acidic, basic, and neutral drugs on an Rtx™-5 and Rtx™-200. Large changes in elution order between the two can be attributed to the presence of specific functional groups in the analytes. Benzodiazepines exhibit strong affinity on the Rtx™-200 because of an azo and carbonyl group in the molecule. Cotinine and caffeine are retained significantly longer on the Rtx™-200 than the other early eluting compounds due to the presence of a carbonyl group on the ring of both compounds.

#### Explosive analysis

Due to the nature of explosive compounds, they are typically performed using HPLC with either a C-18 or a CN reverse phase column. A common problem that arises when using HPLC columns is that the isomer pair; 2,4-diaminotoluene and 2,6-diaminotoluene are only partially resolved. The resolution

can be reduced when one isomer exists at a much higher concentration than the other, causing a complete coelution between the two isomers. The Rtx™-200 column is ideal for analyzing explosives because of nitro groups in the analyte structure (Figure 2). The Rtx™-200 yields improved resolution between 2,6-diaminotoluene/2,4-diaminotoluene and excellent separation between 21 other explosives in under 60 minutes.

The Rtx™-200 is a highly selective stationary phase that is ideal for many types of analyses. Because of its unique selectivity, it offers analysts an alternative to other intermediate polarity columns. The maximum operating temperature, low column bleed, and excellent inertness make the Rtx™-200 a superb confirmation column. Rtx™-200's are available in a wide variety of lengths, film thicknesses, and diameters to solve your most difficult analytical separations. ■

## Rtx™-200 Product Listing

length	df (µm)	0.25mm ID	0.32mm ID	0.53mm ID
15 meter	0.10	15005 \$260	15006 \$285	15007 \$300
	0.25	15020 \$250	15021 \$275	15022 \$290
	0.50	15035 \$250	15036 \$275	15037 \$290
	1.00	15050 \$250	15051 \$275	15052 \$290
	1.50		15066 \$275	15067 \$290
	3.00			15082 \$290
30 meter	0.10	15008 \$410	15009 \$435	15010 \$485
	0.25	15023 \$400	15024 \$425	15025 \$475
	0.50	15038 \$400	15039 \$425	15040 \$475
	1.00	15053 \$400	15054 \$425	15055 \$475
	1.50		15069 \$425	15070 \$475
	3.00			15085 \$475

length	df (µm)	0.25mm ID	0.32mm ID	0.53mm ID
60 meter	0.10	15011 \$695	15012 \$750	15013 \$875
	0.25	15026 \$685	15027 \$740	15028 \$850
	0.50	15041 \$685	15042 \$740	15043 \$850
	1.00	15056 \$685	15057 \$740	15058 \$850
	1.50		15072 \$740	15073 \$850
	3.00			15088 \$850
105 meter	0.10	15014 \$920	15015 \$995	
	0.25	15029 \$900	15030 \$975	
	0.50	15044 \$900	15045 \$975	
	1.00	15059 \$900	15060 \$975	
	1.50		15075 \$975	
	3.00			15091 \$1400

length	df (µm)	0.18mm ID	length	df (µm)	0.18mm ID	length	df (µm)	0.18mm ID
10 meter	0.20	45001 \$225	20 meter	0.20	45002 \$350	40 meter	0.20	45003 \$625
	0.40	45010 \$225		0.40	45011 \$350		0.40	45012 \$625





# Clinical Corner

## Testing for Organic Volatile Impurities - Updates on USP 467

In the Third Supplement to the USP XXII-NF XVII, a new test for the analysis of Organic Volatile Impurities (OVI) in pharmaceutical products was published that became effective November 15, 1990. Since its original appearance in the USP, this testing protocol has undergone many revisions and additions. Table I shows the current list of methods and their corresponding chromatographic systems. Many issues related to USP 467 have been addressed in the Pharmacopeial Forum including sample introduction, standard preparation, detection limits, sample amounts, and column selection.

Table I

	Column	Detector	Sample Introduction
Method I	5% phenyl/95% methyl polysiloxane (G27) 30m, 0.53mm ID, 5.0µm (cat.# 10279)	FID	Direct Aqueous Injection
Method II	1% polyethylene glycol/TPA (G25) on graphitized carbon (S12)	FID	Dynamic Headspace
Method III	1% polyethylene glycol/TPA (G25) on graphitized carbon (S12)	MSD	Dynamic Headspace
Method IV	6% cyanopropylphenyl/94% dimethylpolysiloxane (G43) 30m, 0.53mm ID, 3.0µm (cat.# 16085)	FID	Static Headspace
Method V	6% cyanopropylphenyl/94% dimethylpolysiloxane (G43) 30m, 0.53mm ID, 3.0µm (cat.# 16085)	FID	Direct Aqueous Injection
Method for Coated Tablets	0.2% polyethylene glycol/MW 1500 (G39) on graphitized carbon (S7)	FID	Static Headspace

Methods I and V are the most commonly used methods for OVI analysis. One of the drawbacks associated with these methods is the use of aqueous injections for sample introduction. High injection port temperatures can produce large expansion volumes for injections of as little as 1µl of water. When the expansion volume of the sample exceeds the buffer volume of the injection port liner, backflash can occur and some sample can be lost through the septum purge line. The injection port temperatures for Methods I and V were originally specified to be 180°C and 140°C respectively. At high temperatures, reproducibility of injections is poor. Data supplied by Bergren and Foust<sup>1</sup> demonstrated that a decrease in injection port temperature from 180°C to 70°C yielded lower relative standard deviations for peak area response for replicate injections. Revisions have been made to Method I to lower the injection port temperature to 70°C, but the injection port temperature for Method V has not been revised as of the date of this article.

Poor reproducibility of peak area response is also related to the amount of analyte reaching the column. The response for chloroform on an FID is very poor. At the concentrations originally specified for the Standard Solutions, the chloroform response cannot be reproducibly detected above the baseline noise. Krasowski<sup>2</sup> et al. proposed two solutions that had been previously mentioned in the In Process Revision<sup>3</sup> comments in the Pharmacopeial Forum. The first was to double the concentration of OVIs in the Standard Solution and the second was to double the amount of bulk pharmaceutical used to produce the test solution. Both of these modifications increased the on-column concentration and produced a more consistent peak area response for each analyte. USP also increased the allowable relative standard deviation to 15% after finding that 10% was too demanding.

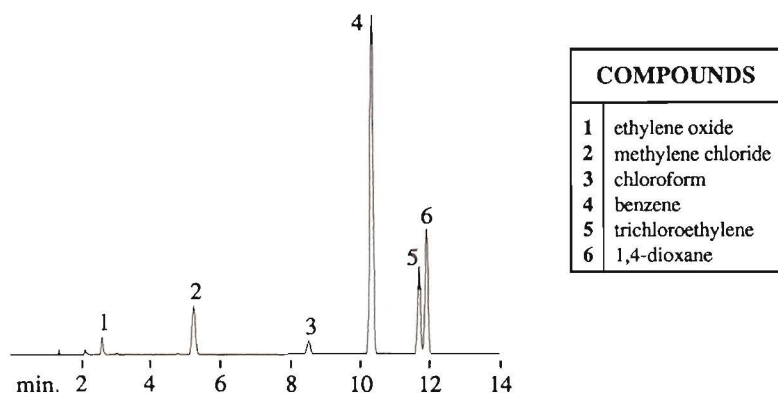
USP has also simplified the standard preparation procedure. The solubility for the OVI's in water is very poor and direct dissolution of these compounds in water is difficult. Standard stability and lifetime can be improved by using stock solutions of the OVI's prepared in DMSO and then making dilutions of the stock standard to produce working standards. Comments in the September/October 1992 Pharmacopeial Forum<sup>4</sup> propose the use of DMSO as the solvent for the stock standard.

Choosing a capillary column to perform OVI analysis has also been a subject for debate. Method I uses a capillary column interfaced with an FID with sample introduction via direct injection of an aqueous sample. The column specified is a 30 meter, 0.53mm ID, 5µm 5% phenyl/95% methyl polysiloxane (G27). When Method I was originally published, a resolution factor of 1.5 was included in the system suitability parameters. Figure 1 shows the analysis of the target compounds for USP 467 on the Rtx™-5 column. Peaks 5 and 6, trichloroethylene and 1,4-dioxane, are not completely resolved and have a calculated resolution factor (R) of 1.4. The criteria for a resolution factor of 1.5 was reduced to 1.0 in the Fifth Supplement in order to make the system suitability requirements easier to achieve. Method V was also introduced in the Fifth Supplement and incorporated the use of a 6% cyanopropylphenyl/94% dimethylpolysiloxane (G43) stationary phase as an alternative to the 5% phenyl/95% methyl polysiloxane stationary phase. Figure 2 shows the use of an Rtx™-1301 column, 6% cyanopropylphenyl stationary phase, for the analysis of organic volatile impurities. Baseline resolution of all of the compounds is obtained and the resolution criteria of 3.0 is easily met.

(Clinical Corner is continued on page 11.)

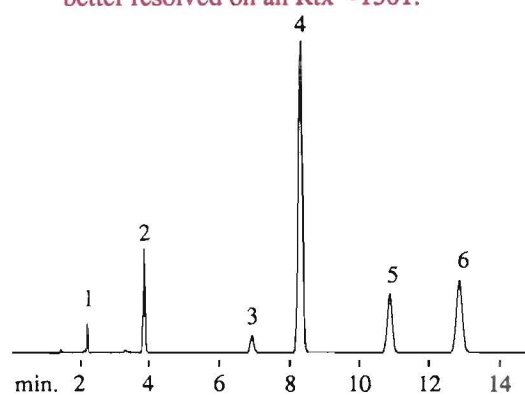


**Figure 1 - USP 467 target compounds run on an Rtx™-5.**



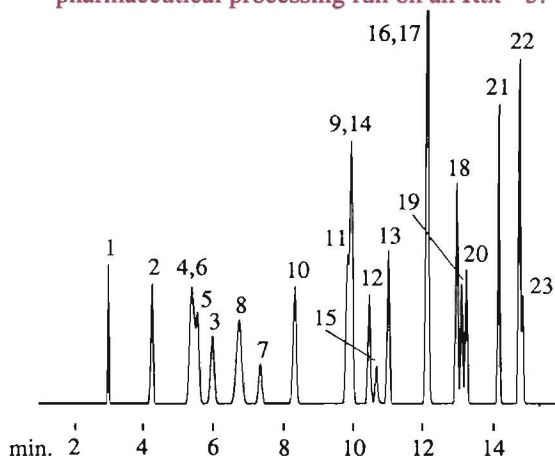
30m, 0.53mm ID, 5.0µm, Rtx™-5 (cat.# 10279)  
 1.0µl split injection of USP 467 Calibration Mix  
**Oven temp.:** 35°C (hold 5 min.) to 175°C @ 8°C/min.,  
 then to 260°C @ 35°C/min.  
**Inj./ det. temp.:** 180°C/260°C  
**FID sensitivity:** 1.28 x 10<sup>-10</sup> AFS  
**Carrier gas:** helium  
**Linear velocity:** 35cm/sec. @ 35°C  
**Split ratio:** 10:1

**Figure 2 - USP 467 target compounds are better resolved on an Rtx™-1301.**



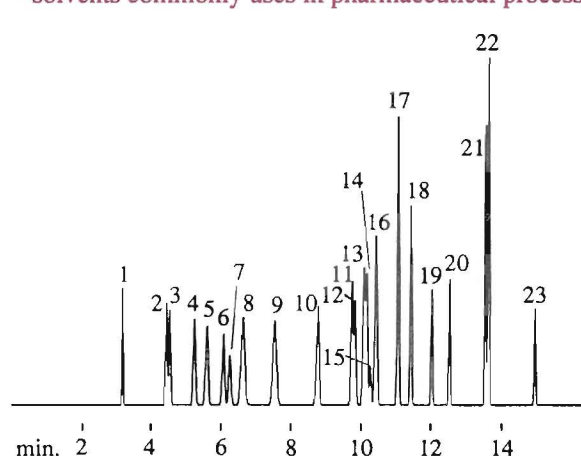
30m, 0.53mm ID, 3.0µm, Rtx™-1301 (cat.# 16085)  
 1.0µl split injection of USP 467 Calibration Mix  
**Oven temp.:** 40°C (hold 20 min.) to 240°C @ 35°C/min. (hold 10 min.)  
**Inj./ det. temp.:** 180°C/260°C  
**FID sensitivity:** 1.28 x 10<sup>-10</sup> AFS  
**Carrier gas:** helium  
**Linear velocity:** 35cm/sec. @ 40°C  
**Split ratio:** 10:1

**Figure 3 - Solvents commonly used in pharmaceutical processing run on an Rtx™-5.**



30m, 0.53mm ID, 5.0µm, Rtx™-5 (cat.# 10279)  
 0.5µl split injection of residual solvents from pharmaceutical processing  
**Oven temp.:** 35°C (hold 7 min.) to 240°C @ 15°C/min  
**Inj./ det. temp.:** 180°C/260°C  
**FID sensitivity:** 1.28 x 10<sup>-10</sup> AFS  
**Carrier gas:** helium  
**Linear velocity:** 25cm/sec. @ 35°C  
**Split ratio:** 30:1

**Figure 4 - Better resolution is observed on an Rtx™-1301 for solvents commonly uses in pharmaceutical processing.**



30m, 0.53mm ID, 3.0µm, Rtx™-1301 (cat.# 16085)  
 0.5µl split injection of residual solvents from pharmaceutical processing  
**Oven temp.:** 35°C (hold 8 min.) to 240°C @ 20°C/min.  
**Inj./ det. temp.:** 180°C/260°C  
**FID sensitivity:** 1.28 x 10<sup>-10</sup> AFS  
**Carrier gas:** helium  
**Linear velocity:** 25cm/sec. @ 35°C  
**Split ratio:** 30:1

**Peak List for Figures 3 and 4.**

COMPOUNDS		
1	methanol	9
2	ethanol	10
3	diethyl ether	11
4	acetone	12
5	isopropanol	13
6	acetonitrile	14
7	methylene chloride	15
8	tert-butanol	16
		17
		18
		19
		20
		21
		22
		23

## Product Listing

30m, 0.53mm ID, 5.0µm <b>Rtx™-5</b>	cat.# 10279, \$455
30m, 0.53mm ID, 3.0µm <b>Rtx™-1301</b>	cat.# 16085, \$445
<b>USP 467 Calibration Mix</b>	cat.# 36000, \$20 each
	cat.# 36100, \$180/10pk.
<b>5m, 0.53mm ID Phenyl Methyl Deactivated Guard Columns</b>	cat.# 10045, \$60 each
	cat.# 10045-600, \$300/6pk.

# Standards Spotlight



## Additional Standard for Underground Storage Tank Monitoring

• Latest protocol revisions • Important product changes • Full data packs available •

The State of Wisconsin, Department of Natural Resources has modified the composition of the Gasoline Range Organics (GRO) standard enabling laboratories to calibrate for both the Petroleum Volatile Organic Compound (PVOC) and the GRO simultaneously (1). This new standard may be used by laboratories to increase lab efficiency and decrease overall cost by streamlining the analytical method calibration sequence.

Restek's commitment has been to provide quality standards for all method modifications as quickly and cost effectively as possible. In addition, unlike other companies, full data pack documentation is available for every environmental standard we produce.

### Wisconsin PVOC/GRO Mix

1000µg/ml each in 1ml purge & trap grade methanol.

methyl-t-butyl ether	benzene
toluene	ethylbenzene
o-xylene	m-xylene
naphthalene	1,2,4-trimethylbenzene
1,3,5-trimethylbenzene	
Cat.# 30085	\$25 ea.
30085-500	\$55 ea. w/data pack
30185	\$225 10pk. w/data pack

1) LUST RELEASE, Vol. 2, No. 3, April 1992, Wisconsin Department of Natural Resources, Leaking Underground Storage Tank Program, P.O. Box 7921, Madison, WI 53707, Phone: (608)266-2172.

## LUST Retention Time Standard Changes

In *The Restek Advantage*, Vol. 3 No. 6, November 1992, we introduced a product called the LUST Retention Time Standard. This mixture initially contained the normal paraffins C5, C6, C10, C12, C24, C28, C30, and C40 in methylene chloride at 2500µg/ml each (cat.#'s 31099, 31099-500, and 31199). After further method review and discussion with several analytical laboratories, it became evident that this mixture had several problems associated with its use.

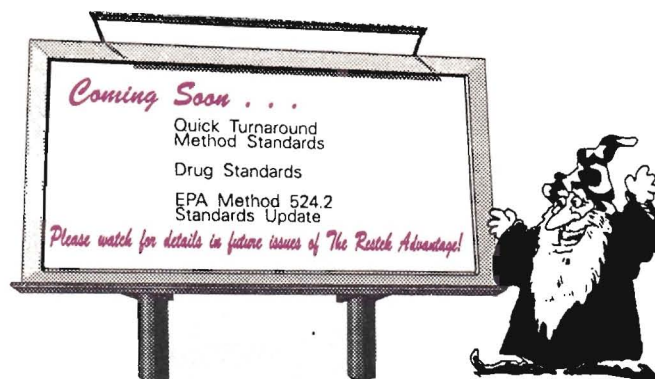
To circumvent these analytical problems, we are discontinuing this mixture (cat.#'s 31099, 31099-500, 31199) and replacing it with a new mixture. This new mixture is designed to

determine the retention time windows for elution of gasoline, diesel, and other heavy oils during initial sample screening.

### LUST Retention Time Standard

25µg/ml each in 1ml methylene chloride.

hexane (C6)	
decane (C10)	
dodecane (C12)	
tetracosane (C24)	
octacosane (C28)	
triacontane (C30)	
tetracontane (C40)	
Cat.# 31200	\$28 ea.
31200-500	\$58 ea. w/data pack
31300	\$252 10pk. w/data pack





# Improved Surrogate Mixture for SW-846 Method 8021

We have carefully reviewed EPA Method 8021 and found several problems with the specified standards; in particular, the surrogate mixture. As written, the internal standard mixture specified is to contain fluorobenzene and 2-bromo-1-chloropropane. The surrogate mixture specified contains bromochloromethane, 2-bromo-1-chloropropane, 1,4-dichlorobutane, and bromochlorobenzene.

During our initial review, we inadvertently missed the duplication of 2-bromo-1-chloropropane in both mixtures, and the inclusion of bromochloromethane (which is also a target analyte). Also, the EPA had failed to specify which bromochlorobenzene (2-, 3-, or 4-) should be used. Our testing has determined that the 2-bromochlorobenzene should be used since it can be easily resolved from other analytes. As a result, the 8021 Volatile Organics Kit (cat.#'s 30072 and 30072-500) is being discontinued. We are now offering a replacement 8021 Volatile Organics Kit which includes the new 8021 Surrogate Mix.

## 8021 Surrogate Mix

1500µg/ml each in 1ml purge & trap grade methanol.

1,4-dichlorobutane	2-bromochlorobenzene
Cat.# 30086	\$25 ea.
30086-500	\$35 ea. w/data pack
30186	\$225 10pk. w/data pack

## 8021 Volatile Organics Kit

Contains one ampul (1ml) each of the following mixtures:

30041	502.2 Internal Standards Mix (IS)
30042	502.2 Calibration Mix #1
30043	502.2 Calibration Mix #2
30044	502.2 Calibration Mix #3
30045	502.2 Calibration Mix #4
30046	502.2 Calibration Mix #5
30047	502.2 Calibration Mix #6
30086	8021 Surrogate Mix

Cat.# 30087	\$210 ea.
30087-500	\$360 ea. w/data pack

## Attention VOA Lab Analysts . . .

## We're Working Harder to Make Your Job Easier

Restek has acquired pure individual cis- and trans-1,3-dichloropropene. All mixtures made after July 1992 that contain these two compounds will be exactly the concentration specified in our literature. Analysts using these mixtures won't have to change computer calibration files to adjust concentration for these compounds with each lot of material purchased. Verify the exact mixture composition on the certificate of analysis supplied with each ampul.

Restek mixtures that contain cis- and trans-1,3-dichloropropene:

**VOA Calibration Mix #4** (cat.#'s 30009, 30009-500, 30109)  
**502.2 Calibration Mix #2** (cat.#'s 30043, 30043-500, 30143)  
**624 Calibration Mix #3** (cat.#'s 30022, 30022-500, 30122)  
**8010A Calibration Mix #2** (cat.#'s 30056, 30056-500, 30156)

## Clinical Corner (continued from page 8)

In addition to giving superior resolution for the organic volatile impurities listed in USP 467, the Rtx™-1301 column also shows improved performance for analyzing other solvents as well. Figures 3 and 4 show the analysis of a set of commonly used solvents in pharmaceutical processing. The Rtx™-1301 is able to at least partially resolve all of the solvents in the mixture while the Rtx™-5 has three complete coelutions.

In a review<sup>5</sup> of the current status of USP 467, the USP is advocating the conversion of monograph requirements from Method I to Method V to allow for the use of the cyanopropyl stationary phase for better resolution. They are also anticipating that more laboratories will begin to use the static headspace technique as a means of replacing the direct injection of aqueous samples and its associated problems. These changes,

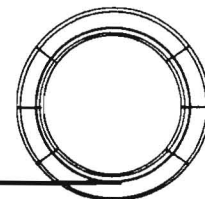
along with the current revisions to USP 467, should result in an easier to use and more reproducible method for the future. ■

### References

1. Bergren, M.S., Foust, D.W., Comments on USP General Chapter, Organic Volatile Impurities <467>, and Associated Monograph Proposals. *Pharmacopeial Forum*, May/June 1991, Volume 17 Number 3, pp. 1963-1968.
2. Krasowski, J.A., Dinh, H., O'Hanlon, T.J., Lindauer, R.F., Comments on Organic Volatile Impurities, Method I, <467>. *Pharmacopeial Forum*, May/June 1991, Volume 17 Number 3, pp. 1969-1972.
3. *Pharmacopeial Forum*, March/April 1991, Volume 17 Number 2, p. 1653.
4. *Pharmacopeial Forum*, September/October 1992, Volume 18 Number 5, p.4028.
5. Gray, V., Organic Volatile Impurities Testing Initiative: An Update. *Pharmacopeial Forum*, March/April 1992, Volume 18 Number 2, p. 3205.



# Hints for the Capillary Chromatographer



## Solvent Loss from Snap-Cap Autosampler Vials

### What are snap-cap autosampler vials?

Snap-cap vials and closures are being marketed as an alternative to crimp type aluminum seals used with autosampler vials. The plastic seals are typically made of polypropylene or polyethylene. Snap-caps can be pushed on or pried off by hand, without the use of tools like crimpers and decappers. The snap-cap stays on by either gripping under the lip of a standard autosampler vial, or the snap-cap may have teeth that pop into a special slot-lipped autosampler vial.

### Determining the suitability for storing organic solvents

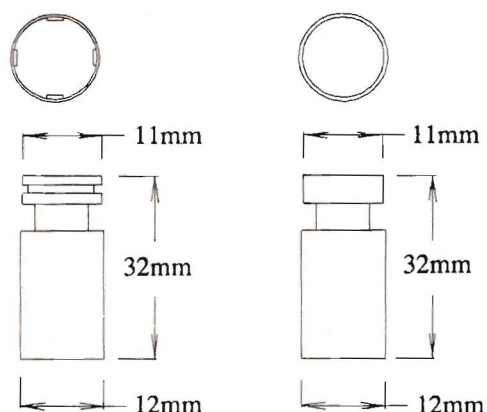
Three brands of 12 x 32mm vials with snap-caps were evaluated against standard vials with aluminum crimp-tops, to determine if the snap-caps could prevent solvent loss at room temperature. The products evaluated were: Brand X and Brand Y snap-caps using standard autosampler vials, and Brand Z snap-caps using special slot-lipped autosampler vials. The reference, used for comparison, were aluminum crimp-top vials equipped with Teflon/red rubber septum.

A slot-lipped autosampler vial and a bottom view of its snap-cap are shown on the left side of Figure 1. This is the design of the Brand Z snap-cap vials. Its snap-cap is held down by its four "teeth" that pop into the vial's slotted lip. A standard autosampler vial and a bottom view of its toothless snap-cap are shown on the right side of Figure 1. This is the design of the Brand X and Y snap-caps. This snap-cap has a ridge around the bottom inside of the cap that grips under the lip of a standard vial.

The two solvents used in this study were methylene chloride (40°C boiling point) and methanol (65°C boiling point). These are two of the most common solvents used in gas chromatography. One milliliter of solvent was volumetrically pipetted into each vial to ensure equal headspace. The vials were then carefully capped and the absolute weight of the vial, solvent, and cap was then determined to the nearest tenth of a milligram. The samples were then stored at room temperature (22 +/- 2°C) and reweighed at selected time intervals over a period of 6 days.

The test results are shown in Figures 2 and 3. The reference crimp-top vials showed the least solvent loss. The Brand X vials were the best performing snap-cap vials and their solvent loss was slightly greater than the crimp-top vials. Figure 2 shows the results for the crimp-top vials compared to Brand X snap-cap vials using a magnified scale. While the solvent loss with Brand X snap-cap vials reached approximately 0.7% with

Figure 1 - Design of Snap-Cap Autosampler Vials



*Note: While the vials alone are identical in their overall dimensions, the assembled snap-cap autosampler vials may differ significantly from standard crimp-top vials. The snap-cap vials may be taller, wider, or have shorter necks than assembled crimp-top vials.*

methylene chloride over a 135 hour period, this may not be significant enough to be of concern.

Figure 3 shows results for crimp-top vials compared to Brand Y and Z plotted on a larger scale. The scale had to be significantly expanded to show the extreme loss of solvent with these two types of snap-cap vials. Brand Y and Z closures performed so poorly that by comparison, the crimp-top vials show no apparent loss of solvent.

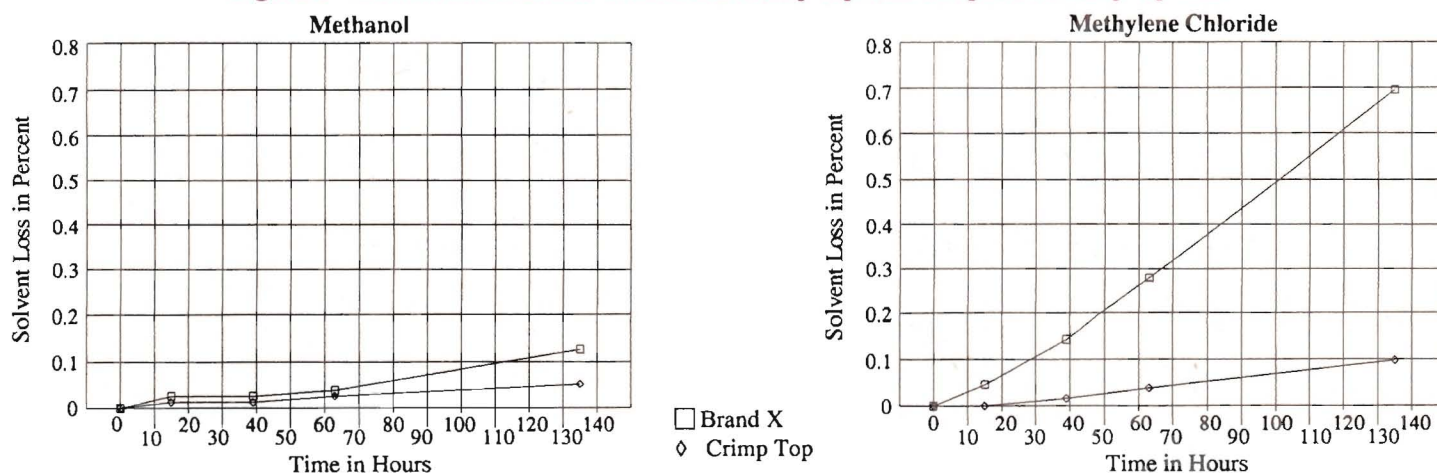
As shown in both figures, the more volatile the solvent being stored in the snap-cap vial, the greater the loss of solvent over a period of time. The snap-cap vials tested did not hold the septum as firmly in place against the top of the vial as the crimp-top vials did. This may be the most significant factor for the solvent losses measured. There is some speculation that chlorinated solvents may also cause swelling of the plastic caps, further aggravating the problem. This idea is currently being evaluated.

### How much does solvent loss effect sample concentration?

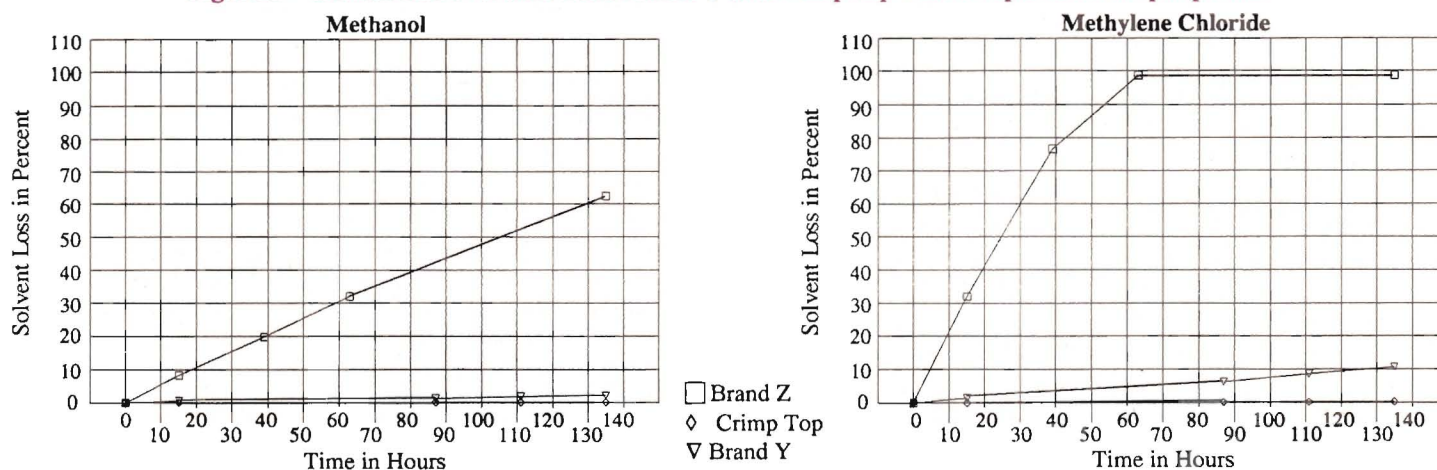
The loss of solvent with Brand Y and Z closures would cause a significant increase in the concentration of non-volatile analytes stored in a volatile solvent such as methylene chloride. Since all calibration standards are prepared on a weight per volume basis, any loss of volume will cause an increase in effective concentration of a non-volatile analyte.



**Figure 2 - Solvent loss over time from Brand X snap-cap vials compared to crimp-top vials**



**Figure 3 - Solvent loss over time from Brands Y and Z snap-cap vials compared to crimp-top vials.**



This increase can be calculated if the amount of solvent loss is known, as shown in this example. Brand Z snap-cap vials containing methylene chloride lost 32% during a 15 hour time period. If the initial concentration of the non-volatile analyte was 100µg/ml, the loss of 32% of the solvent in a 1ml sample would increase the concentration to 147µg/ml.

$$\frac{\text{weight of the analyte in vial}}{(\text{1ml} - \text{volume lost})} = \frac{100\mu\text{g}}{(\text{1ml} - 0.32\text{ml})} = \frac{100\mu\text{g}}{0.68\text{ml}} = 147\mu\text{g/ml}$$

If volatile analytes dissolved in a less volatile solvent are stored in a snap-cap system, the concentration change would be greatly dependant upon the partial vapor pressure and solubility partition coefficient of each material. The change in concentration would have to be determined experimentally with each compound of interest being tested.

#### What to check before using snap-cap vials

Thoroughly testing a snap-cap autosampler vial system before you use it with your valuable samples can save you lost time and money. First, a test to determine solvent or volatile analyte loss to confirm the quality of the closure. Next, a test should be conducted to determine if the snap-cap vials will feed reliably through your autosampler without jamming. This is especially

important with snap-cap vials since the overall assembled dimensions of a snap-cap vial may vary compared to crimp-top vials. The final test should be to evaluate an entire sampling sequence to insure trouble-free unattended operation. Taking some time to fully evaluate a snap-cap vial can save you the loss of your valuable samples.

#### How to get the best performance out of crimp-top vials

A few simple steps is all it takes to protect your valuable samples in a crimp-top autosampler vial. Fill the vial to the very top if possible. Limiting the vial headspace is essential with volatile gases dissolved in solution. Always crimp the cap tight enough that the cap does not move freely around the vial lip. This ensures that the septum is being held firmly against the top of the vial. Store samples at reduced temperatures in deactivated vials with an unpierced, Teflon® faced septum. This will reduce sample evaporation and prevent analyte degradation and adsorption.

While snap-cap autosampler vials offer ease of use over crimp-top vials, they may not be suitable for volatile solvents or analytes. Snap-cap vials should be thoroughly tested against crimp-top vials with representative samples under the same analysis conditions to ensure that they work properly. ■



# Peak Performers

## Visually Confirm Proper Column Installation with Vu-Tight™ Direct Injection Sleeves

- Visually confirm connection between the column end and sleeve
- Fits HP, Varian, and most 1/4-inch packed column injection ports with maximum insertion depths of 4 inches
- Converts packed column inlets for use with 0.32 and 0.53mm ID fused silica capillary columns (tubing OD must be 0.4mm or greater)
- Deactivated, strong, and extremely inert
- Slotted top prevents obstruction of carrier gas flow
- Low cost

Convert packed column inlets for use with 0.32 and 0.53mm ID high resolution capillary columns using the new Vu-Tight™ Direct Injection Sleeve. To install the Vu-Tight™ sleeve, simply insert the 1/4-inch inlet sleeve into the packed column injection port and tighten it with a 1/4-inch nut and ferrule. Then connect the column to the outlet of the sleeve with a 1/4 to 1/16-inch stainless steel reducing fitting. The press-tight taper is positioned for easy observation of a proper seal between the column end and the direct injection sleeve.

Vu-Tight™ sleeve designs are also available for use with dirty samples. A Cyclo Vu-Tight™ or a Vu-Tight™ packed with wool or beads effectively traps non-volatile sample residue and can prevent column contamination.

### Vu-Tight™ Direct Injection Sleeves (1/4" OD)



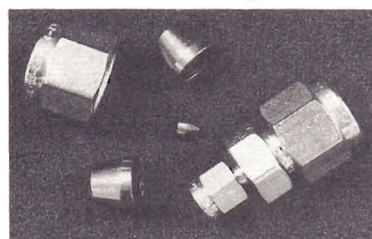
cat.# 20342, \$28 each  
cat.# 20343, \$115/5-pk.  
cat.# 20344, \$480/25-pk.

### Cyclo Vu-Tight™ Direct Injection Sleeves



cat.# 20787, \$55 each  
cat.# 20788, \$220/5-pk.

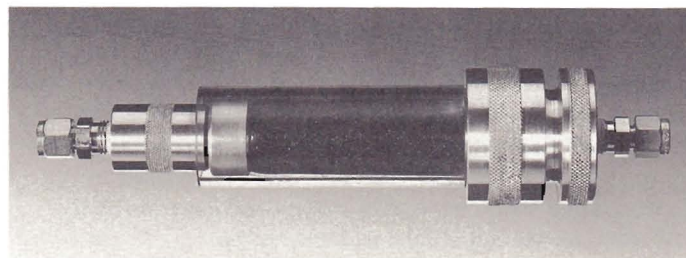
### Vu-Tight™ Installation Fittings



Includes a 1/4-inch SS nut and 1/4-inch graphite ferrule for attaching the sleeve to the GC inlet and a 1/4 to 1/16-inch SS reducing nut plus a 1/4-inch and 0.5mm ID graphite ferrule for attaching the column to the Vu-Tight™ direct injection sleeve.  
cat.# 20504, \$30 each

## High Capacity Indicating Oxygen Trap

- Indicator changes color as O<sub>2</sub> & H<sub>2</sub>O are trapped.
  - Heavy duty body design virtually eliminates breakage.
  - High capacity (>300 s.c.f.) design lasts longer than three smaller traps.
  - Economic replacement cartridges change easily.
  - Usable with multiple GC systems.
  - Removes impurities at flow rates up to 230 s.c.f./hour.
  - Removes O<sub>2</sub>, H<sub>2</sub>O, and trace contaminants.
  - Usable with all carrier gases.
  - Ambient operating temperature, 100psig operating pressure.
  - Built-in microparticulate frit.
  - Discharge Gas Purity:  
O<sub>2</sub> < 0.1 ppm where inlet does not exceed 15 ppm  
H<sub>2</sub>O < 0.5 ppm where inlet does not exceed 10 ppm
- Includes cartridge housing and one cartridge.



1/4" tube compression fittings: cat.# 20623, \$170 each  
1/8" tube compression fittings: cat.# 20624, \$170 each  
Refill cartridge (fits 1/4 or 1/8"): cat.# 20625, \$55 each



## Now Available - Untreated Autosampler Vials

*Screw-top or crimp-top styles • Clear or amber borosilicate glass*

*Buy pieces separately or as kits • 100 or 1000 packs available*

We now offer untreated vials for most GC autosamplers. These high quality vials are available in either screw-top or crimp-top styles. We offer vials made from both clear or amber borosilicate glass. Both designs offer a Teflon® lined septa in the closure to prevent sample contamination during storage. They can be purchased as complete kits including closures or as vials or closures only. Available in standard 100 packs or economical 1000 packs, these vials are guaranteed to work perfectly with your autosampler.

Screw-top vials	100 Pack		1000 Pack	
Clear, complete kit	21192	\$26	21193	\$225
Amber, complete kit	21194	\$28	21195	\$245
Clear, vial only	21184	\$15	21185	\$125
Amber, vial only	21186	\$16	21187	\$140
8-425 hole cap	21176	\$6	21177	\$50
8mm PTFE/silicone septa	21178	\$12	21179	\$85

Crimp-top vials	100 Pack		1000 Pack	
Clear, complete kit	21196	\$20	21197	\$175
Amber, complete kit	21198	\$20	21199	\$175
Clear, vial only	21188	\$15	21189	\$125
Amber, vial only	21190	\$16	21191	\$140
11mm aluminum seals	21174	\$9	21175	\$75
w/PTFE-Rubber septa				

### Use the Screw-top vials for these autosamplers:

- Varian (all models)
- Shimadzu AOC-14
- Hewlett-Packard (7670A, 7671A)
- Perkin-Elmer ISS-100

### Use the Crimp-top vials for these autosamplers:

- Antek
- Hewlett-Packard (all models)
- Perkin-Elmer (models: LC-600, 420, 600, 4900, & ISS-100)
- Spectra Physics (7110, 8110)
- Tracor 770
- Dynatech Precision Sampling

## **new!** Deactivated Inlet Sleeves for Fisons/Carlo Erba GCs

- Fits new 8000 series GC
- Fully deactivated for exceptional inertness
- Available for split and splitless injection ports in 3 and 5mm IDs

Restek now offers deactivated inlet sleeves for the Fisons/Carlo Erba 8000 series GC. Both 3 and 5mm ID split and splitless designs are available. Sold individually or in economical 5 and 25 packs, these sleeves are guaranteed to meet the original equipment specifications. (OD 8mm, length 105mm)

Let Restek prepack your sleeves with deactivated fused silica wool or beads. To order prepacked sleeves, simply add the correct suffix to any sleeve catalog number. For sleeves prepacked with wool, add the suffix "200.1" per single sleeve, "200.5" for 5-packs, and "200.25" for 25-packs. For sleeves prepacked with beads, add suffix "201.1" per single sleeve, "201.5" for 5-packs, and "201.25" for 25-packs. When ordering prepacked sleeves, add \$10 to the price per single sleeve, \$25 for 5-packs, and \$75 for 25-packs.



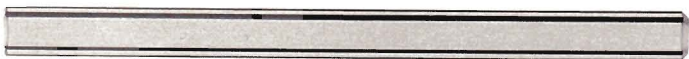
#### 3mm Split

cat.# 20936, \$20 each  
cat.# 20937, \$80/5-pk.  
cat.# 20938, \$370/25-pk.



#### 3mm Splitless

cat.# 20942, \$29 each  
cat.# 20943, \$115/5-pk.  
cat.# 20944, \$465/25-pk.



#### 5mm Split

cat.# 20939, \$18 each  
cat.# 20940, \$75/5-pk.  
cat.# 20941, \$345/25-pk.



#### 5mm Splitless

cat.# 20945, \$25 each  
cat.# 20946, \$100/5-pk.  
cat.# 20947, \$400/25-pk.



# News from Restek

## Good News for our Neighbors to the North

Restek is very pleased to announce that, effective immediately, our products will be available in Canada through Chromatographic Specialties, in Brockville, Ontario. They can be reached at (612) 342-4678. We have also expanded our toll-free number for technical support into Canada. Restek's technical support number for the U.S. and Canada is 1-800-356-1688.



## Restek Acquires Amchro, Expands to Germany

To improve service to our European customers and expand our distribution network in Europe, Restek Corporation has acquired Amchro in Frankfurt, Germany.

**RESTEK**  
EUROPA

Amchro is an established chromatography products distributor that has successfully distributed Restek products for 5 years. Under its new name, Restek Europa, Amchro will continue selling chromatography products to increase Restek's market share in Europe.

Dr. Johann Vasgyura, Amchro's president, has been appointed as managing director of the new Restek Europa.

## We're Sorry, No More Multipliers

Due to circumstances beyond our control, we no longer offer electron multipliers for Hewlett-Packard 5971 MSD systems. With very limited notification, our supplier has chosen to offer these multipliers only through HP. We regret any inconvenience this may have caused our customers.

## No More Saturday Service

For almost a full year, Restek has offered our customers the convenience of Saturday ordering, shipping, and technical support. Because response to these services has been very minimal, effective January 23 we will no longer offer Saturday hours. You can still place orders Monday through Friday from 8am to 7pm Eastern Standard Time (EST). Technical Support will be available Monday through Thursday from 8am to 8pm EST and Friday from 8am to 5pm EST.

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Orders: (800)356-1688



## Look Out! The Wizard Dollars are Coming

Starting January 4, for every \$50 you spend on Restek products you will receive one Wizard Dollar. These Wizard Dollars can be redeemed for valuable gifts ranging from coffee mugs to color televisions. The more products you buy, the more dollars you accumulate, to get bigger and bigger prizes. Look for details about the Wizard Dollar promotion in our new 1993-1994 catalog.

## Upcoming Restek Exhibits:

**American Academy of Forensic Science Meeting**  
February 15-19 in Boston, MA (Booth #235)

Paper Presentation: "Evaluation of an Open Tubular Solid Phase Extraction System for Drugs of Abuse".

**The 1993 Pittsburgh Conference**  
March 8-11 in Atlanta, GA (Booth #'s 2009 and 4542).

See back cover for a complete list of our Pittsburgh Conference technical presentations and a coupon for a free gift.

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