the RESTEK Advantage

Innovators of High Resolution Chromatography Products

Intermediate Polarity Capillary Column for the GC Analysis of Basic Compounds

new

Rtx®-35 Amine GC Column

by Neil Mosesman, GC Columns Product Marketing Manager

- ✔ Achieves symmetrical peaks for basic compounds.
- ✔ Improved response over traditional columns.
- ✔ Resolves low-molecular-weight primary amines.

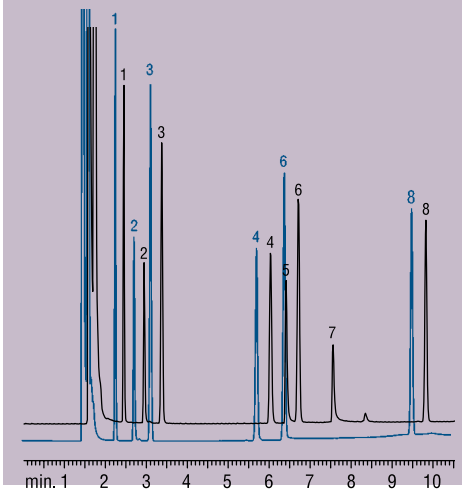
Amines and nitrogen heterocyclics are used to manufacture a wide variety of products including dyes, chelating agents, stabilizers, pesticides, and pharmaceuticals. Analyzing amines and other basic compounds by gas chromatography (GC) can be difficult as the active nature of these compounds causes adsorption and peak tailing. Several years ago Restek introduced the Rtx®-5 Amine column, which uses a unique deactivation chemistry to improve the response and peak symmetry of amines, especially alkyl amines, diamines, triamines, ethanolamines, and ethyleneamines. Now Restek is introducing the new Rtx®-35 Amine column, which employs the same deactivation technology as the Rtx®-5 Amine, but features a higher polarity that is ideal for separating more polar amines and lower molecular weight amines.

Enhanced Peak Symmetry for Amines

The proprietary deactivation of the Rtx®-35 Amine results in improved response and better peak symmetry compared to other 35% phenyl columns (Figure 1). A test mixture with a wide variety of amines at concentrations of 10 to 15ng/µL was analyzed using an Rtx®-35 Amine column and a standard 35% phenyl column. While the Rtx®-5 Amine column shows complete adsorption of diethylenetriamine and diethanolamine, the Rtx®-35 Amine offers excellent response and peak shape for these compounds.

Figure 1

The Rtx®-35 Amine column prevents adsorption and improves response for amines.



1. pyridine
2. 1,2-butanediol
3. C10
4. 2-nonanol
5. diethylenetriamine
6. C12
7. diethanolamine
8. 2,6-dimethylaniline

30m, 0.53mm ID, 1.0µm Rtx®-35Amine (cat.# 11355)
30m, 0.53mm ID, 1.0µm Rtx®-35 (cat.# 10455)
Sample: amine test mix (cat.# 35002); **Conc.:** 450-900ppm; **Solvent:** methanol/methylene chloride; **Sample size:** 1.0µL; **Inj. temp.:** 250°C; **Inj. mode:** split (10:1); **Inlet liner:** base-deactivated 4mm Single Gooseneck (cat.# 20798-210.1); **Carrier gas:** helium; **Linear velocity:** 30cm/sec.; **Detector:** FID/300°C; **Temp. program:** 110°C (hold 4.0 min.) to 200°C @ 8°C/min. (hold 5.0 min.)

GC_CH00577
GC_EX00579

in this issue

RESTEK
800-356-1688 ★ 814-353-1300
www.restekcorp.com

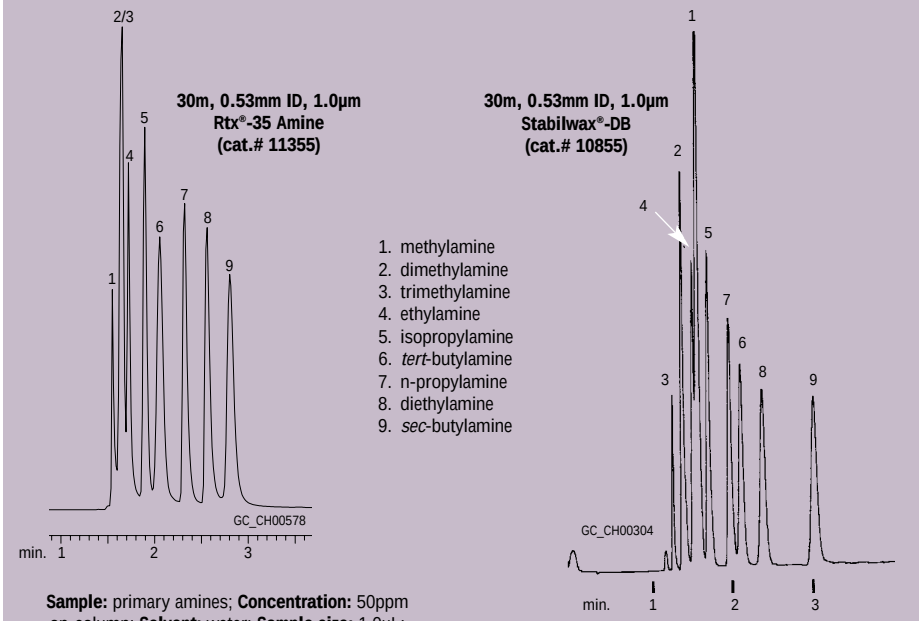
Winter '02
INTERNATIONAL

Improved Resolution of Primary Amines
Primary amines normally are analyzed on a Stabilwax®-DB column because it has a special deactivation that helps to easily resolve these compounds. However the maximum operating temperature of this column is 220°C, which limits the molecular weight range of the amines that can be analyzed.The Rtx®-5 Amine column is at the other end of the spectrum in terms of polarity and selectivity, and does not adequately resolve the primary amines even though it has excellent stability and a higher maximum operating temperature (315°C).

The Rtx®-35 Amine column was designed to provide a range of polarity and selectivity that falls between the Stabilwax®-DB and Rtx®-5 Amine columns. The benefits of the Rtx®-35 Amine column include excellent thermal stability and good resolution for primary amines as shown in Figure 2.

Because the Rtx®-35 Amine column offers excellent response and peak symmetry for more polar amines and has high thermal stability, laboratories analyzing amines and other basic compounds can benefit from better results.

Figure 2
The Rtx®-35 Amine column offers good resolution of primary amines compared to the more polar Stabilwax®-DB column.



Sample: primary amines; **Concentration:** 50ppm on-column; **Solvent:** water; **Sample size:** 1.0µL; **Inj. temp.:** 250°C; **Injection mode:** split (10:1); **Inlet liner:** base-deactivated 4mm Single Gooseneck (cat.# 20798-210.1); **Carrier gas:** helium; **Linear velocity:** 35.7cm/sec.; **Detector:** FID @ 300°C; **Oven temp.:** 35°C (hold 5.0 min.)

1.0µL direct injection of amines in water; **Oven temp.:** 45°C isothermal; **Inj. & det. temp.:** 250°C; **Carrier gas:** hydrogen; **Linear velocity:** 40cm/sec. (flow rate: 5cc/min.); **FID sensitivity:** 1 x 10^{-11} AFS

Rtx®-35 Amine (fused silica) Stable to 340°C

ID (mm)	df(µm)	temp. limits	15-Meter	30-Meter
0.25	0.50	0 to 290/310°C	11335	11338
	1.00	0 to 280/300°C	11350	11353
0.32	1.00	0 to 280/300°C	11351	11354
	1.50	0 to 270/290°C	11366	11369
0.53	1.00	0 to 260/280°C	11352	11355
	3.00	0 to 240/260°C	11382	11385

Base-Deactivated Inlet Liners for Agilent GCs

Description	ea.	5-pk.	25-pk.
4mm Split Straight w/Wool	20781-211.1	20782-211.5	20783-211.25
Cyclosplitter®	20706-210.1	20707-210.5	—
4mm Splitless Straight	20772-210.1	20773-210.5	20774-210.25
2mm Gooseneck	20795-210.1	20796-210.5	20797-210.25
4mm Gooseneck	20798-210.1	20799-210.5	20800-210.25

If you do not see the liner you need, orders can be placed on a custom basis with the appropriate suffix number added. For base deactivation, each (-210.1), 5-pack (-210-5), 25-pack (-210.25). For base-deactivated liners with base-deactivated wool: each (-211.1), 5-pack (-211.5), 25-pack (-211.25). For a complete list of inlet liners, refer to the annual *Chromatography Products Guide* (lit. cat.# 59662).

Base-Deactivated Guard Columns

For analyzing basic compounds, use base-deactivated guard columns. Order cat. #s 10000 , 10001 , 10002 (0.25, 0.32, and 0.53mm ID respectively) for 5m **base-deativated guard columns.** More information on guard columns can be found on page 7. For detailed pricing, refer to the annual *Chromatography Products Guide* (lit. cat.# 59662).

HOT techtip *from the* **Restek Wizards**

Many GC problems can be avoided by electronically leak checking the system during the plumbing process. Thorough leak checking will prevent loss of GC gases and reduce damage to capillary columns, and will help decrease detector maintenance. Oxygen can move into the system via a leak due to the Venturi effect, and irreversible damage can occur if a column is exposed to oxygen at high temperatures. Also, some detectors are very sensitive to oxygen. Leak checking the instrument before column installation and conditioning prevents column degradation indicated by high bleed and short lifetime. Leak checking should be performed on the entire gas system and GC. Begin by checking all fittings inside the GC. Next check the external fittings along the carrier gas lines, all the way to the gas tanks. Never use liquid leak detectors that contain soap or surfactants because liquids can be drawn inside the fitting at the site of the leak and contaminate the system.

Leak Detective™ Electronic Leak Detector

- Compact, lightweight, hand-held design.
- Contamination-free leak detection.
- Detects helium or hydrogen trace leaks at ≥3 x 10^{-4}cc/sec. or ≥200ppm.
- Audible alarm and LED readout.
- Responds in less than 2 seconds to trace leaks of gases.*
- Operates on two 9-volt batteries or AC adaptor, both included.

(110 VAC): cat.# 21607, (ea.)
(220 VAC): cat.# 21609, (ea.)
European 2-prong plug (220 VAC): cat.# 21382 (ea.)
**Not designed for use in explosive atmospheres.*

New Electronic Leak Detector Coming Soon!
Designed to be more sensitive, smaller, and ergonomic. Watch the Restek Advantage newsletter and www.restekcorp.com for details.

Low-Bleed Septa with Less Coring

InfraRed™ Septa

- ✔ Stable to 325°C for high-temperature analyses.
- ✔ Low bleed prevents baseline disturbance.
- ✔ Excellent puncturability and long life means you can make hundreds of injections on one septum.
- ✔ Does not adhere to injectors so removal is easy.

For a **FREE sample of InfraRed™ septa**, call 800-356-1688 or 814-353-1300, ext. 3, or contact your local Restek representative.

InfraRed™ Septa

Septum Diameter	25-pk.	50-pk.	100-pk.
9mm	21417	21418	21419
9.5mm (3/8")	21421	21422	21423
10mm	21424	21425	21426
11mm (7/16")	21427	21428	21429
11.5mm	21430	21431	21432
12.5mm (1/2")	21433	21434	21435
17mm	21436	21437	21438
Shimadzu Plug	21439	21440	21441

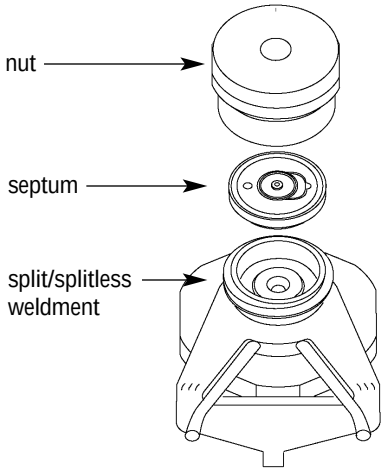
Instrument	Septum Size
Agilent (HP)	
5880A, 5890, 6890, 6850	11mm
5700, 5880	9.5/10mm
On-Column Injection	5mm
CE Instruments (TMQ)	
TRACE GC	17mm
Finnigan (TMQ)	
GC 9001	9.5mm
GCQ	9.5mm
GCQ w/TRACE	17mm
QCQ™	9.5mm
TRACE 2000	9.5mm
Fisons/Carlo Erba (TMQ)	
8000 series	17mm
Gow-Mac	
6890 series	11mm
All other models	9.5mm
PerkinElmer	
Sigma series	11mm
900, 990	11mm
8000 series	11mm
Auto SYS	11mm
Auto SYS XL	11mm
Pye/Unicam	
All models	7mm
Shimadzu	
All models	Plug
SRI	
All models	Plug
Tracor	
540	11.5mm
550, 560	9.5mm
220, 222	12.5mm
Varian	
Injector type:	
Packed column	9.5/10mm
Split/splitless 1078/1079	10/11mm
1075/1077	11mm
1177	9mm

Measure your old septum here (size in mm)

Septa Alternative Provides Longer Life and Wear Resistance

Merlin Microseal™ Septa

- ✔ For Agilent 5890/6890/6850 GCs compatible with EPC.
- ✔ High-pressure capability allows operation from 2 to 100psi.
- ✔ A top wiper rib improves resistance to particulate contamination and can be taken apart for cleaning.
- ✔ Reduces shedding of septum particles into the injection port liner, eliminating a major source of septum bleed and ghost peaks.
- ✔ Reduces the risk of septum leaks occurring during extended automated runs.



Microseal™ High-Pressure Septa 400 Series	Merlin#	Similar to Agilent#	cat.#
Nut kit (1 nut, fits 300 & 400 series septa)	403	5182-3445	22809
Standard kit (nut, 2 high-pressure septa)	404	Not offered	22810
Starter kit (nut, 1 high-pressure septum)	405	5182-3442	22811
High-pressure replacement septum (1 septum)	410	5182-3444	22812

Bubble Trouble in Your HPLC Mobile Phase?

Degasys In-Line Mobile Phase Degasser

by Greg France, HPLC Product Marketing Manager

- ✔ Prevents out-gassing to improve flow rate stability and reduce baseline noise.
- ✔ Quick equilibration and changeover of mobile phase solvents.
- ✔ Less solvent waste due to low internal volume (400µL).

Dissolved gases in mobile phases can be the source of several common HPLC system problems, such as pump flow rate instability and irreproducible gradients. Out-gassing from the mobile phases can result in air bubbles in the check valves, observed as cavitations or pressure fluctuations in the pump (remember gases are compressible while liquids are not). Air bubbles also may form within the detector flow cell leading to spikes in the resulting chromatogram. Gases that remain dissolved in the mobile phase can have a quenching effect when using fluorescence detectors and can cause increased background noise in UV-visible detectors. This can result in lowered sensitivity. Therefore, in order to optimize system performance, mobile phases should be degassed prior to entering the HPLC pumps.

Some of the traditional degassing techniques include sonication with off-line vacuum degassing or helium sparging. Each has varying degrees of effectiveness, but neither approaches the level of gas removal efficiency achieved through the use of an in-line vacuum degasser.

Sonication in conjunction with off-line vacuum degassing helps reduce the presence of dissolved gases. But there is the possibility that gases can redissolve into the mobile phase over time because, once degassing is complete, the mobile phase is reexposed to the atmosphere. Helium sparging also is useful at removing dissolved gases. One benefit over sonication/vacuum is that you can prevent gases from redissolving by maintaining a helium blanket over the mobile phase after sparging. A drawback to helium sparging is dealing with bulky gas tank cylinders in the lab. You must use chromatographic-grade helium so that the mobile phase is not contaminated, which can be an expensive proposition if used routinely.

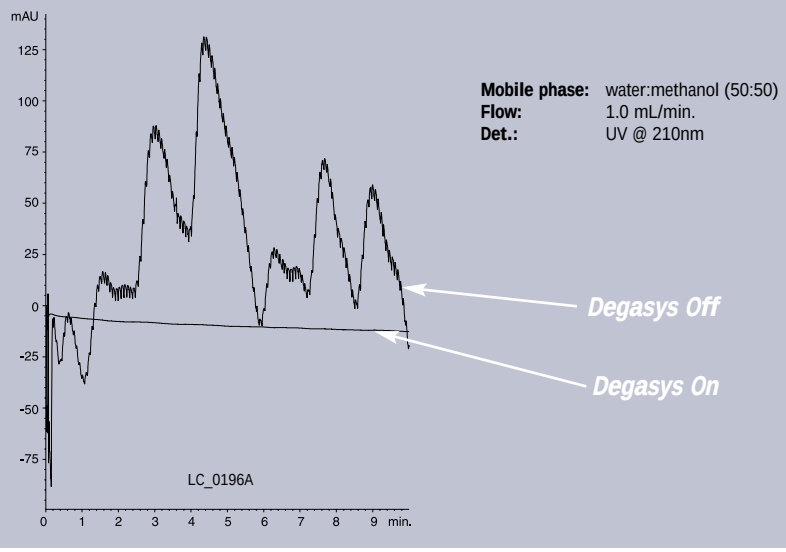
In-line vacuum degassers minimize these problems. Restek now carries an in-line degasser that offers several advantages over other manufacturers—the Degasys in-line mobile phase degasser. These units are more effective at removing dissolved gases than either vacuum/sonication or helium sparging (Figure 1), and because the mobile phase is being degassed just prior to entering the HPLC system there is significantly less opportunity for gases to redissolve in the mobile phase. In addition, the units are easy to install and take up very little bench-top space.

In-line degassers work by passing the mobile phase through a length of tubing made of a semi-permeable material, traditionally this has been PTFE. The tubing is encased in a vacuum chamber and, as the mobile phase passes through, the dissolved gases are pulled through the semi-permeable membrane while the liquid continues to flow through the tube. The Degasys system uses an amorphous fluoropolymer, rather than the traditional PTFE as the transfer tubing. This material is 200 to 300 times more gas permeable than PTFE, which allows a shorter length of tubing in the vacuum chamber and the use of lower internal volumes. Most degassers have an internal volume of 8 to 12mL. The Degasys has an internal volume of only 400µL. The smaller internal volume allows for quicker equilibration and changeover of mobile phase solvents, resulting in less solvent waste. Additionally, each of the four channels of the Degasys system is encased within its own chamber to prevent any type of cross-contamination.

Use the Degasys in-line mobile phase degasser to effectively and conveniently reduce the problems associated with dissolved gases in your mobile phases.

Figure 1

The Degasys in-line mobile phase degasser improves baseline stability.



Degasys In-Line Mobile Phase Degasser

Description	each
110V Mobile phase degasser (4 channel, 7mL/min./channel)	25189
220V Mobile phase degasser (4 channel, 7mL/min./channel)	25194

Degasys unit comes with all nuts and ferrules needed for installation and operation. Order Teflon® tubing separately.

Teflon® Tubing

Description	cat.#	3-meter length
1/8" OD x 0.063" ID	25306	
1/8" OD x 0.094" ID	25307	

for more info on tubing and HPLC Accessories, request the Fast Facts *HPLC Mobile Phase Accessories* (lit. cat.# 59728A).

Restek HPLC Columns

Three Generations of Silica Technology

by Terry Reid, HPLC Chemist

- ✔ Pinnacle II™ silica—columns packed using Restek-manufactured silica.
- ✔ Ultra silica—similar pore size, but greater retention compared to Pinnacle II™ silica.
- ✔ Allure™ silica—largest surface area and greatest retention.

Silica remains the most common support for HPLC columns despite the more recent development of alternative supports such as organic polymers and zirconia. Since the introduction of silica supports for HPLC approximately 30 years ago, the evolution of silica manufacturing technology can be described as having three generations. First generation silica (Type A) is synthesized from inorganic sols. The second generation is base deactivated silica prepared by chemical treatment of Type A silica to remove surface metal impurities. Third generation silica (Type B) is synthesized from an organic sol starting material. Type B silica contains only trace amounts (ppm levels) of metal impurities, giving it attributes similar to those of base-deactivated silica without the chemical treatments needed to remove metal impurities.

The evolution of silica from Type A to Type B was largely driven by the desire for reversed phase silica supports that could analyze basic compounds without mobile phase additives and without excessive peak tailing. Because most HPLC analysts use the reversed phase mode and a large proportion of samples analyzed by reversed phase contain basic analytes (e.g., most pharmaceuticals), base deactivation of silica is an important issue. As a result, many HPLC users prefer columns made from Type B silica. However, many HPLC analysts still want to buy columns made with Type A and/or base-deactivated silica because they are using methods that were developed with these types of columns. Also, for some applications, first or second generation silica can perform just as well as or even better than Type B products. To satisfy all these needs, Restek offers several lines of HPLC columns that cover the three generations of silica.

In 2001 Restek introduced the Pinnacle II™ product line, which is based on new Type A silica developed and manufactured in our Bellefonte facility. The Pinnacle II™ products are very similar to our original Pinnacle™ product line, but are controlled by Restek's in-house silica production. The analysis of phenolic compounds in Echinacea using a Pinnacle II™ C18 column shows excellent performance for neutral and acidic compounds (Figure 1). Research is currently in progress to develop a second-generation product from our Pinnacle II™ silica; one that will allow us to offer an alternative to the well-established Pinnacle™ Amine (base-deactivated) product line.

The Ultra and Allure™ product lines are manufactured from Type B silica, but differ in their pore sizes. Ultra silica is 100Å while Allure™ silica is 60Å. Type B silica typically is higher in surface area than Type A silica. The Ultra silica has a similar pore size to Pinnacle and Pinnacle II™ silica but has a much greater surface area, making it considerably more retentive. Because of its smaller pore size, the Allure™ silica provides even greater surface area and greater retention than the Ultra silica. The Allure™ product line was developed for LC/MS applications where it often is beneficial to have maximum retention. A separation of an antibiotic sample containing two basic compounds using an Allure™ C18 column is shown in Figure 2. Although this is UV detection, the completely volatile mobile phase is compatible with MS detection.

Figure 1

The Pinnacle II™ C18 analysis of Echinacea shows excellent performance for neutral and acidic compounds.

Pinnacle II™ C18 (cat.# 9214565)
Dimensions: 150 x 4.6mm
Particle size: 5µm; Pore Size: 110Å
Conditions:
Mobile phase: A=0.1% phosphoric acid, B=acetonitrile

Time	%A	%B
0	90	10
13	78	22
14	60	40
14.5	60	40
15	90	10
20	90	10

Flow: 1.5 mL/min.
Temp.: 35°C
Det.: UV @ 330nm

Sample: Echinacea capsule
Inj.: 10µL
Conc.: 6.7mg/mL capsule contents in sample diluent
Solvent: ethanol:water (70:30)
Sample temp.: 25°C

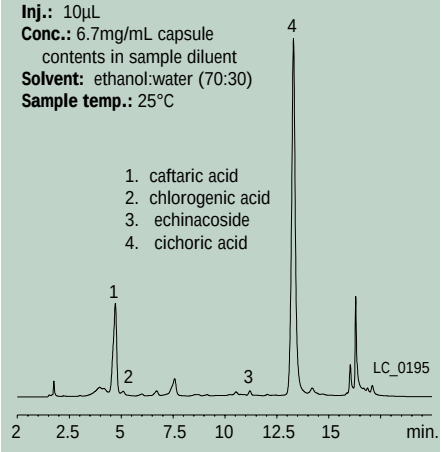


Figure 2

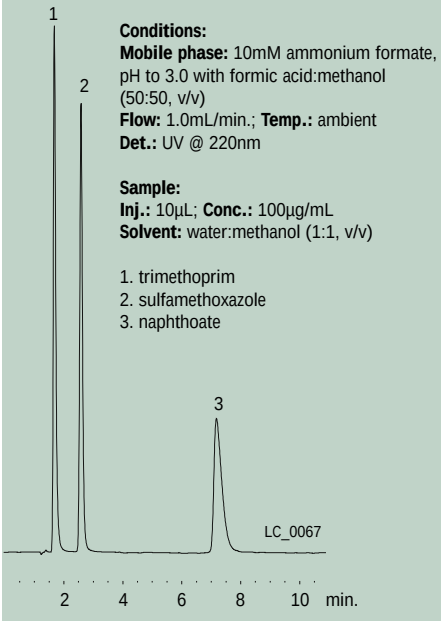
The Allure™ C18 column separates two basic compounds using a mobile phase that is compatible with MS detection.

Allure™ C18 (cat.# 9164565)
Dimensions: 150 x 4.6mm
Particle size: 5µm; Pore size: 60Å

Conditions:
Mobile phase: 10mM ammonium formate, pH to 3.0 with formic acid:methanol (50:50, v/v)
Flow: 1.0mL/min.; **Temp.:** ambient
Det.: UV @ 220nm

Sample:
Inj.: 10µL; **Conc.:** 100µg/mL
Solvent: water:methanol (1:1, v/v)

1. trimethoprim
2. sulfamethoxazole
3. naphthoate



Pinnacle II™ C18 5µm Columns

Length	4.6mm ID
50mm	9214555
100mm	9214515
150mm	9214565
250mm	9214575

Ultra C18 5µm Columns

Length	4.6mm ID
30mm	9174535
50mm	9174555
100mm	9174515
150mm	9174565
200mm	9174525
250mm	9174575

Allure™ C18 5µm Columns

Length	4.6mm ID
30mm	9164535
50mm	9164555
100mm	9164515
150mm	9164565
200mm	9164525
250mm	9164575

for more info

including a complete product listing, request lit. cat.# 59241, *HPLC Columns and Accessories Catalog.*

Rapid Analysis of Marine Oil-Based FAMEs

FAMEWAX™ Capillary GC Column

by Rebecca E. Wittrig, Ph.D., Food, Flavor, and Fragrance Innovations Team Manager

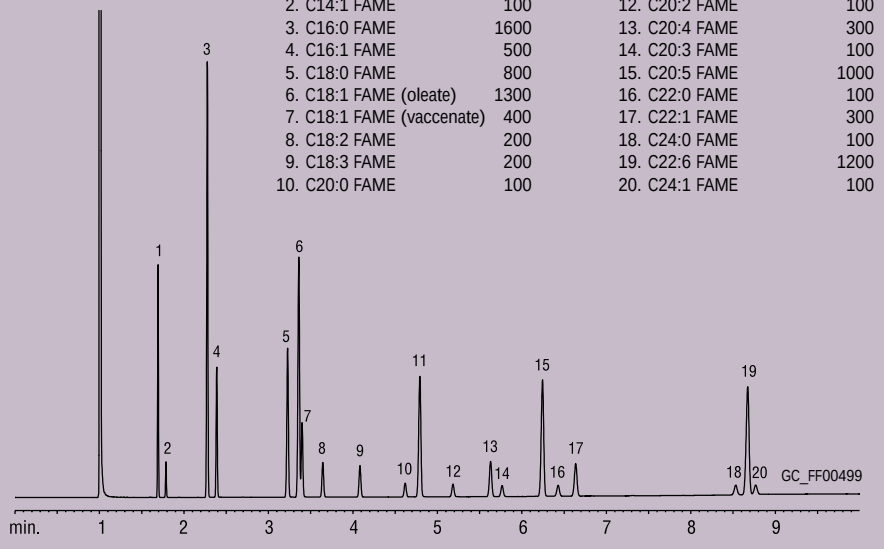
✔ Excellent resolution in less than 10 minutes!
✔ Ideal for all FAME analyses, particularly polyunsaturated FAMEs.

Marine oil products, such as fish oils, are generating a significant amount of interest based on recent medical studies indicating health benefits from consuming these products. Of these oils, the long-chain polyunsaturated fatty acids (PUFAs) such as eicosapentaenoic acid (EPA, C20:5) and docosahexaenoic acid (DHA, C22:6) have been studied extensively due to claims that they reduce the risk of a variety of diseases including hypertension, cardiovascular disease, and autoimmune disorders. These Omega-3 fatty acids are present in high quantities in fish oils. Because the health benefits are thought to be associated with these specific PUFAs, it is necessary to accurately monitor their levels in marine oil raw materials and finished products.

Figure 1

The FAMEWAX™ column shows excellent resolution of marine oil-based FAMEs **in less than 10 minutes!** Note the excellent separation of peaks 18-20.

		conc.		conc.
1.	C14:0 FAME	600µg/mL	11. C20:1 FAME	900
2.	C14:1 FAME	100	12. C20:2 FAME	100
3.	C16:0 FAME	1600	13. C20:4 FAME	300
4.	C16:1 FAME	500	14. C20:3 FAME	100
5.	C18:0 FAME	800	15. C20:5 FAME	1000
6.	C18:1 FAME (oleate)	1300	16. C22:0 FAME	100
7.	C18:1 FAME (vaccenate)	400	17. C22:1 FAME	300
8.	C18:2 FAME	200	18. C24:0 FAME	100
9.	C18:3 FAME	200	19. C22:6 FAME	1200
10.	C20:0 FAME	100	20. C24:1 FAME	100



30m, 0.32mm, 0.25µm FAMEWAX™ (cat.# 12498)
Oven temp.: 195°C to 240°C at 5°C/min. (hold 1 min.); **Inj. & det. temp.:** 250°C (inj.), 275°C (det.); **Carrier gas:** hydrogen; **Linear velocity:** 3mL/min. (constant flow); **Split ratio:** 100:1; **Injection volume:** 1µL; **Std. concentration:** 10,000µg/mL in isooctane (total FAMES), see breakdown in peak list.

✔ **FAMEWAX™** (fused silica) (Crossbond® polyethylene glycol)

Length (m)	ID (mm)	df(µm)	Temp. Limits	cat.#
30	0.25	0.25	20 to 250°C	12497
30	0.32	0.25	20 to 250°C	12498
30	0.53	0.50	20 to 250°C	12499

A typical procedure for analyzing marine oil-based FAMEs involves saponifying the oils and forming the methyl ester derivatives. The FAMEs then can be separated and quantitated by GC using a polar polyethylene glycol (PEG)-type capillary column. In specific, the Omega-3 fatty acids (EPA, C20:5 and DHA, C22:6) need to be completely resolved from all of the other FAME species present. A standard procedure requires a run time of 30-40 minutes to achieve this separation. In comparison, the Restek FAMEWAX™ column shows an excellent separation in less than 10 minutes! Using the FAMEWAX™ capillary GC column will give you much higher throughput for your marine oil-based nutraceutical products and ingredients.

Restek offers several different FAME mixtures for your food and nutraceutical testing needs. Refer to the annual *Chromatography Products Guide* (lit. cat.# 59662) or visit us online at www.restekcorp.com for the complete listing.

✔ **Marine Oil FAME Mix**

Contains:

Chain	Description	% by Weight
C14:0	methyl myristate	6.0
C14:1	methyl myristoleate	1.0
C16:0	methyl palmitate	16.0
C16:1	methyl palmitoleate	5.0
C18:0	methyl stearate	8.0
C18:1	methyl oleate	13.0
C18:1	methyl vaccenate	4.0
C18:2	methyl linoleate	2.0
C18:3	methyl linolenate	2.0
C20:0	methyl arachidate	1.0
C20:1	methyl 11-eicosenoate	9.0
C20:2	methyl 11-14-eicosadienoate	1.0
C20:4	methyl arachidonate	3.0
C20:3	methyl 11-14-17-eicosatrienoate	1.0
C20:5	methyl eicosapentaenoate	10.0
C22:0	methyl behenate	1.0
C22:1	methyl erucate	3.0
C22:6	methyl docosahexaenoate	12.0
C24:0	methyl lingnocerate	1.0
C24:1	methyl nervonate	1.0

Description	cat.#
100mg	35066

Monitor Food Packaging?

Check out our new Applications Note *Monitoring Volatile Compounds in Food Contact Packaging Using Purge and Trap GC/MS and an Rtx®-5MS Capillary Column* (lit. cat.# 59348).

Watch...

for new food, flavor, and fragrance reference materials coming soon.

GC Capillary Guard Column Options

by Christine Vargo, US Sales and Distribution Manager

- ✔ Save money by prolonging the lifetime of your analytical column.
- ✔ Ensure reproducible analyses by keeping nonvolatile residue from collecting at the front of the analytical column.
- ✔ May improve sample focusing and separation efficiency.

Selection Tips

Several types of guard columns are available. The choice of guard column should be made depending upon the compatibility of the guard column type with the compounds of interest, or if the tubing is being used as a transfer line to carry the sample from an inlet device to the column or from the column outlet to the detector. Choosing a guard column that is compatible with your compounds of interest ensures focused sample bands, and good peak shape with minimal peak tailing.

Integra-Guard™ Guard Columns

- Continuous length of tubing containing both the guard column and the analytical column—no connector required.
- Available in many phases.
- Guaranteed leak-free.

Specialized Deactivations

Siltek™ Guard Columns

Revolutionary deactivation lowers endrin breakdown to less than 1%.
Inertness retained over a wide range of sample pH.

- Minimal bleed.
- Ideal for chlorinated pesticide analysis.
- Individually tested for chlorinated pesticide breakdown.

Recommended for difficult matrix and reactive compound analysis
Ideal for use as transfer lines.

- Recommended for use with Rtx®-CLPesticides, Stx®-CLPesticides, Stx®-1HT, and Rtx®-TNT columns.

Base-Deactivated Guard Columns

- Provides excellent inertness for the analysis of basic compounds.
- Tested with basic amine test mix (chromatogram included).
- Recommended for use with Rtx®-5 Amine, Rtx®-35 Amine, and Stabilwax®-DB columns

General-Purpose Deactivations

In most cases, the standard IP tubing should be chosen. The IP surface contains methyl, as well as phenyl groups, making this surface compatible with most common solvents.

Intermediate Polarity (IP) Tubing

- The most universal guard column tubing material.
- Phenylmethyl-deactivated surface provides optimum compatibility for both polar and non-polar compounds.

Polar-Deactivated Tubing

- Provides optimum wettability for polar compounds.
- Minimizes peak splitting when using polar solvents such as methanol and water.
- Uses a polyethylene glycol deactivation layer.
- Compatible with Stabilwax®, Rtx®-225, and Rtx®-2330 capillary columns.

If methanol or water is the primary solvent, then polar surfaces should be used such as our polar-deactivated tubing. The polar-deactivated surface is not resistant to harsh water vaporization, which occurs when water in the liquid state is injected onto the tubing surface and rapidly vaporized.

Hydroguard™ Tubing

- Provides excellent inertness for water-based samples.
- Reduces effects of dirty samples on column performance.
- Reduces downtime and maintenance.

Hydroguard™ tubing is preferred for situations where there is harsh water vaporization. By using a unique deactivation chemistry, the resulting high-density surface is not readily attacked after an aggressive hydrolysis treatment. The high-density surface coverage effectively prevents water vapor from reaching the fused silica surface beneath the Hydroguard™ deactivation layer.

Why use a guard column?

Capillary gas chromatography (GC) guard columns protect analytical columns by trapping nonvolatile residues, preventing them from collecting at the front of the analytical column. These nonvolatile residues may be very high molecular weight organic compounds, inorganic salts, or particulates. If these contaminants enter the analytical column, they can cause adsorption of active compounds, retention time drift, loss of resolution, and poor peak symmetry. When this contamination begins to affect sample analysis, a small section of the analytical column must be removed to restore proper performance. Each time a section of the analytical column is removed, retention times change, and some resolution is lost. By using a guard column and removing contaminated loops from it instead of the analytical column, the separation power of the analytical column remains intact.

When should a guard column be replaced?

The guard column should be replaced as it becomes contaminated with nonvolatile residue. At this point, the performance of the entire chromatographic system will begin to deteriorate. This normally is exhibited as a drastic decrease in the response of active compounds and peak tailing.

What is the life expectancy of a guard column?

The life expectancy of a guard column depends on its length, the amount of nonvolatile residue in the samples, and the nature of samples injected on the column. When analyzing dirty samples, the guard column becomes contaminated quickly. Normally, contamination deposits in the first meter of the guard column. If a short guard column (1m) is used, it must be completely replaced when it becomes contaminated. If a longer guard column (5m) is used, the contaminated sections can be removed without having to reconnect it to the analytical column.

What length guard column do I need?

A guard column should be long enough to keep non-volatile residue from entering the column, but short enough so that the analysis time is not dramatically increased. Five-meter guard columns are more cost effective, reduce the frustrations of making constant connections between shorter guard columns and the analytical column. Ten-meter guard columns often are used when analyzing very dirty environmental samples. If a very long guard column (>10 meters) is used, the residence time of sample components increases, resulting in a slightly longer analysis time. Guard columns over 30 meters long can cause peak distortion and a loss in efficiency; they are not recommended. In any case, it is important to adjust the column flow rate to account for the length of the guard column that is used, even though the guard column does not have retention.

Fast, High-Temperature Sim Dist Analysis

MXT®-1HT Sim Dist Capillary GC Column and the GC Racer*

by Neil Mosesman, GC Columns Product Marketing Manager

- ✔ Analysis time reduced by 75%, increases throughput.
- ✔ Meets all criteria of ASTM Method D-6352.
- ✔ Excellent peak shape for high-boiling compounds.

ASTM Method D-6352 is a gas chromatography (GC) method developed for the determination of petroleum distillates with a boiling point range of 174°C to 700°C. Often referred to as "high-temperature simulated distillation," this method requires a capillary column capable of withstanding GC oven temperatures up to 430°C. This presents many challenges for analysts because most capillary columns are manufactured using polyimide-coated fused silica tubing. At temperatures above 380°C, even the best polyimide coating becomes brittle, which leads to very short column lifetimes. In addition, the methyl silicone stationary phase recommended in the method also must survive these high temperatures.

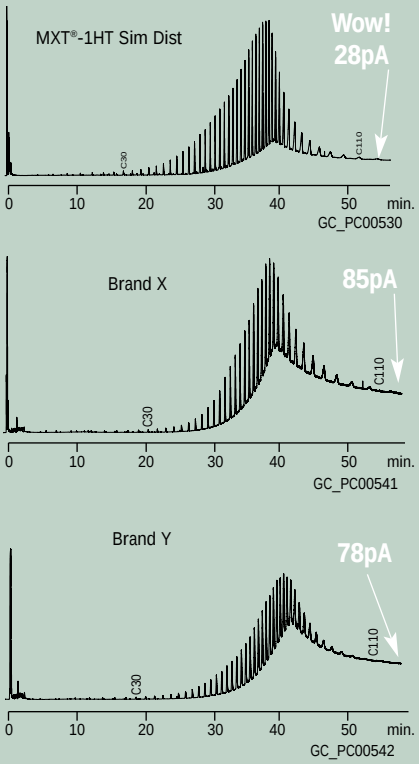
The MXT®-1 HT Sim Dist column is a major improvement in column technology for high-temperature simulated distillation. By combining a new, proprietary polymer synthesis technology, Siltek™ deactivation, and rugged tubing, we developed a capillary column that meets all the criteria of ASTM Method D-6352. This MXT®-1HT Sim Dist column is available as a 5m, 0.53mm ID, 0.1µm film to conform to the requirements of this method. It exceeds the resolution, peak shape, and bleed criteria for hydrocarbons ranging up to C-110. Because the MXT®-1HT Sim Dist column is coated with a 100% dimethyl polysiloxane polymer, it will give the correct retention time/boiling point curve. The MXT®-1HT Sim Dist column exhibits low bleed and excellent inertness, and the rugged tubing will hold up to temperatures in excess of 430°C.

To demonstrate the lower bleed and improved peak shape of this innovative column, a Polywax® 1000 reference material was analyzed using an MXT®-1HT Sim Dist column and two other columns that are commonly used for this application (Figure 1). The MXT®-1HT Sim Dist column exhibits lower bleed and improved peak symmetry compared to other columns on the market.

As part of cost reduction efforts, many laboratories try to reduce individual sample analysis times in the interest of increasing overall throughput. High-temperature simulated distillation analyses can take as long as an hour, especially when samples contain hydrocarbons up to C110. An effective technique to reduce analysis time is to use rapid temperature programming. Unfortunately, most GC systems have temperature-programming limitations of 20°C to 25°C/min. To overcome these limitations, Restek offers the GC Racer, an attachment to your Agilent

Figure 1

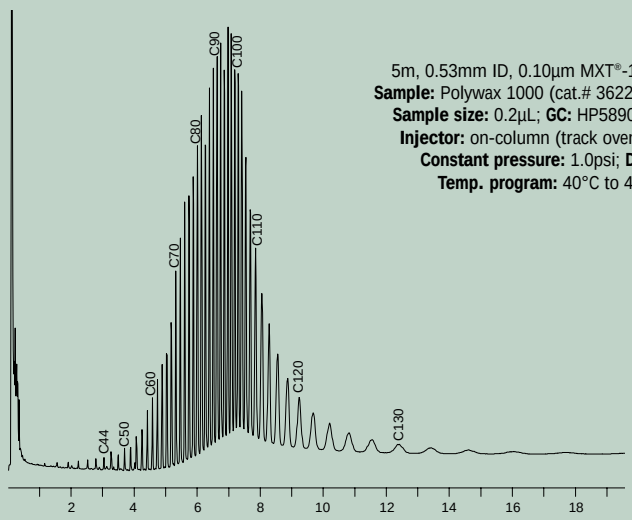
The MXT®-1HT Sim Dist column exhibits lower bleed and improved peak shape compared to other columns used for simulated distillation.



Sample: 0.2µL Polywax® 1000 standard (cat.# 36227); **Solvent:** carbon disulfide; **Injector:** on-column (track oven); **Carier gas:** helium (constant pressure); **Head pressure:** 1.0psi; **Linear velocity:** 60cm/sec.; **Flow rate:** 7.8mL/min.; **Detector:** FID @ 430°C; **Make-up gas flow:** 40cc/min.; **Temp. program:** 40°C to 430°C @ 10°C/min. (hold 30 min.)

Figure 2

Significantly reduce simulated distillation analysis time using the MXT®-1HT Sim Dist column and the GC Racer attachment.



5m, 0.53mm ID, 0.10µm MXT®-1HT Sim Dist (cat.# 70100)
Sample: Polywax 1000 (cat.# 36227); **Solvent:** carbon disulfide;
Sample size: 0.2µL; **GC:** HP5890 GC w/ GC Racer™ system;
Injector: on-column (track oven); **Carrier gas:** hydrogen;
Constant pressure: 1.0psi; **Detector:** FID @ 430°C;
Temp. program: 40°C to 430° C @ 60°C/min.

D6352-98 Polywax® Standards

These high molecular weight hydrocarbon waxes are useful for simulated distillation and other high-temperature GC work.

Description	qty.	cat.#	Ea.
Polywax 500	1 gram	36224	
Polywax 655	1 gram	36225	
Polywax 850	1 gram	36226	
Polywax 1000	1 gram	36227	

5890 GC that increases the rate of temperature programming. Using the GC Racer, the analysis of the Polywax® 1000 reference material can be reduced from over 50 minutes to less than 15 minutes by temperature programming at 60°C/min. (Figure 2)!

The Restek MXT®-1HT Sim Dist column is the ideal choice for high-temperature simulated distillation. It meets all the criteria of ASTM Method D-6352 while providing low bleed and excellent peak shape. Combining the MXT®-1HT Sim Dist column with the GC Racer attachment significantly reduces overall analysis time and greatly increases sample throughput.

MXT®-1HT Sim Dist (metal column)
Temp Limits: -60 to 430°C

Length (m)	ID (mm)	df(µm)	cat.#
5	0.53	0.10	70100

HOT techtip *from the* ***Restek Wizards***

To maintain the low bleed and high performance of the MXT®-1HT Sim Dist column, it is critical to prevent oxygen from entering the column. This can be achieved by routinely checking your entire system for leaks and using a high-quality gas purifier such as the Super-Clean™ SGT gas filter. We also recommend the use of graphite ferrules; Vespel® or Vespel®/graphite ferrules will not withstand the high temperatures required for this analysis.

Super-Clean™ SGT Gas Filters

- High-purity output (99.9999% purity).
- Features a "quick connect" for fast and simple cartridge changes.
- Full glass/metal design with easy-to-read indicators.

Ultra-High Capacity Oxygen Filter:
cat.# 22029, (ea.)

Single-Position Baseplate:
cat.# 22025, (ea.)

for more info
on SGT Super-Clean™ Gas Filters, request lit. cat.# 59280.

Fast GC Temperature Programming

GC Racer System*

new

by Gary Barone, GC Accessories Product Marketing Manager

- ✔ Save time and money by increasing throughput.
- ✔ Makes fast GC possible with any capillary GC column.
- ✔ Easy to operate and install—truly a "plug and play" accessory.

Fast temperature programs are commonly used in gas chromatographic applications to speed up elution of high boiling point compounds and late eluters. The most common gas chromatograph, the Agilent 5890, has a maximum temperature programmable rate of 70°C/min. The factory heating elements in the 5890 only allow for this maximum temperature program rate to be maintained up to a temperature of 100°C. For analysts trying to push temperature ramps as fast as possible, this inhibited program rate leads to longer analysis time and broader peaks. Now, using the GC Racer auxilliary heating unit, temperature program rates of 70°C/min. can be maintained up to 350°C (Figure 1).

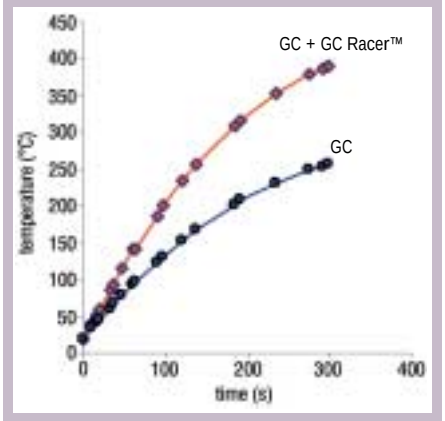
The Restek GC Racer temperature programmer consists of a resistive heating element placed on the floor of the GC oven. The heating element is connected to a controller that is plugged into the main PC board of the GC. When the GC Racer programmer detects that the factory heating elements are not keeping up with the programmed heating rate, the heater is brought into the circuit to augment the heat being supplied to the oven. The GC Racer system will maintain temperature program rates of 70°C/min. up to 350°C and 60°C/min. to temperatures as high as 450°C.

The simplicity of its components and installation makes the GC Racer system a must have add-on accessory for every 5890 GC. The auxilliary heater design is similar to that of the original GC heater. The heater plugs into the GC-Racer controller, which plugs into the main PC board on the GC. The only other connection needed is plugging the GC Racer controller into a 110V standard grounded wall outlet. At no time during the installation of the GC Racer system does the column need to be removed from the oven, or disconnected from the detector or injection port.

The GC Racer system is a new tool in the quest for high-speed GC. The speed of analysis that now can be achieved and the ease of installation will lead to direct savings of time and money by decreasing run time and increasing sample throughput.

Operate your Agilent 5890 as fast as a 6890!

Figure 1
The GC Racer allows temperature program rates of 70°C/min. to be maintained up to 350°C!



GC: Agilent 5890; **Service:** 120V/15 amp; **Start Temp:** 20 °C; Set Oven to 400°C and monitor oven temp.

GC Racer GC Temperature Programmer**

Description	each
For Agilent 5890 Series II (only) GC	23024
For Agilent 5890A (only) GC	23025

*Patent pending
**The GC Racer is currently only available for sale in the US. For availability in your area, contact your local Restek representative.

Improved GC Analysis of Semivolatile Compounds

Using a Siltek™ Drilled Uniliner® Inlet Liner & Rtx®-5Sil MS Column

by Gary Stidsen, Innovations Manager, and David Smith, Ph.D., R&D Senior Chemist

- ✔ Sensitive enough for on-column concentrations down to 4ng.
- ✔ Siltek™ deactivation ensures reproducibility.
- ✔ Fast analysis for US EPA Method 8270.
- ✔ For Agilent GCs.

A new era in inlet liner inertness was realized with the development of Siltek™ passivation. The inert surface of Siltek™ inlet liners has been shown to reduce the loss of basic and acidic compounds.[1,2] To further investigate the benefits of Siltek™ deactivation, semivolatile compounds listed in EPA Method 8270 were analyzed to test for response and linearity.

The chromatographic system used for these liner evaluations included an Agilent 6890 GC with a 5973 MS detector. Restek engineers have designed a unique drilledUniliner® liner that can be used in the split/splitless injection ports of 5890 and 6890 GCs (Figure 1). A small hole drilled into the upper part of the liner results in sample discrimination characteristics of direct injection in combination with the splitless injection technique. This equalizes the pressure between the upstream and split vent pressure sensors and eliminates pressure malfunctions. These liners also reduce injection port discrimination and prevent the injected sample from contacting metal injection port parts. This is accomplished by sealing the column into the press-tight taper in the Uniliner® liner. The compounds are then completely contained in the deactivated liner. Another important characteristic in obtaining optimum inertness is proper inlet liner deactivation. Siltek™ drilled Uniliner® inlet liners were used to analyze the complete Method 8270 list at five on-column concentration levels: 4, 10, 16, 24, and 32ng per component.

Figure 1
The drilled hole makes direct injection possible with EPC systems.

Table I
Active compounds from the Method 8270 list were evaluated for relative response and linearity (4, 10, 16, 24, 32ng on-column) using the Rtx®-5Sil MS with the Agilent 6890 GC/5973 MS.

	ISTD	QIon	4ppm RRF	10ppm RRF	16ppm RRF	24ppm RRF	32ppm RRF	ave RRF	%RSD
N-nitrosodimethylamine	1	74	0.700	0.682	0.684	0.691	0.682	0.686	1%
pyridine	1	79	0.594	0.738	0.701	0.916	0.823	0.711	16%
aniline	1	93	2.197	2.148	2.080	2.051	2.031	2.067	3%
N-nitroso-di-*n*-propylamine	1	70	0.635	0.684	0.617	0.654	0.599	0.609	5%
benzoic acid	2	122	0.291	0.185	0.196	0.221	0.215	0.209	19%
2,4-dichlorophenol	2	162	0.250	0.252	0.248	0.240	0.240	0.241	2%
2,4-dinitrophenol	3	184	0.105	0.152	0.160	0.172	0.163	0.155	17%
3-nitroanaline	3	138	0.322	0.359	0.358	0.363	0.342	0.347	5%
4-nitrophenol	3	109	0.157	0.186	0.190	0.183	0.175	0.177	7%
acenaphthene	3	152	1.200	1.160	1.130	1.030	1.010	1.110	8%
hexachlorocyclopentadiene	3	237	0.263	0.297	0.293	0.288	0.290	0.282	5%
azobenzene	3	77	1.358	1.460	1.396	1.296	1.246	1.296	6%
pentachlorophenol	4	266	0.169	0.189	0.191	0.183	0.172	0.181	5%
nitrosodiphenylamine	4	169	0.781	0.786	0.742	0.705	0.640	0.704	8%
benzidine	5	184	0.418	0.548	0.504	0.623	0.539	0.538	14%
benzo(b)fluoranthene	6	252	1.251	1.381	1.333	1.324	1.295	1.358	4%
benzo(g,h,i)perylene	6	276	1.347	1.472	1.441	1.427	1.372	1.446	4%

A subset of active compounds from the EPA Method 8270 compound list was used to determine the effectiveness of these liners. This list contains the most active compounds, which were evaluated for response factors and linearity over the five different concentrations. The compounds are listed in Table I with response factors and linearity results.

At 4ng on-column concentration per component, the Siltek™ liners show a high response with low standard deviation for these active Method 8270 compounds. Furthermore, the liners show excellent linearity over the calibration curve. Figure 2 illustrates a sample chromatogram of 24ng per component with an analysis time of less than 22 minutes. As this analytical system shows, the inertness of Siltek™ deactivation in combination with the fast analysis time using optimized run conditions has the capability of improving sample output in the laboratory. For more detailed information, request Application Note #59125.

[1]Restek Applications Note #59111 *Minimizing Breakdown of Chlorinated Pesticides Using Siltek™-Deactivated GC Accessories.*
[2]Restek Applications Note #59113 *Siltek™-Deactivation Delivers Inertness to Analyte Breakdown and Reactivity, and Durability to Physical and Chemical Challenges.*

Siltek™—by Restek

Siltek™ Press-Tight® Connectors

5-pk.	25-pk.	100-pk.
	straight	
20480	20449	20481
	angled	
20482	20483	20484
ea.		**3-pk.**
	"Y"	
20485		20486
	Angled "Y"	
20487		20469

Siltek™ Guard Columns

ID	5-Meter (ea.)	10-Meter (ea.)
0.25mm	10026	10036
0.32mm	10027	10037
0.53mm	10028	10038

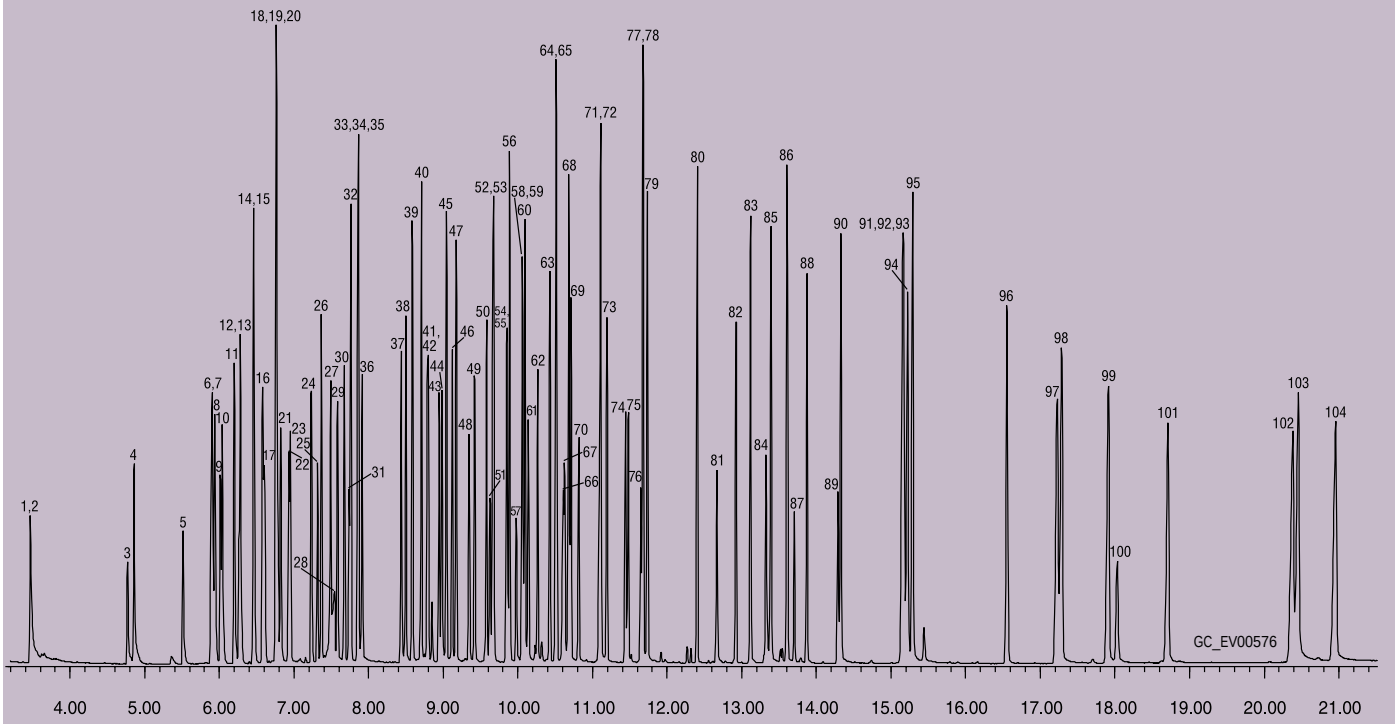
Integra-Guard™ Columns

Guard columns without press-tight connections—protecting your analytical column has never been this easy! Simply add the appropriate suffix number and price to the analytical column's catalog number and price.

ID	length	suffix #
0.25mm	5m	-124
	10m	-127
0.28mm	5m	-243
	10m	-244
0.32mm	5m	-125
	10m	-128

Figure 2

The Rtx®-5Sil MS column, combined with the Siltek™ drilled Uniliner® inlet liner exhibits excellent peak shape and response for semivolatile compounds listed in US EPA Method 8270.



1. N-nitrosodimethylamine
2. pyridine
3. methyl methanesulfonate
4. 2-fluorophenol
5. ethyl methanesulfonate
6. phenol-d6
7. phenol
8. aniline
9. bis(2-chloroethyl)ether
10. 2-chlorophenol
11. 1,3-dichlorobenzene
12. 1,4-dichlorobenzene-d4
13. 1,4-dichlorobenzene
14. 1,2-dichlorobenzene
15. benzyl alcohol
16. 2-methylphenol
17. bis(2-chloroisopropyl)ether
18. acetophenone
19. 4-methylphenol/3-methylphenol
20. N-nitroso-di-{n}-propylamine
21. hexachloroethane
22. nitrobenzene-d5
23. nitrobenzene
24. isophorone
25. 2-nitrophenol
26. 2,4-dimethylphenol
27. bis(2-chloroethoxy)methane
28. benzoic acid
29. 2,4-dichlorophenol
30. 1,2,4-trichlorobenzene
31. naphthalene-d8
32. naphthalene
33. 2,6-dichlorophenol
34. 4-chloroaniline
35. hexachloropropene
36. hexachlorobutadiene
37. 4-chloro-3-methylphenol
38. isosafrole
39. 2-methylnaphthalene
40. 1-methylnaphthalene
41. hexachlorocyclopentadiene
42. 1,2,4,5-tetrachlorobenzene
43. 2,4,6-trichlorophenol
44. 2,4,5-trichlorophenol
45. 2-fluorobiphenyl
46. safrole
47. 2-chloronaphthalene
48. 2-nitroaniline
49. 1,4-naphthoquinone
50. dimethylphthalate
51. 1,3-dinitrobenzene
52. 2,6-dinitrotoluene
53. acenaphthylene
54. acenaphthene-d10
55. 3-nitroaniline
56. acenaphthene
57. 2,4-dinitrophenol
58. pentachlorobenzene
59. 4-nitrophenol
60. dibenzofuran
61. 2,4-dinitrotoluene
62. 2,3,4,6-tetrachlorophenol
63. diethyl phthalate
64. fluorene
65. 4-chlorophenyl phenyl ether
66. 4-nitroaniline
67. 4,6-dinitro-2-methylphenol
68. diphenylamine
69. azobenzene
70. 2,4,6-tribromophenol
71. phenacetin
72. 4-bromophenyl phenyl ether
73. hexachlorobenzene
74. pentachlorophenol
75. pentachloronitrobenzene
76. phenanthrene-d10
77. dinoseb
78. phenanthrene
79. anthracene
80. di-{n}-butylphthalate
81. 4-nitroquinoline-1-oxide
82. isodrin
83. fluoranthene
84. benzidine
85. pyrene
86. {p}-terphenyl-d14
87. aramite
88. chlorbenzilate
89. kepone
90. butyl benzyl phthalate
91. benzo(a)anthracene
92. 3,3{'}-dichlorobenzidine
93. chrysene-d12
94. chrysene
95. bis(2-ethylhexyl)phthalate
96. di-{n}-octyl phthalate
97. benzo(b)fluoranthene
98. benzo(k)fluoranthene
99. benzo(a)pyrene
100. perylene-d12
101. 3-methylcholanthrene
102. indeno(1,2,3-cd)pyrene
103. dibenzo(a,h)anthracene
104. benzo(ghi)perylene

30m, 0.25mm ID, 0.25µm Rtx®-5Sil MS (cat.# 12723)
Conc.: 24µg/mL in methylene chloride
(cat.#s: 31618, 31619, 31620, 31621, 31622, 31206, 31062, 31063) Note: Internal standards at 8ppm

Inj. vol.:	1µL
Inj type:	splitless
Hold time:	0.4 min.
Inlet liner:	drilled Uniliner® liner, Siltek™ deactivation (cat# 21054-214.1)
Inj. temp.:	300°C
Carrier gas:	helium (1mL/min. constant flow)
Linear velocity:	34cm/sec.
Oven temp.:	35°C (2 min.) to 260°C @ 20°C min., to 330° @ 6°C/min. (hold 1 min.)
Det. type:	MS
Transfer line temp.:	280°C
Scan range:	35 to 550amu
Ionization:	EI
Mode:	full scan

Rtx®-5Sil MS (fused silica)

ID (mm)	df(µm)	temp. limits	15-Meter	30-Meter
0.25	0.10	-60 to 330/350°C	12705	12708
	0.25	-60 to 330/350°C	12720	12723
	0.50	-60 to 330/350°C	12735	12738
	1.00	-60 to 325/350°C	12750	12753
0.28	0.25	-60 to 330/350°C	12790	12793
	0.50	-60 to 330/350°C	12791	12794
	1.00	-60 to 325/350°C	12792	12795
0.32	0.10	-60 to 330/350°C	12706	12709
	0.25	-60 to 330/350°C	12721	12724
	0.50	-60 to 330/350°C	12736	12739
	1.00	-60 to 325/350°C	12751	12754

Siltek™ Drilled Uniliner® Inlet Liner for Agilent GCs

4.0mm ID, 6.3mm OD, 78.5mm length

each	5-pk.
21054-214.1	21055-214.5

Haloacetic Acid Mixtures

For GC/ECD Analysis of Haloacetic Acids in Water

by Ken Herwehe, Analytical Reference Materials Product Marketing Manager

- ✔ Meet requirements for US EPA Methods 552, 552.1 and 552.2.
- ✔ Prepared from purified neat reference materials for the highest quality.
- ✔ Lot-to-lot consistency ensures analytical reproducibility.
- ✔ Certificate of analysis available or data pack containing statistical QA results for concentration and homogeneity, and a lot sheet with a balance printout of each analyte.

Haloacetic acids and other disinfectant byproducts are formed during the chlorination of drinking water. The US Environmental Protection Agency (EPA) has published *Stage 1 Disinfectants and Disinfection Byproducts Rule* to regulate haloacetic acids at 60ppb on an annual average. This standard became effective December 2001 for large surface water public systems. In December 2003, it will become effective for small surface water and all ground water public water systems.

✔ Haloacetic Acid Mix, 6 Components

bromochloroacetic acid
dibromoacetic acid
dichloroacetic acid
monobromoacetic acid
monochloroacetic acid
trichloroacetic acid

2,000µg/mL each in MTBE, 1mL per ampule

Ea.	5-pk.	10-pk.
31644	31644-510	—
with data pack		
31644-500	31644-520	31744

✔ Haloacetic Acid Methyl Ester Mix, 6 Components

methyl bromochloroacetate
methyl dibromoacetate
methyl dichloroacetate
methyl monobromoacetate
methyl monochloroacetate
methyl trichloroacetate

1,000µg/mL each in MTBE, 1mL per ampule

Ea.	5-pk.	10-pk.
31645	31645-510	—
with data pack		
31645-500	31645-520	31745

✔ Haloacetic Acid Mix, 9 Components

bromochloroacetic acid	400µg/mL
dibromoacetic acid	200
dichloroacetic acid	600
monobromoacetic acid	400
monochloroacetic acid	600
trichloroacetic acid	200
bromodichloroacetic acid	400
chlorodibromoacetic acid	1000
tribromoacetic acid	2000

In MTBE, 1mL per ampule

Ea.	5-pk.	10-pk.
31646	31646-510	—
with data pack		
31646-500	31646-520	31746

✔ Haloacetic Acid Methyl Ester Mix, 9 Components

methyl bromochloroacetate	400µg/mL
methyl dibromoacetate	200
methyl dichloroacetate	600
methyl monobromoacetate	400
methyl monochloroacetate	600
methyl trichloroacetate	200
methyl bromodichloroacetate	400
methyl chlorodibromoacetate	1000
methyl tribromoacetate	2000

In MTBE, 1mL per ampule

Ea.	5-pk.	10-pk.
31647	31647-510	—
with data pack		
31647-500	31647-520	31747

✔ Internal and Surrogate Standards

Description	compound	µg/mL in MTBE	per ampul	qty.	cat.#
Internal Standard	1,2,3-trichloropropane	1000	1mL	ea.	31648
Surrogate Standard	3,5-dichlorobenzoic acid methyl ester	1000	1mL	ea.	31649
Surrogate Standard	2,3-dichloropropionic acid	1000	1mL	ea.	31650
Surrogate Standard	2,3-dichloropropionic acid methy ester	1000	1mL	ea.	31651
Surrogate Standard	3,5-dichlorobenzoic acid	1000	1mL	ea.	31652
Surrogate Standard	2-bromoproionic acid	1000	1mL	ea.	31653
Surrogate Standard	methyl 2-bromopropionate	1000	1mL	ea.	31654
Surrogate Standard	2,3-dibromoproionic acid	1000	1mL	ea.	31655
Surrogate Standard	methyl 2,3-dibromopropionate	1000	1mL	ea.	31656

50 State UST Methods

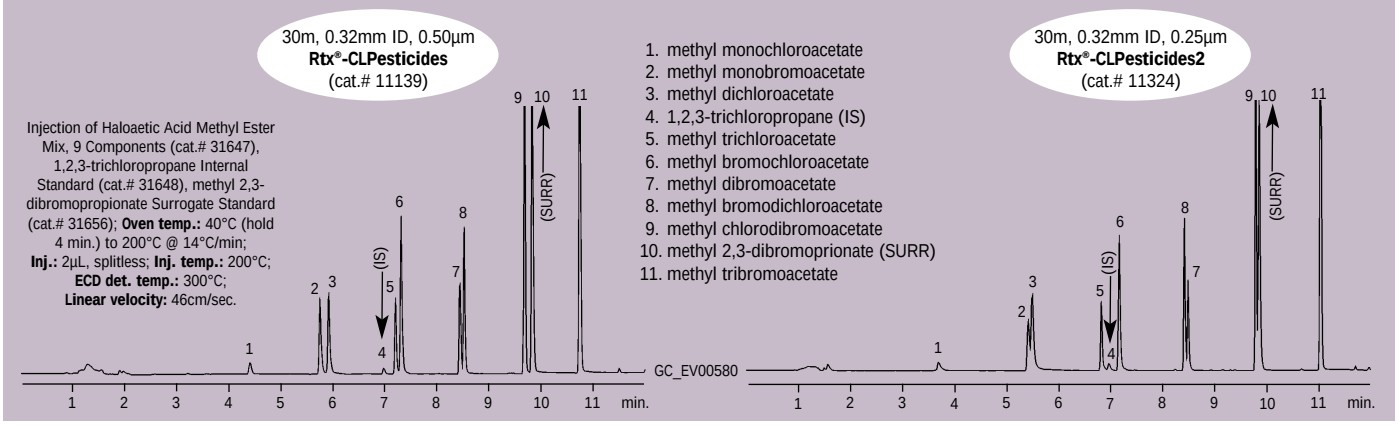
Latest Revisions for All 50 States Available Soon!

- ✔ Detailed product listing available for all 50 states in convenient *Fast Facts* format.
- ✔ Completely updated with the latest method revisions.
- ✔ Allows easy ordering and method setup.
- ✔ Convenient listing of analytical column, sample preparation, reference material, and other consumables needed for all methods.

Fast Facts available at PittCon® 2002—UST method product listings for California, Florida, Massachusetts, Texas, Washington, and Wisconsin. Call Technical Service at 800-356-1688 or 814-353-1300, ext. 4, for more information, or contact your local Restek representative.

Figure 1

The Rtx®-CLPesticides and Rtx®-CLPesticides2 columns resolve haloacetic acid methyl esters in one 12-minute, dual-column run.



Water Quality Testing Standards & Columns

ISO/DIS 9377-4 & H53 Water Quality Testing for Total Petroleum Hydrocarbons (TPH)

by Ken Herwehe, Analytical Reference Materials Product Marketing Manager

✔ Updated reference materials for GC analysis of TPH in water.
✔ Determination of hydrocarbon oil index—applicable to drinking, surface, waste, and treated water.

ISO/DIS 9377-4 describes a gas chromatography/flame ionization detection (GC/FID) method to analyze total petroleum hydrocarbons (TPHs) in drinking, surface, waste, and treated waste water. Previous methods used Freon® extraction, which was harmful to the environment. This new method uses less harmful solvents such as pentane, hexane, or cyclohexane for sample extraction.

Restek now offers mixtures for ISO/DIS 9377-4 analyses. Florisil® cleanup to remove polar compounds is accomplished using a 150-250µm (60/100 mesh) sample preparation column. The analytical column suggested is either an Rtx®-1 or an Rtx®-5 column with dimensions of 10-25m, 0.25-0.53mm ID, and 0.25-1.0µm film thickness. See highlighted columns in product listing for recommended dimensions.

✔ Standard Mixture Stock Solution

diesel #2 (additive free)
motor oil (additive free bp 325–460 or C18–C32 retention time range)
5,000 µg/mL each in cyclohexane, 1mL per ampule (prepares 8mL of 1.25µg/µL calibration curve high point)
Total hydrocarbon concentration 10,000 µg/mL

Ea.	5-pk.	10-pk.
31640	31640-510	—
with data pack		
31640-500	31640-520	31740

✔ Quality Control Standard Mixture

diesel #2 (additive free)
motor oil (additive free bp 325–460 or C18–C32 retention time range)
500µg/mL each in acetone, 1mL per ampule (enough to spike one 900mL quality control sample)
Total hydrocarbon concentration 1,000µg/mL

Ea.	5-pk.	10-pk.
31641	31641-510	—
with data pack		
31641-500	31641-520	31741

✔ Florisil® Cartridge Quality Control Standard Mixture

diesel #2 (additive free)
motor oil (additive free bp 325–460 or C18–C32 retention time range)
1,000µg/mL each in cyclohexane, 10mL per ampule (enough to check one 2g Florisil®/2g sodium sulfate cartridge)
Total hydrocarbon concentration 2,000µg/mL

Ea.	5-pk.	10-pk.
31642	31642-510	—
with data pack		
31642-500	31642-520	31742

✔ Standard Mixture of *n*-alkanes for System Performance Test

n-decane	*n*-hexacosane
n-dodecane	*n*-octacosane
n-tetradecane	*n*-triacontane
n-hexadecane	*n*-dotriacontane
n-octadecane	*n*-tetratriacontane
n-eicosane	*n*-hexatriacontane
n-docosane	*n*-octatriacontane
n-tetracosane	*n*-tetracontane

50µg/mL each in cyclohexane, 1mL per ampule

Ea.	5-pk.	10-pk.
31633	31633-510	—
with data pack		
31633-500	31633-520	31733

✔ Extraction Solvent Stock Solution #1

n-decane	20µL/L
n-tetracontane	20mg/L

in n-hexane, 5mL per ampule (makes 50mL of extraction solvent, enough for 1 sample)

Ea.	5-pk.	10-pk.
31634	31634-510	—
with data pack		
31634-500	31634-520	31734

✔ Extraction Solvent Stock Solution #2

n-decane	20µL/L
n-tetracontane	20mg/L

in n-hexane, 20mL per ampule (makes 200mL of extraction solvent, enough for 4 samples)

Ea.	5-pk.	10-pk.
31635	31635-510	—
with data pack		
31635-500	31635-520	31735

✔ Stearyl Stearate Test Solution

stearyl stearate
2,000 µg/mL in cyclohexane, 10mL per ampule, (enough to check one 2g Florisil®/2g sodium sulfate cartridge)

Ea.	5-pk.	10-pk.
31636	31636-510	—
with data pack		
31636-500	31636-520	31736

Columns

Check the annual Chromatography Products Guide for temp. limits. Highlight indicates a recommended dimension for this analysis.

✔ Rtx®-1 (fused silica)

Crossbond® 100% dimethyl polysiloxane

ID	df (µm)	temp. limits	15-Meter
0.25mm	0.25	-60 to 330/350°C	10120
0.25mm	0.50	-60 to 330/350°C	10135
0.32mm	0.25	-60 to 330/350°C	10121
0.32mm	0.50	-60 to 330/350°C	10136
0.53mm	0.25	-60 to 320/340°C	10122
0.53mm	0.50	-60 to 310/330°C	10137
0.53mm	1.00	-60 to 310/330°C	10152

✔ MXT®-1 (Silcosteel®)

Crossbond® 100% dimethyl polysiloxane

ID	df (µm)	temp. limits	15-Meter
0.25mm	0.25	-60 to 360°C	70120
0.25mm	0.50	-60 to 350°C	70135
0.28mm	0.25	-60 to 360°C	70121
0.28mm	0.50	-60 to 330°C	70136
0.53mm	0.25	-60 to 360°C	70122
0.53mm	0.50	-60 to 330°C	70137
0.53mm	1.00	-60 to 320°C	70152

✔ Rtx®-5 (fused silica)

Crossbond® 5% diphenyl/95% dimethyl polysiloxane

ID	df (µm)	temp. limits	15-Meter
0.25mm	0.25	-60 to 330/350°C	10220
0.25mm	0.50	-60 to 330/350°C	10235
0.32mm	0.25	-60 to 330/350°C	10221
0.32mm	0.50	-60 to 330/350°C	10236
0.53mm	0.25	-60 to 320/340°C	10222
0.53mm	0.50	-60 to 310/330°C	10237
0.53mm	1.00	-60 to 310/330°C	10252

✔ MXT®-5 (Silcosteel®)

Crossbond® 5% diphenyl/95% dimethyl polysiloxane

ID	df (µm)	temp. limits	15-Meter
0.25mm	0.25	-60 to 360°C	70220
0.25mm	0.50	-60 to 350°C	70235
0.28mm	0.25	-60 to 360°C	70221
0.28mm	0.50	-60 to 330°C	70236
0.53mm	0.25	-60 to 360°C	70222
0.53mm	0.50	-60 to 330°C	70237
0.53mm	1.00	-60 to 325°C	70252

Fast, Accurate Analysis of Petrochemicals in Polymers and Plastics

Using an Rtx®-5 Column & EZ Flash® GC

by Ellen Veenstra, Applications Chemist, Thermo Orion and
Christine Vargo, US Sales & Distribution Manager

- ✔ Reduce analysis time by 75%!
- ✔ Ideal for plastics or petrochemicals in packaging testing.

A wide variety of petrochemical materials are used in the synthesis and formulation of polymers and plastics. Low molecular weight monomeric compounds react with an "external" agent, such as a catalyst, UV light, or IR radiation. The reaction creates a high molecular weight polymeric compound by combining the monomers into long or branched chains. If some of the monomer is left unreacted, the small fragments cause physical and sensorial changes in the final plastic. Cracks in structural plastic can form from the stresses due to incomplete polymerization. Discoloration can occur if the reactive monomer interacts with other materials or additives in the final product. Out-gassing can cause an off-odor or "plastic" taste in packaging materials used in foods or beverages.

To ensure product consistency from batch to batch, laboratories must analyze petrochemicals in their finished product. These volatile compounds typically are analyzed by capillary gas chromatography (GC) using a 30-meter column. Analysis times often must exceed 30 minutes to achieve sufficient resolution of these volatile compounds. However, by using a high efficiency, direct thermal transfer of these compounds with an EZ-Flash® GC attachment from Thermo Orion, analysis times can be reduced greatly while still maintaining excellent separation. For example, the typical analysis of plastics in a paint sample on a 30m Rtx®-5 column takes almost 42 minutes. The same analysis using a 10m Rtx®-5 column and an EZ-Flash® system is accomplished in less than 5 minutes (Figure 1).

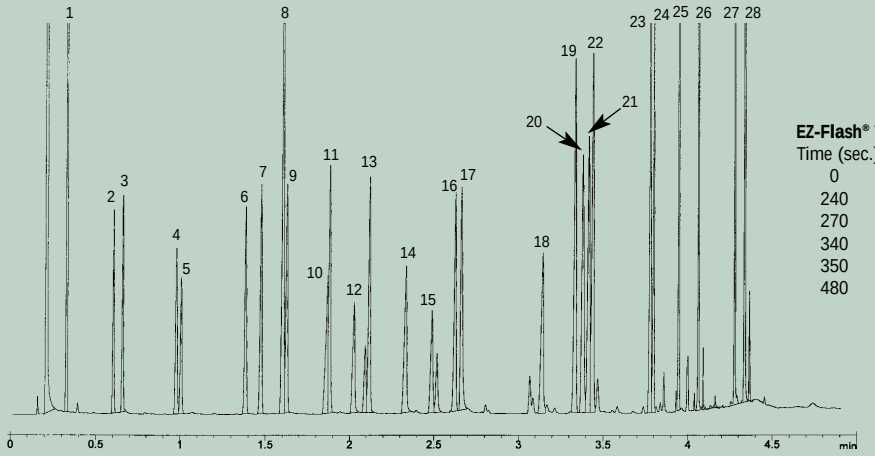
Every minute counts when improving laboratory throughput and efficiency. The EZ-Flash® system uses resistive heating techniques and fast temperature programming to achieve increased productivity. The EZ-Flash® system is compatible with 0.53mm ID, 0.32mm ID, and smaller ID (0.2 -0.10mm) columns.

For more information on the EZ Flash® system, contact Thermo Orion at 1-888-EZFLASH or **www.ezflash.com**

Figure 1

The analysis time of an industrial paint sample is reduced by 75% using the EZ-Flash® system with a 10m, 0.25mm ID, 1.0µm Rtx®-5 column.

1. vinyl acetate
2. ethyl acrylate
3. methyl methacrylate
4. *t*-butyl acrylate
5. ethyl methyl acrylate
6. isobutyl acrylate
7. allyl methacrylate
8. styrene
9. butyl acrylate
10. hydroxyethyl acrylate
11. isobutyl methacrylate
12. hydroxypropyl acrylate
13. butyl methacrylate
14. hydroxyethyl methacrylate
15. hydroxypropyl methacrylate
16. glycidyl methacrylate
17. dimethylaminoethyl methacrylate
18. Hydroxybutyl acrylate
19. cyclohexyl methacrylate
20. *t*-butylaminoethyl methacrylate
21. diethylaminoethyl methacrylate
22. 2-ethylhexyl acrylate
23. 2-ethylhexyl methacrylate
24. ethyleneglycol dimethacrylate
25. iso-bornyl acrylate
26. iso-bornyl methacrylate
27. lauryl methacrylate
28. α-methylstyrene dimer



EZ-Flash® Temperature Profile

Time (sec.)	Temp (ºC)
0	40
240	140
270	140
340	190
350	280
480	280

10m, 0.25mm ID, 1.0µm Rtx®-5 (cat.# 10250-107)
Inj. temp.: 250°C; **Inj. type:** split; **Inj. volume:** 1µL; **Split ratio:** 100:1; **Split flow:** 100mL/min.; **Carrier gas:** helium; **Mode:** ramp pressure: 4.74psi to 7.07psi @ 0.58psi/min. (hold 0.5 min.) to 8.29psi @ 1.05psi/min. to 10.82psi @ 13.38psi.min.; **Nominal initial flow:** 1mL/min.; **Det. type:** FID @290°C; **Oven program:** 40°C (hold 0.5 min.) to 150°C @20°C/min. (hold 2 min.)
Chromatogram courtesy of Thermo Orion, Beverly, MA, www.thermoorion.com.

cool tools

Try These New Tools from Restek for Easier GC Maintenance

by Brad Rightnour and Michael Goss, Instrument Innovations Team

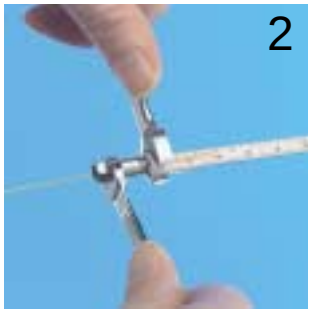
Capillary Installation Gauge

Easily pre-seat ferrules for consistent installations!

✔ Pre-seats ferrule onto column for consistent installation distances.
✔ Made from high-quality stainless steel.

For Agilent-style fittings (0-100mm from front of ferrule)**:** cat.# 21034, (ea.)
For 1/16" fittings (15-115mm from back of nut): cat.# 21399, (ea.)

Install the column nut and ferrule onto the capillary column. Cut the column end squarely to prevent ferrule particles from entering the column. Slide the column into the installation gauge to the recommended insertion distance as specified by the instrument manufacturer. Finger-tighten the column nut at the correct distance.



Using a 5/16" wrench on the installation gauge nut and a 1/4" wrench on the column nut, tighten the assembly with moderate force to ensure a properly seated ferrule.

With the same wrenches, loosen the assembly and remove the column and column nut with seated ferrule from the installation gauge. The ferrule should be properly seated in the column nut, and the column should remain in place when light force is applied. If it slides loosely in the ferrule, repeat steps 1 and 2.

Inlet Liner Packing Tool

Easy and reproducible!

✔ Position wool correctly every time.
✔ Accurate to a specific, measured depth (0-100mm).

cat.# 20339, (ea.)

Loosen the nut on the side of the tool to adjust the gauge to the manufacturer's recommended depth.

Place a one-centimeter plug of loosely bound wool at the top of your inlet liner. Be sure to wear gloves when handling glass wool.

Insert the liner packing tool completely into the liner until the tool bottoms out. Remove the tool. The wool is now positioned correctly in the liner and ready for use.

Rethreading Tool

Achieve a better seal!

✔ Save the cost of replacing expensive injectors!
✔ Repair worn or damaged threads.

For 1/16" compression fittings (thread size, 10-32): cat.# 23016, (ea.)
For 1/8" compression fittings (thread size, 5/16-20): cat.# 23017, (ea.)
For 1/4" compression fittings and Agilent-style split/splitless injection ports (thread size, 7/16-20): cat.# 23018, (ea.)
For Varian injection ports: cat.# 23019, (ea.)

Due to constant installation, removal, and exposure to extreme temperature changes, threads on GC parts easily become worn and damaged. This can cause a poor seal, and oxygen can enter the system, compromising analytical results and possibly destroying expensive analytical columns.

Screw the rethreading tool completely onto the injection port in a clockwise direction. Depending on the severity of thread damage, this may require force.

Unscrew the rethreading tool and inspect the threads. Repeat as necessary. When done, wipe clean with methanol to remove any debris.

RESTEK

Behind the Scenes

Thank You!

Thanks for donating your Wizard Dollars toward disaster relief efforts. With your contributions, Restek is donating $3,268 to the Red Cross, the Salvation Army, and the United Way. On behalf of those that will benefit from your generosity, thank you for supporting the families affected by the Sept. 11 tragedies.

Our New Catalog Is Here!

It's packed with innovative products for GC, HPLC, and Air Monitoring; Analytical Reference Materials; Metals Passivation Technologies; and more! With over 450 Application chromatograms, dozens of reference tables and tech tips, it's a must have for every lab. Order your free copy today (lit. cat.# 59662)!
Call 800-356-1688 or 814-353-1300, ext. 5 or visit us online at www.restekcorp.com

ISO 9001 REGISTERED

Lit. Cat.# 59429

Please direct your comments on this publication to Kristin Cox, Editor, at kristind@restekcorp.com or call Restek, ext. 2313.

Restek-on-the-Road Seminar Tour 2002

Coming to a location near you! We offer four seminars: Environmental Analyses (ENV), Food, Flavor, and Fragrance Analyses (FFF), Comprehensive HPLC (HPLC), and Comprehensive GC (GC). Each is an in-depth, one-day course in an engaging multimedia format taught by real-world chromatographers. For more information and the most current dates and locations, visit **www.restekcorp.com**

Coming to a location near you!

Date	Sem.	State	City
7/15	ENV	AZ	Phoenix
5/6	ENV	CA	Walnut Creek
7/18	ENV	CA	Buena Park
5/20	ENV	FL	Orlando
5/22	ENV	GA	Atlanta
10/16	ENV	IL	Schaumburg
9/12	ENV	MA	Braintree
10/21	ENV	MD	Baltimore
10/14	ENV	MN	Minneapolis
5/23	ENV	NC	Raleigh
10/25	ENV	NY	Tarrytown
11/11	ENV	OK	Oklahoma City
10/23	ENV	PA	King of Prussia
11/13	ENV	TX	Austin
11/14	ENV	TX	Houston
5/9	ENV	WA	Seattle
6/14	FFF	CA	Buena Park
8/26	FFF	CT	Danbury
5/13	FFF	IL	Schaumburg
4/15	FFF	MD	Baltimore
8/28	FFF	MA	Cambridge
5/10	FFF	MN	Minneapolis
4/17	FFF	NJ	Paramus
8/13	FFF	OH	Cincinnati
9/19	FFF	CA	Sacramento
7/16	GC	AZ	Phoenix
5/7	GC	CA	Walnut Creek
7/19	GC	CA	Buena Park
9/12	GC	CO	Boulder
9/13	GC	CT	Hartford
11/11	GC	FL	Jacksonville
11/12	GC	FL	Orlando
11/14	GC	FL	Miami
7/15	GC	GA	Atlanta
7/8	GC	IL	Waukegan
7/10	GC	IN	Indianapolis
8/9	GC	LA	Baton Rouge
9/16	GC	MD	Baltimore

Date	Sem.	State	City
7/9	GC	MO	St. Louis
7/18	GC	NC	Raleigh
9/11	GC	NH	Portsmouth
9/19	GC	NJ	Princeton
9/20	GC	NJ	Paramus
9/9	GC	NM	Albuquerque
6/12	GC	NY	Rochester
7/12	GC	OH	Cincinnati
8/5	GC	OK	Oklahoma City
6/10	GC	PA	Pittsburgh
9/17	GC	PA	King of Prussia
7/16	GC	SC	Columbia
11/15	GC	TN	Memphis
8/6	GC	TX	San Antonio
8/8	GC	TX	Houston
9/11	GC	UT	Salt Lake City
7/19	GC	VA	Richmond
9/9	GC	VT	Burlington
5/10	GC	WA	Seattle
4/16	HPLC	IL	Schaumburg
4/17	HPLC	MO	St. Louis
5/14	HPLC	TX	Houston
5/15	HPLC	TX	San Antonio
6/11	HPLC	CO	Boulder
6/13	HPLC	CA	LaJolla
7/8	HPLC	NY	Rochester
7/10	HPLC	NY	Tarrytown
7/11	HPLC	NJ	Princeton
7/12	HPLC	PA	King of Prussia
8/5	HPLC	CA	Walnut Creek
8/8	HPLC	WA	Seattle
8/14	HPLC	OH	Cincinnati
8/27	HPLC	CT	Hartford
8/29	HPLC	MA	Marlborough
12/9	HPLC	FL	Miami
12/11	HPLC	GA	Atlanta
12/13	HPLC	NC	Raleigh