Packed GC columns
2016 UPDATE

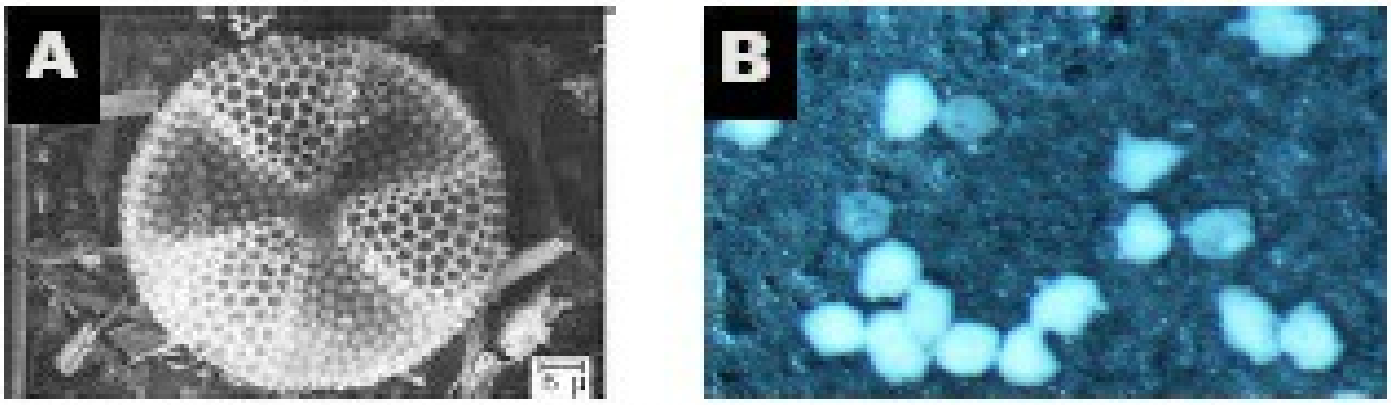
Packed COLUMNS

IMPORTANT UPDATE PITTCON Mar2016

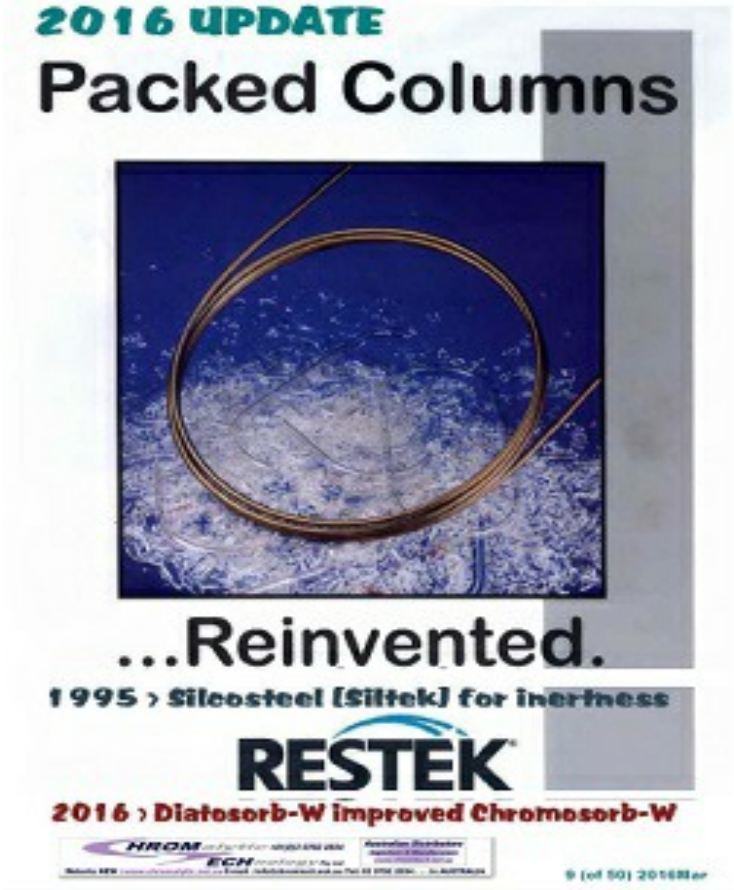
DiatoSorb -W *

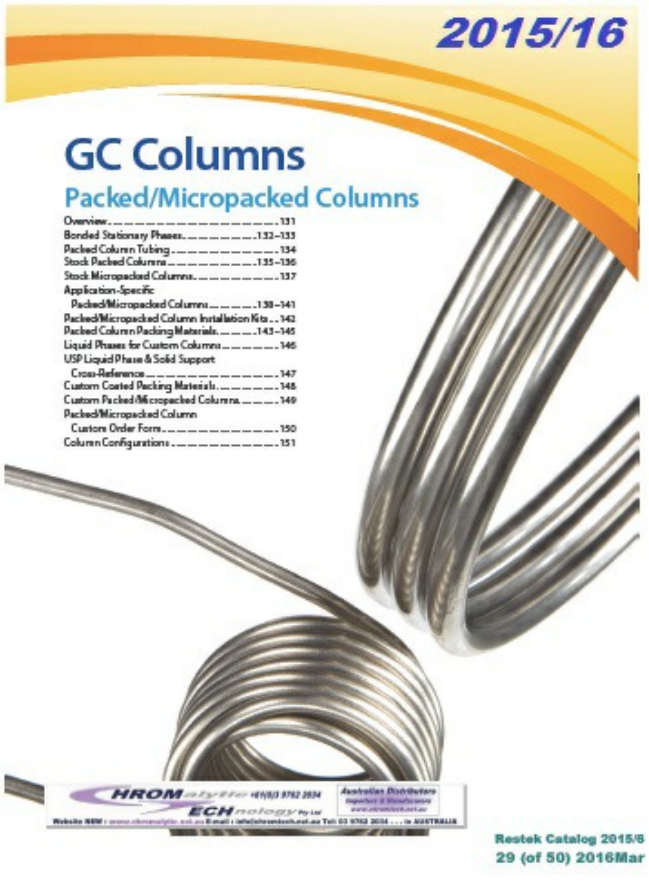
from RESTEK

High Performance Diatomaceouus Earth (DE)



Picture 1 :Under the microscope A) Marine based diatomaceous from the Miocene era used as packing material B) Column uniform and spherical particle size.





Packed COLUMNS

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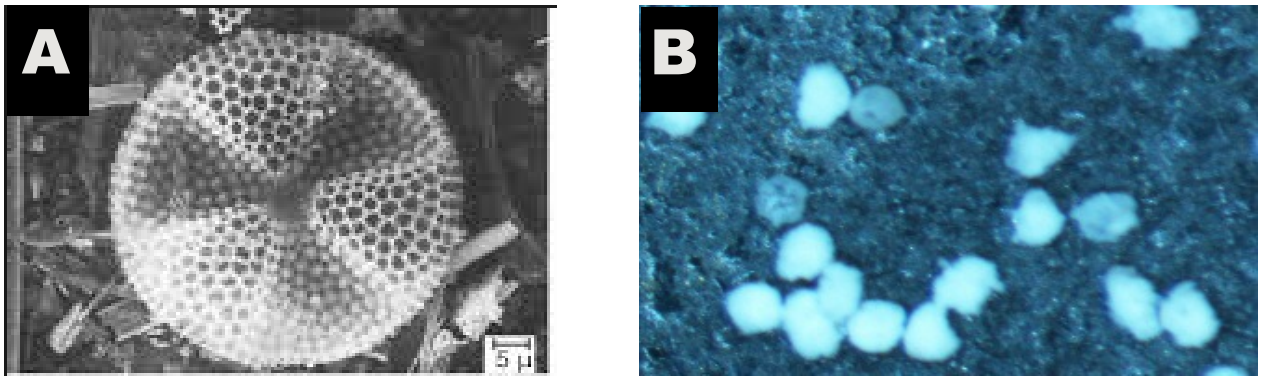
High Performance Diatomaceouus Earth (DE)

Barry L. Burgdraap de Zeeuw, Linx Waclaski, Rebecca Stevens, Katarina Oden; Restek Corporation

Introduction

The frustration of not being able to purchase a quality chromatographic grade solid support has been an issue for years. Restek has addressed this in the form of Restek's new DiatoSorb-W AW, (non-acid washed), W-AW (acid washed), and W-HP (High Performance). Available in particle distributions of 60/80, 80/100 and 100/120 mesh. This material is still the same marine based diatomaceous earth (DE) product from the Miocene era that has been used in gas chromatography for over half a century. The difference is, Restek has applied state of the art technology, and has taken ownership of the entire manufacturing process. The goal of the DiatoSorb project is to meet or exceed the performance of currently available products, and assure customers that chromatographic performance will not be compromised.



Picture 1: Under the microscope A) Marine based diatomaceous from the Miocene era used as packing material B) Column uniform and spherical particle size..

Marine based diatomaceous earth is a mined product and is initially subjected to a calcination process, which removes organics and increases both particle size and pore size.

Specific processing can fine tune the particle size distribution range which contributes to high column efficiencies. A specific density is achieved to assure column to column retention time reproducibility. One of the final steps is the acid wash along with other deactivation procedures which assures superior inertness (Figure 1).

As an improved alternative to Chromosorb W which has been in short supply in recent years (due to a monopolistic cartel arrangement). Restek has taken steps to alleviate this problem by developing their own resource Diatosorb-W and improving the GC performance re column efficiency AND inertness.

Combined with the use of Silcosteel (Siltek) tubing instead of SS, Restek can Now supply the "ultimate" in packed column performance suitable for demanding both USP and ASTM GC methods

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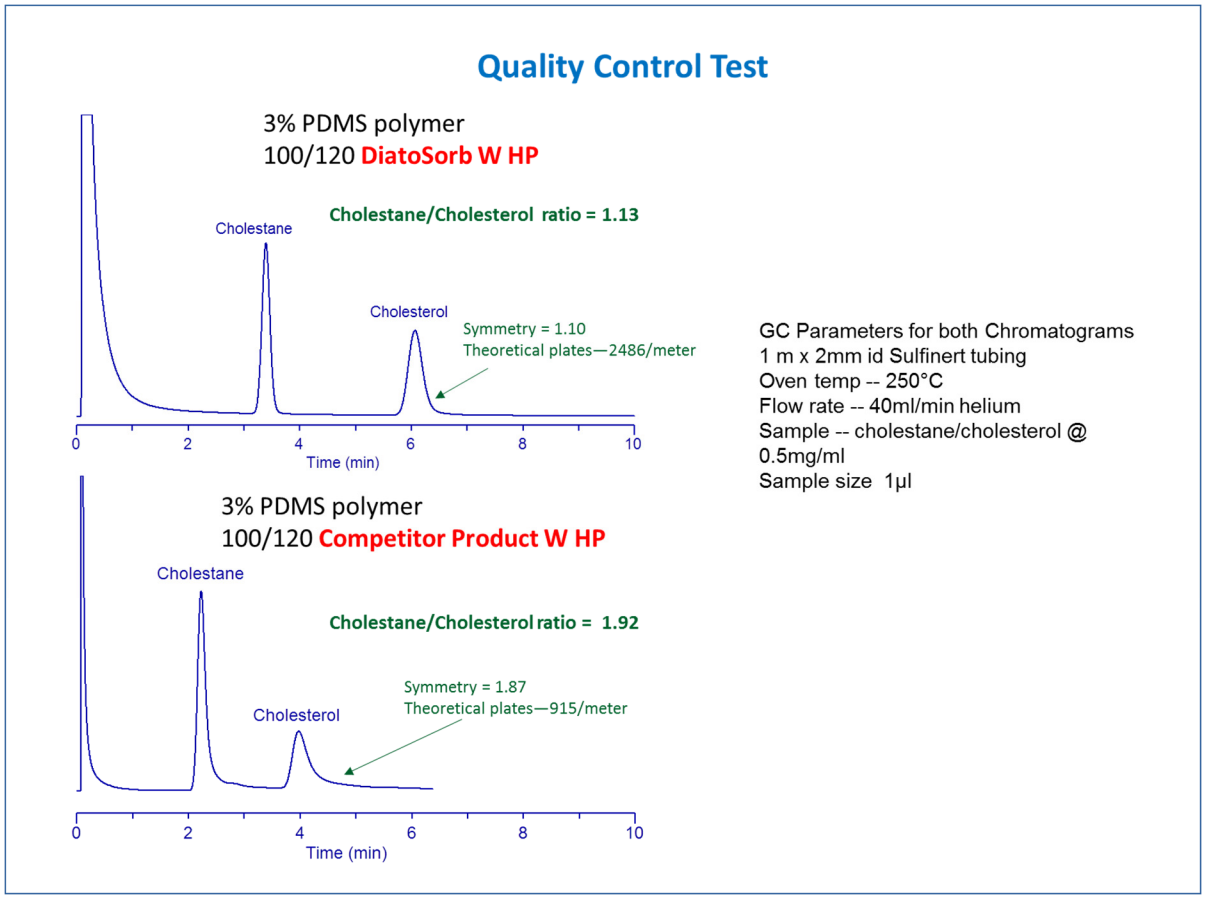

Figure 1: Typical QA test measuring the inertness and particle size distribution (theoretical plates) on a batch of DiatoSorb W HP and compared to a lot of a Competitor's W HP. A clear difference is seen on the DiatoSorb material relative to efficiency, inertness (cholestane/cholesterol ratio) and peak symmetry.

Superior Inertness

The use of DE solid support media for use in packed columns was said to be obsolete back in the early 80's with the introduction of borosilicate capillary columns and soon followed by the introduction of fused silica capillary columns. However, with numerous and robust packed column methods that were established and continue to perform well through the years there hasn't been the justification to revalidate methods utilizing plot or capillary columns. Process analyzer manufacturers, refineries, USP laboratories as well as numerous other private laboratories utilize packed columns.

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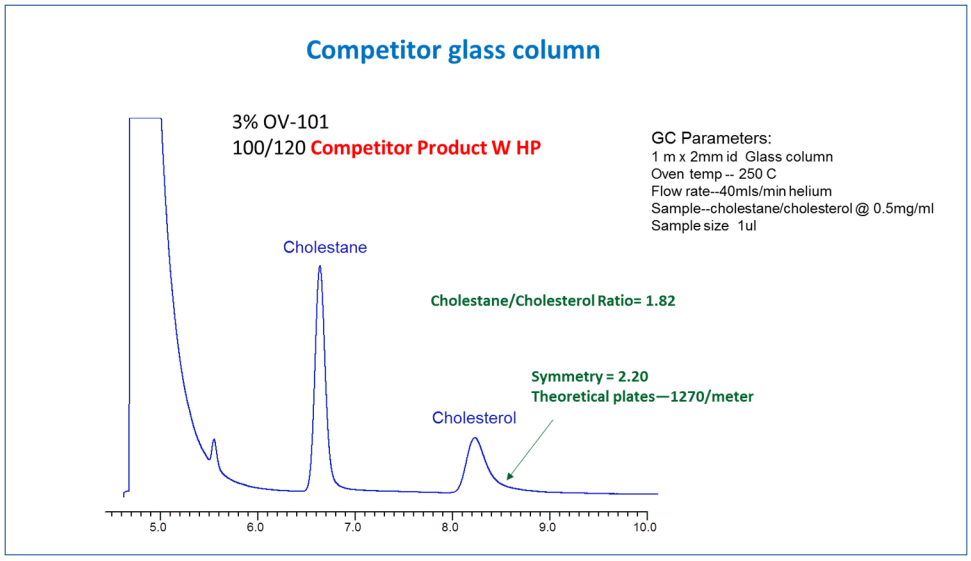

Figure 2: Competitor "A" glass column using the currently available DE W HP measure for inertness, theoretical plates and peak symmetry. As illustrated the column performed poorly in the three (3) categories. The retention time for cholesterol also much longer, likely due to a density issue relative to the solid support.

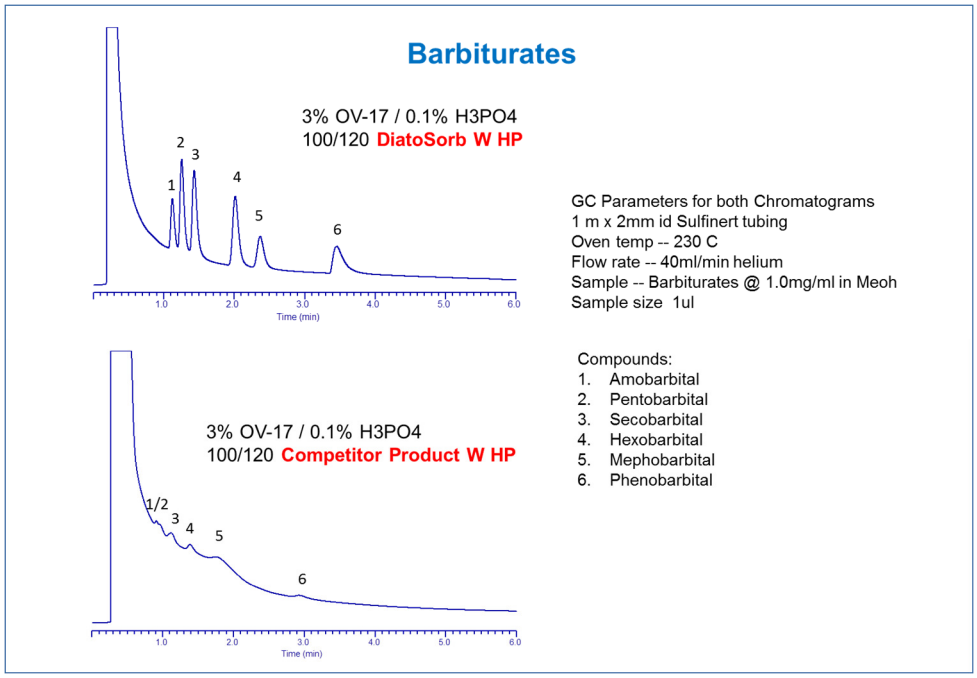

Figure 3: Barbiturate response illustrated the exceptional inertness on the DiatoSorb W HP compared to the currently available competitor product in W HP.

Over the last six decades there have been numerous attempts to manufacture a quality and reproducible chromatographic solid support. There are many companies that supply diatomaceous earth (DE), some examples include; Spherochrom, Chromaton N, Porochrom -2,

4

Gas Chrom Q and Chromosorb. Only one other manufacturer of DE product have complete control of the entire manufacturing process.

Applications

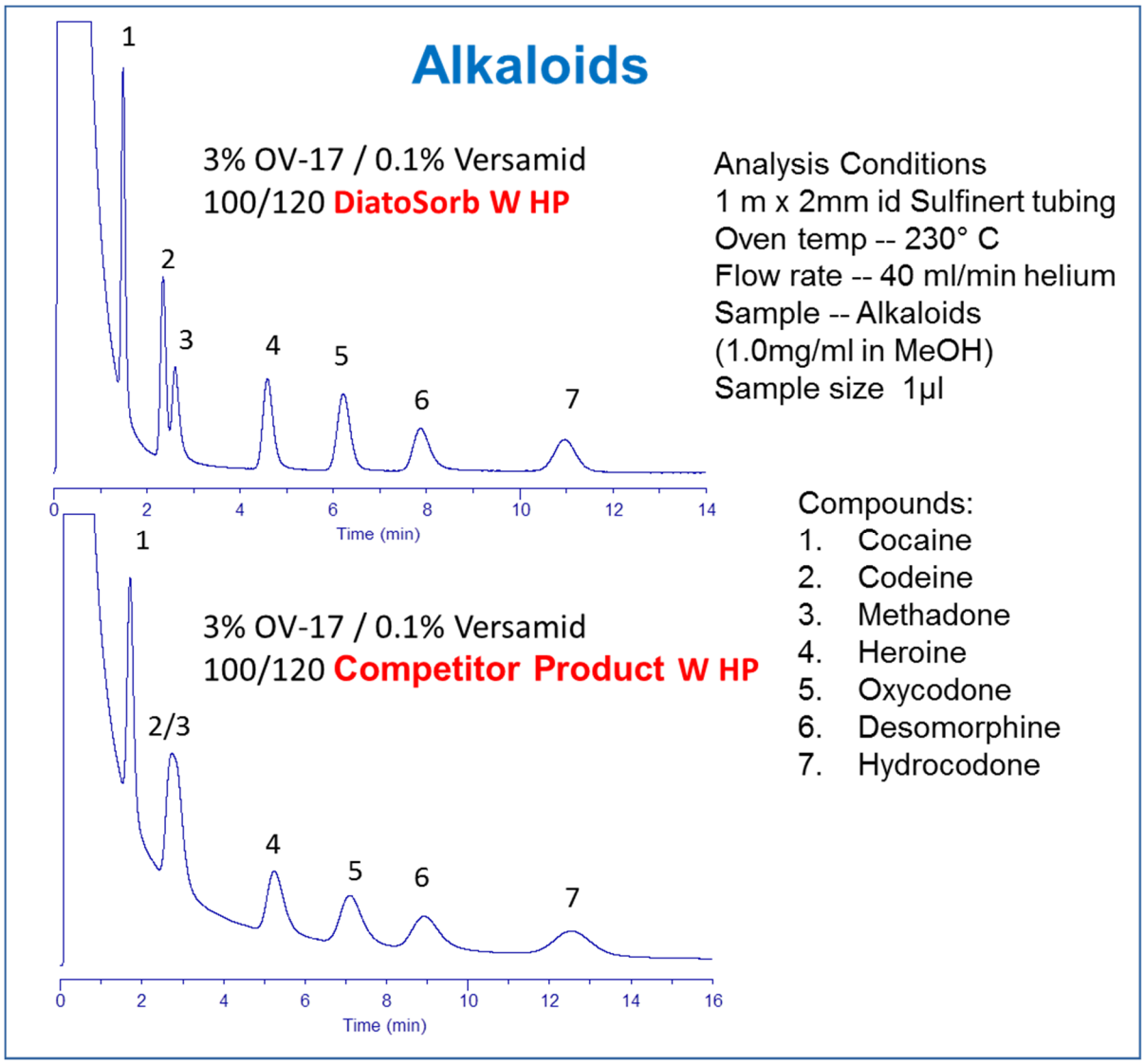

Figure 4: Alkaloid analysis on DiatoSorb W HP and Chromosorb W HP showing improved response with the DiatoSorb W HP analysis and also achieving improved resolution of codeine/methadone.

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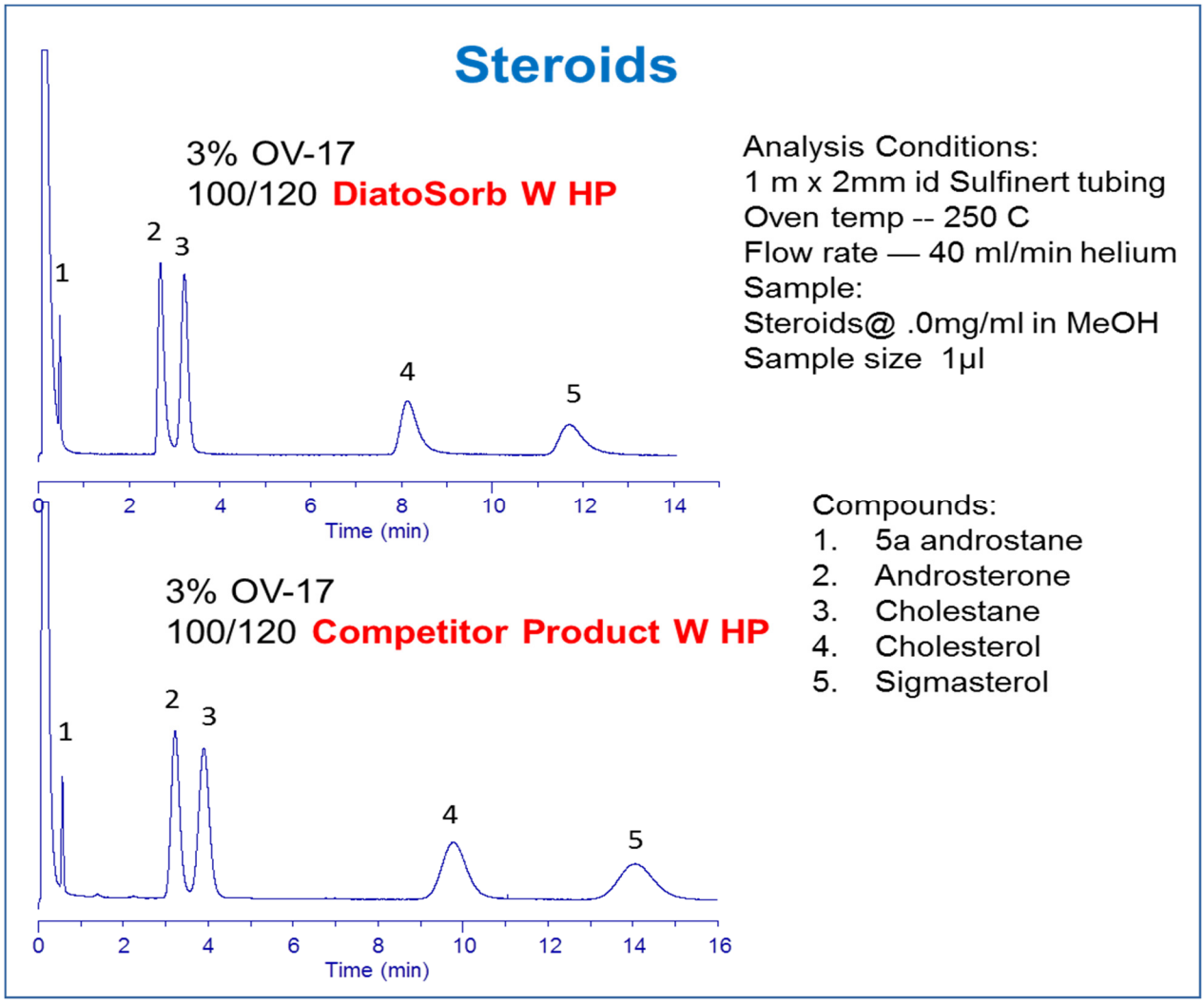

Figure 5: Steroids shown on DiatoSorb W HP and shown on the competitor product W HP illustrating similar results.

6

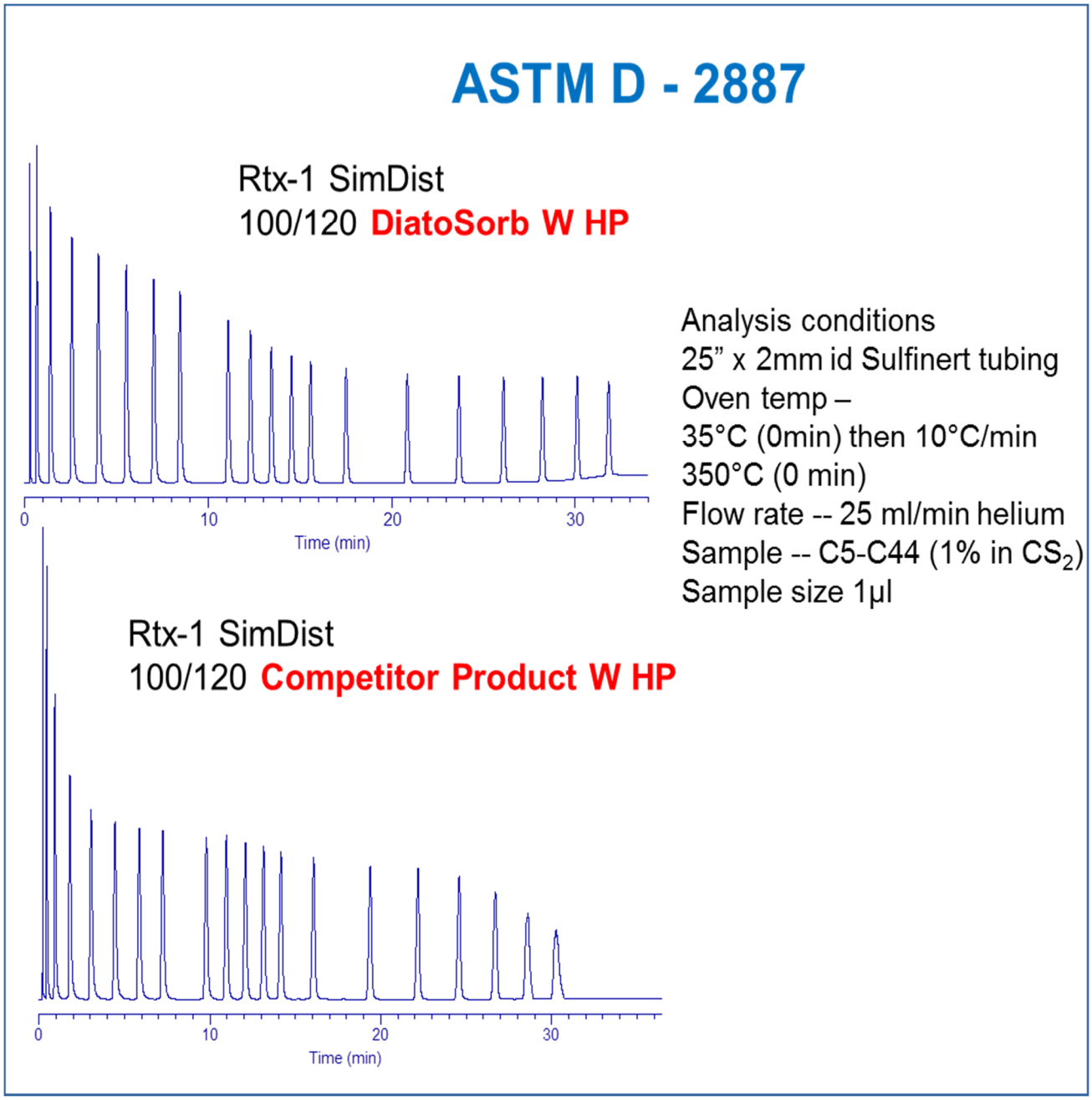

Figure 6: ASTM method D-2887 analysis of C5-C44 hydrocarbons on DiatoSorb W HP and currently available competitor product W HP, comparable results on both solid supports.

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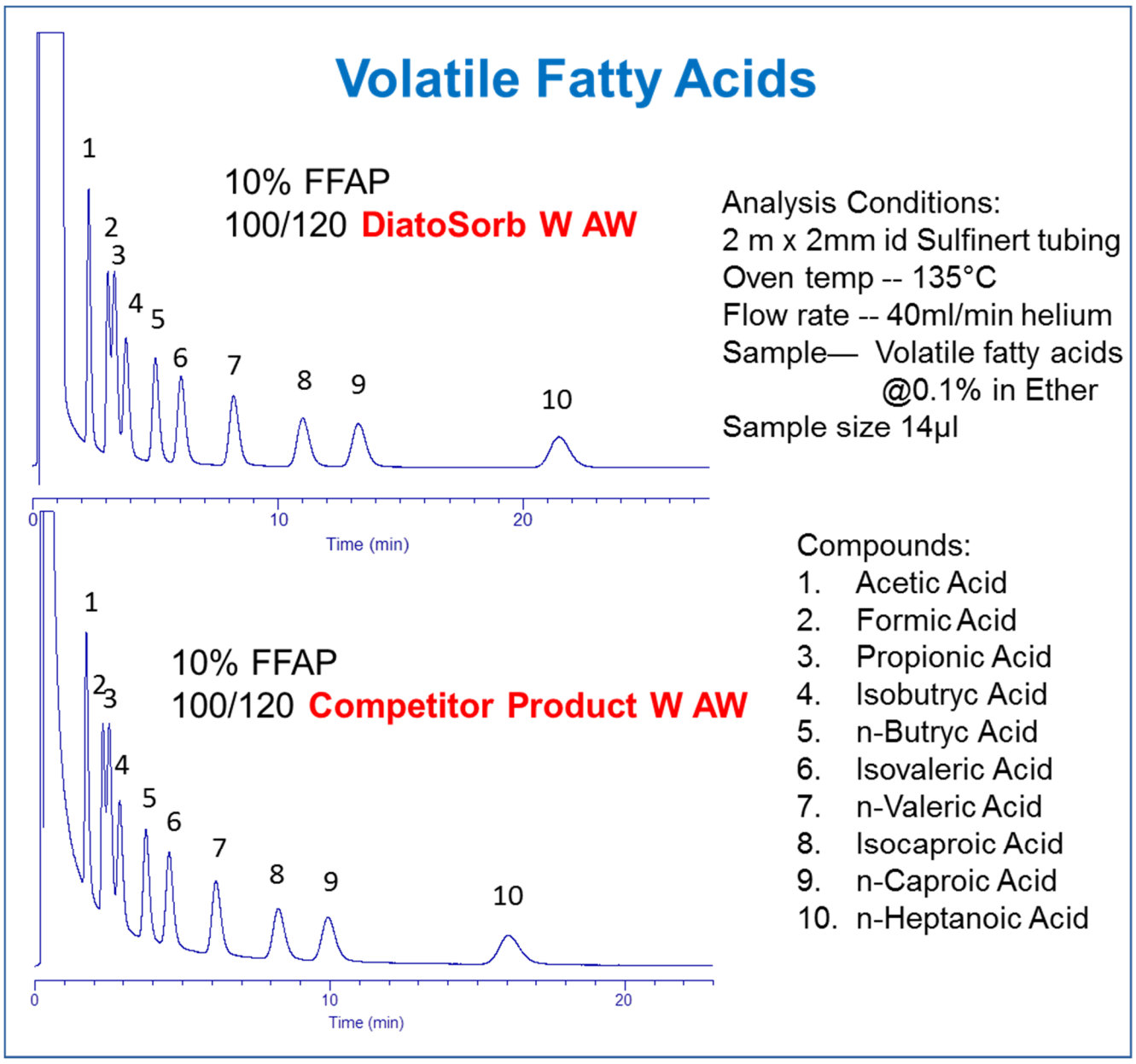

Figure 7: Volatile Fatty Acid analysis on both DiatoSorb WAW and Competitor Product WAW with similar results. A variety of factors in processing could result in poor peak shape.

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Conclusion

The various industries using packed columns utilizing diatomaceous earth (DE) have been plagued by the inability to purchase columns and/or bulk packings. Restek and one other manufacturer control the material from the mine to the column box. When your laboratory requires reproducible columns and/or bulk packing's, remember, no manufacturer or chromatographic supplier in the world controls the physical and chemical properties of chromatographic quality diatomaceous (DE) earth comparable to Restek's state of the art DiatoSorb product.

2016 UPDATE

Packed Columns

...Reinvented.

1995 › Silcosteel [Siltek] for inertness

RESTEK®

2016 › Diatosorb-W improved Chromosorb-W

Introducing The Packed Column of the 21st Century!

Limited time - FREE inlet adaptor kit !!

Get a free inlet adaptor kit with the purchase of any packed column until December 31, 1995. This kit contains the adaptors necessary to use a 1/8" or 3/16" OD packed column in a 1/4" injection port. Also includes the reducing ferrules necessary for installation. See page 19 for a complete description.

Restek Corporation

Best Innovation in More than 25 Years!

- Fused silica coating provides unsurpassed inertness.
- Deactivated with the same high temperature silicone chemistry used for capillary columns.
- Rugged and flexible, can be coiled down to 1-inch diameters without loss of inertness.
- Universal and versatile, can be bent to any instrument or detector configuration.
- Tighter tubing tolerances result in improved reproducibility over glass.
- Available in four IDs from 0.75mm to 4mm.

Overview

For more than 25 years GC packed columns have remained virtually unchanged. Chromatographers had the choice of rugged stainless steel columns that were adsorptive to active compounds, or fragile glass columns that showed improved inertness, but often broke during installation. Restek Corporation, the leader in capillary column technology, now offers a better alternative for both stainless steel and glass packed column users. Silcosteel® packed columns combine the ruggedness of stainless steel with the inertness of glass. These new packed columns are based upon our proprietary Silcosteel® process which bonds a micron layer of pure, flexible fused silica directly onto the inner stainless steel surface. This fused silica layer is then thoroughly deactivated using the same proprietary process used to make our quality capillary columns.

We didn't stop with just improving the tubing. By applying the same deactivation chemistry used for our capillary columns, we were able to significantly improve the inertness of the packing materials as well. Silcoport™ solid support shows excellent inertness for trace levels of active compounds such as drugs and pesticides. Each batch is carefully screened to ensure a bimodal, tight particle distribution which provides maximum efficiency. Advances made in the stationary phase coating process and packing procedures insures high efficiency for every column.

ISO 9001 Registered

RESTEK

Several Reasons Why...

Flexibility and Durability

Eliminate expensive and wasteful breakage of glass columns. Silcosteel® columns are as flexible as conventional stainless steel columns and are easier to handle than glass columns. They can be dropped, over-tightened, flexed, or handled roughly without damage to the inert surface.

Versatility and Universality

Silcosteel® columns have the flexibility necessary to be moved to different instruments, detectors, and injectors. No longer do you need a special glass column configuration if you change detectors. The same Silcosteel® column is flexible enough to be used in different instruments or the same instrument with a different detector. Inventory can be reduced and troubleshooting can be made easier. Unsure if the problem lies in the GC or column? Simply re-install the same column in a different instrument to isolate variables.

Inertness

Since these packed columns are made using Restek's proprietary Silcosteel® process, they offer increased inertness over deactivated glass or conventional stainless steel columns. The stainless steel tubing is coated with a deactivated fused silica inner layer, covering all active sites. The Silcosteel® columns' high degree of inertness can be seen in Figures 1 & 2. Can you tell the difference between the Silcosteel® packed column and the glass packed column when low levels of highly reactive phenols are injected? Superior deactivation technology gives Silcosteel® columns inertness that surpasses traditionally deactivated glass columns.

Restek's pre-tested packings are ready to go - No overnight conditioning is required!

Support Material . . . 2016+

NEW Diatomite -W Diatomaceous Earth material - improved version of CHROMOSORB W

Higher efficiency, more inert . . . Meets USP, ASTM standards

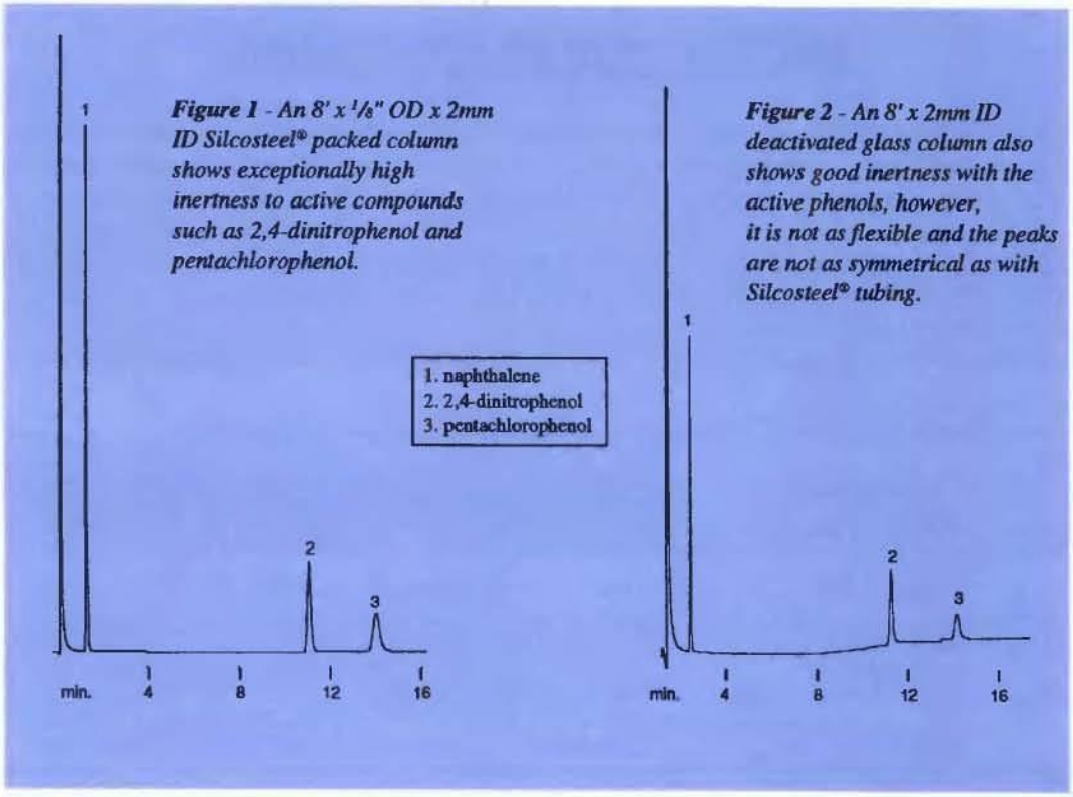


Figure 1 - An 8' x 1/8" OD x 2mm ID Silcosteel® packed column shows exceptionally high inertness to active compounds such as 2,4-dinitrophenol and pentachlorophenol.

1. naphthalene
2. 2,4-dinitrophenol
3. pentachlorophenol

Figure 2 - An 8' x 2mm ID deactivated glass column also shows good inertness with the active phenols, however, it is not as flexible and the peaks are not as symmetrical as with Silcosteel® tubing.

...you should be using Silcosteel® packed columns.

Micropacked Columns

More Reasons Why...

Improved Reproducibility

Silcosteel® columns also offer superior column reproducibility due to more stringent inside diameter (ID) tolerances. The ID tolerance for our stainless steel tubing is 0.001" compared to 0.0025" for glass. In addition, the ID tolerance of glass tubing is further affected during the coiling process. This is attributable to burner temperature inconsistencies and coiling speed which results in poor column-to-column reproducibility. This is not a concern with Silcosteel® columns.

New coating techniques have been developed to insure that the stationary phase is equally distributed on the solid support. Consistent packing procedures are confirmed by testing each column for packing weight and back pressure. Together, all of these factors guarantee excellent column-to-column reproducibility.

Choice of IDs

Silcosteel® packed columns are available in four different inside diameters from 4mm down to 0.75mm. The 4mm ID column has a 3/16" OD which can easily be adapted to any 1/4" packed column injector. The 2mm ID has a 1/8" OD which can be used in either 1/8" or 1/4" packed column injectors. The micropacked columns come in 1mm ID by 1/16" OD and 0.75mm ID by 0.81mm OD. The 1mm ID micropacked column can be inexpensively adapted for use with any packed column injection system. The 0.75mm ID micropacked column was designed for use with capillary injection systems that can utilize 0.53mm ID fused silica columns.

MICROPACKED COLUMNS

Restek's micropacked columns offer a unique mix of efficiency, sample capacity, and inertness. These columns bridge the gap between traditional packed and capillary columns. Due to their narrow diameter, micropacked columns exhibit greater efficiency than standard packed columns. Micropacked columns also offer greater sample capacity than capillary columns. Silcosteel® is used for all micropacked columns to ensure inertness. Even the endplugs are made from braided stainless steel that has been treated using the Silcosteel® process to insure that the sample only contacts inert surfaces. Available in a wide range of porous polymers, molecular sieves, and packings, these micropacked columns can be used for many applications including permanent gases, low molecular weight hydrocarbons, solvents, and oxygenates in gasoline.

Micropacked Column Phase	1-Meter		2-Meter	
	0.75mm ID/ 0.81mm OD	1mm ID/ 1/16" OD	0.75mm ID/ 0.81mm OD	1mm ID/ 1/16" OD
HayeSep® R	19014	19012	19015	19013
HayeSep® Q	19018	19016	19019	19017
HayeSep® N	19022	19020	19023	19021
HayeSep® S	19010	19008	19011	19009
5A Molecular Sieve	19002	19000	19003	19001
13X Molecular Sieve	19006	19004	19007	19005
TCEP	19040*	----	----	----

** 0.56m*

...you should be using Silcosteel® packed columns.

Restek Corporation

STATIONARY PHASES

Restek offers a wide variety of stationary phases from the non-polar SE-30 and OV-1 to the highly polar OV-275 and TCEP. The following is just a sampling of the stationary phases and column configurations that are pre-tested and conditioned. This ensures a stabilization time of only 15-30 minutes after installation to get up and running fast.

To order, specify Restek's catalog number and instrument configuration number. For example, a 2m x 1/8" OD x 2mm ID 1% Rt-1000 on 60/80 CarboBlack™ B, used in an HP 5890 GC would be part number 80207-810. There are many more phases available, so if you don't see your favorite phase or column dimensions listed, just call us at 800-356-1688. For custom configurations, please complete the Custom Packed Column Information Worksheet on the following page

2016+ Silcoport & Chromsorb W replaced by Diatomite -W

PRE-TESTED PACKINGS

Packings	Length, ID, OD	cat.# price
3% Rt-101 on 100/120 Silcoport™	2m, 2mm, 1/8"	80400
3% Rt-2100 on 100/120 Silcoport™	2m, 2mm, 1/8"	80420
10% TCEP on 100/120 Chromosorb® PAW	2.5m, 2mm, 1/8"	80126
5% Rt-1200/1.75% Bentone 34 on 100/120 Silcoport™	2m, 2mm, 1/8"	80125
5% Rt-1200/5% Bentone 34 on 100/120 Silcoport™	2m, 2mm, 1/8"	80129
10% Rtx-1 on 100/120 Silcoport™ (Rtx®-1 Sim Dist)	25", 2mm, 1/8"	80000
23% Rt-Sebaconitrile on 80/100 Chromosorb® PAW	9.2m, 2mm, 1/8"	80128
5% Krytox on 60/80 CarboBlack™ B (Nickel 200 tubing)	3.05m, 2.1mm, 1/8"	80127
5% Carbowax® 20M on 80/120 CarboBlack™ B	2m, 2mm, 1/8"	80105
5% Carbowax® 20M on 60/80 CarboBlack™ B	1.8m, 2mm, 1/8"	80106
6.6% Carbowax® 20M on 80/120 CarboBlack™ B	2m, 2mm, 1/8"	80107
0.3% Carbowax® 20M/0.1% H3PO4 on 60/80 CarboBlack™ C	0.75m, 4mm, 3/16"	80111
4% Carbowax® 20M/0.8% KOH on 60/80 CarboBlack™ B	2m, 2mm, 1/8"	80116
0.2% Carbowax® 1500 on 60/80 CarboBlack™ C	2m, 2mm, 1/8"	80121
0.2% Carbowax® 1500 on 80/100 CarboBlack™ C	2m, 2mm, 1/8"	80122
0.1% Rt-1000 on 80/100 CarboBlack™ C	1.8m, 2mm, 1/8"	80205
1% Rt-1000 on 60/80 CarboBlack™ B	2.4m, 2mm, 1/8"	80206
3% Rt-1500 on 80/120 CarboBlack™ B	3.05m, 2mm, 1/8"	80211
1% Rt-1510 on 60/80 CarboBlack™ B	3.05m, 2mm, 1/8"	80216
1.5% XE-60/1%H3PO4 on 60/80 CarboBlack™ B	1.8m, 2mm, 1/8"	80305
0.19% Picric Acid on 80/100 CarboBlack™ C	2m, 2mm, 1/8"	80311
1% Rt-1000 on 60/80 CarboBlack™ B	2m, 2mm, 1/8"	80207

Instrument Configuration	Restek Part#
General Configuration, fits most GCs	-800
HP 5880, 5890, 5987	-810
Varian 3700, Vista Series, FID	-820
Perkin Elmer 900-3920, Sigma 1,2,3	-830

Other configurations are available,

Stationary Phases

Restek Corporation

Custom Information

CUSTOM PACKED COLUMN INFORMATION WORKSHEET

Packing Description

Liquid Phase(s): _____

% Liquid Phase*: _____

Solid Support: _____

Mesh Size: _____

Nuts: stainless steel _____ brass _____

Column Information

Length: _____

OD & ID: _____

Instrument: _____

Model: _____

Detector: _____

On-Column: Yes_____ No _____ *If yes, the first 2" of the column will be empty to facilitate on-column injections*

*** Phase Coating % Guidelines**

Support	Max. Phase Coating (wt/wt)
SilcoPort Chromosorb W discontinued 2016	
CarboBlack™ B	1-6% non-silicone
CarboBlack™ C	0.1-1% non-silicone
HayeSep® Polymers	15% (5% gum)

Company Information

Company: _____

Address: _____

City: _____ State: _____ Zip: _____

Contact: _____

Phone #: _____ FAX #: _____

Date: _____

Special Instructions

_____

2016+ Silcoport & Chromsorb W replaced by Diatomite -W

60/80, 80/100 & 100/120#

Restek provides custom packed columns in a variety of stationary phases (listed). Please complete the Custom Packed Column Worksheet

In Australia e-mail info@chromtech.net.au

CUSTOM STATIONARY PHASES

Phase	Temp. (°C) Min./ Max.:	Phase	Temp. (°C) Min./ Max.:
Apiezon L	50/300	n,n'-Bis(p-methoxylbenzylidene)-a,a'-bi-p-toluidine (BMBT)	189/225
p,p'-Azoxydiphenetole	132/140		
BC-120	0/125	Butanediol succinate	50/225
Bentone-34	0/180	Carbowax® 1000	40/150
n,n-Bis (2-cyanoethyl) formamide	0/125	Carbowax® 1540	50/175
Bis (2-ethoxyethyl) adipate	0/150	Carbowax® 20M	60/225
Bis (2-ethylhexyl) phthalate	150 max	Carbowax® 20M -terephthalic acid	60/225
Bis (2-methoxy ethyl) adipate	20/100	Carbowax® 400	10/100

Restek Corporation

CUSTOM STATIONARY PHASES, cont.

Phase	Temp. (°C) Min./ Max.:
Carbowax® 4000	60/120
Carbowax® 4000 monostearate	60/200
Carbowax® 600	30/125
Cyclohexanedimethanol succinate	100/250
DC® QF-1	0/250
DC®-11	0/300
DC®-200	0/200
DC®-550	20/250
DC®-710	5/250
DEGS-PS	20/200
Dexsil® 300 carborane/methyl silicone	50/540
Dexsil® 400 carborane/methyl phenyl silicone	50/400
Dexsil® 410 carborane/ methyl cyanoethyl silicone	50/400
Di (2-ethylhexyl) sebacate	0/125
Dibutyl maleate	0/50
Diethylene glycol succinate (DEGS)	20/200
Diethylene glycol adipate (DEGA)	0/200
Diglycerol	20/100
Diisodecyl phthalate	0/175
2,4-Dimethylsulfolane	0/50
Di-n-decyl phthalate	10/175
Dinonyl Phthalate	20/150
Dioctyl sebacate	0/125
Emulphor ON-870	0/200
EPON® 1001	50/225
Ethofat 60/25	50/125
Ethylene glycol adipate	100/225
Ethylene glycol phthalate	100/200
Ethylene glycol succinate	100/200
Ethylene glycol tetrachlophthalate	120/200
FFAP	50/250
Fluorad FC-431, 50% solution in ethyl acetate	40/200
Hallcomid M-18-OL	8/150
Halocarbon 10-25	20/100
Halocarbon K-352	0/250
Halocarbon wax	50/150
1,2,3,4,5,6-Hexakis-(2 cyanoethoxy-cyclohexane)	125/150
Igepal® CO-880 (Nonoxynol)	100/200
Igepal® CO-890	100/200
Neopentyl glycol adipate	50/225
Neopentyl glycol sebacate	50/225
Neopentyl glycol succinate	50/225
N-n-Lauryl-N-L-valine-t-butylamide	60/140
Nonoxynol (Igepal CO-880)	100/200
β,β-Oxydipropionitrile	0/75
OV®-101, dimethyl (fluid)	0/350
OV®-105, cyanopropyl methyl	0/275
OV®-11, phenyl methyl dimethyl, 35% phenyl	0/350
OV®-1701, vinyl	0/250
OV®-17, phenyl methyl, 50% phenyl	0/375
OV®-1, dimethyl (gum)	100/350
OV®-1, vinyl	100/350
OV®-202, trifluoropropyl (fluid)	0/275
OV®-210, trifluoropropyl (fluid)	0/275
OV®-215, trifluoropropyl (gum)	0/275

Phase	Temp. (°C) Min./ Max.:
OV®-225, cyanopropyl methylphenyl methyl	0/265
OV®-22, phenyl methyl diphenyl, 65% phenyl	0/350
OV®-25, phenyl methyl diphenyl, 75% phenyl	0/350
OV®-275, dicyanoallyl	25/250
OV®-330, silicone - Carbowax	0/250
OV®-351	50/270
OV®-3, phenyl methyl	0/350
OV®-61, diphenyl, 33% phenyl	0/350
OV®-73, 5.5% diphenyl	0/325
OV®-7, phenyl methyl dimethyl, 20% phenyl	0/350
Phenyldiethanolamine succinate	0/230
Polethylene glycol adipate (EGA)	100/225
Polethyleneimine	0/175
Polyphenyl ether (5 rings) OS-124	0/200
Polyphenyl ether (6 rings) OS-138	0/225
Polyproplyeneimine	0/200
Polypropylene glycol	0/150
Propylene carbonate	0/50
Quadrol	0/150
Rt-1000	50/250
Rt-1200	25/200
Rt-1220	50/200
Rt-1500	50/230
Rt-1510	50/230
Rt-2100	0/350
Rt-2300	20/275
Rt-2330	25/275
Rt-2340	25/275
Rt-Sebaconitrile	25/110
SE®-30	50/300
SE®-52	50/300
SE®-54	50/300
SF®-96	0/250
Silar® 10 CP	0/250
Silar® 5 CP	0/250
Sorbitol	150 max
Squalane	20/100
Squalene	0/100
Sucrose acetate isobutyrate (SAIB)	0/200
Tetracyanoethylated pentaerythritol	30/175
Tetraethylene glycol dimethyl ether	80 max
Tetraethylenepentamine	0/125
1,2,3,4-Tetrakis (2-cyanoethoxy) butane	110/200
THEED (Tetrahydroxyethlenediamine)	0/125
β,β-Thiodipropionitrile (TDPN)	100
Tricesyl phosphate	20/125
Tris (2-cyanoethyl) nitromethane (TCENM)	20/140
1,2,3-Tris (2-cyanoethoxy)propane (TCEP)	0/175
Triton® X-100	0/200
Triton® X-305	0/200
UC® W982	0/300
UCON® 50-HB-2000	0/200
UCON® 50-HB-280-X	0/200
UCON® 50-HB-5100	0/200
UCON® HB-1800-X	200 max
UCON®-LB-550-X	0/200
Versamid® 9000	190/275
XE®-60, cyanoethyl	0/250

SOLID SUPPORTS

Silcoport™

Silcoport™ is processed from an acid washed version of Chromosorb® W yielding a surface free of metal contaminants which c[illegible] high bleed, sample decomposition and adsorption. A further deactivation is performed using a proprietary, high temperature, silinization technique that results in the most inert solid support available. Each lot is batch tested with 50 pg of DDT and endrin to ensure EPA method compliance. Both 80/100 and 100/120 mesh sizes of Silcoport™ are available.

Chromosorb®

Restek also offers columns with Chromosorb® P, W, T, & G solid supports. Chromosorb® P is manufactured from firebrick and is a hard support. Chromosorb® W is flux-calcined diatomaceous earth that is very fragile, but offers the highest degree of inertness. Chromosorb® G is the hardest support, but due to its low surface area, liquid loadings are restricted to about 5-10%. Chromosorb® T is made from Teflon®.

Diatomaceous Earth

DIATOMITE-W improved version of Chromosoeb W; Higher efficiency, more inert
NEW 2016 overcomes shortage of Chromosorb in recent years [monopoly/cartel?]

CarboBlack™

Graphitized carbon black has been used as a support in gas chromatography for many years. They offer unique selectivity for a wide range of volatile compounds. Restek offers a wide range of packing materials made with CarboBlack™ B and CarboBlack™ C. This material is similar to Supelco's Carbopack® and Alltech's Carbograph®.

Molecular Sieve

Zeolite types of molecular sieves are useful in the separation of permanent gases and light hydrocarbons. Restek offers columns with either Molsieve 5A or Molsieve 13X packings.

HayeSep® Porous Polymers

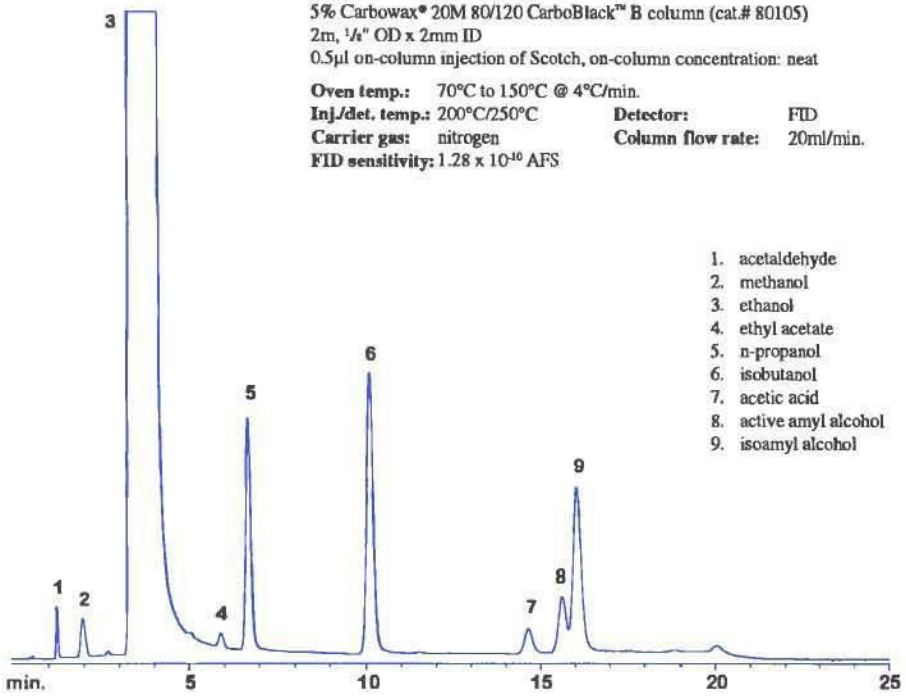
Porous polymers have been used in gas chromatography since the 1960's for the analysis of volatile components such as gases and solvents. Restek offers columns with high quality HayeSep® polymers that are thoroughly cleaned and preconditioned before column preparation. This reduces shrinkage and column bleed and ensures consistent column-to-column performance. The following porous polymers are available:

Support	Composition	Max. Temp.
HayeSep® A	High purity divinyl benzene/ethyleneglycoldimethacrylate copolymer	165°C
HayeSep® B	Divinylbenzene/polyethyleneimine copolymer	190°C
HayeSep® C	Divinylbenzene/acrylonitrile copolymer	250°C
HayeSep® D	High purity divinylbenzene	290°C
HayeSep® N	Divinylbenzene/ethyleneglycoldimethacrylate copolymer	165°C
HayeSep® P	Divinylbenzene/styrene copolymer	250°C
HayeSep® Q	Divinyl benzene polymer	275°C
HayeSep® R	Divinylbenzene/n-vinyl-2pyrollidinone copolymer	250°C
HayeSep® S	Divinylbenzene/4-vinyl-pyridine copolymer	250°C
HayeSep® T	Ethyleneglycoldimethacrylate polymer	165°C

Solid Supports

Restek Corporation

SCOTCH SAMPLE

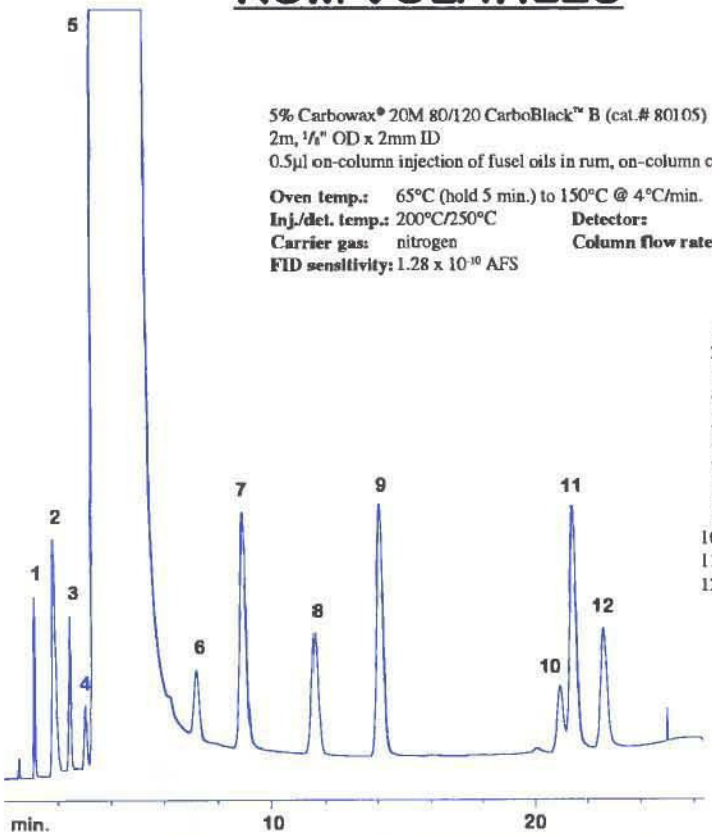


5% Carbowax® 20M 80/120 CarboBlack™ B column (cat.# 80105)
2m, 1/8" OD x 2mm ID
0.5µl on-column injection of Scotch, on-column concentration: neat

Oven temp.: 70°C to 150°C @ 4°C/min.
Inj./det. temp.: 200°C/250°C **Detector:** FID
Carrier gas: nitrogen **Column flow rate:** 20ml/min.
FID sensitivity: 1.28 x 10^{-10} AFS

1. acetaldehyde
2. methanol
3. ethanol
4. ethyl acetate
5. n-propanol
6. isobutanol
7. acetic acid
8. active amyl alcohol
9. isoamyl alcohol

RUM VOLATILES



5% Carbowax® 20M 80/120 CarboBlack™ B (cat.# 80105)
2m, 1/8" OD x 2mm ID
0.5µl on-column injection of fusel oils in rum, on-column concentration: neat

Oven temp.: 65°C (hold 5 min.) to 150°C @ 4°C/min.
Inj./det. temp.: 200°C/250°C **Detector:** FID
Carrier gas: nitrogen **Column flow rate:** 20ml/min.
FID sensitivity: 1.28 x 10^{-10} AFS

1. acetaldehyde
2. methanol
3. acetone
4. ethyl formate
5. ethanol
6. ethyl acetate
7. n-propanol
8. sec-butanol
9. isobutanol
10. active amyl alcohol
11. isoamyl alcohol
12. n-amyl alcohol

Food/Flavor

Chromatograms

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Food/Flavor

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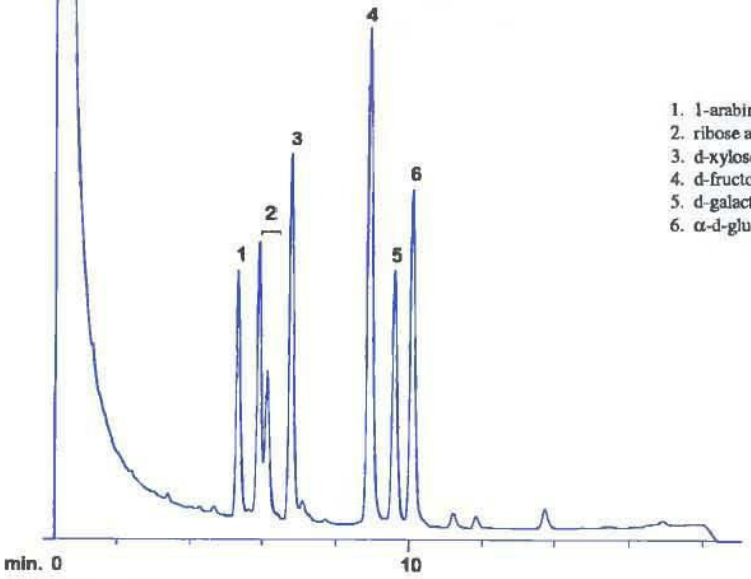
COMPLEX SUGARS

3% Rt-101 on 100/120 Silcoport™ (cat.# 80400)
2m, 1/8" OD x 2mm ID

Oven temp.: 140°C to 230°C @ 5°C/min. (hold 5 min.)
Inj./det. temp.: 250°C / 300°C **Detector:** FID
Carrier gas: helium **Column flow rate:** 35ml/min.
FID sensitivity: 1.28 x 10^{-10} AFS

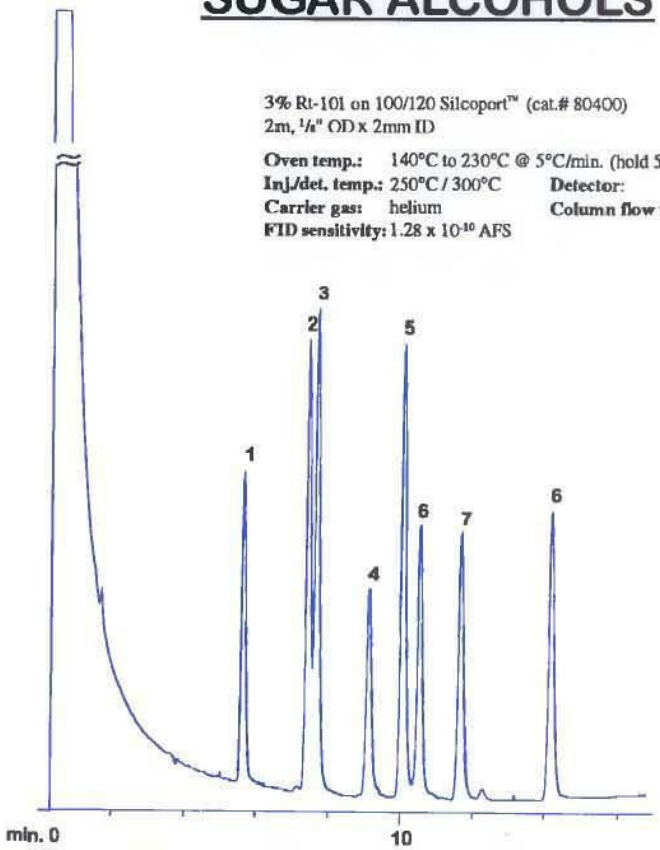


1. l-arabinose
2. ribose anomers
3. d-xylose
4. d-fructose
5. d-galactose
6. α-d-glucose

SUGAR ALCOHOLS

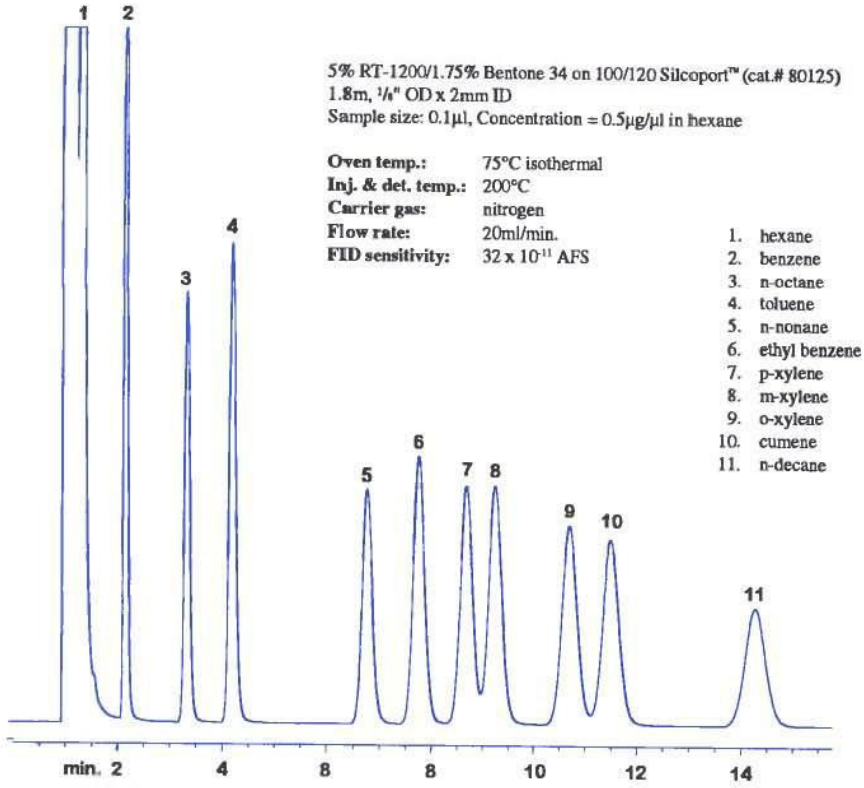
3% Rt-101 on 100/120 Silcoport™ (cat.# 80400)
2m, 1/8" OD x 2mm ID

Oven temp.: 140°C to 230°C @ 5°C/min. (hold 5 min.)
Inj./det. temp.: 250°C / 300°C **Detector:** FID
Carrier gas: helium **Column flow rate:** 35ml/min.
FID sensitivity: 1.28 x 10^{-10} AFS



1. l-arabinose
2. xylitol
3. d-arabinitol
4. d-mannose
5. l-sorbose
6. d-glucose
7. d-sorbitol
8. inositol

XYLENE ISOMERS IN CUMENE

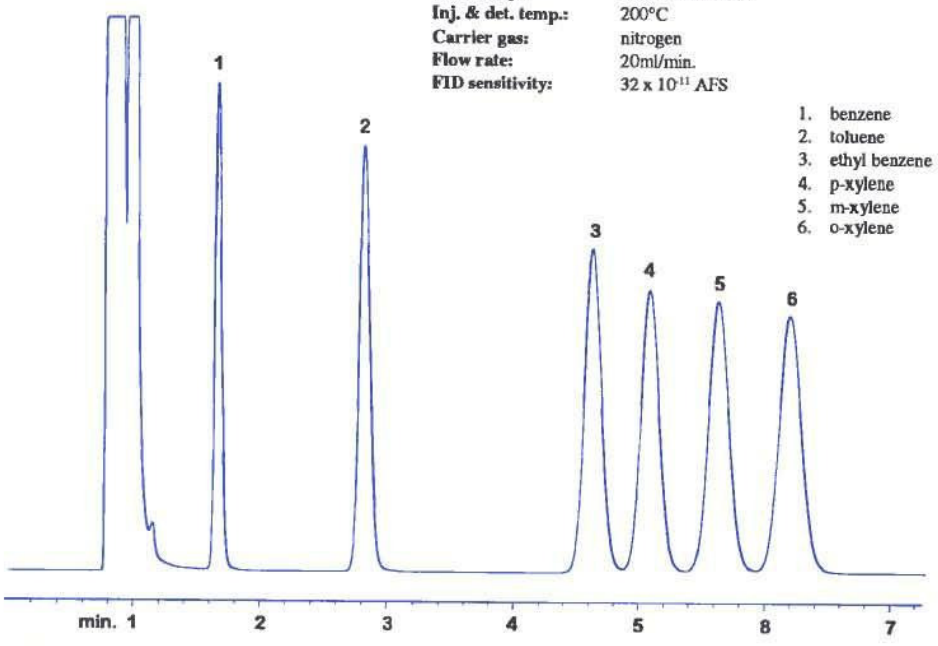


5% RT-1200/1.75% Bentone 34 on 100/120 Silcoport™ (cat.# 80125)
1.8m, 1/8" OD x 2mm ID
Sample size: 0.1µl, Concentration = 0.5µg/µl in hexane

Oven temp.:	75°C isothermal
Inj. & det. temp.:	200°C
Carrier gas:	nitrogen
Flow rate:	20ml/min.
FID sensitivity:	32 x 10^{-11} AFS

1. hexane
2. benzene
3. n-octane
4. toluene
5. n-nonane
6. ethyl benzene
7. p-xylene
8. m-xylene
9. o-xylene
10. cumene
11. n-decane

XYLENE ISOMERS (BTEX)



5% RT-1200/5% Bentone 34 100/120 Silcoport™ (cat.# 80129)
2m, 1/8" OD x 2mm ID Silcosteel®
Sample size: 0.1µl, Concentration = 0.5 µg/µl in hexane

Oven temp.:	100°C isothermal
Inj. & det. temp.:	200°C
Carrier gas:	nitrogen
Flow rate:	20ml/min.
FID sensitivity:	32 x 10^{-11} AFS

1. benzene
2. toluene
3. ethyl benzene
4. p-xylene
5. m-xylene
6. o-xylene

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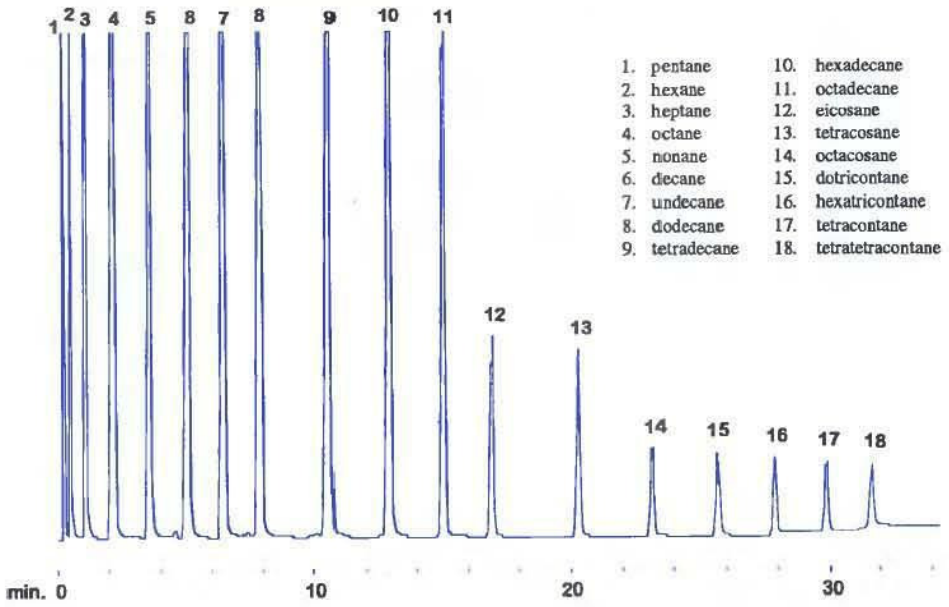
ASTM D-2887 CALIBRATION MIX

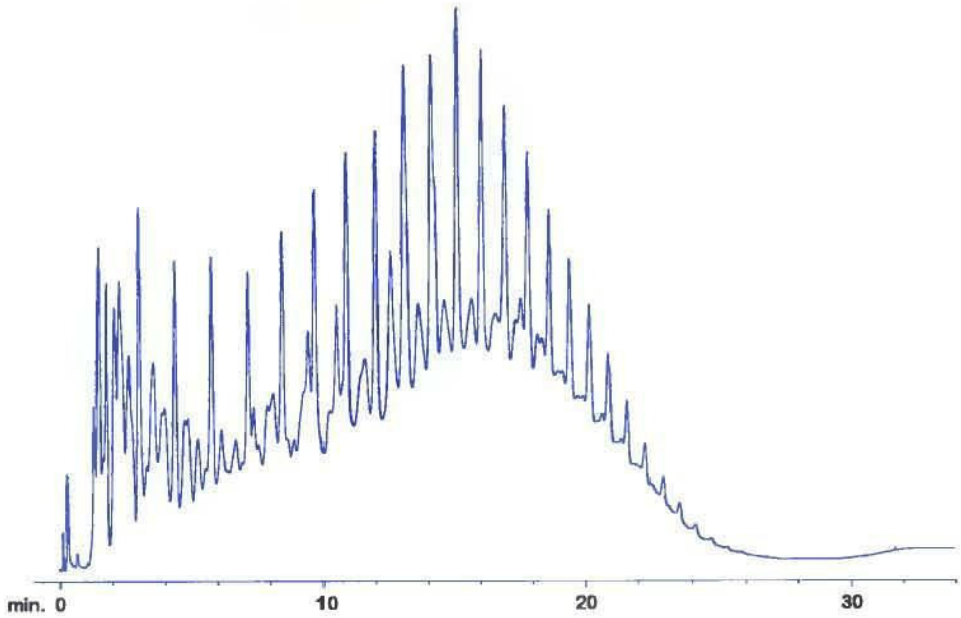


1. pentane
2. hexane
3. heptane
4. octane
5. nonane
6. decane
7. undecane
8. dodecane
9. tetradecane
10. hexadecane
11. octadecane
12. eicosane
13. tetracosane
14. octacosane
15. dotricontane
16. hexatricontane
17. tetracontane
18. tetratetracontane

25" x 1/8" OD x 2mm ID Rtx®-1 SimDist 2887 (cat.# 80000)
1.0µl direct injection of D-2887 Calibration Mix (cat.# 31222)

Oven temp.: 35°C to 350°C @ 10°C/min. (hold 5 min.)
Inj. & det. temp.: 350°C
Carrier gas: helium @ 25ml/min.
FID sensitivity: 256 x 10^{-11} AFS

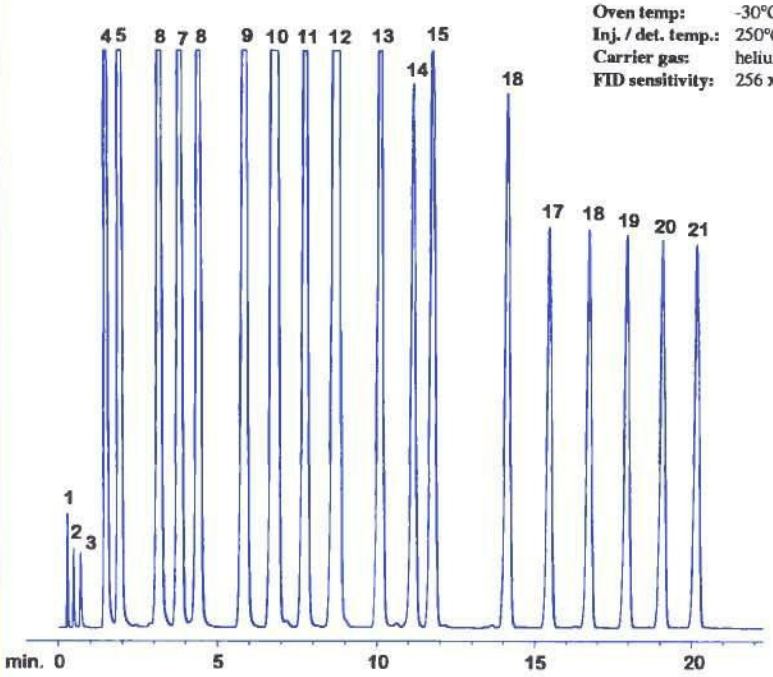
ASTM REFERENCE GAS OIL #1



25" x 1/8" OD x 2mm ID Rtx®-1 SimDist 2887 (cat.# 80000)

Oven temp.: 35°C to 350°C @ 10°C/min. (hold 5 min.)
Inj. & det. temp.: 350°C
Carrier gas: helium @ 25ml/min.
FID sensitivity: 256 x 10^{-11} AFS

SIM DIST ASTM D-3710 CALIBRATION

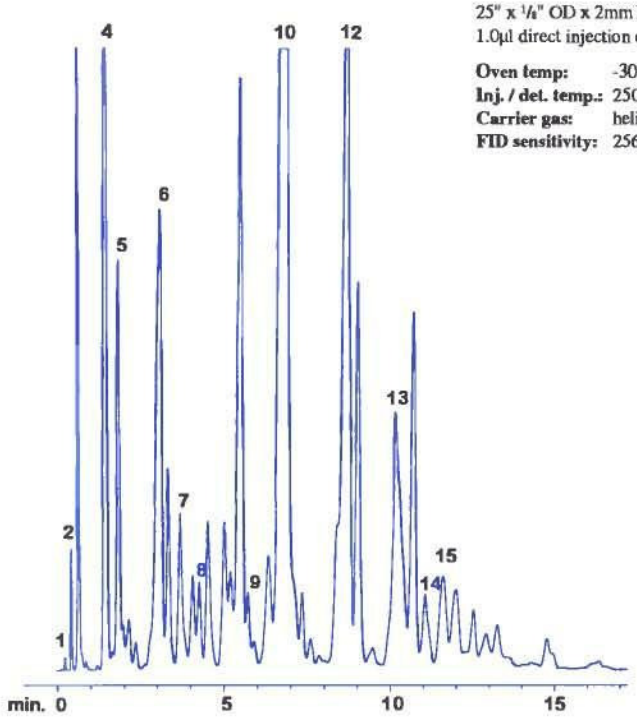


25" x 1/8" OD x 2mm ID Rtx®-1 SimDist 2887 (cat.# 80000)
D-3710 Calibration Mix + C3, C4, C16, & C17 added

Oven temp: -30°C to 250°C @ 10°C/min.
Inj. / det. temp.: 250°C / 300°C
Carrier gas: helium @ 25ml/min.
FID sensitivity: 256 x 10^{-11} AFS

1. n-propane
2. 2-methyl propane
3. n-butane
4. 2-methylbutane
5. n-pentane
6. 2-methylpentane
7. n-hexane
8. 2,4-dimethylpentane
9. n-heptane
10. toluene
11. octane
12. p-xylene
13. n-propylbenzene
14. n-decane
15. n-butylbenzene
16. n-dodecane
17. n-tridecane
18. n-tetradecane
19. n-pentadecane
20. n-hexadecane
21. n-heptadecane

SIM DIST ASTM D-3710 GASOLINE



25" x 1/8" OD x 2mm ID Rtx®-1 SimDist 2887 (cat.# 80000)
1.0µl direct injection of unleaded gasoline

Oven temp: -30°C to 250°C @ 10°C/min
Inj. / det. temp.: 250°C/300°C
Carrier gas: helium @ 25ml/min
FID sensitivity: 256 x 10^{-11} AFS

1. n-propane
2. 2-methyl propane
3. n-butane
4. 2-methylbutane
5. n-pentane
6. 2-methylpentane
7. n-hexane
8. 2,4-dimethylpentane
9. n-heptane
10. toluene
11. octane
12. p-xylene
13. n-propylbenzene
14. n-decane
15. n-butylbenzene
16. n-dodecane
17. n-tridecane
18. n-tetradecane
19. n-pentadecane
20. n-hexadecane
21. n-heptadecane

Petrochemical

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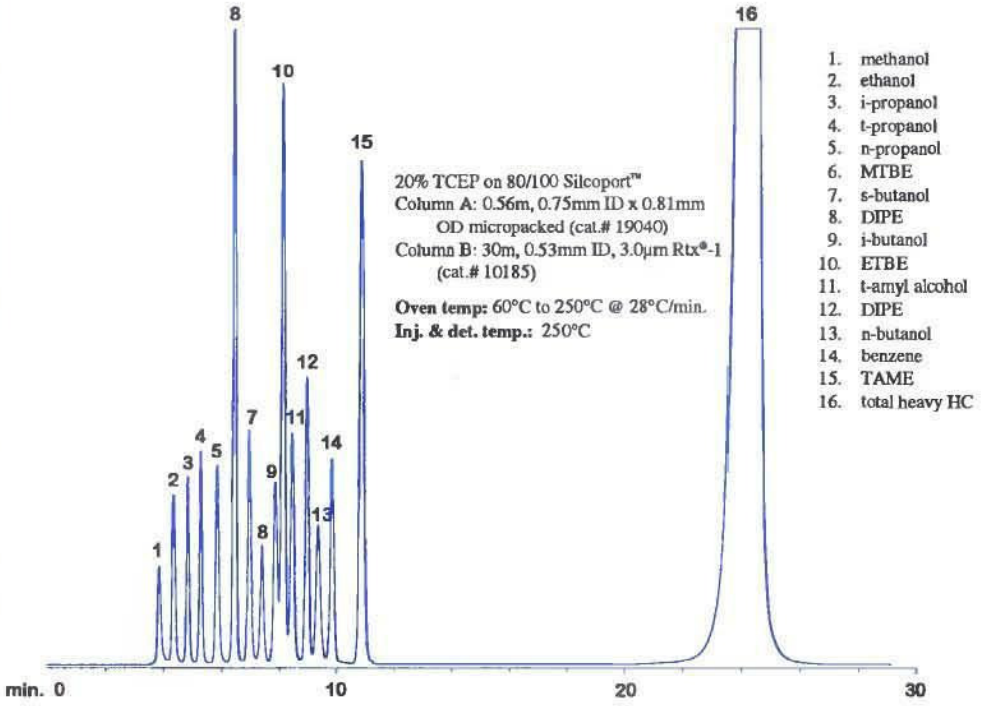
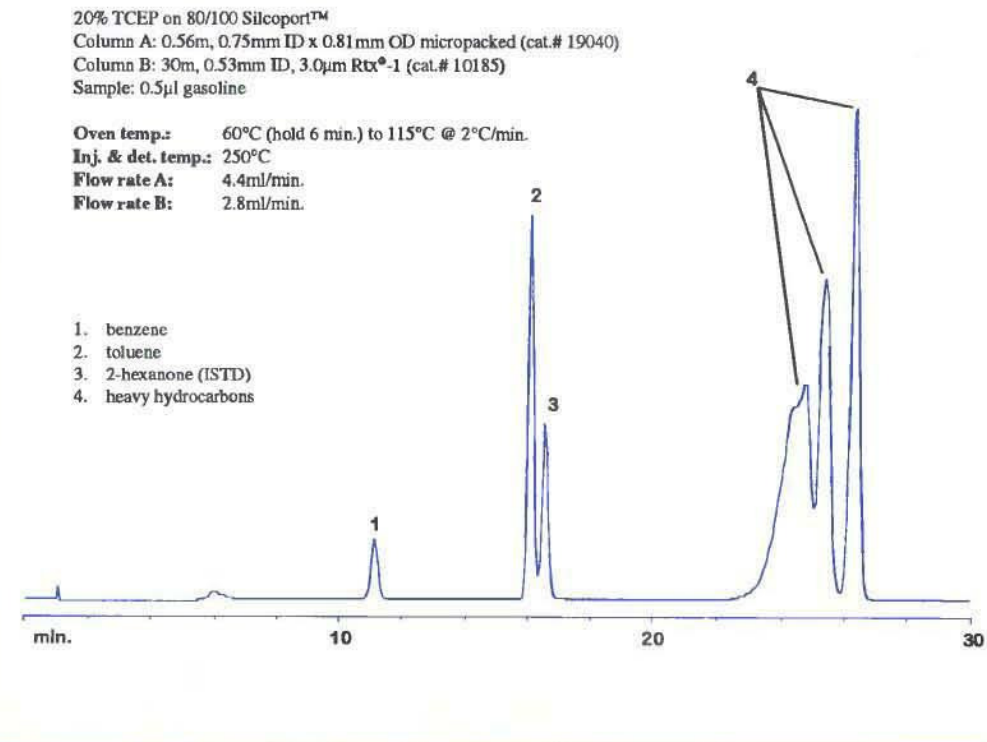
OXYGENATES IN GASOLINE

ASTM D-4815



AROMATICS IN GASOLINE

ASTM D-5580



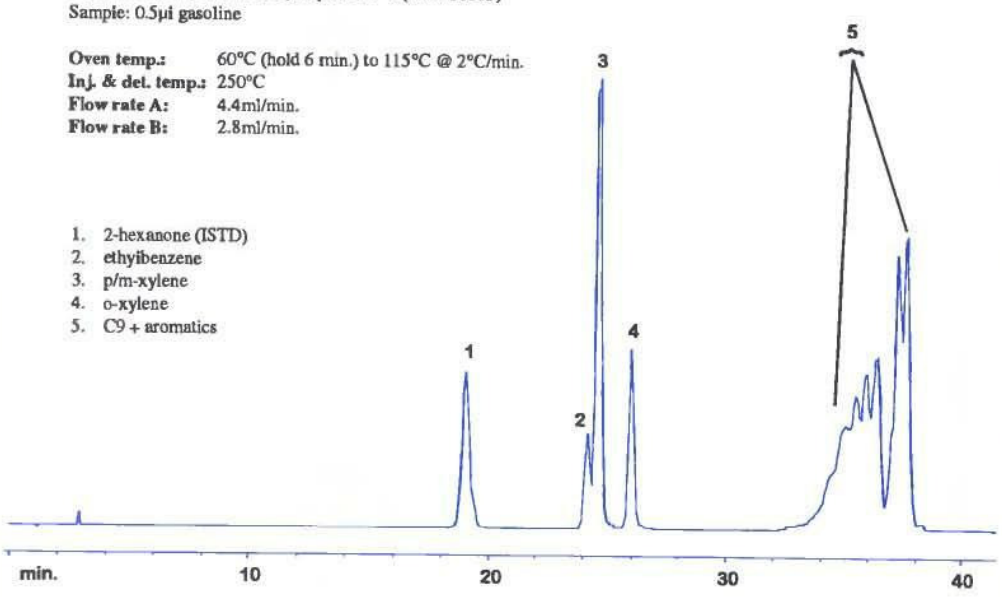
AROMATICS IN GASOLINE

ASTM D-5580

20% TCEP on 80/100 Silcoport™
Column A: 0.56m, 0.75mm ID x 0.81mm OD micropacked (cat.# 19040)
Column B: 30m, 0.53mm ID, 3.0µm Rtx®-1 (cat.# 10185)
Sample: 0.5µl gasoline

Oven temp.: 60°C (hold 6 min.) to 115°C @ 2°C/min.
Inj. & det. temp.: 250°C
Flow rate A: 4.4ml/min.
Flow rate B: 2.8ml/min.

1. 2-hexanone (ISTD)
2. ethyibenzene
3. p/m-xylene
4. o-xylene
5. C9 + aromatics

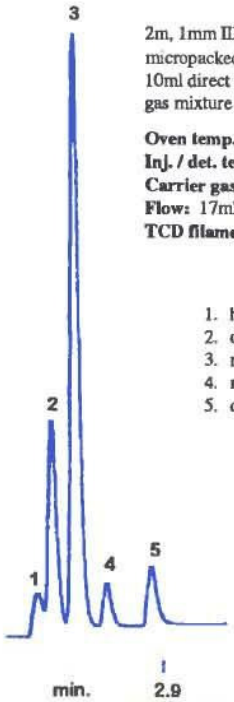


PERMANENT GAS MIXTURE

2m, 1mm ID 13X molecular sieve 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

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

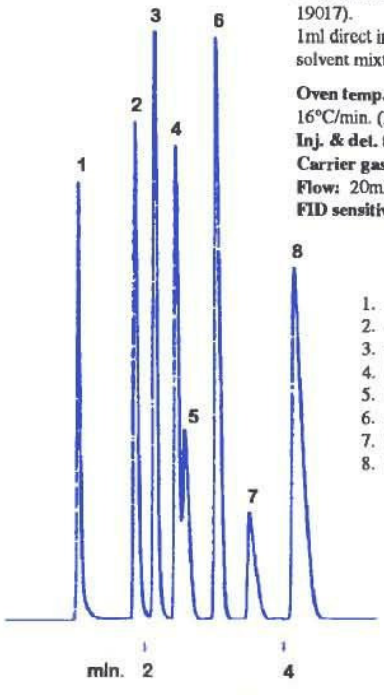


SOLVENTS

2m, 1mm ID HayeSep® Q (cat.# 19017).
1ml direct injection of a neat solvent mixture.

Oven temp.: 80°C 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^{-11} AFS

1. methanol
2. ethanol
3. acetonitrile
4. acetone
5. methylene chloride
6. n-pentane
7. chloroform
8. n-hexane



Petrochemical

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Petrochemical

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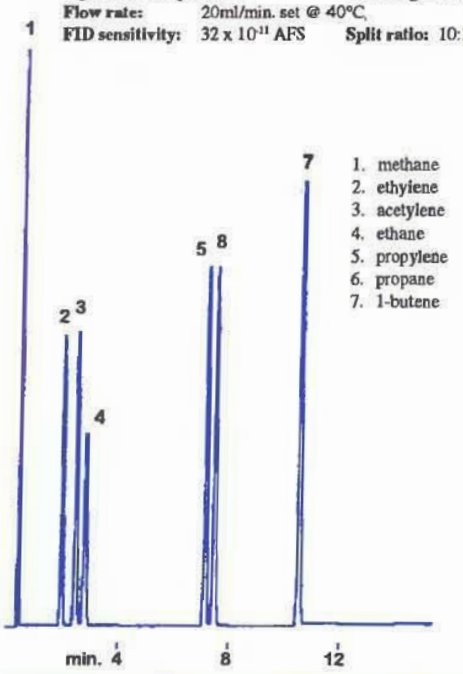
LIGHT HYDROCARBONS TCEP

2m, 0.75mm ID HayeSep® S micropacked (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:** He
Flow rate: 20ml/min. set @ 40°C,
FID sensitivity: 32 x 10^{-11} AFS **Split ratio:** 10:1



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

0.56m, 0.75mm ID TCEP micropacked (cat.# 19040).

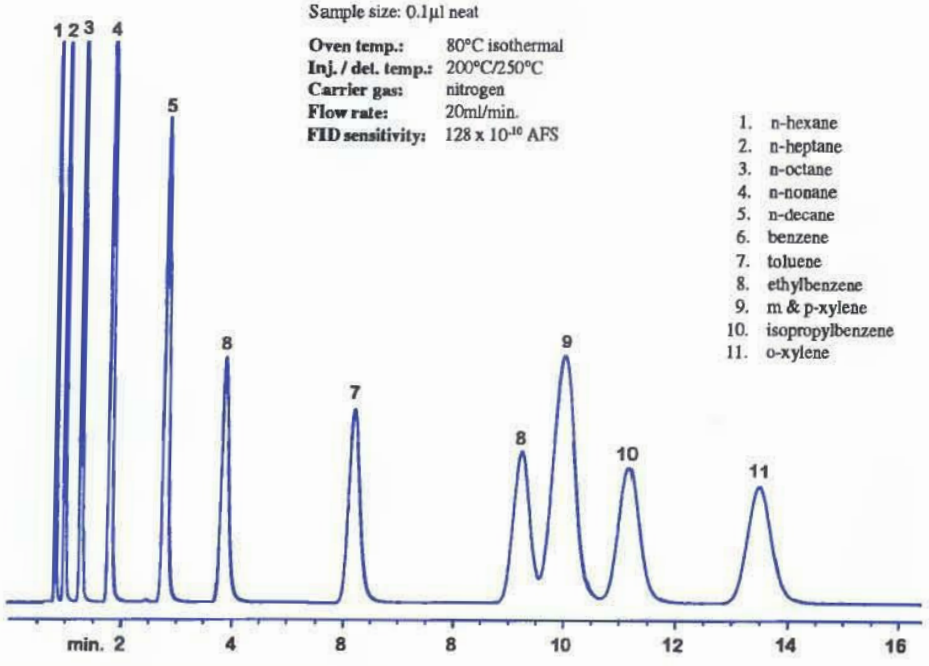
Oven temp.: 60°C isothermal
Inj. & det. temp.: 200°C **Carrier gas:** helium
Flow rate: 2.5ml/min. **Split vent:** 200ml/min.

1. n-pentane
2. methyl-tert-butylether
3. methanol + tert-butanol
4. benzene + isopropyl alcohol
5. toluene
6. n-butanol

AROMATIC & ALIPHATIC HYDROCARBONS

10% TCEP 100/120 Chromosorb® PAW (cat.# 80126)
2.5m, 1/8" OD x 2mm ID Silcosteel®
Sample size: 0.1µl neat

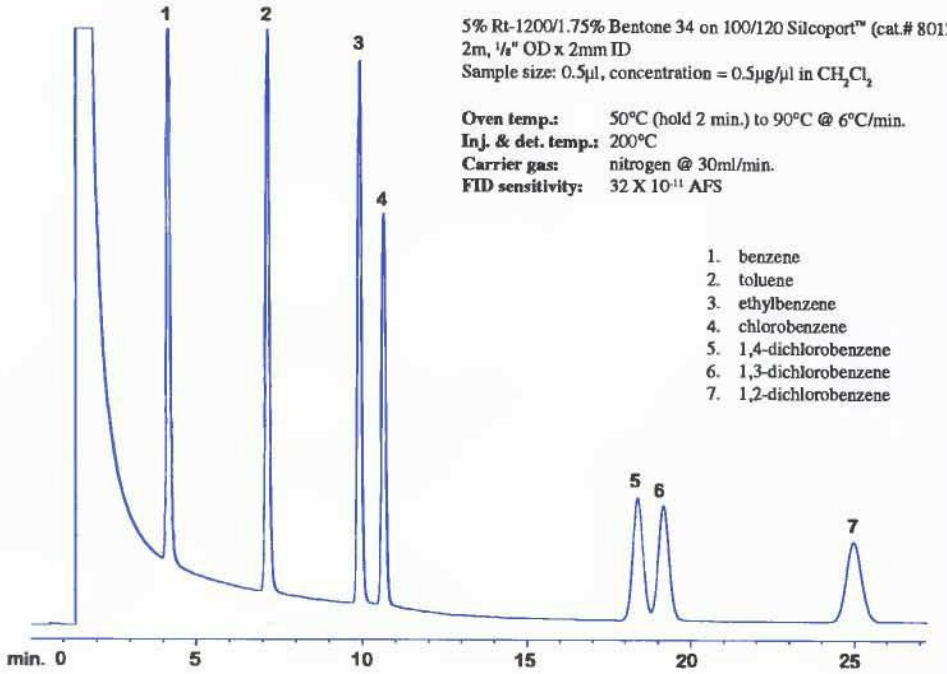
Oven temp.: 80°C isothermal
Inj. / det. temp.: 200°C/250°C
Carrier gas: nitrogen
Flow rate: 20ml/min.
FID sensitivity: 128 x 10^{-10} AFS



1. n-hexane
2. n-heptane
3. n-octane
4. n-nonane
5. n-decane
6. benzene
7. toluene
8. ethylbenzene
9. m & p-xylene
10. isopropylbenzene
11. o-xylene

EPA METHOD 602

Purgeable Aromatics



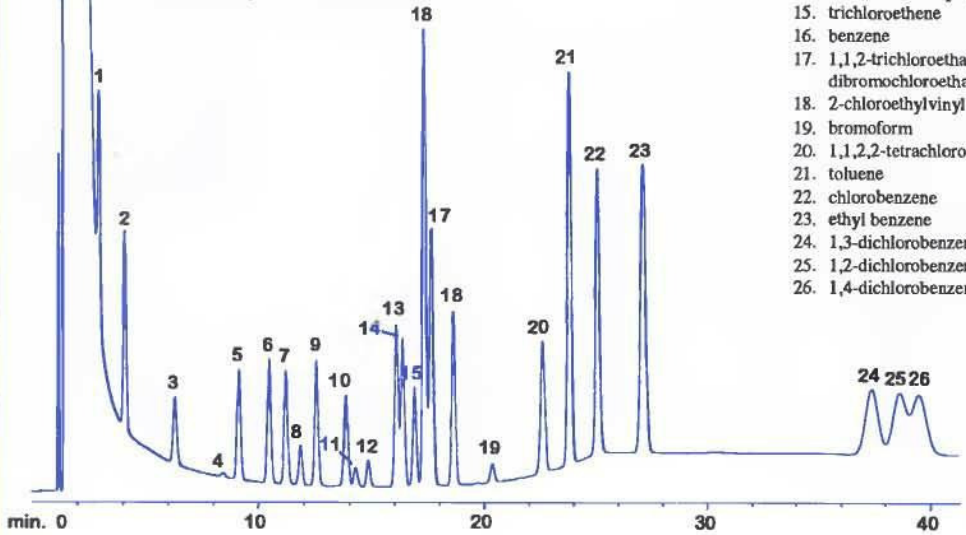
5% Rt-1200/1.75% Bentone 34 on 100/120 Silcoport™ (cat.# 80125)
2m, 1/8" OD x 2mm ID
Sample size: 0.5µl, concentration = 0.5µg/µl in CH_2Cl_2

Oven temp.: 50°C (hold 2 min.) to 90°C @ 6°C/min.
Inj. & det. temp.: 200°C
Carrier gas: nitrogen @ 30ml/min.
FID sensitivity: 32 X 10^{-11} AFS

1. benzene
2. toluene
3. ethylbenzene
4. chlorobenzene
5. 1,4-dichlorobenzene
6. 1,3-dichlorobenzene
7. 1,2-dichlorobenzene

EPA METHOD 624

Volatile Organics



1% Rt-1000 on 60/80 CarboBlack™ B (cat.# 80207)
2m, 1/8" OD x 2mm ID
0.5µl injection of VOC in CH_2Cl_2

Oven temp.: 45°C (hold 3 min.) to 220°C @ 8°C/min.
Inj. / det. temp.: 200°C/250°C
Carrier gas: nitrogen @ 30ml/min.
FID sensitivity: 32 x 10^{-11} AFS

1. vinyl chloride
2. chloroethane
3. methylene chloride
4. trichlorofluoromethane
5. 1,1-dichloroethene
6. 1,1-dichloroethane
7. trans-1,2-dichloroethene
8. chloroform
9. 1,2-dichloroethene
10. 1,1,1-trichloroethane
11. carbon tetrachloride
12. bromodichloroethane
13. 1,2-dichloropropane
14. cis-1,3-dichloropropene
15. trichloroethene
16. benzene
17. 1,1,2-trichloroethane
    dibromochloroethane
18. 2-chloroethylvinyl ether
19. bromoform
20. 1,1,2,2-tetrachloroethane
21. toluene
22. chlorobenzene
23. ethyl benzene
24. 1,3-dichlorobenzene
25. 1,2-dichlorobenzene
26. 1,4-dichlorobenzene

Environmental

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Environmental

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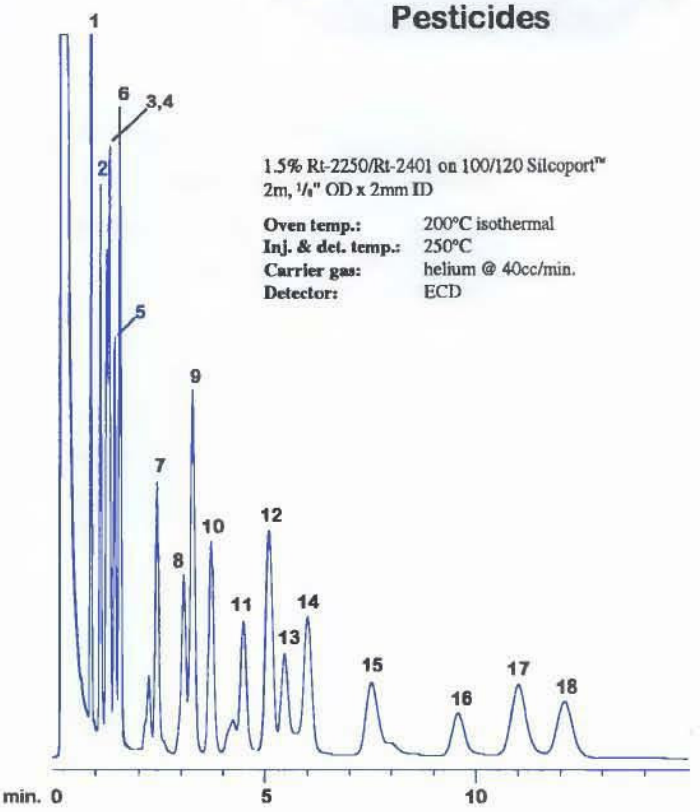
EPA METHOD 608

Pesticides

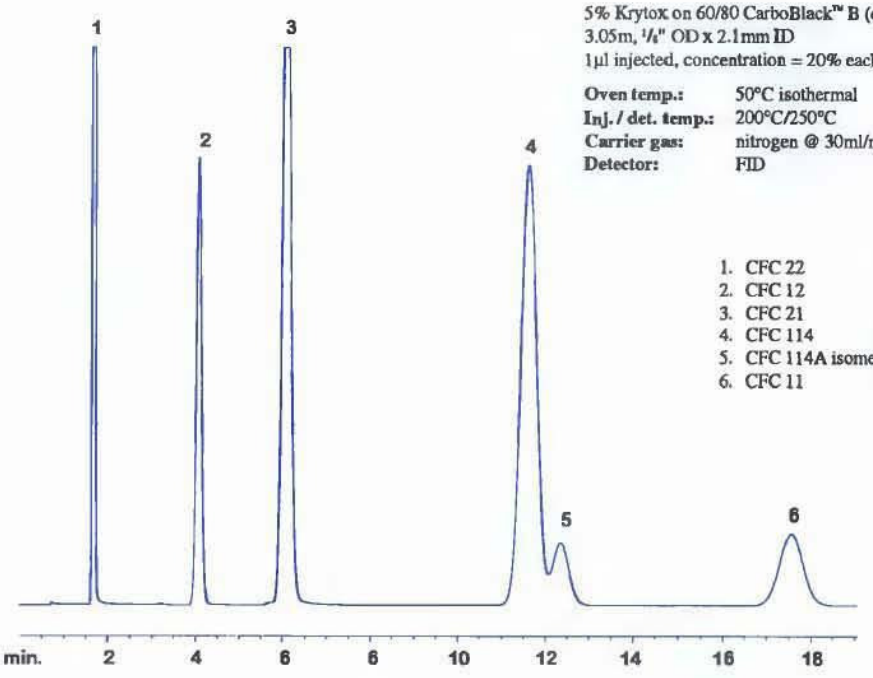


1.5% Rt-2250/Rt-2401 on 100/120 Silcoport™
2m, 1/8" OD x 2mm ID

Oven temp.:	200°C isothermal
Inj. & det. temp.:	250°C
Carrier gas:	helium @ 40cc/min.
Detector:	ECD

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

CHLORO FLUORO CARBONS



5% Krytox on 60/80 CarboBlack™ B (cat.# 80127)
3.05m, 1/8" OD x 2.1mm ID
1µl injected, concentration = 20% each

Oven temp.:	50°C isothermal
Inj. / det. temp.:	200°C/250°C
Carrier gas:	nitrogen @ 30ml/min.
Detector:	FID

1. CFC 22
2. CFC 12
3. CFC 21
4. CFC 114
5. CFC 114A isomer (Freon®)
6. CFC 11

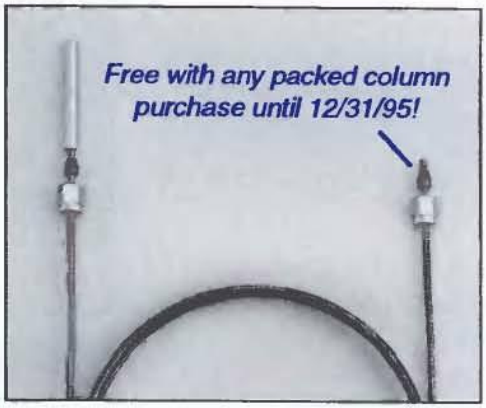
SILCOSMOOTH™ PACKED COLUMN TUBING

We modified the Silcosteel® process to provide an ultra smooth inner surface. We minimized the retention power of the deactivation layer to prevent unwanted retention. We carefully monitor the inside and outside diameters of the tubing to provide maximum reproducibility. The result; high efficiency, consistent retention times, and excellent column-to-column reproducibility.

Product Description	1/8" OD x 2mm ID	3/16" OD x 4mm ID
SilcoSmooth™	21596 $10/ft.	21595 $11/ft.

PACKED COLUMN INLET ADAPTOR KIT

Silcosteel® packed columns can easily be used in 1/4" injection ports for on-column analysis. Restek's low mass inlet adaptors fit over the top of a 1/8" or 3/16" packed column to center the column perfectly in a 1/4" injection port. A slot is positioned at the top of the adaptor to prevent carrier gas flow restriction and a chamfered guide directs the syringe needle to the center of the packed column. The adaptor fitting seals at the base of the 1/4" injection port and detector by using 1/4" to 1/8" or 1/4" to 3/16" reducing ferrules which are included with each kit. Also includes a nut and ferrule to connect the column to the detector.



Free with any packed column purchase until 12/31/95!	1/4" to 1/8"	1/4" to 3/18"
Packed Column Inlet Adaptor Kit	21651 $24	21650 $22

PACKED COLUMN FID JETS FOR HP5890s

Most general purpose packed column applications use 0.018" ID FID jets. However, larger 0.030" ID jets are required for packings which exhibit high bleed and frequently clog the tip of the smaller 0.018" jets. A standard version in stainless steel and a high performance version treated with Silcosteel® are available in both sizes. The standard version is used for non-active compounds, the Silcosteel® version is used for active compounds that are prone to adsorption or tailing.

Type	0.018"	0.030"
Stainless steel* FID Jet	21694 ea. 21695 /3-pk.	21688 ea. 21689 /3-pk.
Silcosteel®-treated FID Jet	21696 ea. 21697 /3-pk.	21686 ea. 21687 /3-pk.

**The 0.018" ID is similar to HP part #18710-20119, the 0.030" ID is similar to HP part #18789-80070.*

Domestic Terms

FOB Bellefonte, PA. Insurance and shipping costs prepaid and added to invoice. Net due in 30 days, 1.5% late charge per month after 30 days. Prices and specifications are subject to change without notice. Standard orders ship UPS or Federal Express. Rush orders ship UPS Overnight or Federal Express Priority 1 (other freight companies available upon request).

Trademarks

CarboBlack, Rtx, Silcoport, SilcoSmooth, and Silcosteel are trademarks of Restek Corporation.
The following are trademarks of their respective owners: HayeSep (Hayes Separations, Inc.); SE (General Electric); OV (Ohio Valley Specialty Chemical Co.); Chromosorb (Manville Corp.); Carbowax (Union Carbide Corp.); Dexsil (Dexsil Chemical Corp.); Igepal (GAF Corp.); Silar (Silar); Triton (Rohm & Haas, Co.); UCON (Union Carbide Corp.); Versamid (General Mills Chemicals, Inc.); XE (General Electric); Carbopack (Supelco); Carbograph (Alltech Associates); Imp (Gould, Inc.); Vespel (E.I. duPont de Nemours & Co., Inc.); Teflon (E.I. duPont de Nemours & Co., Inc.); and Freon (E.I. duPont de Nemours & Co., Inc.).

NUTS & FERRULES

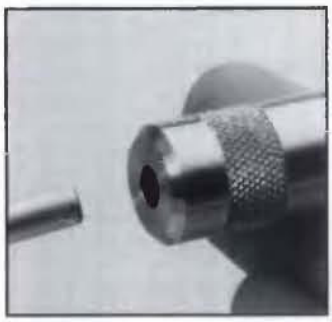
Nuts	Brass		Stainless Steel	
1/8"	21801	40-pk.	21901	10-pk.
1/4"	21802	40-pk.	21902	10-pk.

Ferrules	1/8" (10-pk.)	1/4" (10-pk.)	1/4" to 1/8" (10-pk.)	1/4" to 3/16" (5-pk.)
Vespel®/graphite	20219	20221	20222	20258
Vespel®/graphite reducing				

RESTEK TUBING REAMER

This combination 1/4" and 1/8" tubing reamer incorporates a non-slip safety design and is excellent for deburring stainless steel tubing.

Product Description	cat.#	price
Tubing reamer	20134	



IMP™ TUBING CUTTER

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

Product Description	cat.#	price
Imp™ tubing cutter	20184	
Replacement wheels	20185	3-pk.

DEACTIVATED WOOL

Fused silica wool helps ensure uniform vaporization in split or splitless sleeves and is highly recommended for autosamplers with fast injection rates and when analyzing phenols. Glass wool is flexible for easy insertion into inlet sleeves. Both types of wool are tested for endrin breakdown to ensure complete inertness. Try Restek's Mini Wool Puller/Inserter Tool to make packing sleeves easier. One end is hooked for removing wool and the other end is forked for inserting wool.

Product Description	cat.#	price
Deactivated fused silica wool	20790	10g
Deactivated glass wool	20789	10g
Mini wool puller/inserter	20114	2-pk.

RESTEK CORPORATION

GC Columns

Packed/Micropacked Columns

Put the power of Restek® packed columns to work for you.

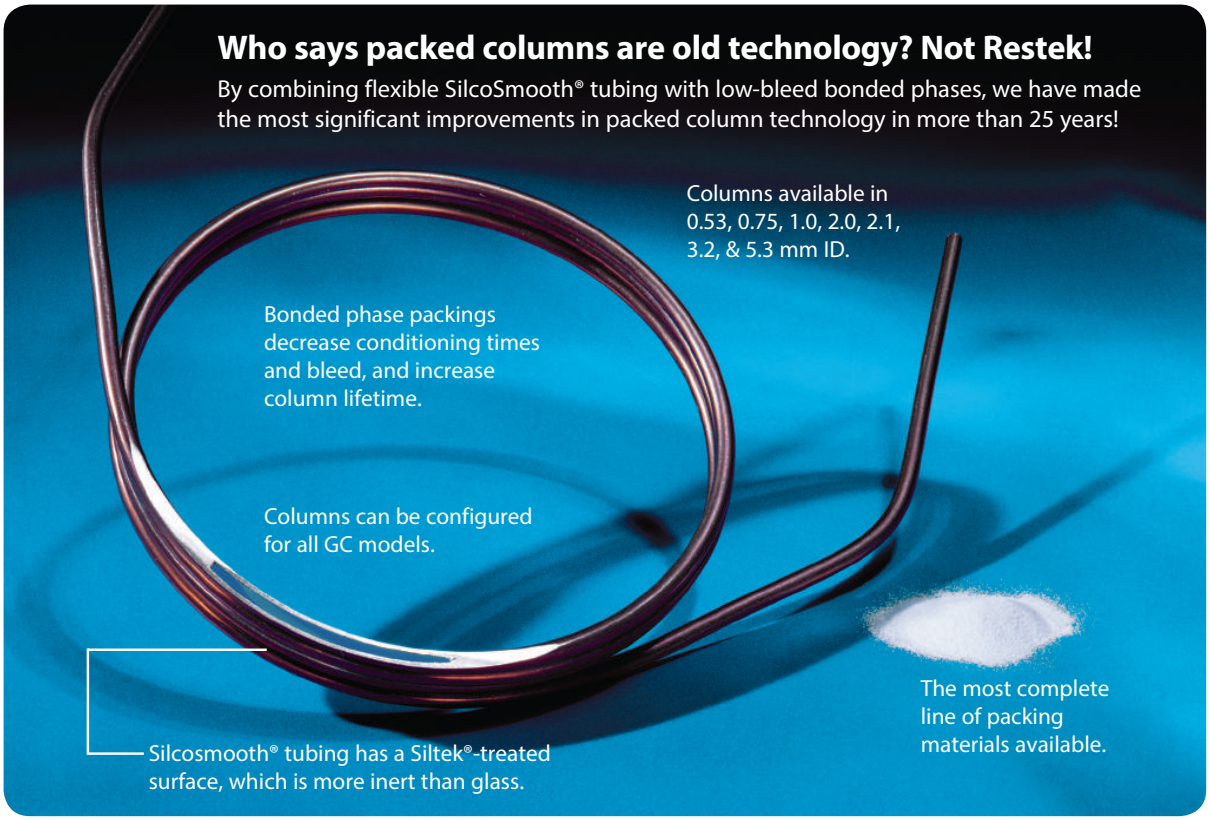
- SilcoSmooth® tubing provides the inertness of glass and the durability of stainless steel, so you get accurate results for a wide range of active compounds.
- Stable bonded stationary phases mean short conditioning times, low bleed, and long column lifetimes.
- Excellent retention time reproducibility delivers reliable, consistent results.

Packed columns offer large sample capacity and often can retain and separate compounds that cannot be analyzed by other techniques. While these advantages have resulted in their use in a wide range of GC applications, traditional packed columns are limited by unstable phases that break down easily, producing high column bleed and short column lifetimes. In addition, the tubing used for packed columns can present challenges; columns packed in glass tubing are inflexible and break easily, whereas columns made with metal tubing typically are not inert, meaning active compounds cannot be analyzed accurately as they react with metal tubing.

Restek® packed columns overcome these problems and are preferred over conventional packed columns, because they are exceptionally rugged and inert. You can generate accurate data quickly and reliably with less downtime for column changes with Restek® packed columns since they combine high-quality SilcoSmooth® tubing with stable bonded phase technology. SilcoSmooth® tubing is rugged, ultra-smooth seamless 304 stainless steel tubing that is deactivated with an innovative Siltek® treatment. This process results in packed columns that have both the inertness of glass and the strength and flexibility of stainless steel. In addition, our bonded phase technology features a coated support that is extremely stable and results in longer column lifetimes, lower bleed, and excellent reproducibility.

Put the power of Restek® packed columns to work in your lab today. We offer a broad range of common phases, as well as application-specific products developed for light hydrocarbon analysis, sulfurs, permanent gases, and ASTM Method D3606.

- Know which Restek® packed column you need? Find it on the following pages and order by web, phone, or fax today.
- Looking for an application-specific column? See what we recommend for your work on the following page.
- Need a custom column? Complete our custom product form on page 150 and we will send you a quote within two business days!



Bonded Stationary Phases

We combined our stationary phase synthesis experience with our unique Silcoport® packing deactivation process to create bonded phase packings that provide longer lifetimes, lower bleed, and shorter conditioning times.

Bonded methyl silicone phases (Rtx®-1 and Rtx®-5 columns) and bonded Carbowax® phase (Stabilwax® columns) are completely cross-linked on Silcoport® packing. We have evaluated Rtx®-1 and Rtx®-5 bonded packed column phases side-by-side with nonbonded phases of comparable polarity; the bonded phases last longer than the equivalent nonbonded packing materials. Table I shows that retention times on an Rtx®-1 bonded packed column are highly repeatable after only 30 minutes of conditioning.

Table I: Retention data shows the perfect reproducibility of the bonded phase packed columns with respect to retention times.

	Retention Time			
Hydrocarbon	Min.	Max.	Mean	Stand. Dev.
C5	0.241	0.243	0.242	0.001
C6	0.493	0.497	0.495	0.002
C10	5.746	5.765	5.752	0.005
C20	18.482	18.491	18.486	0.004
C28	25.093	25.103	25.098	0.004
C40	32.160	32.171	32.166	0.004
C44	34.316	34.328	34.326	0.007

n = 9 columns

Quick Reference Chart

For specific applications, Restek recommends using these optimized columns for better method performance.

Application	Column	Feature	Benefit
ASTM Method D3606	D3606 Application Column Set, p. 138 (Column 1: 6' (1.8 m), 1/8" OD, 2.0 mm ID, Rtx-1; Column 2: 16' (4.9 m), 1/8" OD, 2.0 mm ID, proprietary packing material)	Excellent separation of ethanol and benzene.	Reliably meets method requirements.
Refinery gases	2abc Refinery Gas Column Set , p. 139 Backflush Column	Optimized three-column set. (Backflush column sold separately.)	Elutes C5 hydrocarbons before C1-C4 hydrocarbons for optimized resolution.
Unsaturated light hydrocarbons	*n*-Octane on Res-Sil C Column, p. 139	Unique selectivity for unsaturated hydrocarbons.	Excellent resolution of unsaturated light hydrocarbons gives increased data accuracy.
cis-2-Butene and 1,3-butadiene	OPN on Res-Sil C Column, p. 139	Optimized selectivity for *cis*-2-butene and 1,3-butadiene resolution.	Increases data accuracy.
Permanent gases	Shincarbon ST Columns, p. 140 Packed or micropacked	Optimized selectivity for permanent gas resolution without cryogenic cooling. Preconditioned.	Increases productivity.
Low-level sulfurs	Rt-XLSulfur Columns, p. 141 Packed or micropacked	Highly inert for ppbv levels of sulfur. Eliminates need for PTFE tubing.	Increases data accuracy for low-level sulfur analysis. Eliminates need for a special GC setup.

Bonded Packed Column Stationary Phases

- Short conditioning times.
- Reproducible bonded phase selectivity.
- Low bleed levels.
- Longer column lifetimes.
- Unsurpassed inertness for active compounds.

Bonded phases are used in capillary columns because they provide a dramatic increase in column quality. To truly bridge the gap between traditional packed columns and capillary columns, it was necessary to develop bonded liquid phases for packed columns. Packed column chromatographers can expect shorter conditioning times, lower bleed, and longer column lifetimes by using Restek bonded phase packed columns.

Bonded phases also last much longer than nonbonded phases. Bonded phases are more resistant to oxidation than nonbonded phases because of the stronger intermolecular forces produced by cross-linking. Because the material is thoroughly cross-linked, the phase will not migrate or puddle, as often happens with nonbonded phases. Figure 1 shows a comparison of a bonded and a nonbonded methyl silicone column after 170 temperature cycles. The results show the impressive durability of bonded phases.

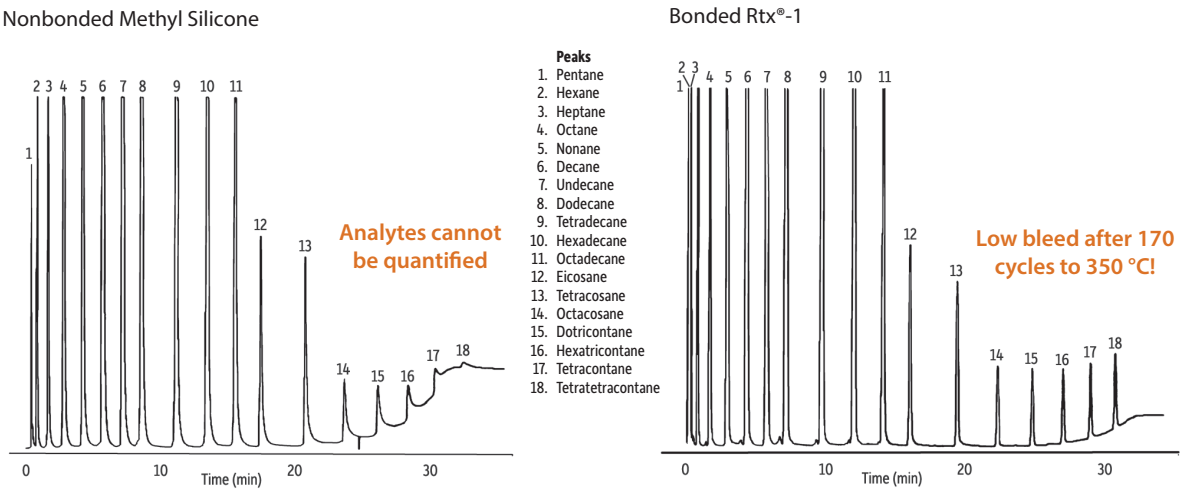
Restek's packed columns deliver the 1-2-3 PUNCH!

1. Bonded stationary phases mean short conditioning times, low bleed, and unsurpassed column lifetimes.
2. SilcoSmooth® tubing provides the inertness of glass and the durability of stainless steel.
3. Excellent retention time reproducibility for reliable, consistent results!

Equivalent Liquid Phases

	BP-1, CC-1, CP-Sil 5CB, DB-1, DC-200, GE-SF-96, HP-1, HP-101, OV-1, OV-101,
Rtx-1	RSK-150, RH-1, SE-30, SP-2100, SPB-1, UCC W-98, G2, G1
Rtx-5	BP-5, CB-5, CC-5, CP-Sil 8CB, DB-5, HP-5, OV-73, SE-52, SE-54, SPB-5, Ultra-5, G27, G36
Stabilwax	BP-20, CP-Wax, CW-20, DB-Wax, HP-Innowax, PE-Wax, Supelcowax-10, G16

Figure 1: Bonded packed columns exhibit longer lifetime than nonbonded packed columns.



GC_PC00369

Column Rtx®-1 Sim Dist 2887, SilcoSmooth® Tubing, 25 inches, 1/8 in. OD, 2 mm ID (cat.# 80000-800)
Sample 1-12% (w/w) each component
ASTM D2887-01 calibration mix (1% each listed analyte in CS_2) (cat.# 31674)
ASTM D2887-01 calibration mix (5% each, neat) (cat.# 31675)
Injection
Inj. Vol.: 1.0 µL packed not on-column
Inj. Temp.: 350 °C
Oven
Oven Temp.: 35 °C to 350 °C at 10 °C/min (hold 5 min)
Carrier Gas He, constant flow
Flow Rate: 25 mL/min
Detector FID @ 350 °C
Notes FID sensitivity: 256 x 10^{-11} AFS

Packed Column Tubing

did you know?

Restek's advanced packed column technology provides columns with unmatched inertness and efficiency.

Packed Column Reduction Fittings

We will weld tubing reducers or VCR fittings to your column. Call Customer Service (ext. 3) or your Restek representative for pricing and availability.

Welded Tubing Reducers

Welded VCR Fittings

also available

For more information on micropacked columns, see **page 137.**

Packed Column Tubing

Restek offers a wide range of tubing choices for our packed columns, including SilcoSmooth® (Siltek®-treated stainless steel), stainless steel, PTFE, nickel, copper, and Hastelloy® tubing. SilcoSmooth® and stainless steel tubing are our two most popular column materials. SilcoSmooth® tubing is an excellent replacement for fragile glass columns. Stainless steel tubing works well with most applications for nonreactive compounds.

SilcoSmooth® Tubing

If your analysis involves reactive compounds, you can use SilcoSmooth® tubing, which combines the inertness of glass with the strength and flexibility of stainless steel. Made from ultra-smooth, seamless 304 stainless steel and treated with the innovative Siltek® process, SilcoSmooth® tubing can replace glass columns for virtually any application.

Stainless Steel Tubing

If you are analyzing hydrocarbons or nonreactive compounds, you can use our rugged, flexible, and economical stainless steel columns. Restek® stainless steel columns are made from high-quality welded and drawn tubing.

Hastelloy® Tubing

Hastelloy® tubing is a nickel-chromium alloy with excellent inertness. It is normally used only for highly corrosive or oxidizing compounds or gases.

Nickel Tubing

Nickel tubing is often used for analyses of caustic or oxidizing compounds or gases.

Copper Tubing

Copper is a general-purpose tubing that is only recommended for inactive compounds.

PTFE Tubing

PTFE tubing is often used for reactive compounds or other special applications. Note that this tubing is permeable to gases.

Table I: Packed and Micropacked Column Tubing Dimensions

	Packed				Micropacked		
Material	**1/4-inch OD x 5.3 mm ID**	**3/16-inch OD x 3.2 mm ID[1]**	**1/8-inch OD x 2.0 mm ID[2]**	**1/8-inch OD x 2.1 mm ID**	**1/16-inch OD x 1.0 mm ID[3]**	**0.95 mm OD x 0.75 mm ID[4]**	**0.74 mm OD x 0.53 mm ID**
SilcoSmooth	✓	✓	✓		✓	✓	✓
Stainless Steel	✓	✓		✓	✓	✓	
Hastelloy				✓			
Nickel				✓			
Copper	✓			✓			
PTFE				✓			

[1] 3/16-inch OD x 3.2 mm ID replaces 1/4-inch OD x 4 mm ID glass columns.
[2] 1/8-inch OD x 2.0 mm ID replaces 1/4-inch OD x 2 mm ID glass columns.
[3] 1/16-inch OD x 1.0 mm ID micropacked columns are designed for packed column injection systems.
[4] 0.95 mm OD x 0.75 mm ID micropacked columns are designed for capillary injection systems.

please note

We do not offer glass packed columns. SilcoSmooth® columns offer the inertness of glass, without the breakage problems.

Chromosorb® Diatomaceous Earth Packed Columns

Bonded Stationary Phase Packed Columns

- Low bleed levels.
- Longer column lifetimes.
- Short conditioning times.

	Stainless Steel Tubing				SilcoSmooth Tubing**			
Bonded Phase on 100/120 Silcoport W***	L (ft)	OD (in)	ID (mm)	cat.#*	L (m)	OD (in)	ID (mm)	cat.#*
3% Rtx-1	6	1/8	2.1	80441-	2	1/8	2.0	80401-
10% Rtx-1	6	1/8	2.1	80442-	2	1/8	2.0	80405-
20% Rtx-1	6	1/8	2.1	80443-	2	1/8	2.0	80409-
3% Rtx-5	6	1/8	2.1	80444-	2	1/8	2.0	80477-
10% Rtx-5	6	1/8	2.1	80445-	2	1/8	2.0	80478-
20% Rtx-5	6	1/8	2.1	80446-	2	1/8	2.0	80479-
5% Rtx-Stabilwax	6	1/8	2.1	80447-	2	1/8	2.0	80415-
10% Rtx-Stabilwax	6	1/8	2.1	80448-	2	1/8	2.0	80416-
20% Rtx-Stabilwax	6	1/8	2.1	80449-	2	1/8	2.0	80417-
Rtx-1 SimDist 2887****	25"	1/8	2.1	80450-	25"	1/8	2.0	80000-

Non-Bonded Stationary Phase Packed Columns

	Stainless Steel Tubing				SilcoSmooth Tubing**			
On 100/120 Silcoport W***	L (ft)	OD (in)	ID (mm)	cat.#*	L (m)	OD (in)	ID (mm)	cat.#*
3% Rt-101	6	1/8	2.1	80461-	2	1/8	2.0	80400-
5% Rt-1200/1.75% Bentone 34	6	1/8	2.1	80463-	2	1/8	2.0	80125-
5% Rt-1200/5% Bentone 34	6	1/8	2.1	80464-	2	1/8	2.0	80129-

		Stainless Steel Tubing				SilcoSmooth Tubing**			
On Chromosorb PAW	Mesh	L (ft)	OD (in)	ID (mm)	cat.#*	L (m)	OD (in)	ID (mm)	cat.#*
10% TCEP	100/120	8	1/8	2.1	80465-	2.5	1/8	2.0	80126-
23% Rt-1700	80/100	30	1/8	2.1	80466-	9.2	1/8	2.0	80128-

*Please add column instrument configuration suffix number to cat.# when ordering. See chart on the next page.
**Siltek-treated stainless steel.
***Modified version of Chromosorb W; highest inertness, most consistent performance.
****Application-specific column.

Porous Polymer Packed Columns

Restek offers a full range of porous polymers, including HayeSep® and Porapak polymer packings for analyses of volatile compounds and light solvents.

	Stainless Steel Tubing				SilcoSmooth Tubing**			
Porous Polymers 80/100 Mesh	L (ft)	OD (in)	ID (mm)	cat.#*	L (m)	OD (in)	ID (mm)	cat.#*
HayeSep Q	6	1/8	2.1	80467-	2	1/8	2.0	80433-
Porapak Q	6	1/8	2.1	80468-	2	1/8	2.0	80427-
Porapak QS	6	1/8	2.1	80469-	2	1/8	2.0	80426-
Porapak R	6	1/8	2.1	80470-	2	1/8	2.0	80425-

*Please add column instrument configuration suffix number to cat.# when ordering. See chart on the next page.
**Siltek-treated stainless steel.

please note

Stock packed columns are designed with a 2" void on the inlet end for on-column injections. For column configurations containing no void, add suffix -901 to the part number.

please note

Temperature limits for stationary phases are listed on **page 146**.

also available

Porapak, HayeSep®, and Tenax® packing materials.

See **page 145.**

also available

CarboBlack packing materials. See **page 143**.

Column Instrument Configurations

General Configuration
Suffix -800

Agilent 5880, 5890, 5987, 6890, 7890:
Suffix -810*

Bruker 430, 3700, Vista Series, FID:
Suffix -820

PE 900-3920, Sigma 1,2,3:
Suffix -830

PE Auto System 8300, 8400, 8700
Suffix -840

See page 151 for additional configurations.

Note: Initial 2" of column will be empty to accommodate a needle. For a completely filled column (not on-column) add suffix -901.
*-810 suffix also includes 1 1/2" void on detector side.
Note: Standard micropacked columns fit all instruments. No special instrument configuration suffix is required.

CarboBlack Packed Columns

Graphitized carbon black offers unique selectivity and very little adsorption for alcohol analyses. Two types of CarboBlack supports are available, CarboBlack B and CarboBlack C. CarboBlack B support, with its higher surface area, can hold up to a 10% loading of a nonsilicone liquid phase. CarboBlack C support can hold up to a 1% loading of a nonsilicone liquid phase. Many Carbowax® 20M-loaded CarboBlack packings are available. CarboBlack packings are treated with KOH or picric acid for basic or acidic compounds, and special alcoholic beverage loadings are available. CarboBlack supports provide resolution and retention similar to Carbopack™ and Carbograph supports.

		Stainless Steel Tubing				SilcoSmooth Tubing**			
On CarboBlack B	Mesh	L (ft)	OD (in)	ID (mm)	cat.#*	L (m)	OD (in)	ID (mm)	cat.#*
5% Carbowax 20M	80/120	—	—	—	—	2	1/8	2.0	80105-
5% Carbowax 20M	60/80	6	1/8	2.1	88012-	1.8	1/8	2.0	80106-
6.6% Carbowax 20M	80/120	6	1/8	2.1	80451-	2	1/8	2.0	80107-
4% Carbowax 20M/ 0.8% KOH	60/80	—	—	—	—	2	1/8	2.0	80116-
1% Rt-1000	60/80	8	1/8	2.1	88013-	2.4	1/8	2.0	80206-
1% Rt-1000	60/80	6	1/8	2.1	80452-	2	1/8	2.0	80207-
3% Rt-1500	80/120	10	1/8	2.1	80453-	3.05	1/8	2.0	80211-
1% Rt-1510	60/80	10	1/8	2.1	80454-	3.05	1/8	2.0	80216-
1.5% XE-60/1% H_3PO_4	60/80	6	1/8	2.1	80455-	1.8	1/8	2.0	80305-

		Nickel 200 Tubing			
On CarboBlack B	Mesh	L (m)	OD (in)	ID (mm)	cat.#*
5% Krytox (Ni 200 tubing)	60/80	3.05	1/8	2.1	80127-

		Stainless Steel Tubing				SilcoSmooth Tubing**			
On CarboBlack C	Mesh	L (ft)	OD (in)	ID (mm)	cat.#*	L (m)	OD (in)	ID (mm)	cat.#*
0.2% Carbowax 1500	60/80	6	1/8	2.1	80456-	2	1/8	2.0	80121-
0.2% Carbowax 1500	80/100	6	1/8	2.1	80457-	2	1/8	2.0	80122-
0.1% Rt-1000	80/100	6	1/8	2.1	80458-	1.8	1/8	2.0	80205-
0.19% picric acid	80/100	6	1/8	2.1	80459-	2	1/8	2.0	80311-

*Please add column instrument configuration suffix number to cat.# when ordering. See chart on this page.
**Siltek-treated stainless steel.

Molecular Sieve Packed Columns

Molecular sieve packed columns easily separate permanent gases at above-ambient temperatures. Restek's R&D chemists have developed a process for preparing molecular sieve packings, which results in excellent batch-to-batch reproducibility. In addition, our molecular sieves are preactivated and ready to use. Each column comes with metal end-fittings to prevent water or carbon dioxide from adsorbing into the packing during shipment.

		Stainless Steel Tubing				SilcoSmooth Tubing**			
Molecular Sieve	Mesh	L (ft)	OD (in)	ID (mm)	cat.#*	L (m)	OD (in)	ID (mm)	cat.#*
Molesieve 5A	60/80	6	1/8	2.1	80473-	2	1/8	2.0	80428-
Molesieve 5A	80/100	3	1/8	2.1	88015-	1	1/8	2.0	80440-
Molesieve 5A	80/100	6	1/8	2.1	80474-	2	1/8	2.0	80429-
Molesieve 5A	80/100	10	1/8	2.1	88014-	3.05	1/8	2.0	80430-
Molesieve 13X	60/80	6	1/8	2.1	80475-	2	1/8	2.0	80480-
Molesieve 13X	80/100	6	1/8	2.1	80476-	2	1/8	2.0	80439-

*Please add column instrument configuration suffix number to cat.# when ordering. See chart on this page.
**Siltek-treated stainless steel.

Micropacked GC Columns

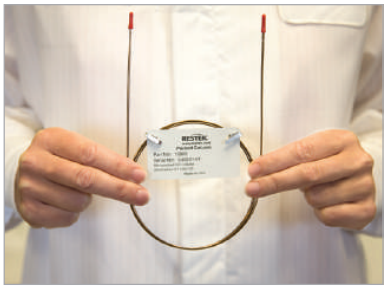
- Increased efficiency over traditional packed columns.
- Higher capacity than PLOT columns.
- Made from inert, flexible SilcoSmooth® tubing.
- Wide range of packings available.
- Standard coils fit all instruments. No special instrument configurations required.

Made with INERT SilcoSmooth® tubing!

All micropacked columns are made with inert SilcoSmooth® tubing, which is Siltek® treated for maximum inertness. See **page 134.**

Efficient, Inert, and Flexible

Micropacked columns are highly efficient and provide good sample capacity, resulting in a powerful tool for solving many difficult application problems. The unsurpassed inertness of SilcoSmooth® tubing is based on Siltek® deactivation, which allows the column to be flexed and coiled without any fear of chipping or cracking the inert surface.



Easy to Install—Multiple Internal Diameters

Our micropacked columns are designed to fit packed and capillary injection systems. Standard wall (1/16-inch OD) micropacked columns offer improved efficiency in packed column instruments without the expense of converting to capillary injection systems. Smaller OD (0.95 mm OD) micropacked columns install easily into a capillary injector, using slightly larger ferrules. Micropacked columns operate at flows exceeding 10 cc/min for trouble-free operation.

Braided Wire End Plugs*

Restek's packed column experts insert braided wire into the column and secure it by making a small crimp near the column outlet. End plugs are Siltek® treated—the sample contacts only inert surfaces.

Micropacked GC Columns (0.53 mm ID)*

	Mesh	ID	OD	Temp. Range	1-Meter cat.#	2-Meter cat.#
HayeSep Q	80/100	0.53 mm	0.74 mm	up to 275 °C		19042
Molesieve 5A	80/100	0.53 mm	0.74 mm	up to 300 °C		19041
Rt-XLSulfur	100/120	0.53 mm	0.74 mm	up to 300 °C		19044
ShinCarbon ST	80/100	0.53 mm	0.74 mm	up to 300 °C	19045	19043

Micropacked GC Columns (0.75 mm ID)

	ID	OD	Temp. Range	0.56-Meter cat.#
20% TCEP on 80/100 Chromosorb PAW	0.75 mm	1/16"	0–175 °C	19040

	Mesh	ID	OD	Temp. Range	1-Meter cat.#	2-Meter cat.#
HayeSep R	100/120	0.75 mm	0.95 mm	up to 250 °C	19014	19015
HayeSep Q	100/120	0.75 mm	0.95 mm	up to 275 °C	19018	19019
HayeSep N	100/120	0.75 mm	0.95 mm	up to 165 °C	19022	19023
HayeSep S	100/120	0.75 mm	0.95 mm	up to 250 °C	19010	19011
Molesieve 5A	80/100	0.75 mm	0.95 mm	up to 300 °C	19002	19003
Molesieve 13X	80/100	0.75 mm	0.95 mm	up to 350 °C	19006	19007

Micropacked GC Columns (1.00 mm ID)

	Mesh	ID	OD	Temp. Range	1-Meter cat.#	2-Meter cat.#
HayeSep R	100/120	1.00 mm	1/16"	up to 250 °C	19012	19013
HayeSep Q	100/120	1.00 mm	1/16"	up to 275 °C	19016	19017
HayeSep N	100/120	1.00 mm	1/16"	up to 165 °C	19020	19021
HayeSep S	100/120	1.00 mm	1/16"	up to 250 °C	19008	19009
Molesieve 5A	80/100	1.00 mm	1/16"	up to 300 °C	19000	19001
Molesieve 13X	80/100	1.00 mm	1/16"	up to 350 °C	19004	19005

*Due to the small internal diameter of 0.53 mm ID columns, braided wire end plugs cannot be used; wool is inserted into the ends instead.

Aromatics Analysis

D3606 Application Column Set (2 column set)

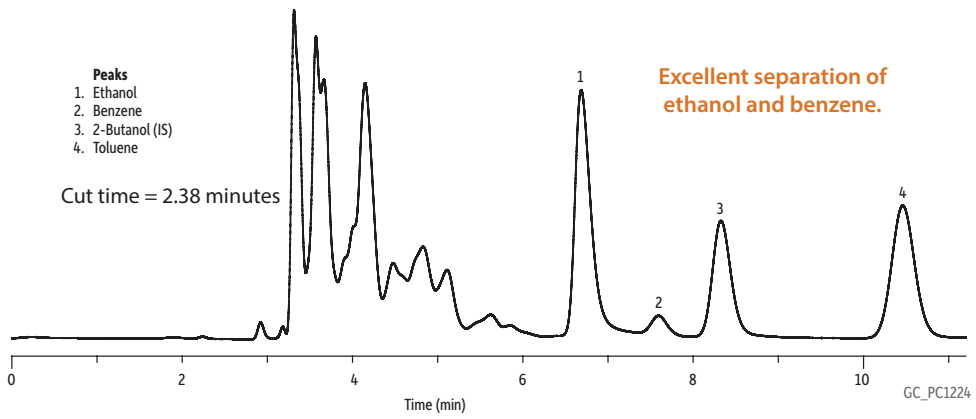
- Complete resolution of benzene from ethanol—no compromising coelutions.
- Accurate quantification of benzene and toluene.
- Fully conditioned two column set—ready to use out of the box.
- Listed in the appendix of ASTM Method D3606 as an acceptable alternative to TCEP columns—get better separation of benzene and ethanol while still following ASTM method requirements.

Conforms to the specifications established in the current ASTM method D3606 for the quantitation of benzene and toluene in spark ignition fuel containing ethanol.

Description	cat.#*
D3606 Application Column (2 column set)**	
Column 1: 6' (1.8 m), 1/8" OD, 2.0 mm ID, nonpolar Rtx-1	83606-
Column 2: 16' (4.9 m), 1/8" OD, 2.0 mm ID, proprietary packing material	

*Please add column instrument configuration suffix number to cat.# when ordering. See chart on page 141.
**The column set is designed to accommodate both valve injection and/or syringe injection. Column 1 is configured with a 2" inlet void to facilitate on-column injection. The inlet is identified on both column 1 and column 2. Note: The inlet of column 2 is identified for proper orientation for connection to the valve.

Gasoline Containing Ethanol on D3606 Application Column Set by ASTM D3606-10 (Modified)



Column D3606 application column (2 column set). Column 1: 6' (1.8 m), 1/8" OD, 2.0 mm ID, nonpolar Rtx®-1; Column 2: 16' (4.9 m), 1/8" OD, 2.0 mm ID, proprietary packing material (cat.# 83606-800)
Sample Diluent: Ethanol-containing gasoline with internal standard (IS)
Injection Sample valve
Sample Loop Vol.: 1.5 µL
Valve Temp.: 150 °C
Oven
Oven Temp.: 135 °C (hold 12 min)
Carrier Gas He, constant flow
Flow Rate: 20.0 mL/min
Detector TCD @ 200 °C
Notes 2.38 minute backflush (must be determined for each GC system).

Light Hydrocarbon Analysis

Special Columns for Unsaturated Light Hydrocarbons

- Faster separations of C1 to C4 hydrocarbons.
- Res-Sil® packing replaces Porasil materials.

n-Octane on Res-Sil® C Packed Column

This packed column has unique selectivity for resolving unsaturated light hydrocarbons (Figure 1).

OPN on Res-Sil® C Packed Column

This column separates the light hydrocarbons, and baseline resolves *cis*-2-butene from 1,3-butadiene (Figure 2).

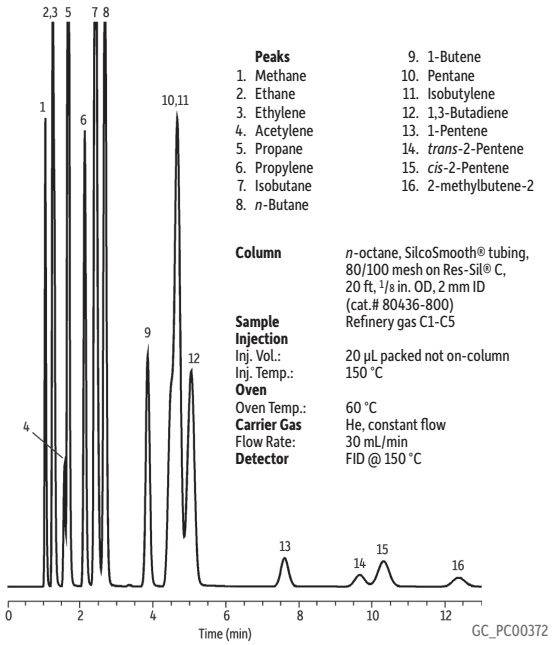
2abc Refinery Gas Column Set

This three-column set is finely tuned to resolve light hydrocarbons. When used in the proper valving system, it will elute C5+ hydrocarbons ahead of C1 through C4 hydrocarbons (Figure 3).

Description	cat.#*
n-Octane on Res-Sil C, 80/100 (20', 2.0 mm ID, 1/8" Silcosmooth OD)	80436-
OPN on Res-Sil C, 80/100 (12', 2.0 mm ID, 1/8" Silcosmooth OD)	80437-
2abc Refinery Gas Column Set (3 column set)**	88000-
2.1% Carbowax 1540 Porasil C (backflush column)***	88004-875

*Please add column instrument configuration suffix number to cat.# when ordering. See chart on page 141.
**This column set is for a valving system; therefore, packing material is filled to ends of columns.
***To be used with 2abc refinery gas column set (cat.# 88000-) to backflush and prevent C6+ hydrocarbons from entering column set.

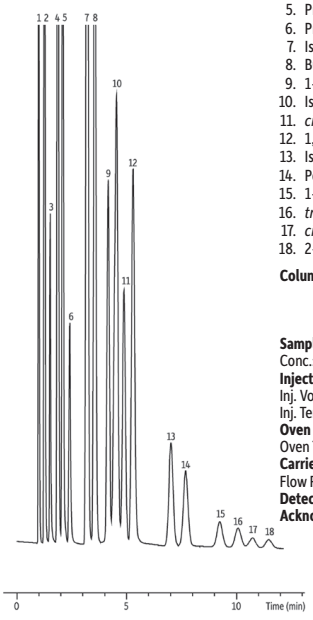
Figure 1: *n*-Octane on Res-Sil® C packing demonstrates unique selectivity for unsaturated light hydrocarbons.



Peaks	
1. Methane	9. 1-Butene
2. Ethane	10. Pentane
3. Ethylene	11. Isobutylene
4. Acetylene	12. 1,3-Butadiene
5. Propane	13. 1-Pentene
6. Propylene	14. *trans*-2-Pentene
7. Isobutane	15. *cis*-2-Pentene
8. *n*-Butane	16. 2-methylbutene-2

Column	*n*-octane, SilcoSmooth® tubing, 80/100 mesh on Res-Sil® C, 20 ft, 1/8 in. OD, 2 mm ID (cat.# 80436-800)
Sample	Refinery gas C1-C5
Injection	
Inj. Vol.:	20 µL packed not on-column
Inj. Temp.:	150 °C
Oven	
Oven Temp.:	60 °C
Carrier Gas	He, constant flow
Flow Rate:	30 mL/min
Detector	FID @ 150 °C

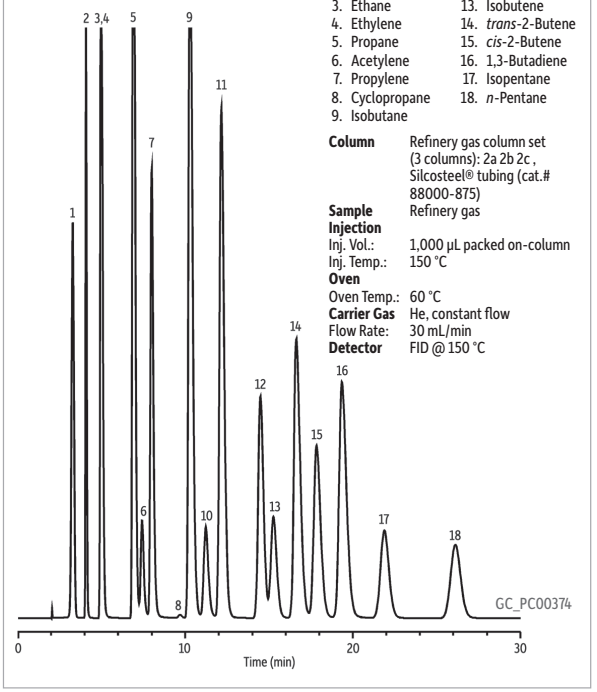
Figure 2: OPN on Res-Sil® C packing demonstrates unique selectivity for *cis*-2-butene and 1,3-butadiene.



Peaks	Retention Indices
1. Methane	100
2. Ethane/ethylene	200
3. Acetylene	260
4. Propane	300
5. Propylene	321
6. Propadiene	345
7. Isobutane	386
8. Butane	400
9. 1-Butene	422
10. Isobutylene/*trans*-2-butene	434
11. *cis*-2-Butene	443
12. 1,3-Butadiene	454
13. Isopentane	488
14. Pentane/3-methyl-1-butene	503
15. 1-Pentene	522
16. *trans*-2-Pentene	533
17. *cis*-2-Pentene	540
18. 2-Methyl-2-butene	549

Column	OPN, SilcoSmooth® Tubing, 80/100 mesh on Res-Sil® C packing, 12 ft, 1/8 in. OD, 2 mm ID (cat.# 80437-800)
Sample	Refinery gas
Conc.:	0.1-6 absolute mole %
Injection	
Inj. Vol.:	20 µL packed on-column
Inj. Temp.:	200 °C
Oven	
Oven Temp.:	50 °C
Carrier Gas	He, constant flow
Flow Rate:	30 mL/min
Detector	FID @ 200 °C
Acknowledgement	Standard courtesy of AC Analytical Controls

Figure 3: Refinery gas calibration standard on refinery gas packed column set.



Peaks	
1. C5-C6+	10. Propadiene
2. Methane	11. *n*-Butane
3. Ethane	12. 1-Butene
4. Ethylene	13. Isobutene
5. Propane	14. *trans*-2-Butene
6. Acetylene	15. *cis*-2-Butene
7. Propylene	16. 1,3-Butadiene
8. Cyclopropane	17. Isopentane
9. Isobutane	18. *n*-Pentane

Column	Refinery gas column set (3 columns): 2a 2b 2c , Silcosteel® tubing (cat.# 88000-875)
Sample	Refinery gas
Injection	
Inj. Vol.:	1,000 µL packed on-column
Inj. Temp.:	150 °C
Oven	
Oven Temp.:	60 °C
Carrier Gas	He, constant flow
Flow Rate:	30 mL/min
Detector	FID @ 150 °C

for more info

See **page 144** for more information on Res-Sil® packing materials.

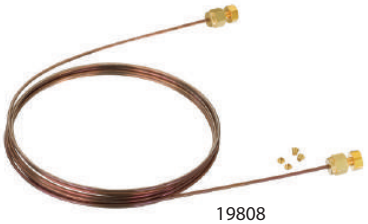
it's a fact

ShinCarbon ST is an ideal packing material for permanent gases, low molecular weight hydrocarbons, sulfur dioxide, and Freon® gases.

also available

Adapter kits for installing packed/micropacked columns.

See **page 142.**



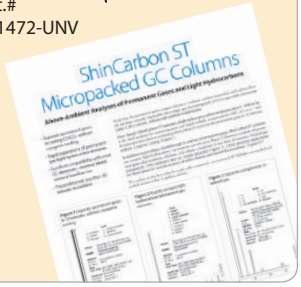
19808

free literature

ShinCarbon ST
Micropacked GC Columns
Above-Ambient Analyses of
Permanent Gases and
Light Hydrocarbons

Download your free copy from
www.restek.com

lit. cat.#
PCTS1472-UNV



Permanent Gases & Hydrocarbon Analysis

ShinCarbon ST Columns (packed & micropacked)
(SilcoSmooth® Stainless Steel)

- Separate permanent gases, including carbon monoxide and carbon dioxide, without cryogenic cooling.
- Rapid separations of permanent gas/light hydrocarbon mixtures.
- Excellent compatibility with most GC detectors—minimal bleed, minimal baseline rise.
- Preconditioned, less than 30 minutes to stabilize.
- Maximum temperature of 280 °C/300 °C.

Analyze oxygen, nitrogen, methane, carbon monoxide, and carbon dioxide with one column at room temperature. ShinCarbon ST material, a high surface area carbon molecular sieve (~1,500 m^2/g), is the ideal medium for separating gases and highly volatile compounds by gas solid chromatography (GSC). The rapid, above-ambient analyses these columns provide is a great convenience. Excellent thermal stability of the high surface area carbon, combined with careful conditioning during column manufacturing, ensures low-bleed operation and rapid stabilization when installing a new column. Custom-made ShinCarbon ST columns are available on request.

ShinCarbon ST is a highly stable material. Its 300 °C upper programmed temperature limit minimizes bleed and baseline rise during temperature programming, making the material compatible with most detection systems used for gas analysis, including TCD or HID. All ShinCarbon ST columns are fully conditioned in an oxygen/moisture-free environment for your convenience. This minimizes stabilization time (less than 30 minutes) when installing a new column which, in turn, reduces downtime.

ShinCarbon ST Columns (packed)*

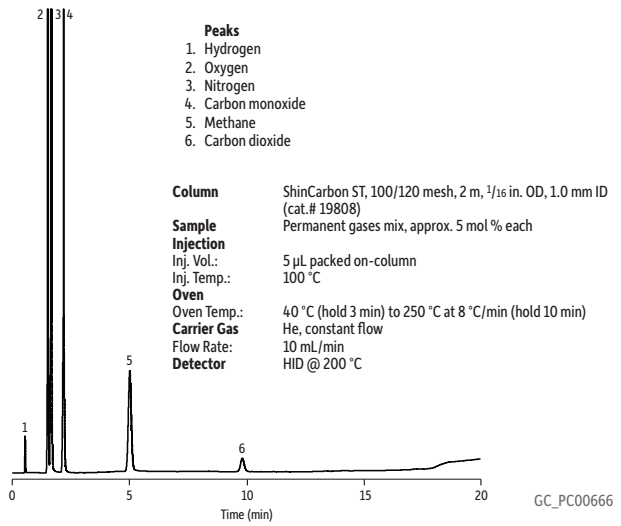
OD	ID	Mesh	2-Meter cat.#*
1/8" Silcosmooth	2.0 mm	80/100	80486-

ShinCarbon ST Columns (micropacked)

OD	ID	Mesh	1-Meter cat.#	2-Meter cat.#
1/16"	1.0 mm	100/120	19809	19808
0.95 mm	0.75 mm	100/120	19810	—
0.74 mm	0.53 mm	80/100	19045	19043

*Please add column instrument configuration suffix number to cat.# when ordering. See chart on the next page.
Note: Columns do not include column nuts and ferrules. Optional installation kits can be ordered separately—see page 142.

Permanent Gases on ShinCarbon ST



Peaks
1. Hydrogen
2. Oxygen
3. Nitrogen
4. Carbon monoxide
5. Methane
6. Carbon dioxide

Column	ShinCarbon ST, 100/120 mesh, 2 m, 1/16 in. OD, 1.0 mm ID (cat.# 19808)
Sample	Permanent gases mix, approx. 5 mol % each
Injection	
Inj. Vol.:	5 µL packed on-column
Inj. Temp.:	100 °C
Oven	
Oven Temp.:	40 °C (hold 3 min) to 250 °C at 8 °C/min (hold 10 min)
Carrier Gas	He, constant flow
Flow Rate:	10 mL/min
Detector	HID @ 200 °C

GC_PC00666

Sulfur Analysis

Rt®-XLSulfur Columns (packed & micropacked)

- Optimized columns for low ppbv sulfur analyses.
- Eliminate the need for PTFE tubing.
- Column and end fittings are Sulfinert® treated for maximum inertness.
- Maximum temperature of 290 °C.

Sulfur analyses are traditionally performed using PTFE tubing to improve column inertness. Unfortunately, PTFE tubing is gas permeable, difficult to pack with high efficiency, prone to shrinkage, and has poor thermal stability. The Rt®-XLSulfur packed or micropacked column eliminates these problems. The packing material for Rt®-XLSulfur columns is extensively deactivated for analysis of low ppbv levels of hydrogen sulfide and methyl mercaptan. It is then treated to achieve effective separation of hydrocarbons from sulfur compounds. The interior wall and the end fittings of the Rt®-XLSulfur column are Sulfinert® treated, making the column as inert as PTFE. The extra care taken to manufacture this column ensures more accurate analyses of sulfur compounds.

Rt®-XLSulfur Columns (packed)*

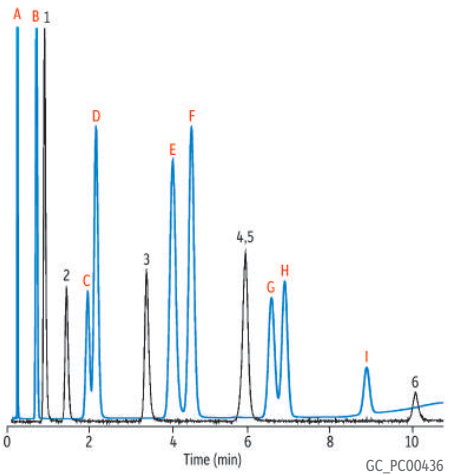
OD	ID	Mesh	1-Meter cat.#*	2-Meter cat.#*
1/8"	2.0 mm	100/120	80484-	80485-
3/16"	3.2 mm	100/120	80482-	80483-

Rt®-XLSulfur Columns (micropacked)

OD	ID	Mesh	1-Meter cat.#	2-Meter cat.#
1/16"	1.0 mm	100/120	19804	19805
0.95 mm	0.75 mm	100/120	19806	19807
0.74 mm	0.53 mm	100/120		19044

*Please add column instrument configuration suffix number to cat.# when ordering. See chart on this page.
NOTE: Columns do not include column nuts and ferrules. Optional installation kits can be ordered separately—see page 142.

Sulfur Compounds and Hydrocarbons on Rt®-XLSulfur



Sulfurs
1. Hydrogen sulfide
2. Carbonyl sulfide
3. Methyl mercaptan
4. Ethyl mercaptan
5. Dimethyl sulfide
6. Dimethyl disulfide

Hydrocarbons
A. Methane
B. Ethane
C. Propylene
D. Propane
E. Isobutane
F. Butane
G. Isopentane
H. Pentane
I. Hexane

Column	Rt®-XLSulfur, 1 m, 0.95 mm OD, 0.75 mm ID (cat.# 19806)
Sample	
Conc.:	50 ppb each
Injection	packed not on-column
Oven	
Oven Temp.:	60 °C to 230 °C at 15 °C/min
Carrier Gas	He, constant flow
Flow Rate:	9 mL/min
Detector	SCD/FID
Acknowledgement	Sulfur standards courtesy of DCG Partnership 1 Ltd., Pearland, TX.

did you know?

Rt®-XLSulfur columns are optimized for low ppb-level sulfur analysis!

also available

Adapter kits for installing packed/micropacked columns.

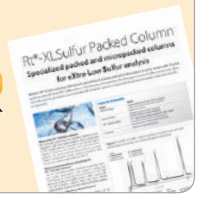
See **page 142.**

free literature

Rt®-XLSulfur Packed Column
Specialized packed and micropacked columns for eXtra-Low Sulfur analysis

Download your free copy from **www.restek.com**

lit. cat.# PCTS1500A-UNV



Column Instrument Configurations

General Configuration
Suffix -800

Agilent 5880, 5890, 5987, 6890, 7890:
Suffix -810*

Bruker 430, 3700, Vista Series, FID:
Suffix -820

PE 900-3920, Sigma 1,2,3:
Suffix -830

PE Auto System 8300, 8400, 8700
Suffix -840

See page 151 for additional configurations.

Note: Initial 2" of column will be empty to accommodate a needle. For a completely filled column (not on-column) add suffix -901.
*-810 suffix also includes 1 1/2" void on detector side.
Note: Standard micropacked columns fit all instruments. No special instrument configuration suffix is required.

Packed/Micropacked Column Installation Kits

Adaptor kit centers the packed column in the injection port, so the syringe will not scrape the sides of the column.

Packed Column Inlet Adaptor Kits

- Use 1/8" and 3/16" OD columns in 1/4" on-column injection ports.
- Centers column perfectly in injection port to eliminate bent syringe needles.
- Slotted design prevents carrier gas occlusion.
- Vespel®/graphite reducing ferrules make installation easy.
- Includes all nuts and ferrules used to attach tubing to the injector or detector.

Description	For 1/8" Columns qty.	cat.#	For 3/16" Columns qty.	cat.#
Packed Column Inlet Adaptor Kit for 1/4" Injection Ports	kit	21651	kit	21650

Installation Kits for Micropacked Columns

21065

Description	qty.	cat.#
Micropacked Column Installation Kit for 1 mm ID columns; for valve applications. Kit contains: 1/16" Valco nut (1), 1/16" stainless steel nut (1), 1/16" Vespel/graphite ferrule (1), 1/16" graphite ferrule (1), stainless steel ferrule (1), 1/16" stainless steel front ferrule (1), 1/16" stainless steel back ferrule (1).	kit	21065
Micropacked Column Installation Kit for 1 mm ID columns; for direct injections. Kit contains: 1/16" stainless steel nuts (2), 1/16" Vespel/graphite ferrules (2), 1/16" graphite ferrules (2), 1/16" stainless steel front ferrules (2), 1/16" stainless steel back ferrules (2).	kit	21066

Installation Kit for Packed Columns

21067

Description	qty.	cat.#
Packed Column Installation Kit for 2 mm ID columns; for valve applications. Kit contains: 1/8" stainless steel nut (1), stainless steel Valco nut (1), 1/8" Vespel/graphite ferrule (1), stainless steel Valco ferrule (1), 1/8" stainless steel front ferrule (1), 1/8" stainless steel back ferrule (1).	kit	21067

Micropacked Inlet Conversion Kits

- Convert a capillary GC split/splitless inlet for use with 1/16" OD micropacked columns.
- For use with Agilent 5890, 6890, and 7890 GCs.
- Sample pathways deactivated for ultimate inertness.

22429
Large-Bore Dual Vespel® Ring Inlet Seals

1/4" SS Nut
23152

Large-Bore
FID Adaptor

1/4" Vespel®/Graphite
Ferrule
20221

1/16" SS Nuts
23150

Large-Bore
Reducing Nut

1/16" Vespel®/
Graphite Ferrules
20218

22430

20772

Description	qty.	cat.#
Micropacked Column Adaptor Kit for Split/Splitless Injection* *Complete kit with FID and injection port adaptors* Kit includes: dual Vespel ring inlet seal, large bore; reducing nut, large bore; FID adaptor, large bore; 1/4" ferrule, Vespel/graphite; 1/4" nut, stainless steel; 1/16" ferrules, Vespel/graphite (2); 4 mm splitless liner, intermediate polarity deactivated; 1/16" nuts, stainless steel (2)	kit	22424
Micropacked Column Adaptor Kit for On-Column Injection* *Complete kit with FID and injection port adaptors* Kit includes: dual Vespel ring inlet seal, large bore; reducing nut, large bore; FID adaptor, large bore; 1/4" ferrule, Vespel/graphite; 1/4" nut, stainless steel; 1/16" ferrules, Vespel/graphite (2); Siltek treated metal liner installation guide; 1/16" nuts, stainless steel (2)	kit	22425
Micropacked Column Adaptor Kit for Split/Splitless Injection *Injection Port Adaptor Kit* Kit includes: dual Vespel ring inlet seal, large bore; reducing nut, large bore; 1/16" ferrule, Vespel/graphite; 1/16" nut, stainless steel; 4 mm splitless liner, intermediate polarity deactivated	kit	22426
Micropacked Column Adaptor Kit for On-Column Injection *Injection Port Adaptor Kit* Kit includes: dual Vespel ring inlet seal, large bore; reducing nut, large bore; 1/16" ferrule, Vespel/graphite; Siltek treated metal liner installation guide; 1/16" nut, stainless steel	kit	22427
Micropacked Column Adaptor Kit for FID* *FID Adaptor Kit* Kit includes: FID adaptor, large bore; 1/4" ferrule, Vespel/graphite; 1/4" nut, stainless steel; 1/16" nut, stainless steel; 1/16" ferrule, Vespel/graphite	kit	22428
Replacement Inlet Seals for Micropacked Column Adaptor Dual Vespel ring inlet seals, large bore (2)	2-pk.	22429
Replacement Metal Liner Installation Guide for On-Column Injection, Siltek Treated	ea.	22430
Replacement 4 mm Splitless Liner	ea.	20772

*For use with packed column FIDs only.

CarboBlack Packing Materials

- CarboBlack B supports up to 10% loading of a nonsilicone liquid phase.
- CarboBlack C supports up to 1% loading of a nonsilicone liquid phase.

Graphitized carbon black offers unique selectivity and very little adsorption for alcohol analyses. Two types of CarboBlack supports are available, CarboBlack B and CarboBlack C. CarboBlack B support, with its higher surface area, can hold up to a 10% loading of a nonsilicone liquid phase. CarboBlack C support can hold up to a 1% loading of a nonsilicone liquid phase. Many Carbowax® 20M-loaded CarboBlack packings are available. CarboBlack packings are treated with KOH or picric acid for basic or acidic compounds, and special alcoholic beverage loadings are available. CarboBlack supports provide resolution and retention similar to Carbopack™ and Carbograph supports.

did you know?

CarboBlack supports replace
- Carbopack™
- Carbograph

Description	Temp. Limit	Mesh	Min. Qty.	cat.#
CarboBlack B	500 °C	60/80	10 g	25500
	500 °C	80/120	10 g	25501
CarboBlack C	500 °C	60/80	10 g	25502
	500 °C	80/100	10 g	25503
CarboBlack BHT-100	150 °C	40/60	10 g	25504
CarboBlack III (F)	175 °C	80/100	10 g	25506
5% Carbowax 20m on CarboBlack B	225 °C	80/120	10 g	25507
6.6% Carbowax 20m on CarboBlack B	225 °C	80/120	10 g	25508
4% Carbowax 20m / 0.8% KOH on CarboBlack B	220 °C	60/80	10 g	25509
0.19% picric acid on CarboBlack C	120 °C	80/100	10 g	25510
4% Carbowax 20m on CarboBlack B-DA	200 °C	80/120	10 g	25511

Minimum order of 10 grams. Price is per gram.

Technical Service

Do you have a technical question? Restek's Technical Service group has answers! Drawing from our extensive libraries of technical information and many years of collective chromatography experience, the experts in Technical Service can help you with everything from setup to method development.

Contact us:

For quick answers to commonly asked questions any time of the day, visit **www.restek.com/answers** or contact us directly:

In the U.S.: Phone: 1-800-356-1688, ext. 4 • e-mail: support@restek.com

Hours of operation (Eastern Time):
Monday - Thursday, 8:00 a.m. to 6:00 p.m.
Friday, 8:00 a.m. to 5:00 p.m.

Outside the U.S.: Contact International Technical Service at intltechsupp@restek.com or find a local distributor at **www.restek.com/distributor**

also available

Custom packing materials are also available.

See **page 148**.

Put our decades of experience to work for you.

Res-Sil® Packing Materials

- Unique separation of saturated and unsaturated hydrocarbons.
- Innovative bonding chemistry for batch-to-batch reproducibility, excellent thermal stability, and long life.
- Wide range of bonded phases available.
- Equivalent to Durapak and Porasil packings.

Bonded silica packings with *n*-octane or cyanopropyl (OPN) functional groups yield faster separations of C1 to C4 hydrocarbons, higher thermal stability, shorter conditioning times, and longer lifetimes than conventional packings. However, bonded silica packings have had inconsistent reproducibility and limited availability. Restek's research team has solved these age-old problems by developing Res-Sil® C packings for consistent performance.

Unique Selectivity for Process GC and High-Speed Analysis of Petrochemicals

Res-Sil® C bonded packings are ideal for fast resolution of difficult-to-separate saturated and unsaturated C4 hydrocarbons (see page 139). This unique selectivity, when combined with other columns in series, provides petroleum and petrochemical method developers with a powerful tool for fast determination of C1 to C5 hydrocarbons.[1]

Innovative Research and Stringent QC Provide Batch-to-Batch Consistency

Restek's synthesis procedure eliminates batch-to-batch variations. The amount of bonded liquid phase is precisely controlled in every batch for reproducible retention times and separations. Each production batch of Res-Sil® C packing is tested with a complex hydrocarbon mixture to meet demanding retention time and retention index specifications and to ensure there are no retention shifts. Column bleed is also evaluated to ensure that baselines remain low.

OPN on Res-Sil® C Packing—the Latest in a Line of Bonded GC Phases

Restek offers a wide range of bonded packings for packed column GC, including Rtx®-1, Stabilwax®, and Carbowax® phases. We have extended this technology to make *n*-octane on Res-Sil® C packing, and OPN on Res-Sil® C packing. Each of these packings has low bleed, conditioning times of less than 30 minutes, long lifetime, and consistent batch-to-batch reproducibility.

did you know?

Res-Sil® replaces
- Porasil B
- Porasil C
- Durapak

Description	temp. limits	Mesh	Min. Qty.	cat.#
Res-Sil C	300 °C	60/80	10 g	25400
	300 °C	80/100	10 g	25028
Res-Sil B	300 °C	60/80	10 g	25401
	300 °C	80/100	10 g	25080
1% TCEP on Res-Sil B	175 °C	80/100	10 g	25081
OPN on Res-Sil C	150 °C	80/100	10 g	25042
n-Octane on Res-Sil C	150 °C	80/100	10 g	25030
2% Carbowax 1540 on Res-Sil C	150 °C	80/100	10 g	25044

Minimum order of 10 grams. Price is per gram.

[1]N.C. Saha, S.K. Jain, and R.K. Dua. J. Chromat. Sci 1978, 323-328.

Porapak Packing Materials

Description	temp. limits	g/btl.	Mesh 50/80 cat.#	Mesh 80/100 cat.#	Mesh 100/120 cat.#
Porapak P	250 °C	20 g	25576	25577	25578
Porapak PS	250 °C	20 g	25579	25580	25581
Porapak Q	250 °C	26 g	25582	25583	25584
Porapak QS	250 °C	26 g	25585	25586	25587
Porapak R	250 °C	24 g	25588	25589	25590
Porapak S	250 °C	26 g	25591	25592	25593
Porapak N	190 °C	29 g	25594	25595	25596
Porapak T	190 °C	31 g	25597	25598	25599

also available

Custom packing materials are also available.

See **page 148**.

HayeSep® Packing Materials

Description	temp. limits	g/btl.	Mesh 60/80 cat.#	Mesh 80/100 cat.#	Mesh 100/120 cat.#
HayeSep A	165 °C	24 g	22560	25032	25033
HayeSep B	190 °C	24 g	25561	25034	25035
HayeSep C	250 °C	24 g	25562	25036	25037
HayeSep D	290 °C	24 g	25563	25038	25039
HayeSep DIP	290 °C	24 g	25564	25565	25566
HayeSep DB	290 °C	24 g	25567	25568	25569
HayeSep DOX			(Use HayeSep DB)		
HayeSep N	165 °C	24 g	25570	25045	25046
HayeSep P	250 °C	24 g	25571	25047	25048
HayeSep Q	275 °C	24 g	25572	25049	25050
HayeSep R	250 °C	24 g	25573	25051	25052
HayeSep S	250 °C	24 g	25574	25053	25054
HayeSep T	165 °C	24 g	25575	25055	25056

Tenax® Packing Materials

Description	temp. limits	Min. Qty.	Mesh 60/80 cat.#	Mesh 80/100 cat.#
Tenax-TA	350 °C	10 g	25550	25551
Tenax-GR	350 °C	10 g	25552	25553

Liquid Phases for Custom Columns

We can prepare packed and micropacked columns from the extensive list of liquid phases shown here. We have many more liquid phases. If you don't see the phase you need, call Technical Service or contact your Restek representative for availability.

Phase	min./max. temp. (°C)
Apiezon L	50/300
p,p'-Azoxydiphenetole	132/140
BC-120	0/125
Bentone-34	0/180
bis (2-ethoxyethyl) adipate	0/150
bis (2-ethylhexyl) phthalate	150 max.
bis (2-methoxyethyl) adipate	20/100
n,n'-Bis(*p*-methoxylbenzylidene)-α,α'-bi-*p*-toluidine (BMBT)	189/225
Carbowax 1000	40/150
Carbowax 20M	60/225
Carbowax 20M-terephthalic acid	60/225
Carbowax 400	10/100
Carbowax 600	30/125
Cyclohexanedimethanol succinate	100/250
DC-11	0/300
DC-200	0/200
DC-550	20/250
DEGS-PS	20/200
Di(2-ethylhexyl)sebacate	0/125
Diethylene glycol succinate (DEGS)	20/200
Diethylene glycol adipate (DEGA)	0/200
Diisodecyl phthalate	0/175
2,4-Dimethylsulfolane	0/50
Di-*n*-decyl phthalate	10/175
Dinonyl phthalate	20/150
Ethylene glycol adipate	100/225
Ethylene glycol phthalate	100/200
Ethylene glycol succinate	100/200
FFAP	50/250
Fluorad FC-431, 50% solution in ethyl acetate	40/200
Hallcomid M-18-OL	8/150
Halocarbon 10-25	20/100
Halocarbon K-352	0/250
Halocarbon wax	50/150
Igepal® CO-880 (Nonoxynol)	100/200
Igepal CO-890	100/200
Krytox	-30/260
Neopentyl glycol adipate	50/225
Neopentyl glycol sebacate	50/225
Neopentyl glycol succinate	50/225
Nonoxynol (Igepal CO-880)	100/200
β,β-Oxydipropionitrile	0/75
OV-1, dimethyl (gum)	100/350
OV-1, vinyl	100/350
OV-3, phenyl methyl	0/350
OV-7, phenyl methyl dimethyl, 20% phenyl	0/350
OV-11, phenyl methyl dimethyl, 35% phenyl	0/350
OV-17, phenyl methyl, 50% phenyl	0/375

Phase	min./max. temp. (°C)
OV-22, phenyl methyl diphenyl, 65% phenyl	0/350
OV-25, phenyl methyl diphenyl, 75% phenyl	0/350
OV-61, diphenyl, 33% phenyl	0/350
OV-73, 5.5% diphenyl	0/325
OV-101, dimethyl (fluid)	0/350
OV-105, cyanopropyl methyl	0/275
OV-202, trifluoropropyl (fluid)	0/275
OV-210, trifluoropropyl (fluid)	0/275
OV-215, trifluoropropyl (gum)	0/275
OV-225, cyanopropyl methylphenyl methyl	0/265
OV-275, dicyanoallyl	25/250
OV-330, silicone - Carbowax	0/250
OV-351	50/270
OV-1701, vinyl	0/250
Phenyldiethanolamine succinate	0/230
Polethylene glycol adipate (EGA)	100/225
Polyphenyl ether (5 rings) OS-124	0/200
Polypropylene glycol	0/150
Rtx-1 (Rt-101)	0/350
Rt-1000	50/250
Rt-1200	25/200
Rt-1220	50/200
Rt-1500, Rt-1510	50/230
Rt-2100	0/350
Rt-2300	20/275
Rt-2330, Rt-2340	25/275
Rt-608Pkd	0/275
Rt-Sebaconitrile	25/110
Rt-XLSulfur	250 max.
SE-30, SE-52, SE-54	50/300
Silar 5 CP, Silar 10 CP	0/250
Sorbitol	150 max.
Squalane	20/100
Squalene	0/100
Stabilwax	40/240
Tetracyanoethylated pentaerythritol	30/175
THEED (Tetrahydroxyethlenediamine)	0/125
β,β-Thiodipropionitrile (TDPN)	100
Tricresyl phosphate	20/125
1,2,3-Tris (2-cyanoethoxy) propane (TCEP)	0/175
Triton X-100, Triton X-305	0/200
UC W982	0/300
UCON 50-HB-2000	0/200
UCON 50-HB-280-X	0/200
UCON 50-HB-5100	0/200
UCON HB-1800-X	200 max.
UCON LB-550-X	0/200
Versamid 900	190/275

Advantages of Using Restek® Packed Columns

- Reasonably priced.
- Low-bleed, long-lifetime bonded phases.
- Wide variety of supports and packings.
- Produced by experienced packed column chromatographers.

USP Liquid Phase & Solid Support Cross-Reference

Restek can meet all of your packed column needs for U.S. Pharmacopeia methods. Commonly used USP liquid phases and supports are listed below. Call Restek or your representative for a quote on your next packed column for pharmaceuticals.

USP	Phase Description	Restek-Supplied Equivalent
G1	Dimethylpolysiloxane oil	Rt-2100, OV-101, Rtx-1
G2	Dimethylpolysiloxane gum	OV-1, Rtx-1
G3	50% Phenyl-50% methylpolysiloxane	Rt-2250, OV-17
G4	Diethylene glycol succinate polyester	DEGS
G5	3-Cyanopropylpolysiloxane	Rt-2340
G6	Trifluoropropylmethylpolysiloxane	Rt-2401, OV-210
G7	50% 3-Cyanopropyl-50% phenylmethylsilicone	Rt-2300
G8	80% Bis (3-cyanopropyl)-20% phenylpolysiloxane	Rt-2330
G9	Methylvinylpolysiloxane	UCW 98
G11	Bis(2 ethylhexyl) sebecate polyester	Bis(2 ethylhexyl) sebecate polyester
G12	Phenyldiethanolamine succinate polyester	Phenyldiethanolamine succinate polyester
G13	Sorbitol	Sorbitol
G14	Polyethylene glycol (average mol. wt. 950-1050)	Carbowax 1000
G15	Polyethylene glycol (average mol. wt. 3000-3700)	Carbowax 4000
G16	Polyethylene glycol compound (average mol. wt. 15,000), a high molecular weight compound of polyethylene glycol and a diepoxide linker	Carbowax 20M
G17	75% Phenyl-25% methylpolysiloxane	OV-25
G18	Polyalkylene glycol	UCON LB 550X
G19	25% Phenyl-25% cyanopropyl-50% methylsilicone	OV 225
G20	Polyethylene glycol (average mol. wt. 380-420)	Carbowax 400
G21	Neopentyl glycol succinate	Neopentyl glycol succinate
G22	Bis(2 ethylhexyl) phthalate	Bis(2 ethylhexyl) phthalate
G23	Polyethylene glycol adipate, ethylene glycol adipate	EGA
G24	Diisodecyl phthalate	Diisodecyl phthalate
G25	Polyethylene glycol compound TPA, a high molecular weight compound of a polyethylene glycol and a diepoxide that is esterified with terephthalic acid	Carbowax 20M TPA
G26	25% 2-Cyanoethyl-75% methylpolysiloxane	XE 60
G27	5% Phenyl-95% methylpolysiloxane	SE-52, Rtx-5
G28	25% Phenyl-75% methylpolysiloxane	DC 550
G29	3,3'-Thiodipropionitrile	TDPN
G30	Tetraethylene glycol dimethyl ether	Tetraethylene glycol dimethyl ether
G31	Nonylphenoxypoly(ethyleneoxy)ethanol (average ethyleneoxy chain length is 30): nonoxynol 30	Igepal CO 880
G32	20% Phenylmethyl-80% dimethylpolysiloxane	OV-7
G33	20% Carborane®-80% methylsilicone	Dexsil 300
G34	Diethylene glycol succinate polyester stabilized with phosphoric acid	DEGS PS
G35	A high molecular weight compound of a polyethylene glycol and a diepoxide that is esterified with nitroterephthalic acid	Rt-1000
G36	1% Vinyl-5% phenylmethylpolysiloxane	SE 54, Rtx-5
G38	Phase G1 containing a small amount of tailing inhibitor	Rt-2100/0.1% Carbowax 1500
G39	Polyethylene glycol (average mol. wt. 1500)	Carbowax 1500
G40	Ethylene glycol adipate	EGA

USP	Support Description	Restek-Supplied Equivalent
S1A	Siliceous earth, see method for details on treatment	Silcoport W
S1AB	Siliceous earth, treated as S1A and both acid- and base-washed	Silcoport WBW
S1C	Crushed firebrick, calcined or burned with a clay binder >900 °C, acid-washed, may be silanized	Chromosorb PAW or PAW DMDCS
S1D	Crushed firebrick, calcined or burned with a clay binder >900 °C, not acid-washed, may be silanized	Chromosorb PNAW
S1NS	Untreated siliceous earth	Chromosorb W- Non Acid Washed
S2	Styrene-divinylbenzene copolymer with nominal surface area of less than 50 m^2/g and an average pore diameter of 0.3 to 0.4 µm	Chromosorb 101
S3	Ethylvinylbenzene-divinylbenzene copolymer with nominal surface area of 500 to 600 m^2/g and an average pore diameter of 0.0075 µm	HayeSep Q
S4	Styrene-divinylbenzene copolymer with aromatic -O and -N groups having a nominal surface area of 400 to 600 m^2/g and an average pore diameter of 0.0076 µm	HayeSep R
S5	High molecular weight tetrafluorethylene polymer, 40- to 60-mesh	Chromosorb T
S6	Styrene-divinylbenzene copolymer having a nominal surface area of 250 to 350 m^2/g and an average pore diameter of 0.0091 µm	Chromosorb 102 HayeSep P
S7	Graphitized carbon having a nominal surface area of 12 m^2/g	CarboBlack C
S8	Copolymer of 4-vinyl-pyridine and styrene-divinylbenzene	HayeSep S
S9	Porous polymer based on 2,6-diphenyl-*p*-phenylene oxide	Tenax TA
S10	Highly cross-linked copolymer of acrylonitrite and divinylbenzene	HayeSep C
S11	Graphitized carbon having a nominal surface area of 100 m^2/g, modified with small amounts of petrolatum and polyethylene glycol compound	CarboBlack B 80/120 3% Rt 1500
S12	Graphitized carbon having a nominal surface area of 100 m^2/g	CarboBlack B

Custom Coated Packing Materials

Custom Coated Packing Materials

Custom coated packing materials can be made with any of the supports listed below. The liquid stationary phases available are listed on page 146 and the coating ranges are listed in the chart. Coated packings are available in minimum orders of 20 grams.

To order, please call your Restek representative for pricing and specify the following:

1) Stationary phase and stationary phase concentration.

2) Support and support mesh size.

3) Amount of packing needed.

Ordering Example: (1%) (XE-60) (CarboBlack B (80/120) (20 g)

Support	Max. Coating %	Mesh Sizes
CarboBlack B	1–10%*	60/80, 80/120
CarboBlack B HT	1–10%	40/60
CarboBlack C	0.1–1%*	60/80, 80/100
HayeSep	15%	60/80, 80/100, 100/120
Porapak	15%	50/80, 80/100, 100/120

ordering note

Mesh Size

When ordering a packed column solid support, please specify mesh size. Refer to this chart to convert microns to mesh size.

Example:
150–180 micron particles = 80/100 mesh

(µm)	Mesh Size
850	20
710	25
600	30
500	35
425	40
355	45
300	50
250	60
212	70
180	80
150	100
125	120
106	140
90	170
75	200
63	230
53	270

ordering note

Special phases that require a surcharge:
OV®-275, OV®-330, OV®-225, BMBT, 2,4-dimethylsulfolane, OV®-1701, and XE-60. Call your Restek representative for pricing.

Custom Packed/Micropacked Columns

Custom Packed Columns

To order, specify the following:

1) Column dimensions (length, ID) and tubing material.
2) Packing description (percent coating and phase, support mesh size, and treatment).
3) Column configuration (instrument manufacturer, model number, on-column injection or not) and with or without nuts and ferrules.

Ordering Example: (6' x 1/8") (stainless steel) (1%) (XE-60) (CarboBlack B 80/120) (Agilent 6890) (on-column injection) (fittings kit)

Please use the custom order form on page 150 or visit **www.restek.com/packed**

did you know?

Packing material in packed and micropacked columns is secured using wire braids or frits. This prevents packing material from exiting the column.

Custom Micropacked Columns

To order, contact your Restek representative and specify the following:

1) Physical dimensions (length, OD, ID, and tubing material).
2) Packing description (percent coating and phase, support mesh size).
3) Installation kit (see page 142), frit type.

Ordering Example: (2 m x 1/16" OD x 1.00 mm ID) (Siltek®-treated tubing) (5%) (Carbowax® 20M) (CarboBlack B) (80/120) (installation kit for valve applications, cat. #21065) (Siltek® frits)

Please use the custom order form on page 150 or visit **www.restek.com/packed**

ordering note

For international pricing on custom packed or micropacked columns, please contact your Restek representative.

Technical Service

Do you have a technical question? Restek's Technical Service group has answers! Drawing from our extensive libraries of technical information and many years of collective chromatography experience, the experts in Technical Service can help you with everything from setup to method development.

Contact us:

For quick answers to commonly asked questions any time of the day, visit **www.restek.com/answers** or contact us directly:

In the U.S.: Phone: 1-800-356-1688, ext. 4 • e-mail: support@restek.com

Hours of operation (Eastern Time):
Monday - Thursday, 8:00 a.m. to 6:00 p.m.
Friday, 8:00 a.m. to 5:00 p.m.

Outside the U.S.: Contact International Technical Service at intltechsupp@restek.com or find a local distributor at **www.restek.com/distributor**

Packed/Micropacked Column Custom Order Form

Order: _____ Quote: _____ Reference # from previous order (if available): _____

Date: _____

Restek Account #: _____

Contact: _____

Company: _____

Address: _____

_____

Phone: _____

Fax: _____

Email: _____

Restek Use Only:

Custom No.: _____

Stock No.: _____

Price: _____

Fitting Costs: _____

Authorization:

_____

Number of Columns: _____

1) Column Dimensions:
   Length _____ OD x ID: _____
2) Tubing (choose one): ❍ SilcoSmooth® ❍ Stainless Steel ❍ Hastelloy® ❍ Nickel ❍ Copper ❍ PTFE
3) Packing Description:
   Liquid Phase A (% + description): _____
   Liquid Phase B (% + description): _____
   Liquid Phase C (% + description): _____
   Solid Support: _____ Mesh: _____
4) Column Configuration:
   Instrument (mfr. + model): _____
   Inlet: Packed Full? ❍ Yes ❍ No, leave_____" void (for on-column injection)
   Outlet: Packed Full? ❍ Yes ❍ No, leave_____" void
   Do you want this column preconditioned? ❍ Yes (additional charge) ❍ No
   Standard configuration suffix number (next page):
   Frits ❍ Hastelloy® ❍ Siltek®
   Special configuration (next page): Figure: _____ Dimensions: _____
   Welded Tubing Reducers ❍ (additional charge)
   Special Instructions: _____

Fittings (check appropriate circle)

❍ **KIT 1S**
1/4" brass nuts
1/4" to 1/8" V/G reducing ferrules
No additional charge

❍ **KIT 2S**
1/4" brass nuts
1/4" to 3/16" V/G reducing ferrules
No additional charge

❍ **KIT A**
1/8" brass nuts
1/8" V/G ferrules
No additional charge

❍ **KIT B**
1/8" brass nuts
1/8" brass front & back ferrules
No additional charge
V/G = Vespel®/graphite

❍ **KIT C**
1/8" stainless steel nuts
1/8" stainless steel front & back ferrules
Additional charge

❍ **KIT D**
1/8" stainless steel nuts
1/8" V/G ferrules
Additional charge

❍ **KIT E**
1/4" stainless steel nuts
1/4" to 1/8" V/G reducing ferrules
Additional charge

❍ **KIT F**
1/4" stainless steel nuts
1/4" to 3/16" V/G reducing ferrules
Additional charge

❍ **KIT V**
1/8" VCR fitting
check appropriate circle:
❍ Stainless Steel (additional charge)
❍ Nickel (additional charge)

for a quote:

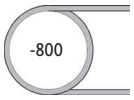
Complete this form and fax to Restek at 814-353-1309, or to your Restek representative.

This form is also available online at:

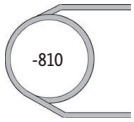
www.restek.com/**packed**

Standard Configurations (choose one)

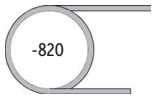
General Configuration



Agilent 5880, 5890, 5987, 6890, 7890



Bruker 430, 450 (Varian 3700, Vista Series, FID)



PE 900-3920, Sigma 1,2,3

PE Auto System 8300, 8400, 8700

-810	Agilent 5880, 5890, 5987, 6890, 7890
-811	Agilent 6850
-820	Scion (Bruker 430, 450) (Varian 3700,Vista Series, FID)
-821	Scion (Bruker 430, 450) (Varian 3800)
-830	PerkinElmer 900-3920, Sigma 1,2,3
-840	PerkinElmer Auto System 8300, 8400, 8700, Clarus 500 (C500)
-841	PerkinElmer Auto Sys XL
-845	ABB 3100, AAI (4" coil)
-850	Shimadzu 14A, 2014
-851	Shimadzu 8A
-852	Shimadzu 9A
-853	Shimadzu 17A, 2010
-854	Shimadzu Mini 2
-860	Thermo Scientific - TRACE 2000
-865	Carlo Erba
-870	Tremetrics/Tracor
-874	HNU 310 & 311 (4.5" coil)
-875	Analytical Controls Configuration
-880	Carle 40030
-881	Hitachi 263
-885	Pye Unicam 4500
-890	Gow Mac 590
-891	Gow Mac 550
-892	Gow Mac 750
-893	Gow Mac 816 (3" coil, 3" spread on the arms, and a total height of 5")
-894	Gow Mac 580
-895	SRI 8610C
-895R	SRI 8610C Dual GC Right Side
-895L	SRI 8610C Dual GC Left Side
-896	SRI 9300

Custom Configurations (Please provide dimensions on order form, page 150, or at **www.restek.com/packed**)

Figure 1

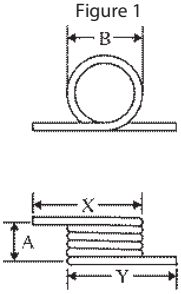


Figure 2

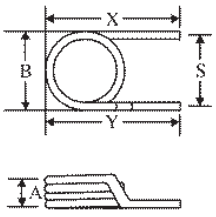


Figure 3

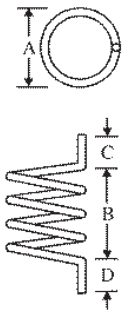


Figure 4

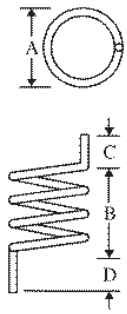


Figure 5

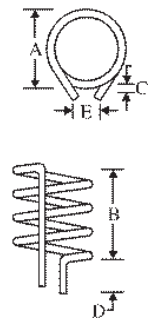


Figure 6

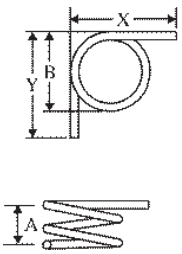


Figure 7

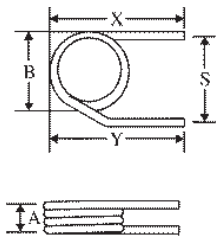


Figure 8

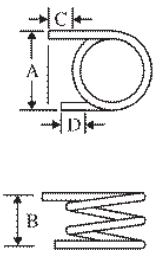


Figure 9

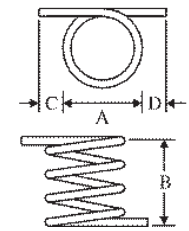


Figure 10

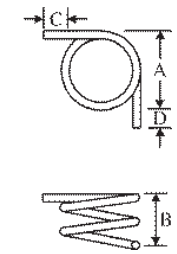


Figure 11

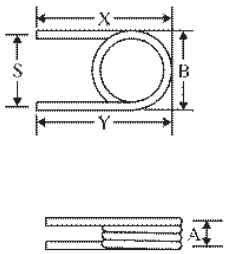


Figure 12

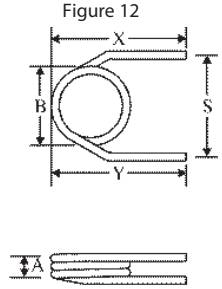


Figure 13

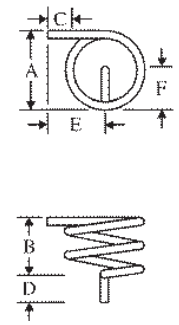


Figure 14

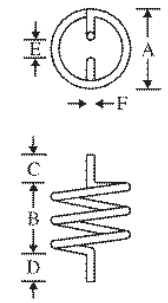


Figure 15