GC Columns

Packed/Micropacked Columns

Packed Columns Overview

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

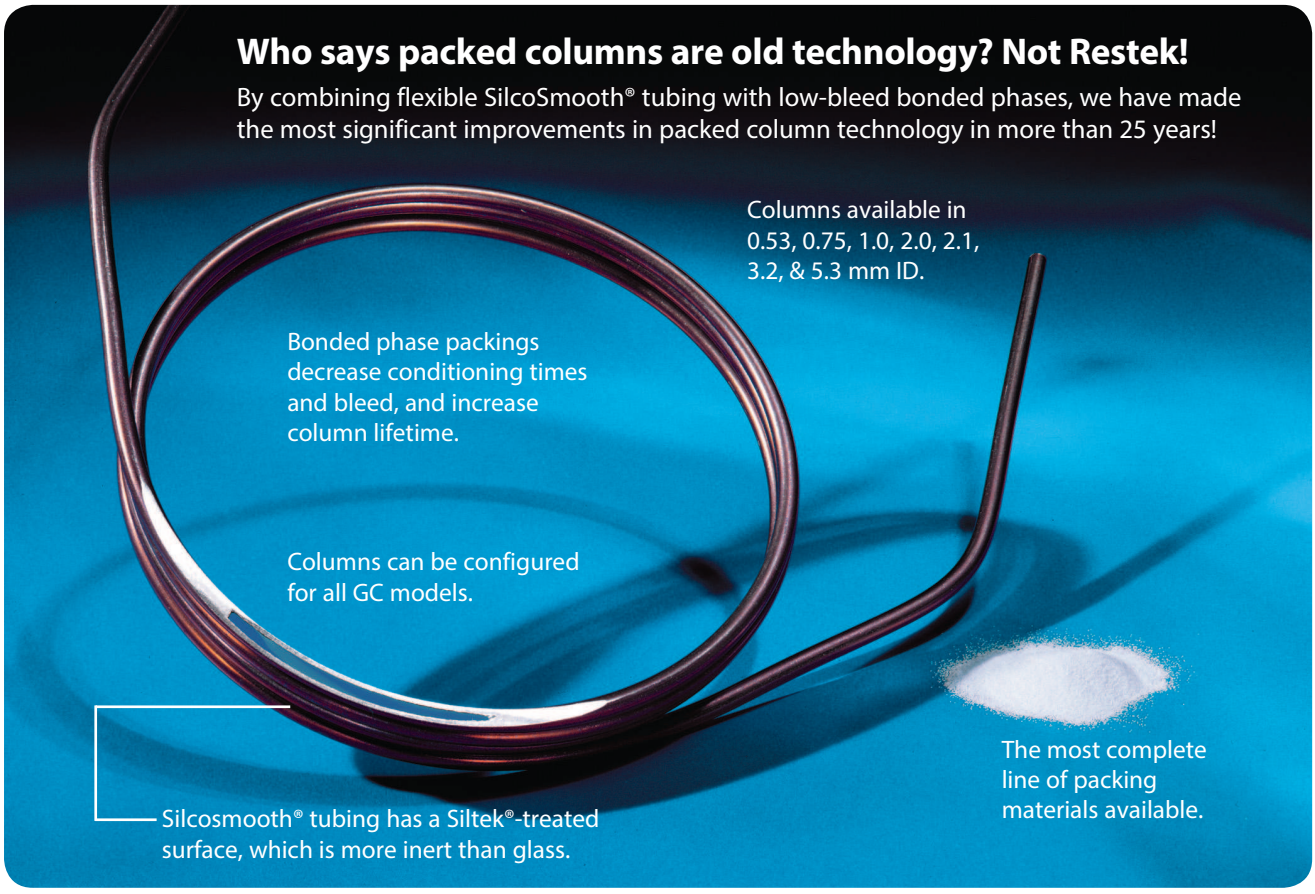
- SilcoSmooth® tubing provides the inertness of glass and the durability of stainless steel, so you get accurate results for a wide range of active compounds.
- Stable bonded stationary phases mean short conditioning times, low bleed, and long column lifetimes.
- Excellent retention time reproducibility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

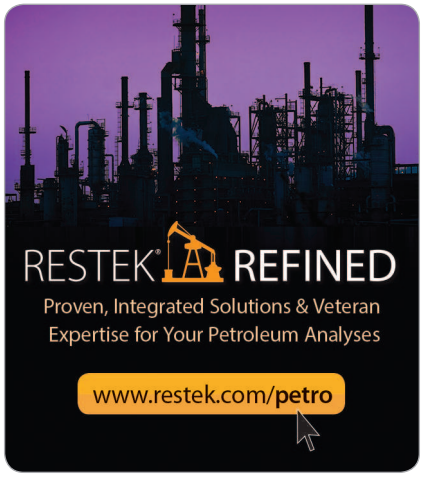
Packed columns offer large sample capacity and often can retain and separate compounds that cannot be analyzed by other techniques. While these advantages have resulted in their use in a wide range of GC applications, traditional packed columns are limited by unstable phases that break down easily, producing 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

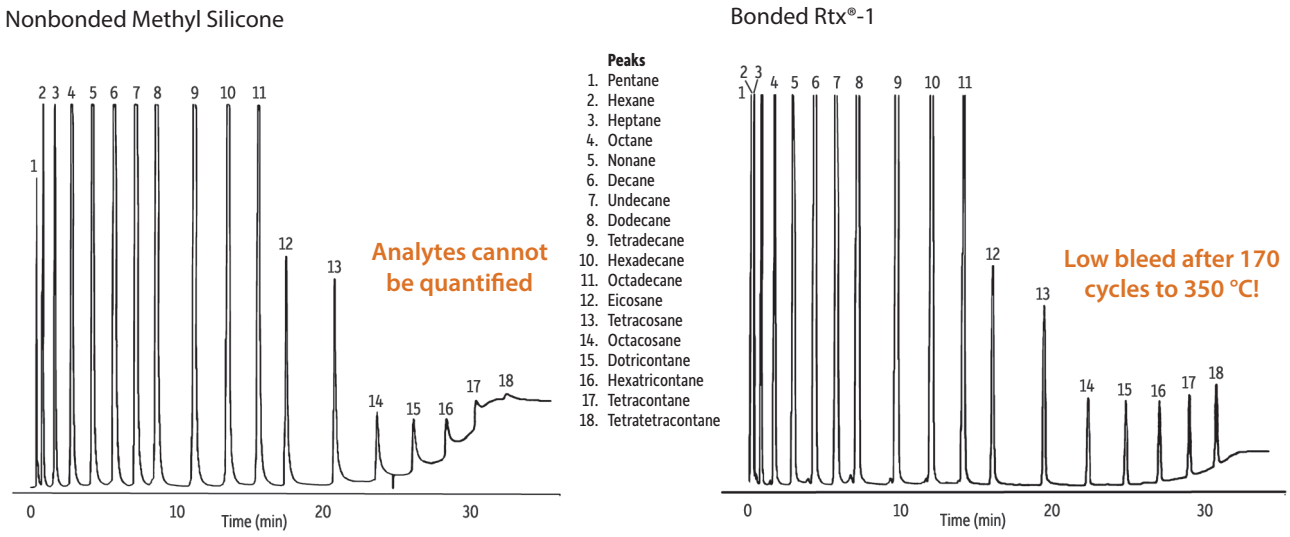
1-2-3 PUNCH!

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.

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**.

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.

also available

Porapak, HayeSep®, and Tenax® packing materials.

See **page 145.**

Stock Packed Columns

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

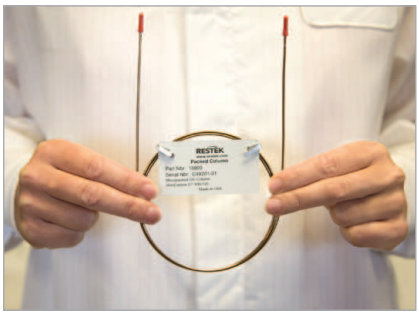
- Increased efficiency over traditional packed columns.
- Higher capacity than PLOT columns.
- Made from inert, flexible SilcoSmooth® tubing.
- Wide range of packings available.
- Standard coils fit all instruments. No special instrument configurations required.

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.

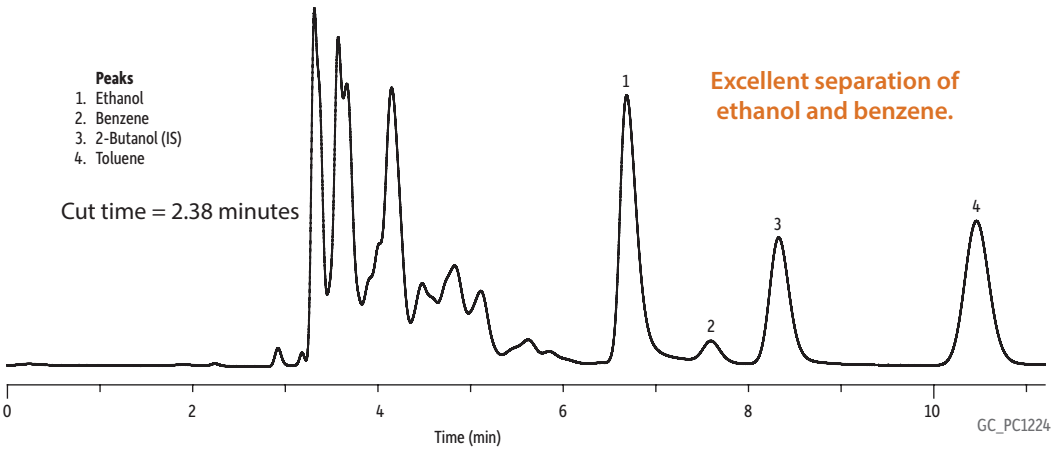
free literature

Resolve Benzene and Toluene in Spark Ignition Fuels Containing Ethanol

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

lit. cat.# PCTS1408-UNV

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	Ethanol-containing gasoline with internal standard (IS)
Diluent:	
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).

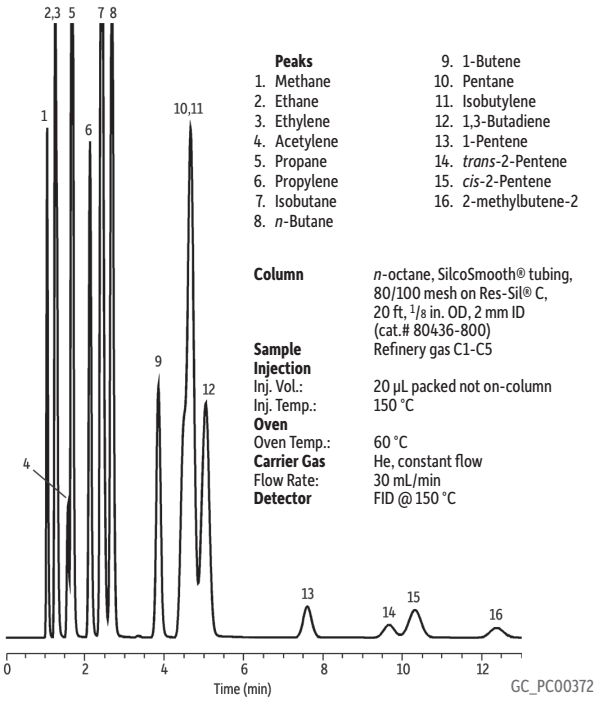
2abc Refinery Gas Column Set

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.

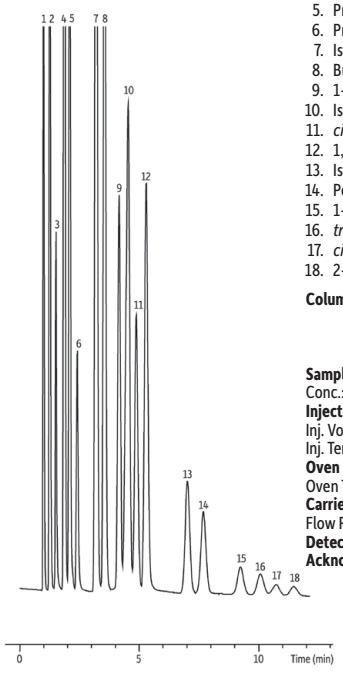
Figure 1: *n*-Octane on Res-Sil® C packing demonstrates unique selectivity for unsaturated light hydrocarbons.



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

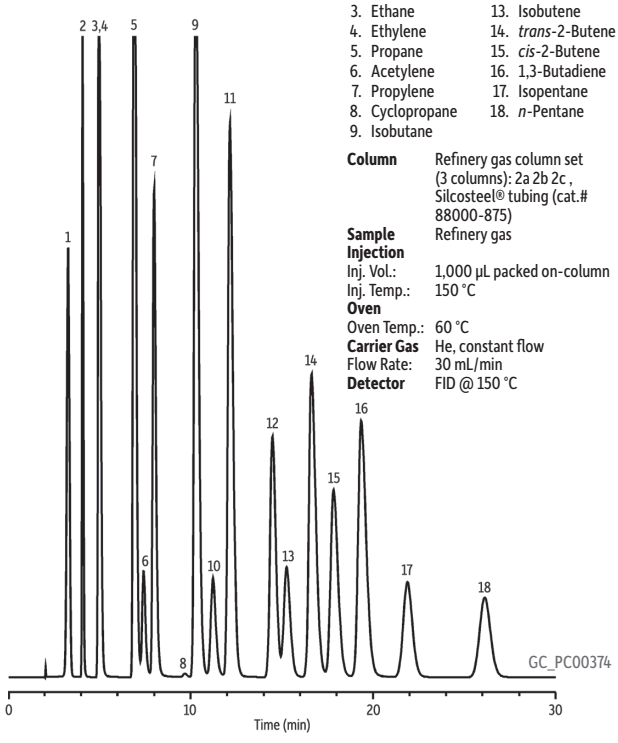
Figure 2: OPN on Res-Sil® C packing demonstrates unique selectivity for *cis*-2-butene and 1,3-butadiene.



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.

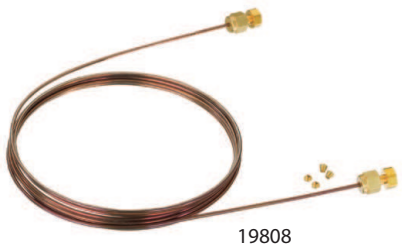
it's a fact

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

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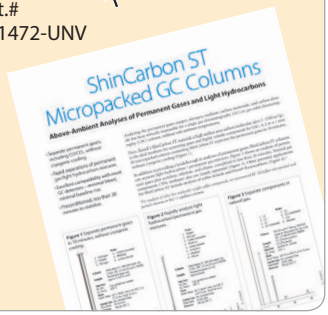
lit. cat.#
PCTS1472-UNV



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)*

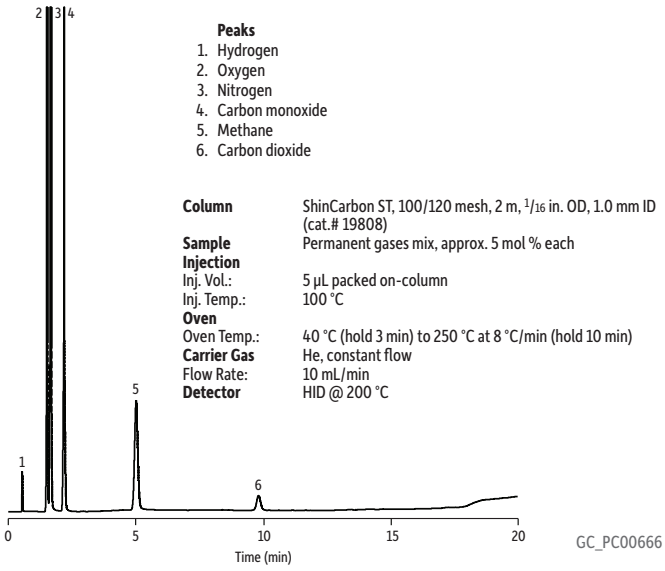
OD	ID	Mesh	2-Meter cat.#*
1/8" Silcosmooth	2.0 mm	80/100	80486-

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.

did you know?

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

also available

Adapter kits for installing packed/micropacked columns.

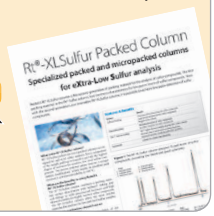
See **page 142.**

free literature

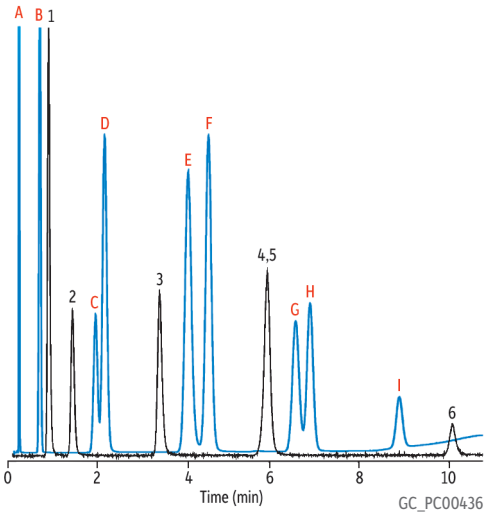
Rt®-XLSulfur Packed Column
Specialized packed and micropacked columns for eXtra-Low Sulfur analysis

Download your free copy from
www.restek.com

lit. cat.#
PCTS1500A-UNV



Sulfur Compounds and Hydrocarbons on Rt®-XLSulfur



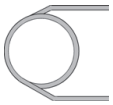
Sulfurs
1. Hydrogen sulfide
2. Carbonyl sulfide
3. Methyl mercaptan
4. Ethyl mercaptan
5. Dimethyl sulfide
6. Dimethyl disulfide

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.

Column Instrument Configurations

General Configuration
Suffix -800



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

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

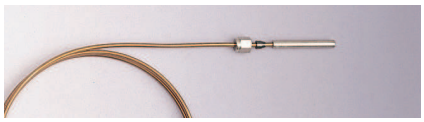
PE 900-3920, Sigma 1,2,3:
Suffix -830

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

21065

Installation Kits for Micropacked Columns

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

21067

Installation Kit for Packed Columns

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

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

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.

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.

22430

20772

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**

Packed Column Packing Materials

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**

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**

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.

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:

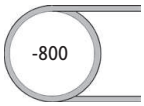
Complete this form and fax to Restek at 814-353-1309, or to your Restek representative.

This form is also available online at:

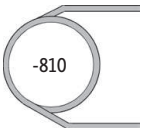
www.restek.com/**packed**

Standard Configurations (choose one)

General Configuration

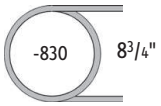


Agilent 5880, 5890, 5987, 6890, 7890

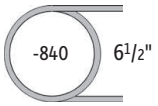


Bruker 430, 450 (Varian 3700, Vista Series, FID)

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

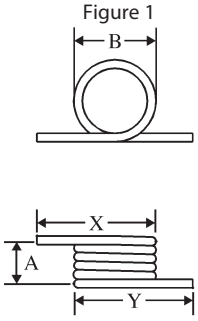


Figure 2

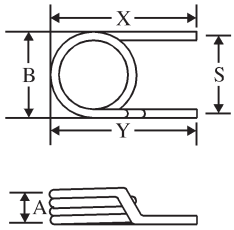


Figure 3

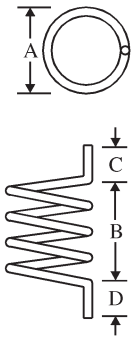


Figure 4

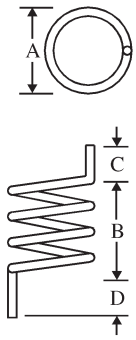


Figure 5

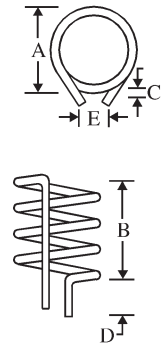


Figure 6

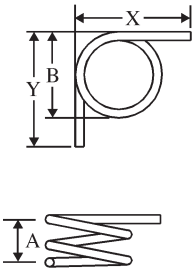


Figure 7

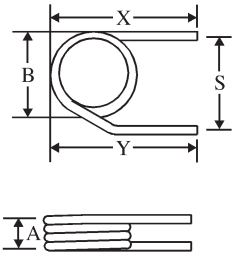


Figure 8

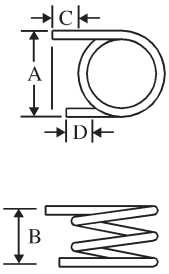


Figure 9

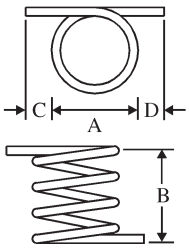


Figure 10

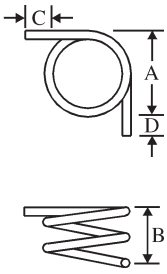


Figure 11

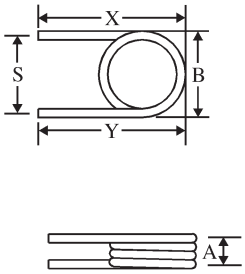


Figure 12

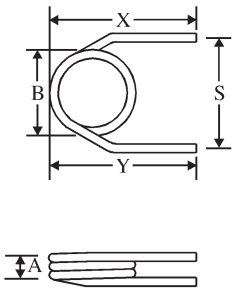


Figure 13

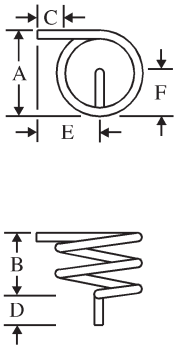


Figure 14

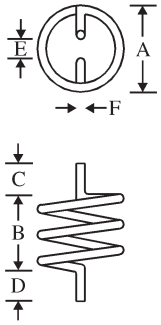


Figure 15