

# Sulfinert®-Treated Sample Cylinders

## Increase Storage Time for Active Sulfur Compounds

**Table I** Minimum bend radius for Sulfinert®-treated tubing.

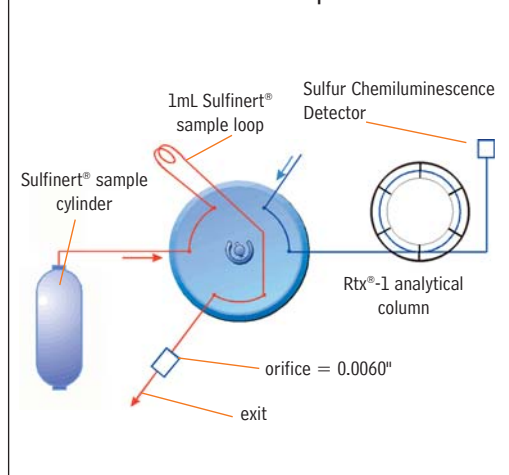
Tubing OD	Minimum Bend Radius
≤ 1/16"	1" (2.5cm)
1/8"	2" (5.1cm)
1/4"	4" (10.2cm)

**Table II** Sulfur compounds used to test the inertness of a Sulfinert®-treated system.

Compound	Formula	Concentration (ppbv)	Retention Time (min)
hydrogen sulfide	H <sub>2</sub> S	1000	17
carbonyl sulfide	COS	1000	17
methyl mercaptan	CH <sub>3</sub> SH	1000	17
ethyl mercaptan	CH <sub>3</sub> CH <sub>2</sub> SH	1000	17
dimethyl sulfide*	CH <sub>3</sub> SCH <sub>3</sub>	1000	17
dimethyl disulfide	CH <sub>3</sub> SSCH <sub>3</sub>	1000	17

\* internal standard

**Figure 1** Analytical system for detecting losses of active sulfur compounds.



Stainless steel sample cylinders commonly are used in the collection and analysis of refinery and natural gas samples. These samples often contain trace amounts of sulfur-containing compounds (e.g., hydrogen sulfide, mercaptans, and sulfides), which can interfere with reactions or poison catalysts in many petrochemical processes. Because sulfur compounds quickly react with stainless steel surfaces, accurate determination of these compounds is impossible when using untreated sample cylinders.

Restek's Sulfinert® passivation technique bonds an inert silica layer into the surface of the stainless steel. This layer acts as a barrier, preventing active compounds from reacting with or adsorbing to the stainless steel. Therefore, Sulfinert® products are ideal for storing and transferring reactive sulfur compounds. Most stainless steel products can be treated with Sulfinert® passivation, including tubing. Because the Sulfinert® layer is incorporated into the structure of the stainless steel, treated surfaces can be bent or flexed without affecting the inertness characteristics (Table I).

We developed a gas chromatographic analytical method to demonstrate the effects of using Sulfinert® transfer lines, sample loops, and sample cylinders for sampling, storing, and analyzing low-level reactive sulfur compounds. To characterize Sulfinert® surfaces, we tested the stability of sulfur compounds in three Sulfinert® sample cylinders over a 54-hour period. Table II lists the test compounds and their concentrations.

### Analytical System

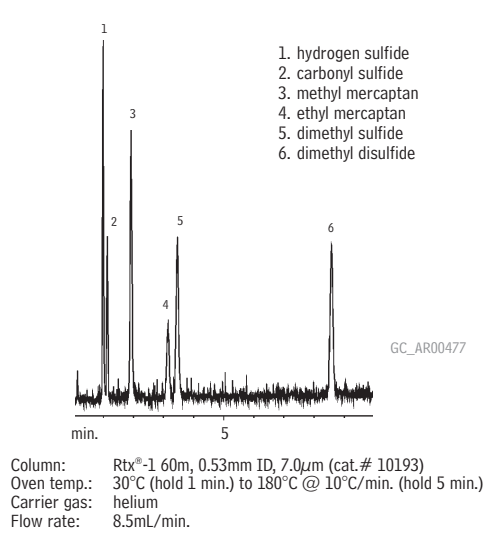
The analytical system was designed so that a 17ppbv standard could be detected with sufficient sensitivity to quantify compound loss. Sample introduction was with a 1mL Sulfinert® sample loop, Sulfinert® Valco® valve, and 1/16-inch Sulfinert® transfer lines (Figure 1). The analytical column was connected directly to the Valco® valve.

In order to control transfer of the sample to the 1mL sample loop, an orifice was attached to the exit of the sample loop. This allowed a controlled flow in the range of 60-120mL/min. during sample transfer (flow was pressure-regulated from the sample cylinder). An Rtx®-1 column (60m x 0.53mm, 7µm) and a Sievers model 355 sulfur chemiluminescence detector (SCD) were used.

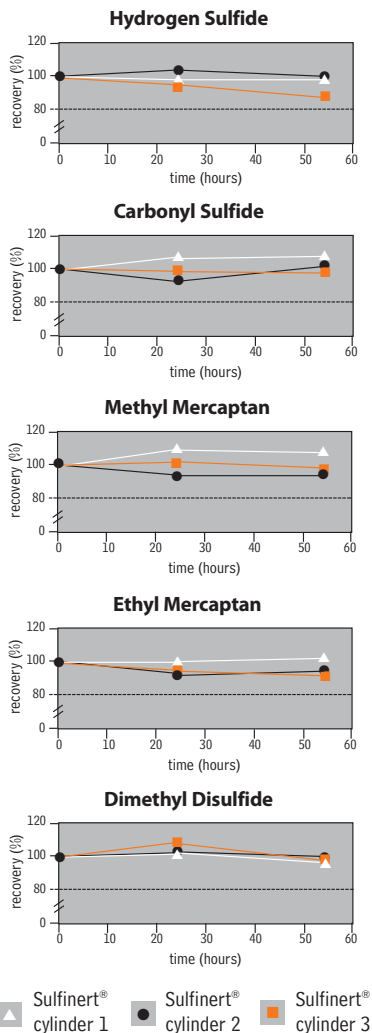
1mL of a 1000ppbv standard was added to a 500cc sample cylinder and pressurized to 160psig. The sample was prepared "dry" (no water added to the cylinder) to simulate a petrochemical process. Dimethyl sulfide, which has been shown to be non-reactive in this mixture and is not adsorbed by stainless steel, was used as an internal standard.

To introduce the sample onto the GC column, the sample loop was flushed with sample for 45 seconds, then the cylinder valve was closed and the sample loop was vented to atmospheric pressure. The Valco® valve was switched to introduce the sample from the loop to the analytical column, and the analysis was started. Figure 2 (page 2) shows the chromatogram.

**Figure 2** 17ppbv sulfur standards on an Rtx®-1 column with SCD detection.



**Figure 3** Stability of sulfur compounds is remarkable in Sulfinert®-treated cylinders.



## Results

As shown in Figure 3, Sulfinert®-treated cylinders and accessories were inert to reactive sulfur compounds over the 54-hour test period. Hydrogen sulfide exhibited greater than 85% recovery over the test period; methyl mercaptan, ethyl mercaptan, carbonyl sulfide, and dimethyl disulfide exhibited greater than 90% recovery.

## Conclusion

This investigation confirms the use of Sulfinert®-treated sample cylinders and transfer lines greatly increases the storage time for reactive sulfur compounds, ensuring more accurate analyses.

## Sulfinert®-Treated Swagelok® Sample Cylinders

- Stable storage of sulfur compounds at ppb levels.
- D.O.T. rated to 1800psi at room temperature.
- High quality cylinders manufactured by Swagelok®.

Sulfinert®-treated gas sampling equipment is ideal for collecting and storing samples containing ppb levels of sulfur compounds, such as natural gas or beverage-grade carbon dioxide. Sulfinert® treatment ensures that sulfur compounds or other highly active compounds remain stable during transport from the field to the laboratory. These cylinders are made from 304 grade stainless steel with 1/4" female NPT threads on both ends.

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

## Sulfinert®-Treated Alta-Robbins Sample Cylinder Valves

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

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

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

## Sulfinert®-Treated Rupture Disc Tee

2850 psig rating, 1/4" NPT connections.

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

## Cleaning Sample Cylinders

Optimum performance of Silcosteel® or Sulfinert® treated surfaces can be maintained by cleaning them with a variety of neutral solvents. An increase in surface activity, with the potential of physical damage to the coating, can occur if the surface is exposed to oxygenated steam. Therefore, we do not recommend exposing Silcosteel® or Sulfinert® treated surfaces to steam environments in the presence of air or oxygen. However, Sulfinert® or Silcosteel® surfaces have been successfully cleaned using nitrogen-enriched steam.

## Sulfinert®-Treated Gas Sampling Valves and Sample Loops

- Ideal for samples containing low concentrations of sulfur compounds.
- Sample loop sizes from 5µL to 5cc.

Use Sulfinert®-treated gas sampling valves for low-level sulfurs and other active compounds. Sulfinert® treatment eliminates active sites on the valve or in the loop, for better recovery of difficult-to-analyze compounds.

### Sulfinert®-Treated Gas Sampling Valves (1/16" fittings, 0.40mm port diameter; "W Type" valve)

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

### Replacement Rotors

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

### Sulfinert®-Treated Gas Sample Loops (1/16" fittings, for "W Type" valves)

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



## please note

For Sulfinert®-treated fittings, see our general catalog or our website.

### Coiled Siltek®/Sulfinert®-Treated† Welded 304 Grade Stainless Steel Tubing

ID	OD	cat.#	5-24 ft.	25-199 ft.	200-399 ft.	>400 ft.
0.011" (0.28mm)	0.022" (0.56mm)	22500				
0.021" (0.53mm)	0.029" (0.74mm)	22501				
0.010" (0.25mm)	1/16" (1.59mm)	22502				
0.020" (0.51mm)	1/16" (1.59mm)	22503				
0.030" (0.76mm)	1/16" (1.59mm)	22504				
0.040" (1.02mm)	1/16" (1.59mm)	22505				
0.085" (2.16mm)	1/8" (3.18mm)*	22506				
0.210" (5.33mm)	1/4" (6.35mm)*	22507				

\*0.020" wall thickness

For prices please refer to our catalog or website

## for more info

Call for availability of lengths greater than 1000ft.

### Metric conversion:

6ft.	1.8m
25ft.	7.6m
50ft.	15.2m
200ft.	61m
>400ft.	>122m

### Coiled Siltek®/Sulfinert®-Treated† Seamless 316 Grade Stainless Steel Tubing

ID	OD	cat.#	5-24 ft.	25-199 ft.	200-399 ft.	>400 ft.
0.055" (1.40mm)	1/8" (3.18mm)	22508				
0.180" (4.57mm)	1/4" (6.35mm)	22509				

\*\*0.035" wall thickness

For prices please refer to our catalog or website

### Minimum Bend Radius

OD	Min. Bend Radius
≤1/16"	1" (2.5cm)
1/8"	2" (5.1cm)
1/4"	4" (10.2cm)

## tech tip

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

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



## Got tape?

Restek offers three types of Teflon® thread-sealing tape. For information, please visit our website:

[www.restekcoatings.com](http://www.restekcoatings.com)

### Rtx®-1 Columns (fused silica)

(Crossbond® 100% dimethyl polysiloxane)

ID	df (μm)	temp. limits	15-Meter	30-Meter	60-Meter
0.53mm	3.00	-60 to 270/290°C	10182	10185	10188
	5.00	-60 to 270/290°C	10177	10179	10183
	7.00	-60 to 240/260°C	10191	10192	10193

The maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

### MXT®-1 Columns (Silcosteel®-treated stainless steel)

(Crossbond® 100% dimethyl polysiloxane)

ID	df (μm)	temp. limits	15-Meter	30-Meter	60-Meter	105-Meter
0.53mm	3.00	-60 to 285°C	70182	70185	70188	70189
	5.00	-60 to 270°C	70177	70179	70183	
	7.00	-60 to 250°C	70191	70192	70193	

The maximum temperatures listed are for 15- and 30-meter lengths. Longer lengths may have a slightly reduced maximum temperature.

### Rt-Sulfur™ Packed/Micropacked Columns for Sulfur Analysis

- Excellent reproducibility for low-level sulfur analysis.
- Eliminate the need for Teflon® tubing.

### Rt-XLSulfur™ Packed Columns

- The best packed columns available for low ppmv sulfur analyses.

OD	ID (mm)	1-Meter*	2-Meter*
1/8"	2.0mm	80484-	80485-
3/16"***	3.2mm	80482-	80483-

\*Please add configuration suffix number to cat.# when ordering - see chart below.

\*\*For installation kits for 3/16" columns, see our catalog or website.

### Rt-Sulfur™ Micropacked Columns

OD	ID	1-Meter	2-Meter
1/16"	1.0mm	19801	19800
0.95mm	0.75mm	19803	19802

Purchase installation kit separately; see our catalog, or website.

## fact

MXT® columns—rugged, flexible, Silcosteel®-treated stainless steel tubing; inertness comparable to fused silica tubing.

## did you know?

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

## for more info

about Siltek® / Sulfinert® treatment, request information packet 59616.

## also available

For adapter kits for installing packed or micropacked columns, see our general catalog, or website.


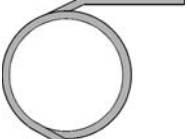
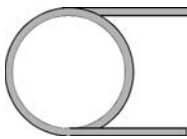


### Restek Trademarks:

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### Other Trademarks:

Valco, Kel-F, Swagelok

### Column Configurations

	General Configuration <b>Suffix -800</b>		Agilent 5880, 5890, 5987, 6890: <b>Suffix -810</b>		Varian 3700, Vista Series, FID: <b>Suffix -820</b>
	PE 900-3920 Sigma 1,2,3: <b>Suffix -830</b>		PE Auto System 8300, 8400, 8700 (Not On-Column): <b>Suffix -840</b>	<b>Note:</b> Initial 2" of column will be empty, to accommodate a needle. For a completely filled column add suffix -901.	



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