



# Extend Process Component Lifetime and Enhance Durability

Restek surface treatments improve sampling and transfer component performance

- **Economical**—Lower cost than specialty alloys, more durable than traditional stainless steels.
- **Versatile**—Suitable in a variety of environments and temperature ranges.
- **Simple**—Can be applied to existing equipment; stock tubing and fittings available.

When corrosion and surface activity are a concern, solutions must be engineered using special alloys or surface treatments. The Restek Performance Coatings group offers a family of surface treatments that address reactivity and corrosion concerns over a wide spectrum of applications. Table 1 lists applications in which Siltek®/Sulfinert® treatment of sample pathway components prevents adsorption of active compounds, thereby contributing toward reliable and accurate information, or in which Silcosteel®-CR treatment greatly reduces corrosion.

sample to the analytical instrument. Always use deactivated tubing for applications involving active compounds. For special requirements, ensure maximum inertness and minimal surface area by applying the deactivating treatment to electropolished tubing. Figure 1 shows the detector signal curves for 500ppbv of methyl mercaptan, an active sulfur compound, in a gas stream passing through a variety of tubing substrates.<sup>1</sup> Siltek®/Sulfinert® treated tubing reduces uptake by orders of magnitude, relative to untreated tubing.

**Restek surface treatments are:**

**Silcosteel®**—A general-purpose passivation layer for steel and stainless steel. U.S. patent 6,511,760.

**Silcosteel®-AC**—Dramatically reduces carbon buildup on stainless steel components. U.S. patent 6,444,326.

**Silcosteel®-CR**—A corrosion resistant layer that increases the lifetime of system components in acidic environments containing hydrochloric acid, nitric acid, or seawater US patent 7,070,833.

**Silcosteel®-UHV**—Greatly reduces out-gassing from components of ultra-high vacuum systems. US patent 7,070,833.

**Siltek®**—The ultimate passivation for treated components, from glass to high nickel alloys of steel. U.S. patent 6,444,326.

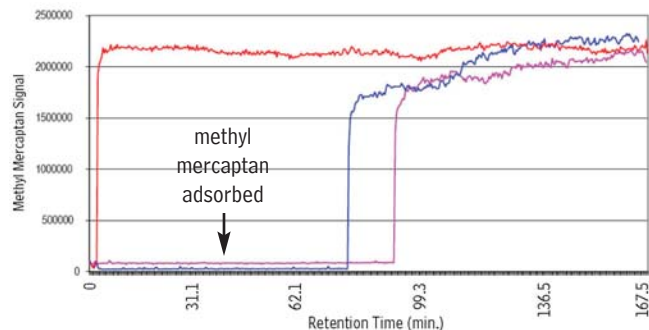
**Sulfinert®**—A required treatment for metal components when analyzing for parts-per-billion levels of organo-sulfur compounds. U.S. patent 6,444,326.

This outline of system components and considerations will help in evaluating the usefulness of surface treatments for analytical and process reliability.

**Tubing used for sampling**

Adsorption problems in sample pathways often can be traced to the tubing used to transfer the

**Figure 1** Sulfinert® treated electropolished seamless stainless steel tubing (red) does not adsorb methyl mercaptan (500ppbv). Blue-untreated electropolished tubing; violet-raw tubing.



**Table 1** Applications in which Restek treated sample pathway components minimize corrosion\*\* or prevent adsorption of active compounds\*.

**Sulfur compounds in:\***

- automotive exhaust
- beverage grade CO<sub>2</sub>
- diesel fuels
- environmental samples
- ethylene
- gasoline
- liquefied petroleum gas
- natural gas (odorants)
- propylene
- stack gas emissions
- wines and beers

**Nitric oxide (NOx) compounds in:\***

- automotive exhaust
- stack gas emissions

**Mercury compounds in:\***

- crude oil
- environmental samples
- exhaust
- stack gas emissions from coal fired electric power plants

**Corrosive environments:\*\***

- hydrochloric acid
- hydrogen peroxide
- seawater

**Moisture hold-up in high purity sampling lines\*\***

- sample systems
- gas delivery systems
- process systems

\*Siltek®/Sulfinert® treatment.  
\*\*Silcosteel®-CR treatment.



**Restek Performance Coatings**

<sup>†</sup>Note that with any corrosive stream, regular inspections are needed to confirm there are no leaks or breakthroughs.

## Tubing used in corrosive environments

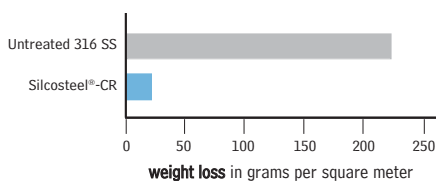
In corrosive environments, Silcosteel®-CR treated tubing is an excellent alternative to expensive alloys. Silcosteel®-CR treatment extends the lifetime of the tubing, reducing the frequency of preventive maintenance and helping to ensure the purity of the process or sample stream. Silcosteel®-CR improves corrosion resistance by up to 10X over untreated 316L stainless steel, per ASTM Method G48, Method B (Figure 2).

**Figure 2** Silcosteel®-CR treated 316L stainless steel coupons show no crevice corrosion and only slight pitting corrosion after 72-hour exposure to ferric chloride; untreated coupons exhibit severe crevice corrosion (per ASTM Method G48, Method B).

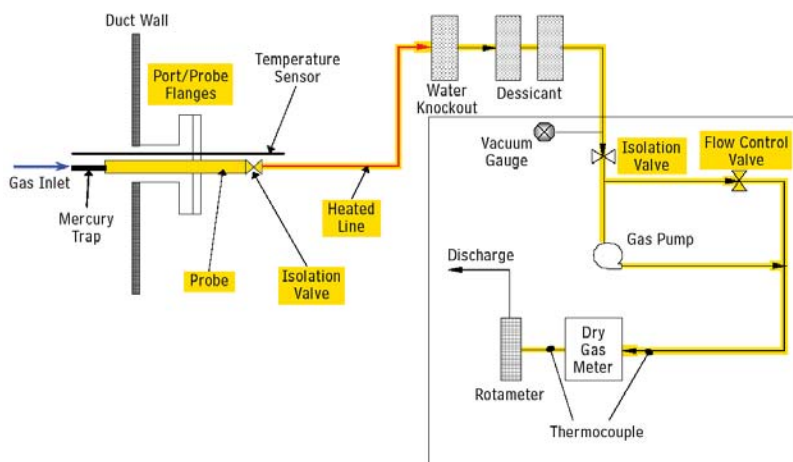


Silcosteel®-CR treated

untreated



**Figure 4** Highlighted components of a mercury sampling train,<sup>2</sup> and all tubing in the system, can be Siltek®/Sulfinert® treated.



## 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.

Figure 3 shows the results of a 4000-hour salt spray test on Silcosteel®-CR treated 316L stainless steel and untreated 316L stainless steel. The Silcosteel®-CR treated material exhibited virtually no change.

**Figure 3** Silcosteel®-CR treated 316L stainless steel coupons show no sign of attack after 4000-hour salt spray exposure, per ASTM B117.



Silcosteel®-CR treated

untreated

## Fittings

Connections can be a source of adsorption and sample loss, and there is benefit to using Restek surface treatment on many of these components. For example, in corrosive environments, Silcosteel®-CR treatment will extend the useful life of system fittings, as it will for tubing.

**We offer extensive lines of treated Swagelok® and Parker fittings, in sizes from 1/16" to 3/8".**

## Valves

The sample flow path through a valve can be tortuous, prolonging contact between the sample stream and the valve components. Restek surface treatments have been applied to many valve geometries, to eliminate adsorption to bodies, stems, diaphragms, or other components.

## Filters

Frits and other filtering devices trap particles and prevent them from entering the analytical instrument, but they also very effectively adsorb active components in sample streams. Their large surface areas can increase sample/system contact by orders of magnitude. Siltek®/Sulfinert® treatment of frits and filters creates an inert flowpath. Our chemical vapor deposition technology ensures the treatment penetrates even the smallest pores in sintered metal frits.

## Sample Vessel Equipment

When samples are taken from a process stream and are transported to the laboratory for evaluation, it is critical to use Restek treated sampling containers, to prevent active components from adsorbing to vessel, valve, or outage tube surfaces. We offer a complete line of high pressure sampling equipment for sampling applications involving liquefied petroleum gases, ethylene, natural gas, or propylene.

## Probes

Sampling probes are used in a variety of applications, including sampling natural gas or other process streams (Figure 4). An untreated probe contributes to the active surface area in the system, and this should be considered when identifying potential adsorption sites during active stream transfer.

## Heated Lines

A heated "trace line" consists of standard grade or electropolished tubing that has been insulated and bundled with heating devices to ensure the sample is transferred at a consistent temperature. Often, samples are transferred at temperatures greater than 150°C, to prevent condensation of moisture in the line. Such lines are used in many gas stacks and other remote sampling points at which a sample is transported through the outdoor environment. Active compounds in the sample quickly can be adsorbed onto the hot tubing. Restek surface treatment prevents adsorption of active compounds.

## Summary

Surface treatments from the Restek Performance Coatings group prevent corrosion or adsorption of active compounds in process systems, and always should be considered in applications in which corrosive or active streams are to be sampled, transferred, or analyzed.

**To determine if a Restek surface treatment can be applied to your system, contact our Technical Service department at 800-356-1688, ext. 4, or visit us at [www.restekcoatings.com/OTC](http://www.restekcoatings.com/OTC).**

## for more info

For more information about Restek performance coatings, request lit. cat. # 59493, or visit us at [www.restekcoatings.com/OTC](http://www.restekcoatings.com/OTC)

## References

- <sup>1</sup>Relative Response Time of True Tube™ when Measuring Moisture Content in a Sample Stream Test Report, Haritec Scientific & Engineering Support, Calgary, Alberta, Canada, May 2004. Reference courtesy of O'Brien Canada. Reference available on request from Restek.
- <sup>2</sup>Proposed Method 324. Determination of Vapor Phase Flue Gas Mercury Emissions from Stationary Sources Using Dry Sorbent Trap Sampling. United States Environmental Protection Agency. Washington, D.C. p. 5.

## Siltek®/Sulfinert® Treated and Silcosteel®-CR Treated Swagelok® Fittings

- Full line of treated 1/16", 1/8", 1/4", and 3/8" fittings.
- Siltek®/Sulfinert® treatment ensures ultimate inertness.
- Silcosteel®-CR treatment enhances corrosion resistance by 10X, or more.
- Custom treatment available for any Swagelok® fitting, or other system parts.

Fitting Type	Size	Siltek®/Sulfinert® Treated		Silcosteel®-CR Treated	
		cat.#	cat.#	cat.#	cat.#
 Union	1/16"	22540	22575		
	1/8"	22541	22576		
	1/4"	22542	22577		
	3/8"	22909	22904		
 Tee	1/16"	22543	22578		
	1/8"	22544	22579		
	1/4"	22545	22580		
	3/8"	22910	22905		
 Reducing Union	1/8" to 1/16"	22546	22581		
	1/4" to 1/16"	22547	22582		
	1/4" to 1/8"	22548	22583		
	3/8" to 1/4"	22911	22906		
 Elbow	1/8"	22549	22584		
	1/4"	22550	22585		
 Plug	1/16"	22572	22619		
	1/8"	22573	22620		
	1/4"	22574	22597		
 Cross	1/8"	22551	22586		
	1/4"	22552	22587		
 Tube End Reducer	1/8" tube to 1/16"	22553	22588		
	1/4" tube to 1/16"	22554	22589		
	1/8" tube to 1/4"	22555	22590		
	1/4" tube to 1/8"	22556	22591		
 Port Connector	1/8"	22557	22592		
	1/4"	22558	22593		
	1/8" tube to 1/4"	22559	22594		
 Male Connector	1/8" to 1/8" NPT	22561	22595		
	1/4" to 1/4" NPT	22562	22596		
	1/16" to 1/8" NPT	22563	22610		
	1/8" to 1/4" NPT	22564	22611		
	1/4" to 1/8" NPT	22565	22612		
	3/8" to 3/8" NPT	22912	22907		
 Female Connector	1/8" to 1/8" NPT	22566	22613		
	1/4" to 1/4" NPT	22567	22614		
	1/4" to 1/8" NPT	22568	22615		
	1/8" to 1/4" NPT	22569	22616		
 Bulkhead Union	1/8"	22570	22617		
	1/4"	22571	22618		

## Sulfinert® Treated Sample Cylinders



- Stable storage of samples containing ppb levels of sulfur compounds.
- D.O.T. rated to 1800psi at room temperature.

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

## Sulfinert® Treated Alta-Robbins Sample Cylinder Valves



- All wetted parts 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)

## Siltek® Treated Filters



Siltek® 2µm frit filter

Siltek® 7µm in-line filter

Description	qty.	cat.#
Siltek® 2µm Frit Filter	3-pk.	24171
Siltek® 7µm In-Line Filter	ea.	24265

## Siltek®/Sulfinert® Treated & Silcosteel®-Treated Parker Plug & Ball Valves



Fitting Type	Size	Siltek®/Sulfinert®		Silcosteel®	
		cat.#	cat.#	cat.#	cat.#
Plug Valve	1/8"	21586	21576		
	1/4"	21587	21577		
Ball Valve	1/8"	21588	21578		
	1/4"	21589	21579		



**Restek Performance Coatings**

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

## simply the best

Siltek®/Sulfinert®- and Silcosteel®-treated electropolished tubing is the best tubing choice when purity, inertness, or reproducibility are concerns.



Top: electropolished finish, surface roughness average number: 5-10. Bottom: conventional finish, surface roughness average number: 23-27.



Restek offers handy **tapes, tools, and accessories** to make installing and maintaining your tubing system easier. Request lit. cat.# or visit us online.



### Restek Performance Coatings

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

Lit. Cat.# 580103

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Other trademarks: Kel-F (3M Co.); Swagelok (Swagelok Co.); TrueTube (O'Brien Corp.).

## Treated Electropolished Tubing

- Exceptional inertness.
- Improved reliability and reproducibility; longer lifetime.
- Use with treated fittings for the most inert sample pathway available.



### Siltek®/Sulfinert® Treated Coiled Electropolished 316L Grade Stainless Steel Tubing

ID	OD	cat.#	5-24 ft.	25-99 ft.	100-299 ft.	> 300 ft.
0.085" (2.16mm)	1/8" (3.18mm)	22538				
0.180" (4.57mm)	3/4" (6.35mm)	22539				

### Silcosteel®-CR Treated Coiled Electropolished 316L Grade Stainless Steel Tubing

ID	OD	cat.#	5-24 ft.	25-99 ft.	100-299 ft.	> 300 ft.
0.085" (2.16mm)	1/8" (3.18mm)	22536				
0.180" (4.57mm)	3/4" (6.35mm)	22537				

## Treated Electropolished Tubing

### Siltek®/Sulfinert® Treated Coiled 316L 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				
0.277" (7.04mm)	3/8" (9.52mm)	22914				

### Silcosteel®-CR Treated Coiled 316L 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)	22896				
0.180" (4.57mm)	1/4" (6.35mm)	22897				
0.277" (7.04mm)	3/8" (9.52mm)	22915				

## Siltek®/Sulfinert® Treated Straight Seamless 316L Grade Stainless Steel Tubing

### 6 foot Length

ID	OD	qty.	cat.#
0.055" (1.40mm)	1/8" (3.18mm)	ea.	22901
0.180" (4.57mm)	1/4" (6.35mm)	ea.	22902
0.277" (7.04mm)	3/8" (9.52mm)	ea.	22903

## Silcosteel®-CR Treated Straight Seamless 316L Grade Stainless Steel Tubing

### 6 foot Length

ID	OD	qty.	cat.#
0.055" (1.40mm)	1/8" (3.18mm)	ea.	22898
0.180" (4.57mm)	1/4" (6.35mm)	ea.	22899
0.277" (7.04mm)	3/8" (9.52mm)	ea.	22900

## Siltek®/Sulfinert® Treated Straight Seamless 304 Grade Stainless Steel Tubing

- Ideal for adsorbent traps, thermal desorption tubes, transfer lines, and instrument interfaces.
- Easily cut to specific lengths using a standard tubing cutter.
- Available in individual 18"/457mm pieces or in economical 5-packs.

### 18" (457mm) Length

ID	OD	qty.	cat.#
0.085" (2.16mm)	1/8" (3.18mm)*	ea.	20575
0.085" (2.16mm)	1/8" (3.18mm)*	5-pk.	20576
0.210" (5.33mm)	1/4" (6.35mm)*	ea.	20577
0.210" (5.33mm)	1/4" (6.35mm)*	5-pk.	20578