



Restek Performance Coatings

General Information

Restek Surface Treatments

Restek passivation and surface protection layers are deposited using a chemical vapor deposition (CVD) process in which the item to be treated is heated under vacuum in a large oven. Our current capacity enables us to treat items up to 6 feet long, or continuous lengths of coiled tubing exceeding 2000 feet (600 meters). Items that can be evacuated, such as gas chambers, can have a volume of up to 3.5 cubic feet.

When the item has been heated to the appropriate temperature, the reacting gases that form the protective surface are introduced, depositing a durable, amorphous layer that grows and overlays itself multiple times. The reaction layer penetrates into the lattice of the treated piece and binds solidly. Consequently, it is possible to work a piece, such as bending a length of treated tubing, without creating cracks, flakes, or other flaws in the layer. By controlling the variables in the process, we control the layer type and thickness. Layer thickness ranges from 0.03 μ m to 30 μ m, controlled to our specifications.

As strong as steel, as inert as glass.

Restek's surface treatments are:

<u>Silcosteel®</u>	A general-purpose passivation layer for steel and stainless steel. U.S. patent 6,511,760.
<u>Siltek®</u>	The ultimate passivation for treated components, from glass to high nickel alloys of steel. U.S. patent 6,444,326.
<u>Sulfinert®</u>	A required treatment for metal components when analyzing for parts-per-billion levels of organo-sulfur compounds. U.S. patent 6,444,326.
<u>Silcosteel®-AC</u>	Dramatically reduces carbon buildup on stainless steel components. U.S. patent 6,444,326.
<u>Silcosteel®-CR</u>	A corrosion resistant layer that increases the lifetime of system components in acidic environments containing hydrochloric acid, nitric acid, sulfuric acid, or seawater. Patent pending.
<u>Silcosteel®-UHV</u>	Greatly reduces outgassing from components of ultra-high vacuum systems. Patent pending.

Surface Passivation

The surface of a system component might be made inert to reduce adsorption or to eliminate the potential for catalyzing reactions. Traditionally, glass linings have been employed to reduce surface activity. Problems with preparing a glass-lined system include the need for careful handling and the difficulty of coating corners, weld seams, and bends, with consequent occurrence of coating flaws. Operating a system with glass-lined components introduces other difficulties, not the least of which is fragility.

Restek offers two treatments, Siltek® and Silcosteel®, that are ideal alternatives to glass linings for passivating many types of surfaces. A Siltek® or Silcosteel® layer provides complete surface isolation while maintaining all the ruggedness of the untreated component. These layers are applied over the entirety of the surface, using a chemical vapor deposition process that does not depend on line-of-sight; corners, bends, and seams are uniformly coated.

In most situations Siltek® treatment is the ideal choice for ultimate inertness. The Siltek® layer is applied at a thickness of up to 0.12µm. At this thickness even parts-per-billion levels of reactive materials will be stable during storage or transfer. A Silcosteel® layer provides equivalent protection for parts-per-million levels of reactive materials.

A selection of Silcosteel®- and Siltek®-treated tubing and fittings are available from stock. All coatings are applied to customer supplied items on a custom basis—see Custom Coating Services.



Compatibility with Restek Performance Coatings			
	Excellent	Good	Poor
Aldehydes	•		
Acetic Acid	•		
Acetone	•		
Alcohol	•		
Amines			•
Ammonium Hydroxide			•
Arsenic	•		
Aromatics	•		
Atmospheric/Humidity Corrosion	•		
Benzene			•
Brine		•	
Carbon Dioxide	•		
Carbon Disulfide	•		
Carbon Monoxide	•		
Dimethyl Disulfide	•		
Dimethyl Sulfide	•		
Ethyl Mercaptan	•		
Fatty Acids	•		
Ferric Chloride		•	
Formaldehyde	•		
Hydrocarbons	•		
Hydrochloric Acid		•	
Hydrofluoric Acid			•
Hydrogen Peroxide	•		
Hydrogen Sulfide	•		

Ketones			
Marine Environments	•		
Mercury	•		
Mercury Oxides	•		
Methyl Mercaptan	•		
Nitric Acid		•	
Phosphoric Acid		•	
Potassium Hydroxide			•
Salt Spray		•	
Sodium Hydroxide			•
Toluene	•		

Purity Control

In many purity-critical applications the potential for contamination created by contact of the process stream with sample transfer components such as tubing, fittings, and valves is a major concern. For example, the slightest contamination in gases used in manufacturing semiconductor devices can create high failure rates in end products.



Siltek®, Sulfinert®, or Silcosteel® treatment can eliminate interactions between process gases and transfer system components. Our extensive evaluations in the fields of passivation, corrosion resistance, and ultra-high vacuum show that these treatments eliminate outgassing of impurities into the sample stream and will not react with process stream components.

Eliminate system
component-process
stream interactions.



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Application Guide

If you have any questions about your application, contact us (800-356-1688 or 814-353-1300) or visit us online at www.restekcoatings.com

	Silcosteel®	Sulfinert®	Siltek®	Silcosteel®-AC	Silcosteel®-CR	Silcosteel®-UHV
Analytical equipment transfer tubing	x	x	x			
Automotive exhaust testing	x	x	x			
Beverage-grade CO ₂ testing		x	x			
Coking application (jet fuels, automotive fuels, petrochemical)				x		
Environmental sampling		x	x			
High-vacuum environments						x
Hydrochloric acid-containing streams					x	
Liquid propane gas	x	x	x			
Moisture control environments			x		x	x
Natural gas testing	x	x	x			
Nitric acid-containing streams					x	
NO _x monitoring	x	x	x			
Odorant testing		x	x			
Seawater environments					x	
Semi-conductor gas transfer			x		x	
SO _x monitoring	x	x	x			
Stack gas monitoring		x	x		x	
Sulfur dioxide		x	x			
Sulfuric acid containing streams					x	
Sulfurs in petroleum streams (levels above 1ppm)	x	x	x			
Sulfurs in petroleum streams (levels below 1ppm)		x	x			

For details on substrate preferences for treatment, request lit. cat.# 59929.

- www.restekcoatings.com



Restek Performance Coatings

Substrate Preferences

Construction Material

300 Series Stainless Steel: Extensive experience with 316L and 304 specifically.

400 Series Stainless Steel: Limited experience, good results.

Carbon Steel: Good results. It is important that we receive items after machining and packed in oil. This will prevent oxidation (rusting) of the carbon steel. Any oxidation of the surface causes the formation of a poor quality layer.

Hastelloy: Limited experience, good results.

Inconel, Monel: Limited experience, occasional poor results.

Titanium: Very limited experience, good results.

Platinum: Very limited experience, successful coating.

Gold/Silver: No experience, concern about outgassing in vacuum +400°C environment.

Aluminum: Limited success; appears to be a surface issue. Temperature of process, 400°C, is very high for aluminum: the aluminum will soften. Also, there is no way to remove the coating if re-work is required—the materials that can remove the coating also will dissolve aluminum.

Borosilicate Glass: Good results. One major issue is breakage rate: breakage can occur during processing/packaging/shipping/transit. Customer should be so advised.

Nickel: Not treatable.

Brass: Not treatable.

Copper: Not treatable.

Bronze: Not treatable.

Plastics: Not treatable.

Plated items: Gold, silver, chrome, or nickel-plated items are not treatable.

Surface Finish

Electropolished Surface: Ideal.

Polished Surface: Very good.

Bead Blasted: Very good if the blasting produces a smoothed surface.

Machined: Quality of coating proportional to surface roughness. If the roughness average is low, the coating will be good. If the surface is rough, the coating will not be as good.

Cast surface: Marginally acceptable. The surface produced by casting usually is rough and requires a thicker film to ensure coverage.

Painted/Coated Surface: Unacceptable. No paints and very few coatings can withstand the temperatures and vacuum in the coating processes.

Welded or Brazed Areas

Vacuum-Nickel Brazing: Ideal.

TIG/MIG Weld: Acceptable.

Silver Solder: Poor. Silver solder creates outgassing during coating and leaves a poor surface.

Bronze Solder: Not treatable.

Common Lead/Tin Solder: Not treatable. Temperatures used in the coating process will melt the solder.

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