Superior Moisture Dry-Down and Corrosion Resistance

Restek treated tubing and system components improve analytical reliability and prolong lifetimes.

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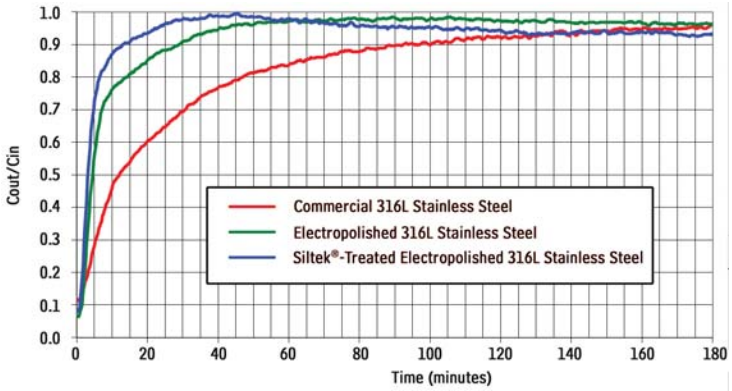
- Up to three times faster response to moisture changes in process streams.
- Corrosion resistance improved tenfold, or more—prolongs component lifetime and maintains pure product stream.
- Custom services: can be applied to existing equipment.

Introduction

Often, gas transfer systems require low moisture content, low moisture retention, and high resistance to corrosion. The current substrates of choice, including electropolished VIM/VAR (vacuum induction melt/vacuum arc melt) 316L stainless steel, typically are insufficient in these capacities, increasing periodic maintenance, prolonging equilibration times, and allowing system contamination and inaccurate analytical results. In contrast, surface treatments available through the Restek Performance Coatings Group greatly accelerate wet-up and dry-down times and dramatically improve corrosion resistance.

Experiments measuring the response time for moisture content change in Restek treated electropolished stainless steel tubing, untreated electropolished stainless steel tubing, and standard 316L stainless steel tubing, demonstrate a significant advantage in Restek treated substrates.[1] Wet-up curves for Siltek®

Figure 1 Restek treated electropolished tubing stabilizes at 1ppm moisture much faster than conventional surfaces.[1]



did **you** know?

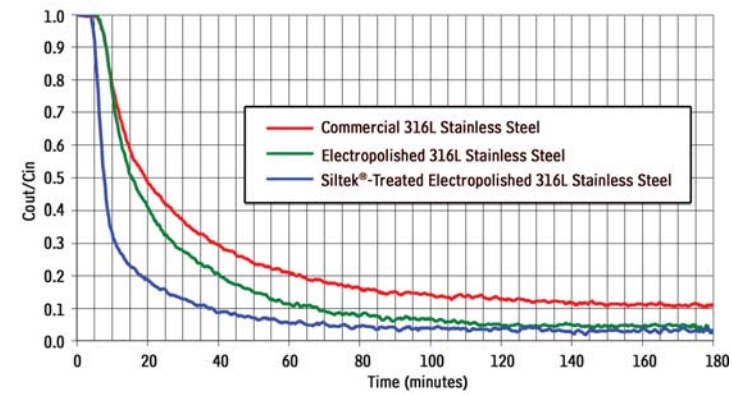
Restek surface treatments deposit an amorphous silicon based layer onto, and into, the steel surface through a chemical vapor deposition (CVD) process. All exposed surfaces are coated. For corrosion resistance, layer depth is optimized at 5 to 10 microns. The amorphous silicon layer can be further functionalized using the patented Siltek® process (US Patent #6,444,326), which reduces moisture hold-up and improves surface inertness.

Table I Restek treated electropolished tubing provides the shortest drying times.[1]

Moisture Concentration		Time Required to Detect Change (min.)		
From	To	Treated Electropolished Tubing	Untreated Electropolished Tubing	Standard Tubing
10ppm*	5ppm	4	5	13
5ppm	1ppm	22	46	71
1ppm	500ppb	40	63	96
500ppb	100ppb	80	103	153
100ppb	50ppb	98	121	—

*Initial moisture concentration.

Figure 2 Restek treated electropolished tubing dries much faster than conventional surfaces.[1]



treated electropolished, electropolished, and standard tubing are compared in Figure 1. Treated electropolished tubing reached the 98% saturation limit in 30 minutes, compared to 60 minutes for electropolished tubing. Standard tubing could only achieve a 96% uptake, after 180 minutes.

After the tubing was stabilized with 1ppm of moisture, dry-down properties were measured. Moisture dry-down curves for the three tubing treatments show treated electropolished tubing achieved dry-down in 35 minutes, electropolished tubing required 65 minutes, and standard tubing required 175 minutes (Figure 2). Table 1 compares time to various dry-down levels for tubing saturated with 10ppm of moisture.

Superior Corrosion Resistance: Silcosteel®-CR

In addition to rapid wet-up and dry-down, the other key advantage of Restek treatment for 316L stainless steel is a dramatic improvement in corrosion resistance. The amorphous silicon layer is insoluble in many acidic environments. Figures 3, 4, and 5 briefly summarize the results of corrosion testing by ASTM methods. Comparisons between treated and untreated test samples illustrate the improvements in corrosion resistance offered by Silcosteel®-CR treatment. For more information about corrosion resistance, request information packet 59048, or visit our website.

When moisture considerations and corrosion concerns arise in transfer of ultra-high purity gas streams, Restek treated tubing and system components will dramatically improve dry-down, reduce contamination from moisture carryover, and extend periodic maintenance cycles.

Reference

1. *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.

Tubing used in the wet-up / dry-down experiments was supplied by Cardinal UHP (St. Louis, MO). All tubing was tested as 100 foot coils of 1/4" OD x 0.020" wall 316L stainless steel. Electropolished tubing had a surface roughness of 10 to 15 microinches. Siltek® treated tubing was finished with 5µm of amorphous silicon, followed by a surface functionalization to increase inertness and hydrophobicity.

Reference courtesy of O'Brien Corporation, available on request from Restek.

Siltek®- and Silcosteel®-CR-Treated Electropolished Tubing

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

ID	OD	cat.#	5-24 ft.	25-99 ft.	100-299 ft.	>300 ft.
Siltek®-Treated Electropolished Tubing						
0.085"	1/8"	22538				
0.180"	1/4"	22539				
Silcosteel®-CR-Treated Electropolished Tubing						
0.085"	1/8"	22536				
0.180"	1/4"	22537				

Coiled, Treated, Seamless 316 Grade Stainless Steel Tubing

ID	OD	cat.#	5-24 ft.	25-199 ft.	200-399 ft.	>400 ft.
Silcosteel®-CR -Treated 316L Tubing**						
0.055" (1.40mm)	1/8" (3.18mm)	22896				
0.180" (4.57mm)	1/4" (6.35mm)	22897				
Siltek® Treated 316L Tubing**						
0.055" (1.40mm)	1/8" (3.18mm)	22508				
0.180" (4.57mm)	1/4" (6.35mm)	22509				

1/8" OD: 5 ft. to 100 ft. in one continuous coil; 1/4" OD: 5 ft. to 300 ft. in one continuous coil. Longer lengths will be more than one coil.
**0.035" wall thickness
Note: (required length in meters) x (3.2808) = length in feet.

Figure 3 In chloride environments, Silcosteel®-CR treated stainless steel outperforms untreated metal by an order of magnitude (ASTM G 48, Method B).

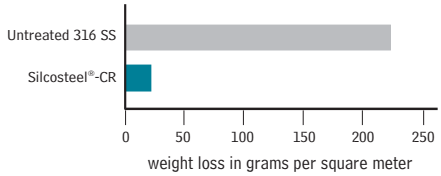
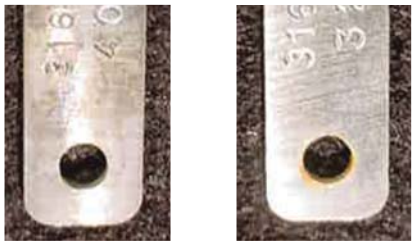


Figure 4 Silcosteel®-CR treated 316L stainless steel shows no sign of attack after 4000-hour salt spray exposure (ASTM B117).



Silcosteel®-CR treated | untreated

Figure 5 Silcosteel®-CR treated 316L stainless steel shows no crevice corrosion and only slight pitting corrosion after 72-hour exposure to ferric chloride; untreated steel exhibits severe crevice corrosion.

Silcosteel®-CR treated | untreated

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Learn more about our precisely applied, highly durable surface treatments:
www.restekcoatings.com