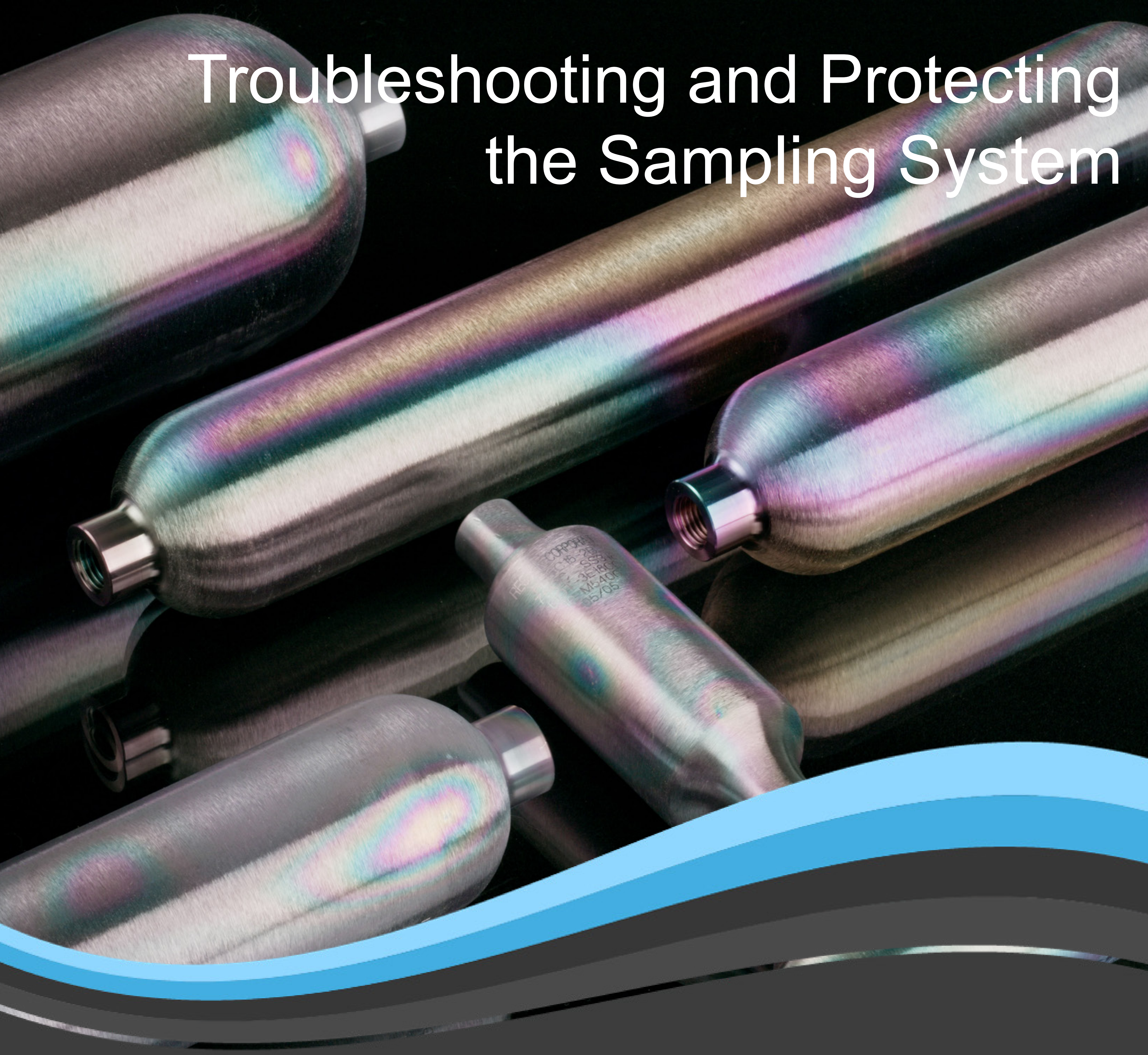
Troubleshooting and Protecting the Sampling System



Tips and Strategies for Solving Industrial Sampling Problems

SilcoTek®

E-book #4 of 4 in
The Ultimate Guide to Reliable Sampling with SilcoTek® Inert Coatings

Table of Contents

1. Introduction

SilcoTek® became a coatings company because we have a passion for helping people and businesses conquer their most difficult material challenges. We help our customers improve analytical results, improve yield and efficiency, and to develop innovations that push the scientific and industrial world forward.

Why Should I Read This E-book?

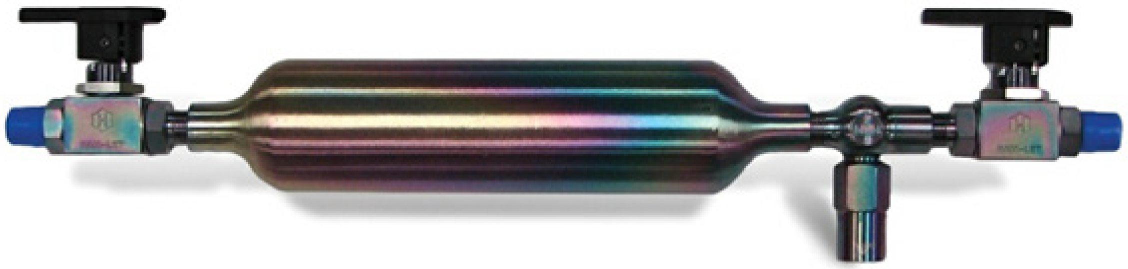
Because you'll learn how to prevent common sampling and analytical problems and learn ways to save time and money. You will learn how to:

• Improve sample system reliability
• Improve system response and process control
• Reduce troubleshooting
• Get the results you need the first time, every time

Our scientists and engineers are dedicated to teaching the customer how to improve the material performance of their products and processes. Read on and benefit from our over 250 years of analytical experience.

Paul Silvis, Head Coach

2. Tips for Solving Sample Cylinder Inertness Problems



Sample cylinders are a key link in many process control regimes. An inert sample cylinder, used to sample process fluids under approved conditions, can allow companies to accurately assess the quality of products and processes. If the sample cylinder is contaminated, mishandled, or poorly maintained, that key link can result in product quality problems, plant system failures, or environmental compliance issues. Is your inert-coated sample cylinder suddenly producing poor analytical results or not producing the sample quality you expect? Has the inert coating gone bad? Maybe not; it may be more about what goes into the sample cylinder and how it's maintained than a coating failure.

SilcoTek® inert coatings do not have a shelf life. Our coatings should deliver ultra-inert performance for years, but that's not to say that the sample cylinder, valves, or fittings may not have inertness issues. Here are some tips for troubleshooting poor sample cylinder performance and improving results.

Have other questions about inert coatings?

Go to our Frequently Asked Questions page.

Tip 1: Check for Corrosion

It's not uncommon for sample cylinders to be exposed to highly corrosive chemicals like H_2S, HF, hydrochloric, and sulfuric acid during analytical process sampling. Exposure to high concentration corrosives can "come with the territory" and can unfortunately compromise inert surfaces like SilcoNert®. Corrosives can attack the surface and potentially result in pinholes, pitting, or generate adsorptive rust particles. What appears to be a minor amount of surface pitting can have a big impact on analytical results, especially when sampling low concentrations of reactive compounds like H_2S.

Here are a few signs that the sample cylinder may have a corrosion problem.

- Loss of analyte. Test results or calibration test is showing lower than expected test results.
- Qualification sample not consistent.
- Particulates in sample stream.
- Liquid in what should be a dry gas sample stream. This could be condensation or acid build-up in the sample cylinder. Both can result in corrosion.
- "Off color" liquid flowing from the sample cylinder.

- Time. If the sample cylinder has been in service for a relatively long time (this can be weeks, months, or years depending on the process environment), the surface may be suffering from corrosion.
- Sample cylinder valves show signs of corrosion or are not operating smoothly. This can be the result of corrosion or other contaminants.

What to do if your sample cylinder shows signs of corrosion.

- Remove sample cylinder valves and visually inspect the sample cylinder with a borescope (magnification helps!).
- Look for pitting and rust, especially at the cylinder shoulder and threads
- If the sample cylinder is dirty, clean it with the least damaging method, i.e. mild high purity solvent or high purity nitrogen

Get our Surface Cleaning Recommendations.

A clean surface will make inspection easier, prevent analyte adsorption, and produce more reliable results.

OK, I've got corrosion. Now what?

If you find pitting or surface rust, you're now faced with a choice, keep the sample cylinder and try and remove the rust, or scrap it and buy a new cylinder. Your choice has a lot to do with the risk you face if cleaning the sample cylinder is not effective.

Attempting to remove the rust and reusing the sample cylinder will likely result in additional rust failures in the future. Analysts are risking future sample results by attempting to save the sample cylinder. But some analysts may feel the risk if acceptable. Be sure to follow your company guidelines for removing rust from stainless steel. Here are some general guidelines for removing rust.

How to Remove Rust from Stainless Steel.

Note that you may still risk the return of rust even after removal and re-coating the sample cylinder with a protective coating. Once rust starts, it can be difficult to stop, so the risk of contamination and adsorption can remain even after applying an inert coating to the surface. That's why we recommend using a new sample cylinder rather than attempting to clean and reuse a corroded sample cylinder.

Preventing Corrosion

You can prolong the life and performance of a sample cylinder by applying an inert, high durability corrosion resistant coating like Dursan® to flow path surfaces.

Dursan® is both inert and resistant to chloride, H_2S, and corrosion from most acids. (Unfortunately, hydrofluoric acid exposure will eventually erode silicon coatings and result in coating failure).

Dursan® is non-reactive and corrosion resistant, improving both test quality and corrosion resistance. The summary below demonstrates the superior corrosion resistance of Dursan to common process chemicals. Immersion in high concentration corrosives show a significant reduction in corrosion.

Comparative Corrosion Summary		
	Stainless Steel Corrosion Rate (mpy)	**Dursan-Coated Stainless Steel (mpy)**
6M Hydrochloric Acid, 24 hr exposure	160	1
25% Sulfuric Acid, 24 hr exposure	55	5
52 Week Salt Spray	<0.01	<0.01
Bleach	1.7	0.1

Tip 2: Check for Contamination

It's not unusual for active particulates to become trapped in sample cylinders. Particulates can adsorb sulfur samples and severely impact sample results.

Here are a few signs that indicate the sample cylinder may have a particulate problem:

- Loss of analyte, adsorption. Test results or calibration test is showing lower than expected test results.
- Qualification sample not consistent.
- Particulates in sample stream. Particulates found in filters.
- Sample cylinder valves are not operating smoothly or have particulate build-up.
- Reduced sample cylinder flow or clogging. Extreme particulate build-up!

What to do if your sample cylinder shows signs of particulate contamination.

Particulate removal can involve more than just blowing out the sample cylinder. Small particulates can stick to the surface by electromagnetic charges (van der wall forces) and may require flushing or washing the cylinder wall with a surfactant to remove particulates. Dursan coated surfaces when used with a surfactant can facilitate release of contaminants. *

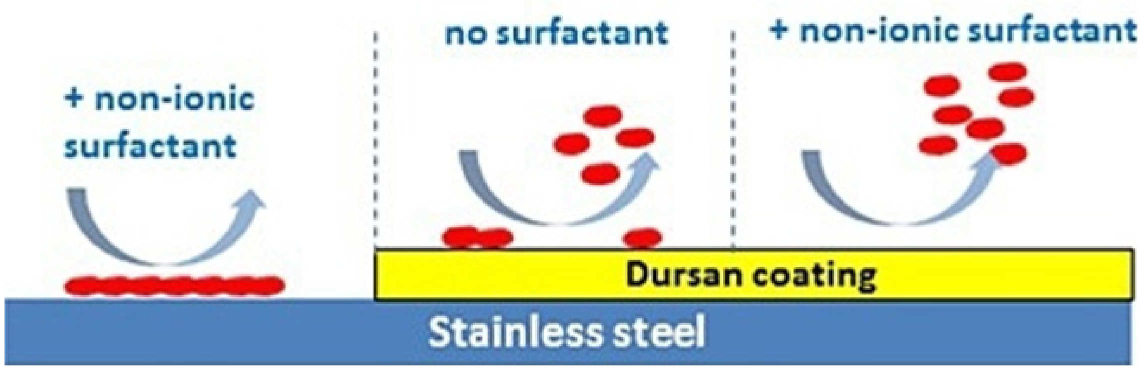


*Image courtesy of Abbott Laboratories: Reducing Adhesion of Proteins on Stainless Steel Components by the Application of a Carboxysilane Coating A. Narváez1 , S. Vaidya1 , D. Daghfal2 , M. Lawrence3 , M. Yuan3 , J. Mattzela3 , D. Smith3 1 Diluent Research & Formulation, Diagnostics R&D, Abbott Laboratories and 2 Abbott Diagnostics Division Technical Services, 100 Abbott Park Road, Abbott Park, IL 60064, USA; 3 SilcoTek Corporation, 225 PennTech Drive, Bellefonte, PA 16823

Inspecting the Sample Cylinder

• Remove valves and visually inspect the sample cylinder (confirm the sample cylinder is not pressurized before removing valves).
• Purge the sample cylinder with dry nitrogen.
• Avoid a high velocity, high pressure blow out. High velocity particulates can damage inert coatings and cylinder liners.
• If nitrogen flow does not remove particulates, flush the cylinder with a high purity mild solvent.

Preventing Particulate Contamination

Install a metal fritted filter in-line to prevent particulate accumulation in the sample cylinder or sample flow path. Replace the filter frequently to prevent exposure to adsorptive particles. Be sure to coat the frit with SilcoNert® or Dursan® before installation. An inert coating will prevent stainless steel adsorption and reactivity in high surface areas like metal filters.

Tip 3: Cleaning may be the Culprit

Regular cleaning of sample cylinders can remove particulates and keep the interior surface looking shiny and new, but cleaners (especially low purity solvents) can leave a reactive film on the surface that can affect surface reactivity.

Signs a sample cylinder may have a surface film problem.

• Loss of analyte, adsorption. Test results or calibration test is showing lower than expected test results.
• Film on interior of sample cylinder valve.
• Extremely dull appearance on interior surface of sample cylinder. Note that interior surfaces are rough, so the surface will inherently not be shiny.
• Film on sample cylinder swab.

What to do if your sample cylinder shows signs of surface film contamination.

• Remove the sample cylinder valves and inspect the interior surface.
• Determine the source of the surface film. If the film is a result of cleaning, find out what the cleaner is to determine the best solvent to remove the film.
• Once you determine the solvent film, source the highest grade of that solvent.
• Triple-rinse the sample cylinder and valves with the high purity solvent.
• If not a solvent-related film, rinse the surface with a solvent that will dissolve the contaminant. Use a nonpolar solvent to remove more active or reactive contaminants.
• Avoid cleaners that contain abrasives. Abrasives can damage the coating surface and roughen the base substrate's surface which can create hiding places for particulates and contaminants.

Tip 4: Avoid Steam Cleaning

Steam will not necessarily damage a SilcoTek-coated surface, but it can change the surface chemistry and render the coating less inert. Steam particles can adsorb compounds, causing unreliable results. Try mild sonication in water or an appropriate solvent or flushing the surface/flow path with a solvent or inert gas like nitrogen to remove particulates.

Here's a quick guide on how to keep SilcoTek coatings running like a top. Or, take a deep dive into how to maintain an inert surface and improve system performance.

Click here to watch our Coating Care Webinar.

Tip 5: Stainless Steel is Reactive!

• Sample cylinder free of corrosion. Check!

• No particulates. Check!

• Surface film? Nope!

• Steam clean? Never!

"What's going on? I still have adsorption. I'm still seeing analyte loss and my calibration sample is gone! What gives?"

Assuming you coated the sample cylinder with SilcoNert® or Dursan® inert coatings, the problem may be other exposed stainless steel surfaces. Did you coat the entirety of the valve's flow path? Maybe you missed coating the fritted filter? Or, was it that short length of uncoated transfer tubing? Even the smallest uncoated surface area can impact sample integrity, especially when testing trace amounts of a reactive compound like H_2S or mercaptans.

Comparative testing by American Mobile Research, Inc. demonstrates how quickly sulfur compounds can be adsorbed on stainless steel surfaces. American Mobile Research tested several sulfur compounds over a period of 72 hours. The results were startling, after 1 hour of exposure, 99 % of the H2S sample was lost! Compare that to a SilcoNert coated surface where after 72 hours nearly 100% of the sample remained intact.

Stainless Steel Surface

Compound	1hr(ppm)	% Loss	24 hr (ppm)	% Loss	72hr (ppm)	% Loss
HYDROGEN SULFIDE	0.03	99.7	< 0.010 PPM	100	< 0.010 PPM	100
CARBONYL SULFIDE	10.175	0.25	9.913	2.81	9.841	3.52
METHYL MERCAPTAN	1.55	84.65	< 0.010 PPM	100	< 0.010 PPM	100
ETHYL MERCAPTAN	2.593	75.07	< 0.010 PPM	100	< 0.010 PPM	100
2-PROPYL MERCAPTAN	2.425	77.75	< 0.010 PPM	100	< 0.010 PPM	100
DIMETHYL SULFIDE	10.2	0	9.907	2.87	9.64	5.49
DIMETHYL DISULFIDE	10.306	0.91	9.758	6.17	9.447	9.16

An uncoated stainless steel surface demonstrates rapid loss of H_2S and other sulfur compounds, leading to severely unreliable results and the need for re-testing.

SilcoNert® Coated Surface

Compound	1hr(ppm)	% Loss	24 hr (ppm)	% Loss	72hr (ppm)	% Loss
HYDROGEN SULFIDE	10.097	0.03	10.09	0.1	10.086	0.14
CARBONYL SULFIDE	10.198	0.02	10.196	0.04	10.192	0.08
METHYL MERCAPTAN	10.088	0.12	10.079	0.21	10.076	0.24
ETHYL MERCAPTAN	10.391	0.09	10.298	0.98	10.275	1.2
2-PROPYL MERCAPTAN	10.885	0.14	10.878	0.21	10.837	0.58
DIMETHYL SULFIDE	10.2	0	10.192	0.08	10.141	0.58
DIMETHYL DISULFIDE	10.399	0.01	10.39	0.1	10.368	0.31

SilcoNert®-coated stainless steel sampling equipment yields great recovery for all sulfur compounds in the test, ensuring reliable results run after run.

[Read the Entire Study from American Mobile Research, Inc.]

Once the sample cylinder assembly has checked out and a maintenance plan is in place, it’s time to move onto the rest of the sampling system.

3. Solving Sample Transfer Problems

Stack and flare emission monitoring can be a challenge. Changing sampling environmental conditions, exposure to corrosives, and high temperatures lead to frequent system failures and data quality problems. Often the failure can be traced to the sample transfer flow path. Here are tips on how to improve reliability and solve emission monitoring problems in stack and flare sample transfer systems.

Poor sample results?

If H_2S, mercury, ammonia, or sulfur sampling is not producing expected results, it could be because there are active or reactive surfaces in the sample system. If you're calibrating or sampling for part-per-million sensitivity, small details in system design can make a big difference in results.

Stainless steel, ceramic and glass surfaces can react with mercury, sulfur and ammonia, altering test quality. Results can range from unexpected high readings due to desorption of compounds, or unexpected low readings due to adsorption of the sample.

The first step in mitigating the effects of a reactive surface is to be sure the sample flow path is inert. Inspect and confirm all components in the flow path are coated with an inert surface like SilcoNert® or Dursan®. A single uncoated reactive component can distort sample results or cause complete loss of the sample at part-per-million levels.

Key flow path components that should have an inert coating include:

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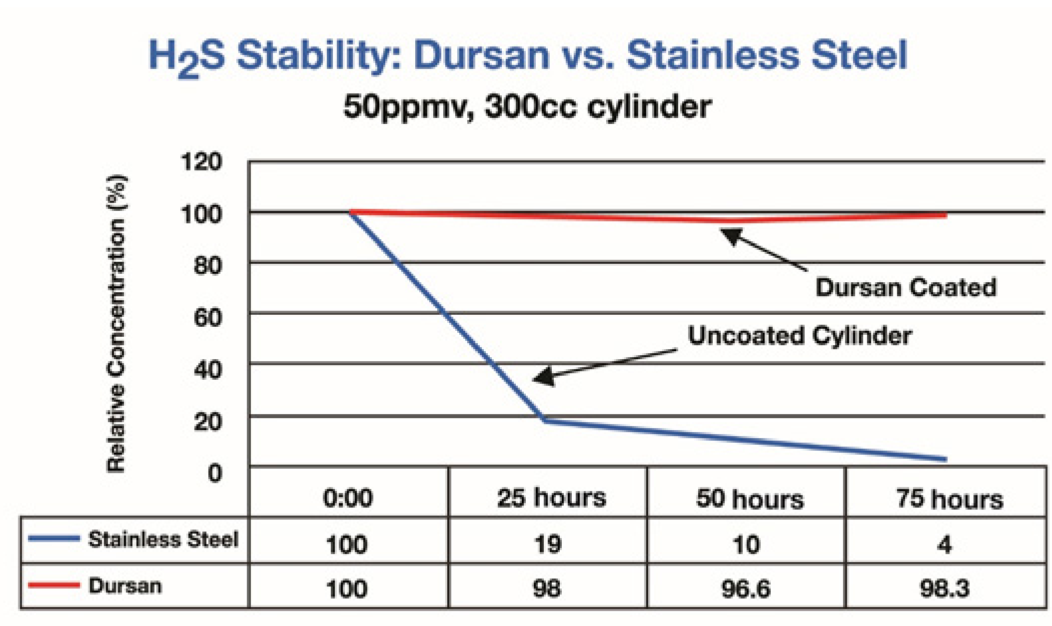
Key flow path components that should have an inert coating include:

Key Sample Flow Path Components		
Metal fritted filters	IR cell bodies	Gas bottle pig tails
Regulator body and components	Tubing, including heat trace tubing	Multiport valves
Fittings	Valves	Process GC components like liners
Sample loops	Calibration flow path	Mass flow controller bodies

The test comparison below demonstrates the rapid loss of a reactive sample when exposed to stainless steel. The uncoated 300cc sample cylinder quickly loses the H_2S sample while the Dursan coated sample cylinder does not adsorb the H2S sample over the duration of the test.

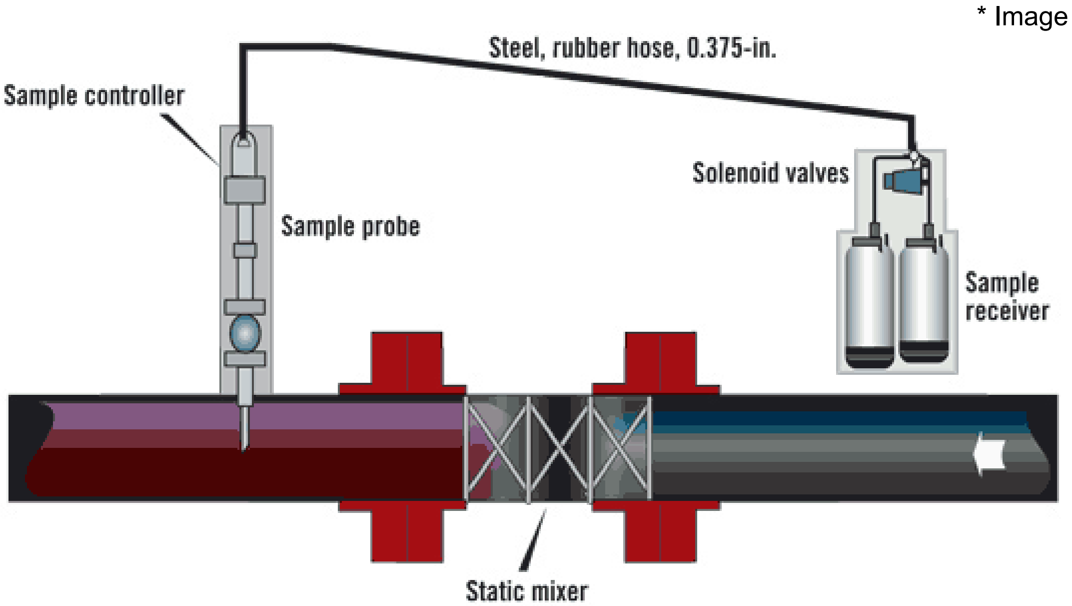


Check for Contamination

If all surfaces are coated, confirm the flow path is free of particulates, corrosion and moisture. Rust particles can quickly adsorb reactive substances. Moisture can solvate the analyte and distort test results and can facilitate system corrosion. Finally check the cleaning protocol. As noted in chapter 2, some solvents can leave a reactive film or damage the SilcoNert or Dursan surface. Steam cleaning can contaminate the system with particulates and also damage the surface under some conditions.

Check for Stack and Flare Probe Damage

* Image courtesy of Welker Inc.



Probes are exposed to high temperatures, corrosives and abrasion, making them a source of continuous maintenance and possibly sample loss due to adsorption. Coating the probe with an inert, high durability coating like Silcolloy® or Dursan® will improve high temperature oxidation resistance, abrasion resistance, and corrosion resistance. An inert, corrosion resistant coating can protect the probe and improve corrosion resistance by 10x or more. The example below shows the Dursan- and Silcolloy- coated surfaces resist sulfuric acid damage, while the uncoated stainless steel quickly corrodes. A coated probe will reduce maintenance and prevent sample adsorption, making a more reliable sample system.

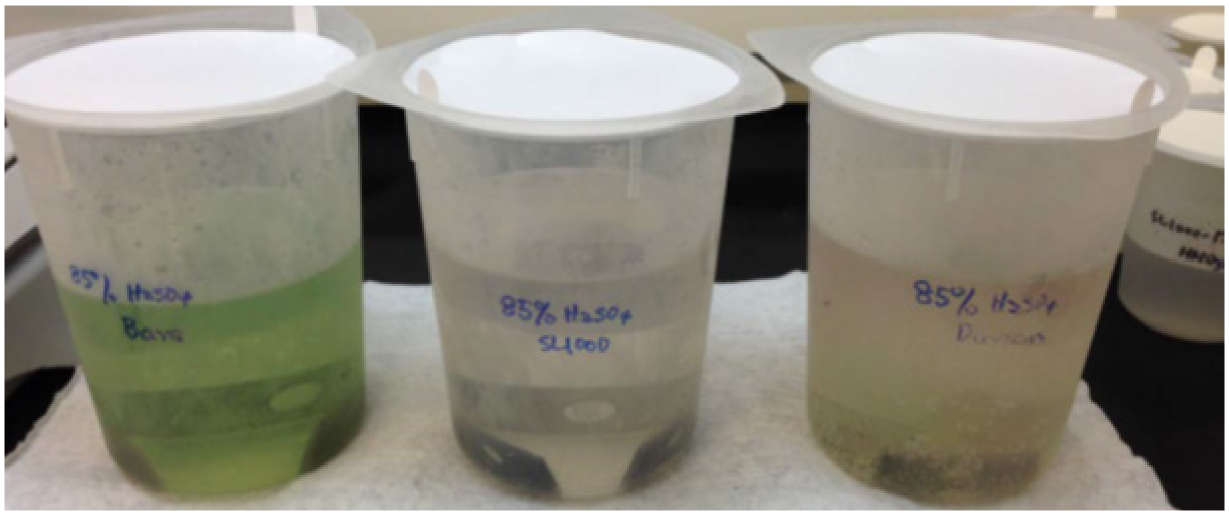
Extended exposure to 85% sulfuric acid shows that after 312 hours the Silcolloy coated coupon showed minimal corrosion while the uncoated surface is pitted.

Uncoated Coupon

Silcolloy-Coated

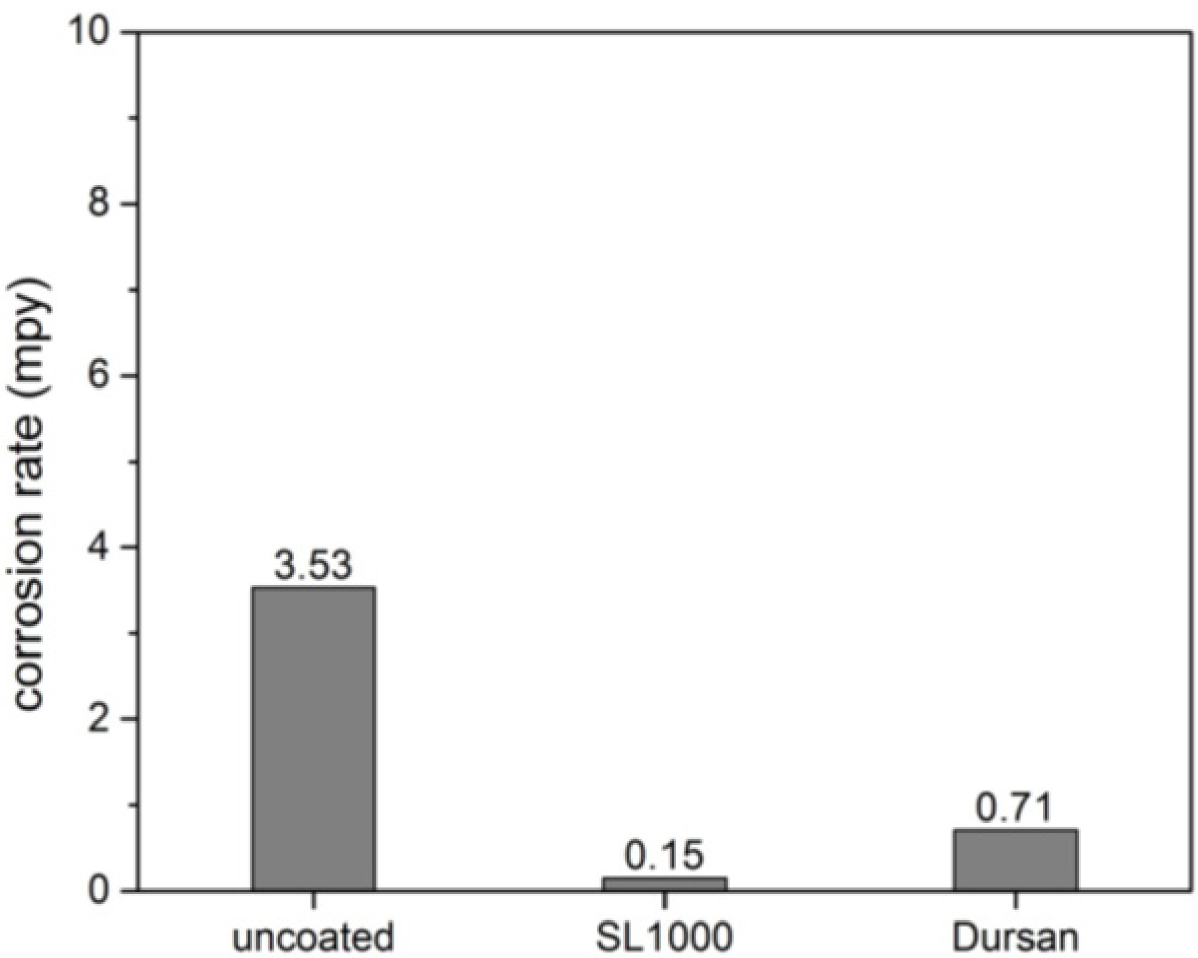
Dursan-Coated

Comparing the acid color after 312 hours of immersion is an easy-to-tell indicator of potential process contamination from metal leaching into the acid solution. The uncoated coupon acid solution (left) is green, showing severe metal contamination from the coupon. The Silcolloy acid solution (center) is clear, showing little contamination. The Dursan acid solution (right) shows some attack and contamination, but at a rate significantly less than the uncoated coupon.



Comparing the data (below), the uncoated coupon corrosion rate, 3.53 mills per year, is 20x greater than the Silcolloy-coated coupon. The Dursan coupon showed a slightly higher corrosion rate, but significantly less than the uncoated coupon.

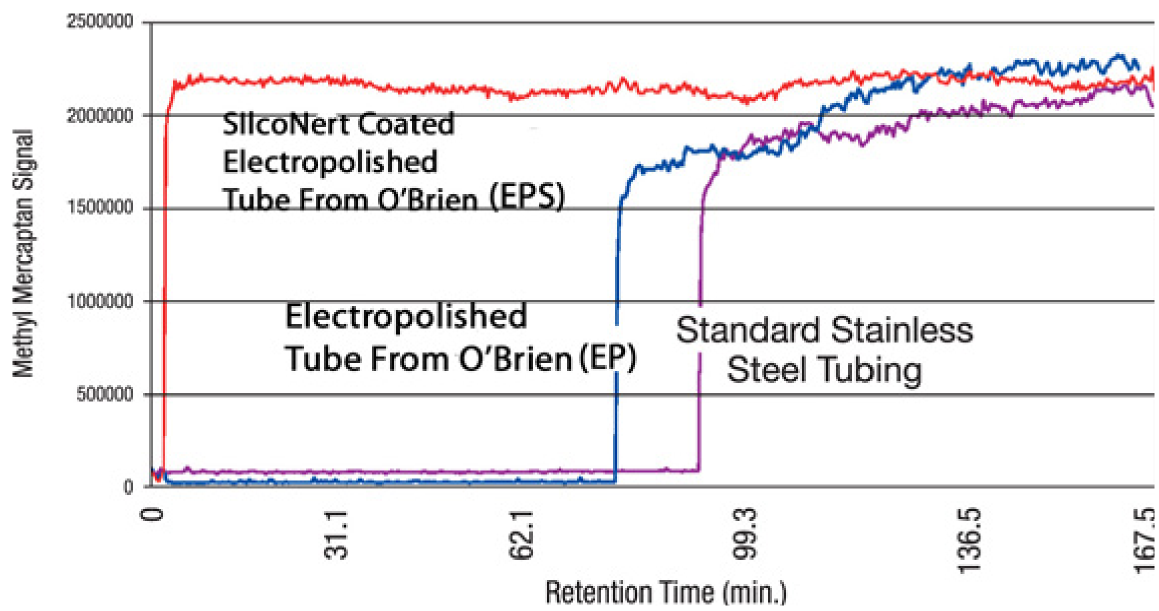
The first step in mitigating the effects of a reactive surface is to be sure the sample flow path is inert. Inspect and confirm all components in the flow path are coated with an inert surface like SilcoNert® or Dursan®. A single uncoated reactive component can distort sample results or cause complete loss of the sample at part-per-million levels.



Slow Response

Delayed response from analytical systems can lead to a downward spiral of over or under correction to process systems. Slow results from process monitoring and stack monitoring systems not only take more of your valuable time to resolve, but can lead to making process adjustments based on old or inaccurate information. The results can be devastating to your downstream customers or can lead to emissions noncompliance issues.

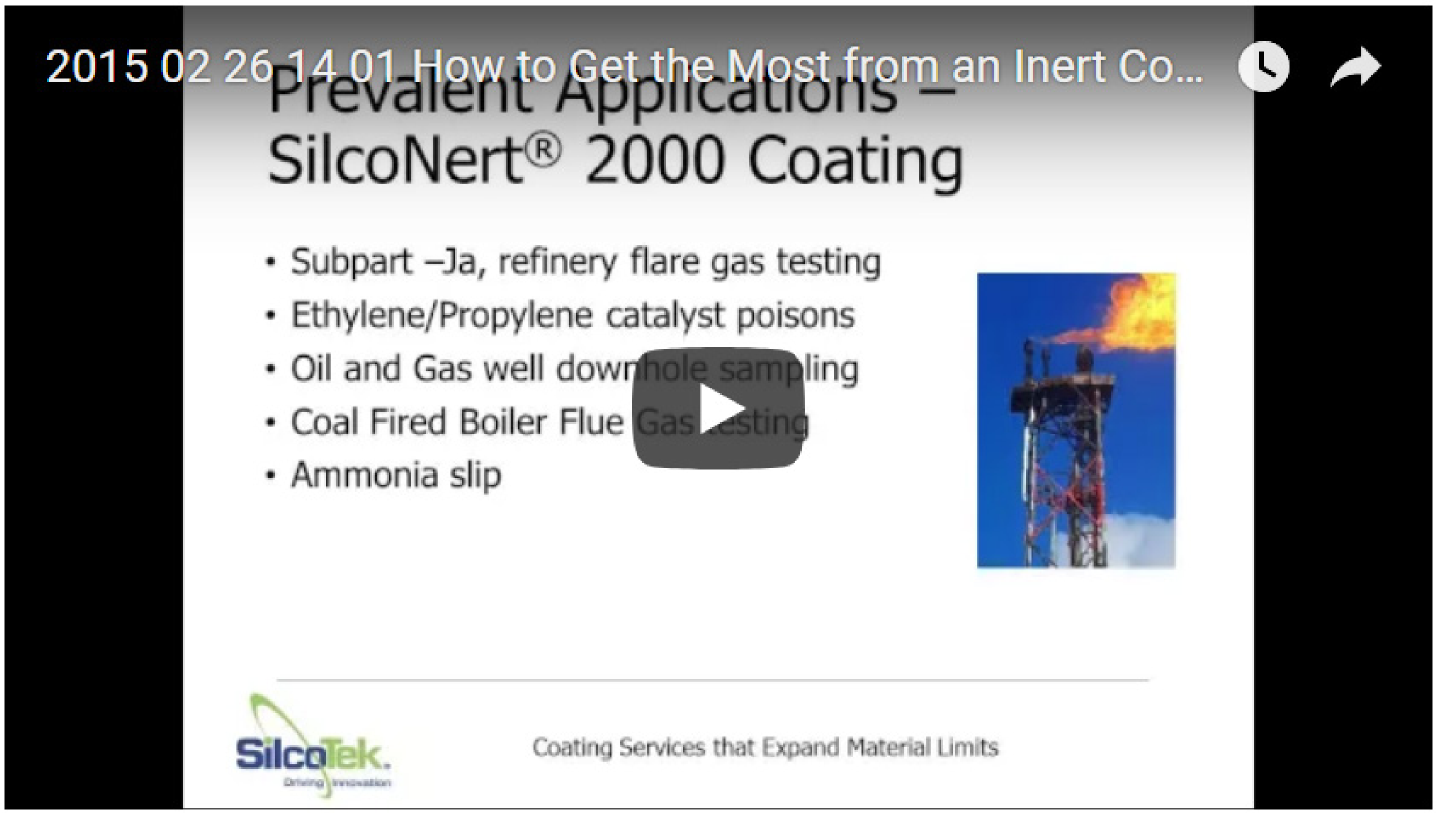
SilcoNert®-coated sample flow paths can improve response by orders of magnitude, assuring you're getting real-time information. A study by Shell and O'Brien Analytical compared response time of SilcoNert-coated electropolished tube (EPS) and stainless steel tubing. Response time of methyl mercaptan through 100ft of 1/8" tubing was improved from over a 90 minute delay to just 3 minutes, a 96% improvement in response.



To learn more, read our presentation about how to improve your emissions monitoring system.

If you really want to become an expert in troubleshooting and understanding sample and transfer,

Watch our Coating Webinar.



4. Improve Sample and Transfer Reliability in Process and Analytical Systems

Process analyzers and process sampling systems are exposed to challenging environments both internally and externally. Many sample streams are corrosive or contain active compounds that reduce equipment lifetime or require extended preventative maintenance. Instrumentation and sample flow paths can be exposed to extreme temperatures, rough handling by operators and abrasive materials; all can severely damage the analyzer flow path.

The combined extreme environments found in refinery, petrochemical, and process monitoring can lead to frequent system failures and costly maintenance; ultimately leading to poor yield, off spec product, or regulatory compliance issues. Improving sample system reliability is a key factor in the success of plant processes, making the right material selection and optimizing sample system performance all the more critical.

This chapter will examine factors impacting sample system performance and ways to improve the reliability of sample systems.

Improving Heat Resistance

Heat trace sample lines, reactors, regulators and other sample system components are often run at elevated temperatures in order to prevent condensation and preserve analyte integrity. Unfortunately, common inert materials like PTFE are not appropriate for elevated temperature applications. The graph below demonstrates how increasing temperature above 464° F will result in outgassing of fluoropolymers into the flow path.*

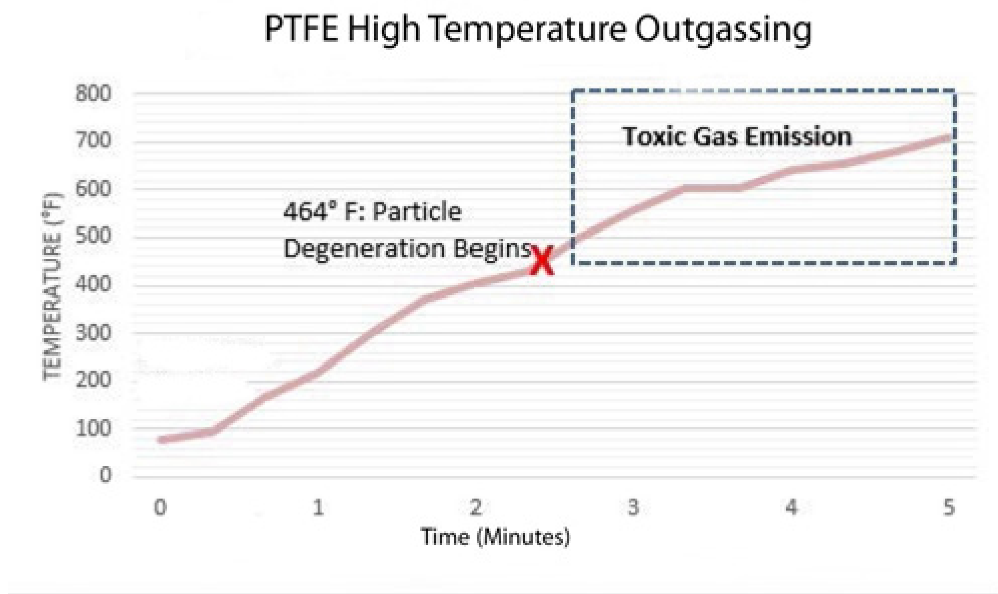
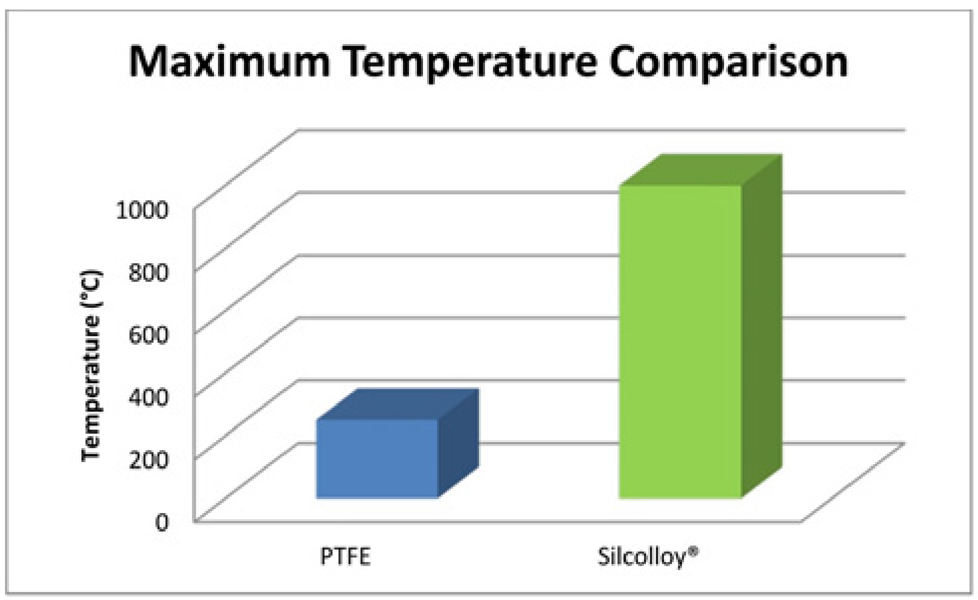


*Chart courtesy of http://www.mindfully.org/Plastic/Teflon/Canary-Teflon-ToxicosisAug03.htm

Additionally, PTFE can “cold flow” at temperatures well below the outgassing temperature, causing flow path obstructions and sample system failure.

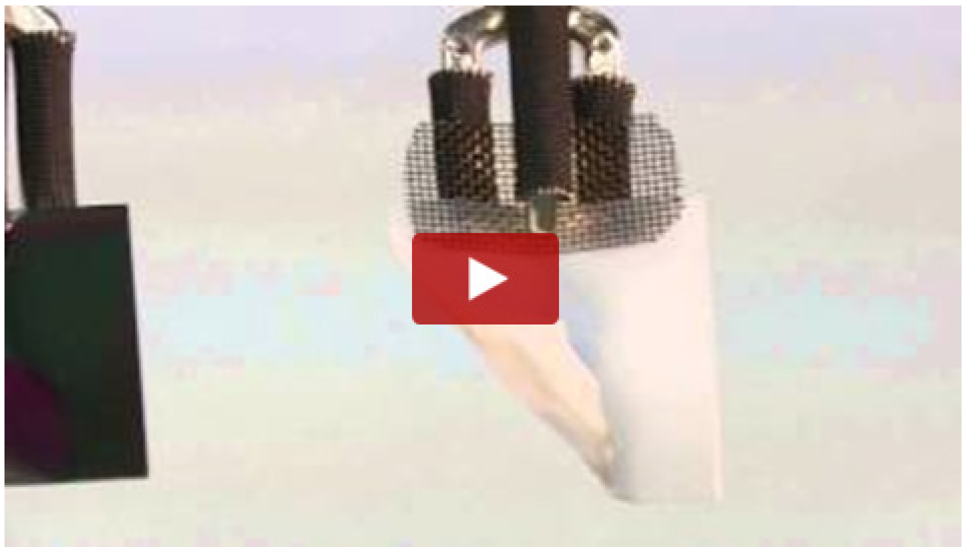


The Solution

Use a high temperature silicon coating to improve high temperature durability. Use the recommended maximum temperature table below to select the right coating for the right temperature.

Inert Coating	Maximum Temperature (Inert Atm)	Maximum Temp (Oxidative Atm)
SilcoNert® 2000	450° C	400° C
Dursan®	500° C	450° C
Silcolloy®	1000° C	1000° C
SilcoKlean®	1000° C	1000° C +
SilcoNert® 1000	1000° C	1000° C +
Dursox™	1000° C	1000° C +

Inert silicon coatings can withstand temperatures up to 1000° C, making silicon coatings ideal for stack and flare sampling applications. Watch our heat resistance video to see for yourself.



High Pressure Capability

Sampling oil & gas upstream and downstream systems often expose system components to high pressure gas and liquids. High pressure sampling can stress and expand sample cylinder and tube walls. Consequently, inert flow path surfaces must be flexible in order to withstand the stress of expansion cycles and remain intact.

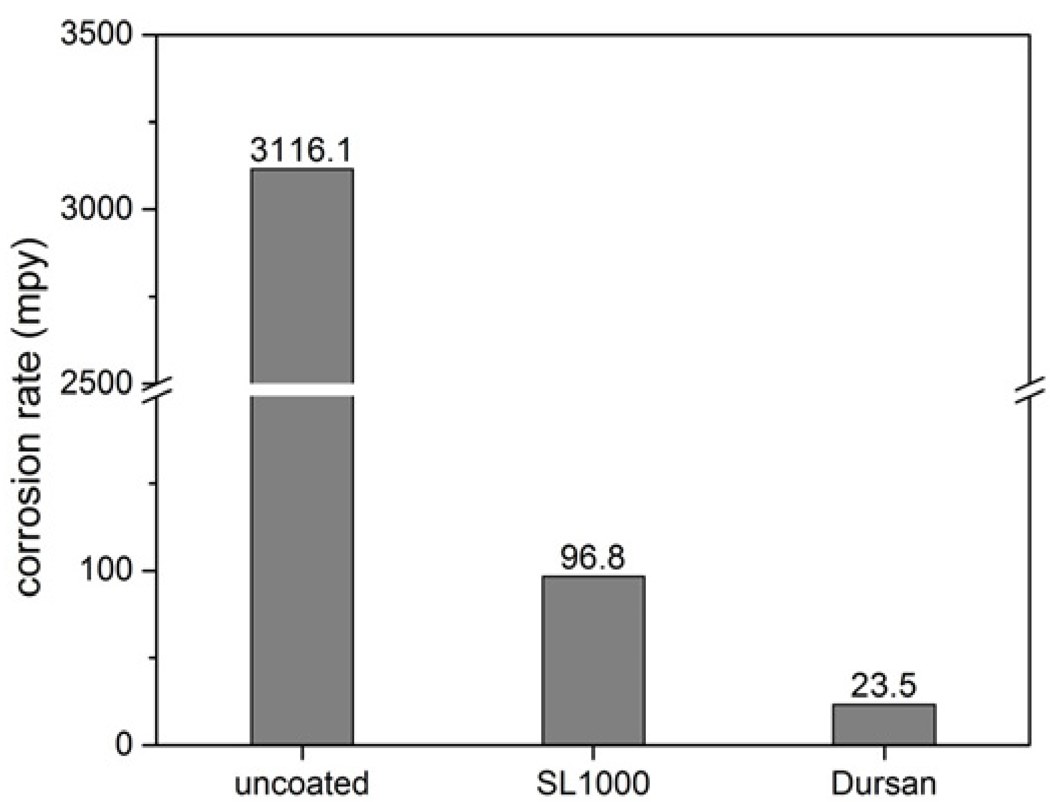
Under pressure, SilcoTek's CVD surface will flex with metal substrates, allowing ultra-high pressure systems of 25,000 psi and more to be treated and continue to meet operating requirements. Other coatings will often fail under high pressure. Watch our video and see how the coating flexes under extreme conditions.

Improving Corrosion Resistance

Sampling systems in coastal locations can be exposed to sea water or salt spray which causes rapid deterioration of equipment, requiring more money to keep them operating. For systems that are required to give accurate, reliable and repeatable data in such conditions, the cost of upkeep and maintenance is much larger than systems in more benign environments.

The exceptional chloride resistance of silicon CVD coatings like Dursan® can prevent salt-related corrosive attack. The 4000 hour salt spray comparison below demonstrates the improvement a protective coating can have on sample transfer systems. The uncoated test coupons (left) show significant corrosion while the Silcolloy®-coated coupon shows very light rust spots. Dursan®-coated coupons remain corrosion-free.

Other chloride containing streams can greatly reduce the lifetime of process systems. The corrosion graph below provides the results obtained from [ASTM G31 testing] of common sample flow path materials. The immersion test in a 6M HCl (18%) solution at 50° C and atmospheric pressure can quickly damage stainless steel surfaces. Dursan-coated stainless steel performs at levels comparable to high-quality super alloys, reducing corrosion rate from 3116 mills per year to 23 mpy.



After immersion, differential weighing allows the amount of material loss to be determined. The amorphous silicon-coated stainless steel shows greater than 20 times the resistance of non-treated stainless steel in these environments.

Any loss in the coated samples occurred as a result of pitting corrosion. The pitting is an indication that there are still pin-holes present in the surface which allowed corrosive attack to initiate.

Read more about how SilcoTek adds value and improves performance in offshore applications:

Read our Case Study.

Improving Wear Resistance

Another factor for consideration is the wear resistance of coatings applied to analytical sampling equipment. This factor is critical, especially in applications where mechanical action such as valve actuation or physical abrasion like particulates moving through the sampling equipment at high velocity can damage flow path surfaces.

Table II summarizes the data obtained from wear studies conducted on both non-treated and treated surfaces. Data was generated using a pin-on-disk tribometer (Nanovea, Irvin, CA). The experiment uses a flat plate loaded onto the test rig and an indenter which applies a precise force to the surface. The plate is then rotated and forces are measured between the pin and the disc.

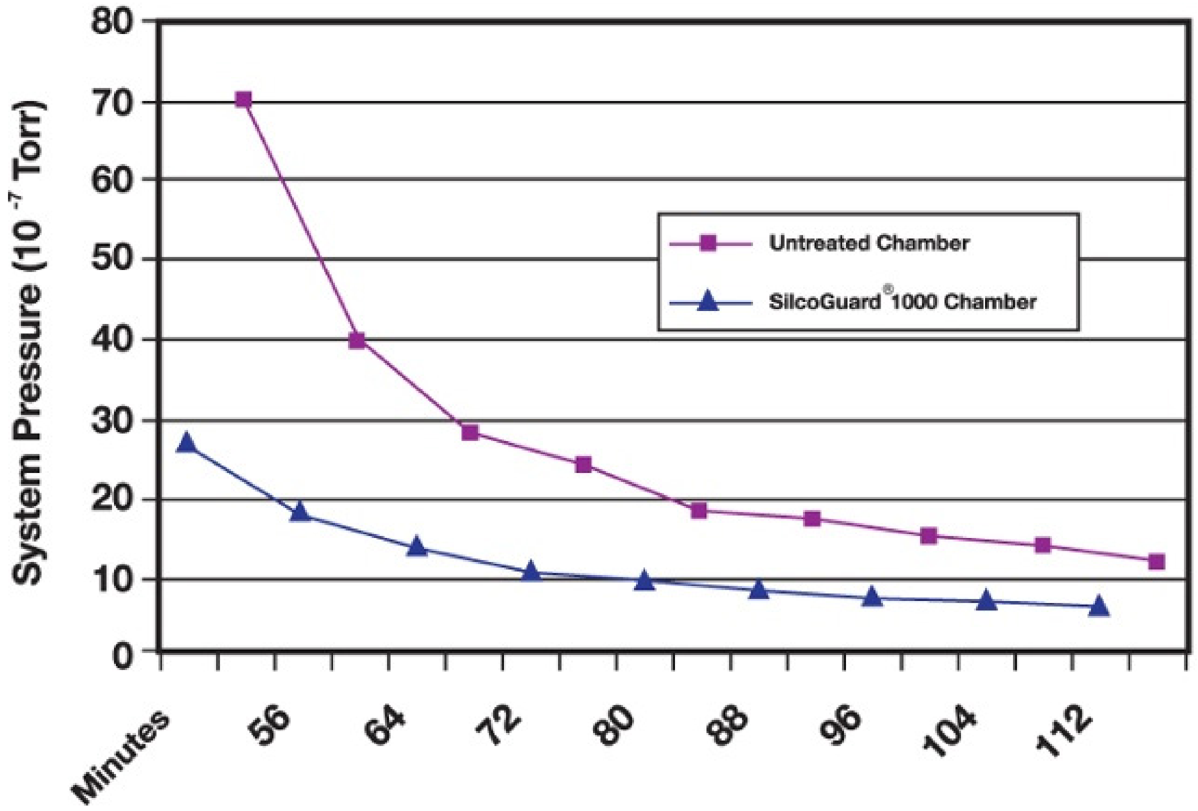
Pin on Disc; 2.0N	**316 stainless steel**	**Carboxysilane coated 316 stainless steel**	**Silicon coated 316 stainless steel**
Wear rate ($x10^{-5} mm^3/N m$)	13.810	6.129	2
Improvement Factor over SS	---	2 times	1/3 times

Results from this experimental method can produce wear behavior and friction coefficients of the plate surface[1]. Results from this study demonstrate that the carboxysilane coatings (Dursan®) wear less than untreated steel and silicon coated surface. The improved wear resistance as a result of the coating will lead to longer lifetimes of system components in extreme environments.

See it in action. Watch our abrasion resistance demo video.

Reducing Leak Rate

SilcoTek surfaces maximize the performance of vacuum systems. Comparative studies show how SilcoTek-coated surfaces can reduce pump down time by up to 3X or more. The result? Coated UHV surfaces improve system productivity while preventing contamination from stainless steel flow paths. SilcoTek-treated vacuum chamber surfaces achieve a lower base pressure significantly faster than uncoated surfaces, saving time, improving productivity and reducing process cost.



Now that the sample system is running at peak performance, let's keep it that way. Next we'll explore how to maintain inert coated surfaces.

5. Coating Care: Do's and Don'ts of Maintaining an Inert Coating

Okay, you're now the proud owner of a super inert SilcoTek® coating like SilcoNert® or Dursan®. Now what? The "care and feeding" of a coating is probably the most important factor in determining if the surface will continue to deliver high purity, corrosion resistance or inertness over the life of the project or process. Ignore proper coating care and we'll likely be hearing from you about troubleshooting your system for reactivity or coating failure.

But before we venture into tips for keeping your coating running at peak performance we must first mention the number one rule and our secret to good coating results.

#1 Rule: Select the right coating for the application in the first place!

It may seem like an obvious statement, but sample transfer systems can suffer from improper material selection in general. Whether it's selecting a PTFE liner when the system temperature approaches 250° C or selecting a Monel sample cylinder and expecting it to not adsorb sulfur compounds. Material selection can be a difficult but important task. We throw coatings into that material selection "bin" as well. To help with the task, SilcoTek developed a quick coating selection guide to help analysts make better coating decisions.

Get our Coating Selection Guide.

Okay, so you've now got the right coating for the application. Here are a few helpful tips about how to keep your coating running like a top:

Keep it Clean

We've mentioned this a few times but can't emphasize it enough: maintain surface cleanliness to prevent cross contamination and accumulation of reactive particulates. You should clean surfaces using the best minimally-invasive method. A highly abrasive or basic (pH above 8) cleaner will damage the coated surface.

To avoid reactivity and potential surface damage, we recommend using a non-polar solvent like a high purity hexane to remove hydrocarbon contaminants, and a polar solvent to remove more active compounds. Get the highest purity solvent available because lower grades will leave an unwanted film on the surface. As noted in Chapter 2, we've found that many solvents can leave trace amounts of adsorptive or reactive substances on surfaces. Always test cleaning solvents for inertness and contamination before use in high purity or analytical applications.

Don't Get Steamed

We've also mentioned to avoid steam cleaning. Refiners often use steam to clean or purge sample transport flow paths. However, live steam can cause silicon surfaces to become active. Live steam can also deliver particulates at high velocity to the surface, damaging the coating. As an alternative, consider sonication of components for a short duration or flushing the system with a solvent. (Note: sonication can also damage the coating surface. Avoid leaving parts in ultrasonic cleaners for more than a few minutes.)

Don't Exceed the pH Range

Exposure to bases above a pH of 8 can erode the silicon surface. One way to tell if the surface is being eroded is to check the color of the part. If you notice the iridescent rainbow coating color changing, it's a good indicator that the coating is becoming thinner and is being damaged.

Install Filters in the Flow Path 

Particulates can damage silicon surfaces, especially when moving at high velocity. Particles can also react with process fluids or adsorb sample compounds, contaminating the flow path. Installing fritted filters in the sample flow path will prevent system contamination and avoid potential damage to SilcoTek®-coated surfaces. Worried about activity in sintered metal frits? SilcoTek® can coat metal filters, helping analysts maintain system inertness while preventing particulate contamination.

So here's the million dollar question: "*If I follow the care guidelines, how long will SilcoTek coatings last?"*

It's not unusual to find a coated part still performing at peak inertness after many years of service. It all depends on the severity of the environment.

For critical or severe environments, it's a good idea to inventory key coated components and monitor/calibrate performance over time. Depending on the process environment and use, some customers re-coat components periodically as part of an overall preventative maintenance program. Others monitor performance either through calibration or data trends and if they find inertness is declining due to surface damage or contamination, they'll send the used part back to us for re-coating. Most likely, the part will perform well over the life of the system and won't need to be re-coated, but for critical applications, it's prudent to monitor performance.

Following these simple guidelines will keep the coating running at peak performance, help you avoid costly sample system failures, and improve your company's bottom line!

6. Conclusion

So, what have we learned about troubleshooting and protecting the sampling system in this e-book?

• The impact of corrosion, contamination, particulates, and cleaning on sample cylinder and sample system inertness performance.

• Ways to prevent sample system damage and improve system response.

• How to improve sample system reliability.

• The impact of uncoated stainless steel on sample system analytical performance.

• How to care for and maintain inert-coated surfaces.

Inert coatings from can be a cost effective solution in many industries and applications including analytical/laboratory instrumentation and sampling, oil and gas upstream and downstream sampling, refinery/petrochemical, semiconductor and research, amongst many more.

Go to our coating selection guide to get the right coating solution for your application. Or contact our technical service staff, and we'll be happy to discuss your application in detail.

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