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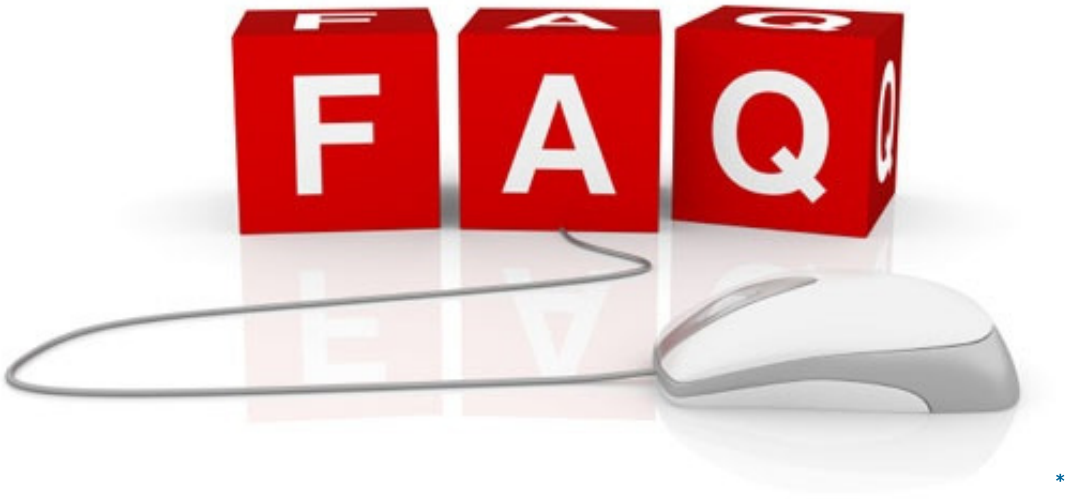
SilcoTek®
Driving Innovation



Frequently Asked Questions

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How do I select the most appropriate treatment for my application?
The following definitions explain the various treatments currently available and their recommended applications:

- **SilcoNert® 1000** (Silcosteel®)
  A general-purpose passivation layer for steel and stainless steel.
- **SilcoNert® 2000** (Siltek®/Sulfinert®)
  The ultimate passivation of treated surfaces, from glass to high nickel alloys of steel. A required treatment for metal components when analyzing for parts-per-billion levels of organo-sulfur compounds & mercury.
- **Silcolloy® 1000** (Silcosteel®-CR)
  A corrosion resistant layer that increases the lifetime of system components in acidic environments containing hydrochloric acid, nitric acid, or seawater.
- **SilcoKlean®1000** (Silcosteel®-AC)
  Dramatically reduces carbon buildup on stainless steel components.
- **SilcoGuard® 1000** (Silcosteel®-UHV)
  Greatly reduces outgassing from components of ultra-high vacuum systems.
- **Dursan®** Our newest coating! A high durability, wear resistant, corrosion resistant, and inert

coating. Great for field sampling, process, Oil & Gas appications.

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What materials can be surface treated?
Virtually all alloys of stainless steel, ceramic, and most glass materials can be treated. Some other metallic materials, such as nickel, brass, copper, and aluminum, are incompatible with the high (400°C) temperatures used in the process, and should not be treated.

Note: carbon steel, F22 or similar carbon steel, is not recommended for coating in corrosion resistant applications. Treated carbon steel may rust in corrosive environments. Avoid corrosive environments when using treated carbon steel in inert sampling applications.

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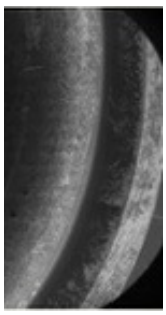
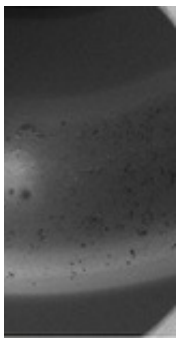
Can sealing surfaces like CF, face seal, threaded and compression fittings be coated?

Yes! SilcoTek coatings are proven to withstand compression and shear stress common to CF, face seal, and threaded sealing systems.



FESEM (Field Emission Scanning Electron Microscopy) image of the coated pre-sealed surface shows the coating conforms to the sealing area. The raised surfaces of the face seal gland area can be seen. SilcoTek coatings conform to surface contours and small orifices.



After making the metal-to-metal face seal per manufacturers instruction, a second FESEM image of the post sealing surface shows no scarring or scratching, only trace particulate from the silver gasket.

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Can ferrules be treated?
SilcoTek does not recommend coating ferrules as we have found this may lead to leaking problems after coating.

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What are the operating temperatures for SilcoTek treated surfaces?
Maximum temperatures usually will be dictated by the construction material (glass, stainless steel, etc.), not by the surface treatment. In general, temperatures should not exceed those listed in Table I. Temperatures greater than 450°C for SilcoNert®2000 (formerly Sulfinert® or Siltek®) and Dursan® treated surfaces or greater than 600°C for SilcoNert®1000 (formerly Silcosteel®), Silcolloy® (formerly Silcosteel®-CR), or SilcoGuard® (formerly Silcosteel®-UHV) treated surfaces can be used under certain conditions. Heat treatment of parts before applying a Silcolloy, SilcoNert1000, SilcoGuard, coating extends the maximum temperature limit. Please contact technical support at 814-353-1778, for additional information.

SilcoTek® coatings are stable to the following temperatures in an inert atmosphere:

SilcoNert® 2000
SilcoNert® 1000
Silcolloy®
SilcoGuard®
SilcoKlean®

Dursan®

450°C
600°C
600°C
600°C
600°C

450°C

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How can I receive pricing for custom surface treatment?
Click here to request a quotation for custom surface deactivation of sample pathway components, inlet liners, etc. Please forward a scaled drawing or photograph detailing the product to be treated. Upon receipt of this completed worksheet, SilcoTek's Technical Staff will contact you with a quotation, typically within 1-2 business days. When you are ready to send items to SilcoTek for treatment, contact technical support at 814-353-1778 to request service number. When submitting parts for treatment, remember that parts must be completely dissembled, and components that cannot withstand the high (400°C) temperatures associated with the process (rubber o-rings, brass, etc.) must be removed. Note that SilcoTek cannot assume liability for warping of stainless regulators due to process heat.

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How will SilcoTek surface treatments work in my acidic environment?
SilcoNert 1000 and SilcoNert 2000 treated materials have improved corrosion resistance, but

Silcolloy (formerly Silcosteel®-CR) and Dursan surface treatments are optimized to enhance resistance to many common acids; providing a 10-fold improvement in corrosion resistance, compared to untreated stainless steel, and a 4-fold improvement compared to SilcoNert 1000 coated stainless steel.

Note: carbon steel, F22 or similar carbon steel, is not recommended for coating in corrosion resistant applications. Treated carbon steel may rust in corrosive environments. Avoid corrosive environments when using treated carbon steel in inert sampling applications.

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What is SilcoNert 2000?
SilcoNert2000 (U.S. patent 6,444,326) is a passivation process that applies an inert, integral layer to components used for chromatographic analysis. Unlike traditional deactivations, it is not susceptible to cleavage or formation of active silanols and, therefore, greatly reduces bleed, and breakdown or adsorption of active components, compared to conventional surface coatings.

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What are the unique benefits of SilcoNert 2000 deactivation?
SilcoNert2000 creates a unique surface with an inertness range that surpasses all other known surface deactivations used in gas chromatography. In sensitive analyses, SilcoNert2000 deactivated system components provide outstanding results.

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Does anyone else offer an equivalent to SilcoNert 2000 deactivation?
No. SilcoNert 2000 deactivation was created exclusively by SilcoTek and is protected by a US patent (Pat. No. 6,444,326).

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Why is SilcoNert 2000 on glass gold in color?
The color of a surface coating is an expression of the light diffraction qualities and thickness of the layer. The thickness of a SilcoNert 2000 layer determines the degree of darkness, secondary reflectivity, and/or final color of the item. The color can range from light golden-brown (thin coatings) to reflective silver (heavier coatings). We deposit a layer that provides a gold color on liners to aid analysts in inspecting for cleanliness. Chromatographic performance does not depend on the thickness of the layer.

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How thick is the SilcoNert 2000 layer?
Depending on the item, the SilcoNert 2000 layer can be as much as 2,500 Angstroms (250 nanometers) thick. At this thickness, the layer exhibits a reflective silver color on treated glass surfaces or a rainbow on metal surfaces. Chromatographic performance does not depend on the thickness of the layer.

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What is the maximum temperature limit for SilcoNert 2000 deactivated glass?
Maximum temperatures usually will be dictated by the composition of the glass, not by the surface treatment. The SilcoNert 2000 layer is stable at temperatures up to 450°C, but some glasses can soften at lower temperatures. Injection port temperatures normally are well below the SilcoNert 2000 maximum temperature limit, so SilcoNert 2000 treatment is an excellent deactivation for all injection port surfaces.

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Does SilcoTek offer custom SilcoNert treatment?
We are always interested in your specific surface passivation needs. Surface deactivation of glass or metal with a SilcoNert 2000 layer is available on a custom basis, and liner deactivation has become popular with some customers. Please keep in mind that treated surfaces must be able to withstand temperatures up to 400°C, as well as vacuum and pressure environments. It is important to remove any o-rings, seals, or other materials that will not withstand the treatment environment prior to sending items to SilcoTek for coating.
Our SilcoTek Group can provide a quote. Please submit a quote or contact us at 814-353-1778.

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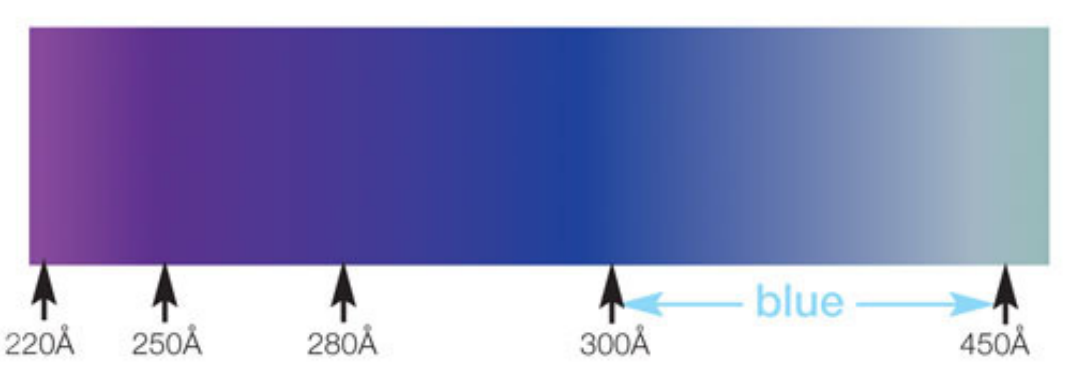
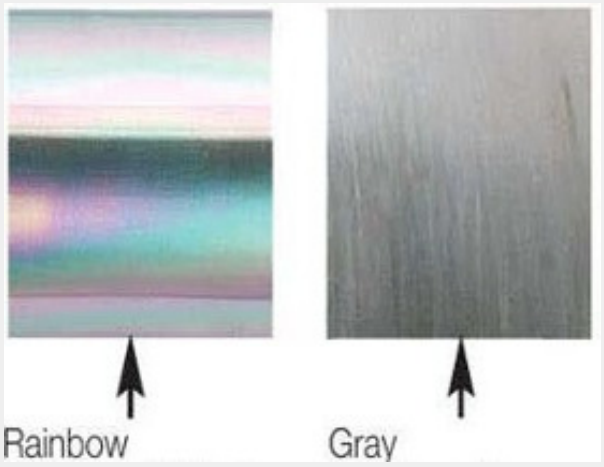
Why do Silco'd™ treated pieces have different colors?
The different colors observed on Silco'd treated parts indicate different layer thicknesses. A blue color corresponds to a 300 to 450 Angstrom layer while a rainbow color indicates a coating of at least 1200 Angstroms (120 nanometers).
Colors associated with layer thickness are:



Depositions used in our Silcolloy and SilcoGuard processes are up to 1µm and have a silver/metallic gray appearance. The photos below show colors created by SilcoNert 1000 (left) and Silcolloy 1000 (right).



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Will you re-deactivate my SilcoNert 2000 treated glass liners or SilcoNert 1000 metal liners after I clean them?
Request re-deactivation of SilcoNert 2000 treated glass liners by contacting SilcoTek's Customer Service department at 814-353-1778. Requesting SilcoNert 2000 re-deactivation of customer supplied liners. A minimum of ten liners is required. Metal inlet liners are designed as inexpensive, disposable products and it is not cost effective to re-treat them. We recommend discarding them when they are no longer serviceable.

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How tightly can the tubing be bent?

OD
<= 1/16"
1/8"
1/4"
3/8"

Min. Bend Radius
1" (2.5 cm)
2" (5.1 cm)
4" (10.2 cm)
6" 15.2 cm)

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Can SilcoTek coat assemblies like valves, regulators, and flow controllers?
Absolutely! SilcoTek can coat the internal and external metal pathways for most flow regulating and metering devices to enhance their inertness and provide corrosion resistance. In order to coat the surfaces, all valves, regulators, and flow meters should be dissembled and all seals or parts which cannot be exposed to temperatures of approximately 400°C must be removed. Disassembly should only be performed by qualified personnel with the appropriate seal kits, tools, and training OR damage or failure to the device will occur. For these reasons, SilcoTek cannot take on the responsibility of disassembly or reassembly of any valve, regulator, or flow meter. If you do not have the experience

and parts necessary to dissemble these devices, we recommend that you get in touch with Swagelok, Parker, or your valve manufacturer and order the coating treatment directly from them. SilcoTek has business relationships with most manufacturers and routinely coats the internal and external surfaces of valves, regulators, and flow meters for them. The manufacturer will send the parts prior to assembling to SilcoTek for coating and will assemble the parts at their factory under the guidance of their quality systems.

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Where can I order products that are already coated by SilcoTek?

SilcoTek does not sell anything besides our coating services, but our Channel Partners work with us to stock their products with our coatings to help you supply chain. **Click here to see product listings.**

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Will brazing impact the quality of the coating?
Yes, brazed joints will outgas during the coating process and will negatively impact the coating quality. SilcoTek does not recommend coating over brazed joints. Coated brazed joints appear as a matte brown finish and can have increased activity/reactivity at the brazed joint. SilcoTek recommends vacuum brazing or welding of joints for best coating quality. Vacuum brazing is a high temperature, flux-free brazing process that results in a contamination free joint. SilcoTek recommends vacuum brazing services from Solar Atmospheres Inc.

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Do I need to pre-clean my parts prior to sending them to SilcoTek for coating?
Your parts are precision cleaned by SilcoTek prior to processing. Additional pre-cleaning by the customer is often unnecessary and at times can be detrimental to our coating process.

In order to provide the highest quality coating and fastest processing; notify SilcoTek of any prior chemical exposure (regardless of whether the part is new or used). Chemicals like cutting oils, pickling acids, solvents, water based cleaning compounds or other hazardous or non hazardous chemicals may impact the coating process. Many times the customer's cleaning process or chemical exposure can be eliminated, saving the customer time and money. Before sending parts to SilcoTek, contact your SilcoTek representative at **silcod@SilcoTek.com** or call us at (814) 353-1778

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Can SilcoTek coat fritted liners?
SPECIAL NOTE: Coating of glass fritted liners: SilcoTek would prefer that all glass liners be sent without deactivation (e.g. silanization) since the deactivation layer will prevent our intermolecular coatings from bonding to the surface. For most glass liners, our cleaning process will remove all prior deactivants. However, SilcoTek cannot put fritted liners through our cleaning process without damaging the frit.

Fritted liners are special because there is no effective way of cleaning glass frits or stripping the coating in case of failure. As we continue to gain experience with glass frits and tailor our processes, we will get better. Our major hurdle is being able to "test" fritted liners prior to coating to ensure they

are clean. We continue to work on this aspect of our operation.

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Are SilcoTek's coatings RoHS and REACH compliant? What about their SDS sheets?

Visit http://www.silcotek.com/compliance-statements to learn more about how our coatings are non-hazardous and in compliance with the law. The treatments do not require SDS sheets.

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Do SilcoTek coatings change the roughness of the surface?

SilcoTek coatings conform to the microstructure of the part surface. There is minimal filling of voids or change to the overall surface roughness. Overall roughness measurement may be reduced slightly (1-2 RA reduction), but not a significant change in roughness. Some SilcoTek coatings have a higher lubricity than stainless steel, so even though surface roughness has not changed, the surface may have a lower friction coefficient.

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*FAQ image courtesy of St. Odilia School, Shoreview, MN

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