

Removing Rust Prior to Coating

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Abstract

Silcolloy® and Dursan® coatings are both applied to improve the corrosion resistance of stainless steel and other alloys. The effectiveness of the coating as a barrier to corrosion can be compromised if the substrate surface has pre-existing rust or corrosion spots (stains). Once noted, rust can easily be removed prior to coating by utilizing some simple chemical techniques to create an optimum surface.

Stainless Steel Rust

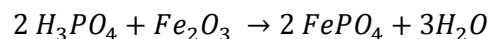
Stainless steel is typically specified because of its ability to resist corrosion in a variety of environments. Unfortunately, stainless steel is not fully stain- or rust-proof, it is just more *resistant* to corrosion. Exposure to high salinity environments such as sea water can remove the native protective layer (chromium oxide) and allow oxidation/corrosion to occur at the substrateⁱ. Another common factor which can cause the stainless steel to rust or corrode is so-called 'free iron' on the surfaceⁱⁱ. This iron residue can come from a variety of sources such as transfer of tooling particulate that remains after machining and is very susceptible to corrosion if not handled properly.

SilcoTek's Experience

Any pre-existing surface corrosion can degrade the performance of SilcoTek-coated parts. We have found that even minor rusting should be removed prior to coating for optimum value. Pre-coating surface treatments are selected so that the iron oxide (rust) is removed while the majority of the substrate is unaffected. SilcoTek employs two different treatments to achieve this result: exposure to phosphoric acid or exposure to acetic acid.

Phosphoric Acid

Phosphoric acid will dissolve iron oxide without attacking the other components of the steel (chromium and chromium oxide, nickel, and iron). The rust is dissolved by the following reaction:



Phosphoric acid is readily available from a number of commercial suppliers (SilcoTek uses 85% 'food grade') and it can be used with no dilution because of its non-aggressive nature. Clean up after acid treatment is done by rinsing parts in deionized water thoroughly and then returned to the coating process. Unfortunately, this technique is not 100% effective on all the forms of iron oxide and other surface preparation treatments could be necessary.

Acetic Acid

Another acid treatment which is effective for removing some iron oxides uses acetic acid. Acetic acid is also available commercially (SilcoTek uses glacial acetic acid which is greater than 99.7% pure) and requires no dilution prior to use as a rust remover. The reaction with acetic acid is often slower than phosphoric acid and can be a better choice when the underlying corrosion/staining affects a larger percentage of the substrate. Following the acid exposure, parts must be rinsed thoroughly with deionized water prior to re-entry into the coating process.

Some Results

Below is an example of a part which showed rusting prior to coating and the results from our recommended acid treatments.

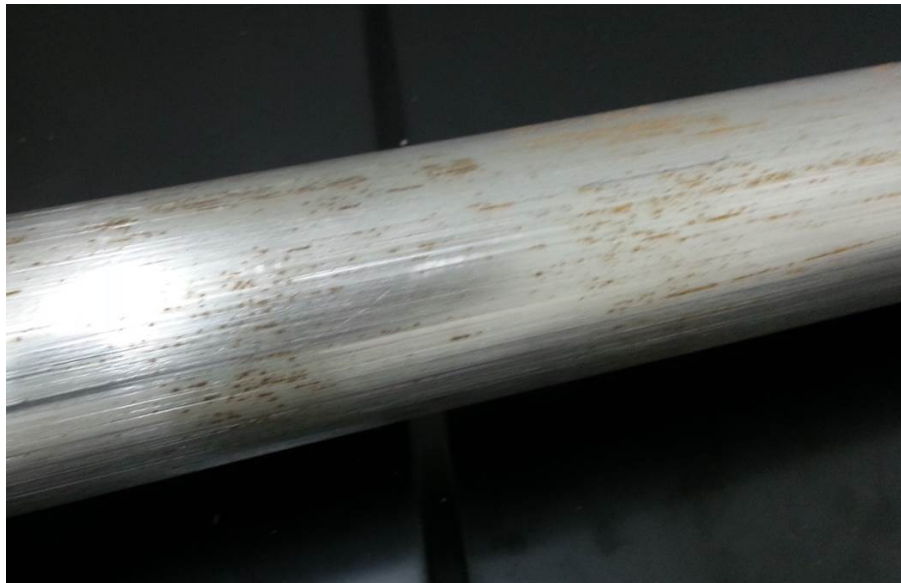


Figure 1 - Stainless steel part showing rust of surface free iron.

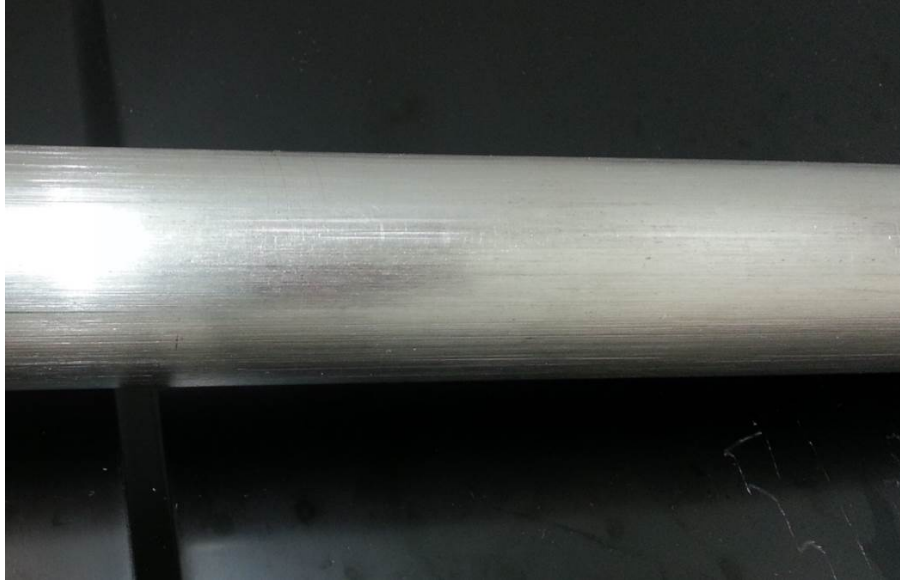


Figure 2 - Stainless steel part following treatment with phosphoric acid removal of surface rust.

Recommendation

The best substrate to coat is one that is clean and does not show rust. If there is a potential for free iron on your part's surface, SilcoTek recommends addressing it prior to shipping to us. The easiest method to remove free iron is through passivation (nitric or citric acid exposure). Any oxidized free iron (rust) can then be removed by one of the methods described above. If it is not possible to apply the removal techniques in-house, SilcoTek's sales group can provide a quote for the acid cleaning process upon request.

ⁱ <http://www.stainless-steel-blog.com/2013/09/06/why-is-stainless-steel-stainless/>

ⁱⁱ <http://www.stainlessfoundry.com/FreeIron.asp>