

# In the SPOTLIGHT:

## GALLING RESISTANCE OF S<sup>3</sup>P-TREATED STAINLESS STEELS

Stainless steel alloys are commonly used in corrosive environments for their superb corrosion resistance. Unfortunately these alloys exhibit poor galling and wear resistance limiting their life or range of application. This is why many industrial applications rely on S<sup>3</sup>P to eliminate galling. S<sup>3</sup>P treatments are proprietary processes developed to significantly improve the performance of such alloy systems all while maintaining their corrosion resistant behavior. All in all, S<sup>3</sup>P not only overcomes the galling phenomenon, but also dramatically improves wear resistance and fatigue strength.



### Galling of stainless steels

Galling is a type of wear caused by a combination of friction and adhesion between sliding surfaces typically under compressive loading. The wear is a result of tearing and slipping of the crystal structure at the surface. When material begins to tear it may become stuck or welded to the mating surface. In general the harder the material, the more galling resistant the material behaves. Many stainless steel metal-on-metal applications in Food Manufacturing and Production, Industrial Fluid Handling, Fastener, and Medical Device Industry require outstanding corrosion resistance coupled with non-galling behavior. Bodycote’s S<sup>3</sup>P treatments can provide a solution for these systems resulting in superior performance.

### ASTM G98 standard test

Solution annealed AISI 316 (1.4401) and 17-4PH (1.4542) in the H900 condition were analyzed per ASTM G98 – “Standard Test Method for Galling Resistance of Materials”. The classification number is the threshold galling stress. The higher it is, the better the galling resistance.

### S<sup>3</sup>P vs. Galling

Threshold galling stress results are presented in fig. 1. For all stainless steel grades analyzed the S<sup>3</sup>P processes demonstrated the ability to have a significant impact on improving the material’s resistance to gall. 17-4 PH improved from 16.5 MPa (2.4 KSI) in the untreated condition to 763.8 MPa (110.8 KSI) in the S<sup>3</sup>P M condition. However the most impressive response was observed with AISI 316. In the untreated condition a threshold galling stress of 45.5 MPa (6.6 KSI) was measured. In the S<sup>3</sup>P K22 condition galling was completely eliminated. At a load setting of 842.5 MPa (122.2 KSI) the compressive yield strength of the material was exceeded, yet no galling was observed (See fig. 2 and 3).

### Advantages

- Eliminate galling
- Maintain corrosion resistance
- Diffusion based process, no peel-off possible
- Improve wear resistance

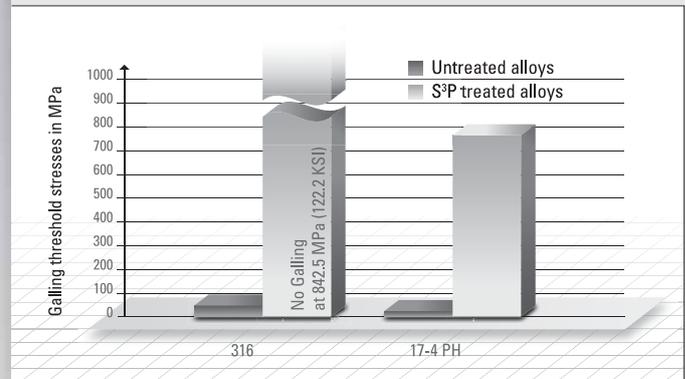


Fig. 1 Galling resistance of materials, ASTM G98 testing; threshold galling stress of untreated and S<sup>3</sup>P treated materials.

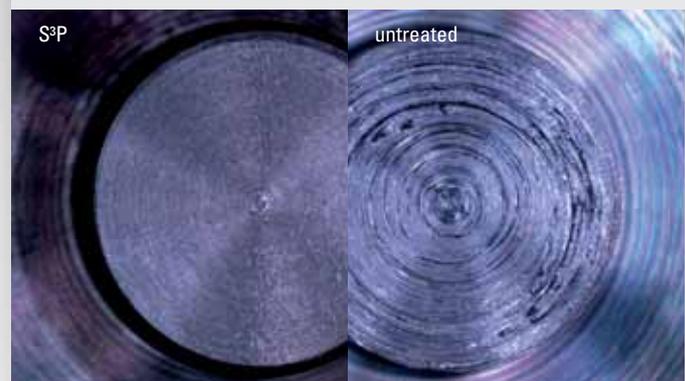


Fig. 2 Photographs of AISI 316 buttons after G98 galling test. Left: S<sup>3</sup>P treated condition at 842.5 MPa (122.2 KSI), no galling; right: untreated condition at 45.5 MPa (6.6 KSI), galling.

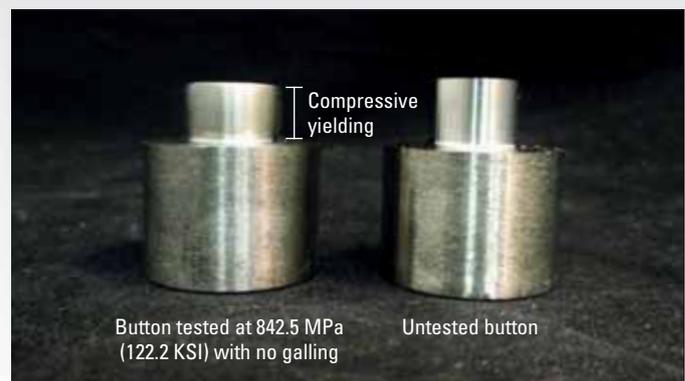


Fig. 3 Photo of AISI 316 button tested at 842.5 MPa (122.2 KSI) resulting in compressive yielding; no galling was observed.