

In the  
SPOTLIGHT

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

INCREASE MECHANICAL PERFORMANCE  
METAL-ON-METAL SLIDING POSSIBLE  
NEW DESIGN OPPORTUNITIES  
MAINTAIN CORROSION RESISTANCE



**Bodycote**

### 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 industries require outstanding corrosion resistance coupled with non-galling behaviour. Bodycote's S<sup>3</sup>P treatments can provide a solution for these systems, resulting in superior performance.

### S<sup>3</sup>P eliminates galling

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 lifetime 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, featuring Kolsterising® and S<sup>3</sup>P AMD, are proprietary processes developed to significantly improve the performance of such alloy systems whilst maintaining their corrosion resistant behaviour. S<sup>3</sup>P not only eliminates galling, it also dramatically improves wear resistance and fatigue strength.

### ASTM G98 standard test

Solution annealed AISI 316 (1.4401) and 17-4PH (1.4542) in the H900 condition were analysed 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.

Threshold galling stress results are presented in Fig. 1. For all stainless steel grades analysed the S<sup>3</sup>P processes demonstrated the ability to have a significant impact on improving the material's resistance to galling. 17-4 PH improved from 16.5 MPa (2.4 KSI) in the untreated condition to 763.8 MPa (110.8 KSI) in the treated 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 of S<sup>3</sup>P

- Eliminates galling
- Maintains corrosion resistance
- Diffusion based process, no flaking off possible
- Improves wear resistance

\*S<sup>3</sup>P M and S<sup>3</sup>P K22 are surface hardening processes offered by Bodycote S<sup>3</sup>P Kolsterising® is a registered trademark of Bodycote

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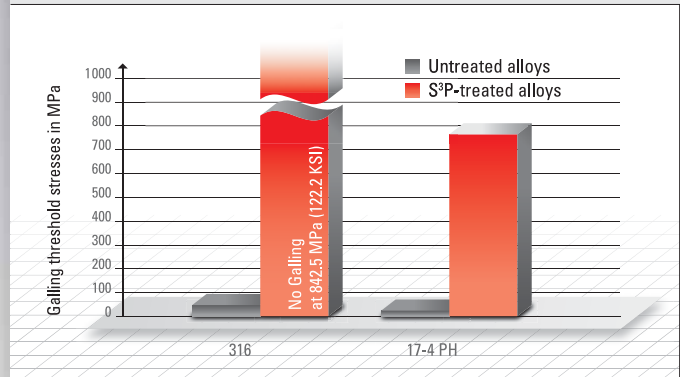


Fig. 1 Massively increased galling resistance of materials AISI 316 and 17-4PH when S<sup>3</sup>P-treated; ASTM G98 testing.

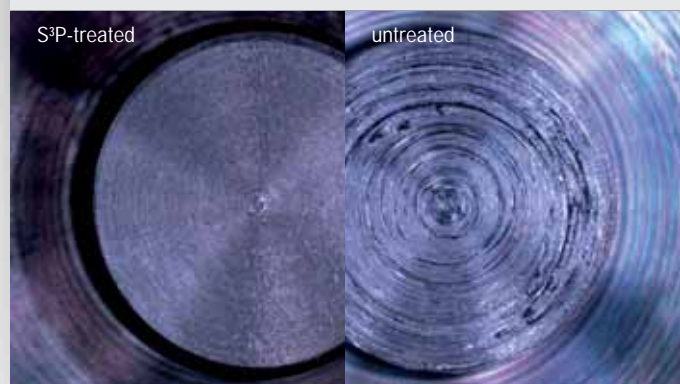


Fig. 2 Photographs of AISI 316 buttons after G98 galling test. Left: S<sup>3</sup>P-treated condition at 842.5 MPa (122.2 KSI), no galling; right: untreated condition at 45.5 MPa (6.6 KSI), galling.

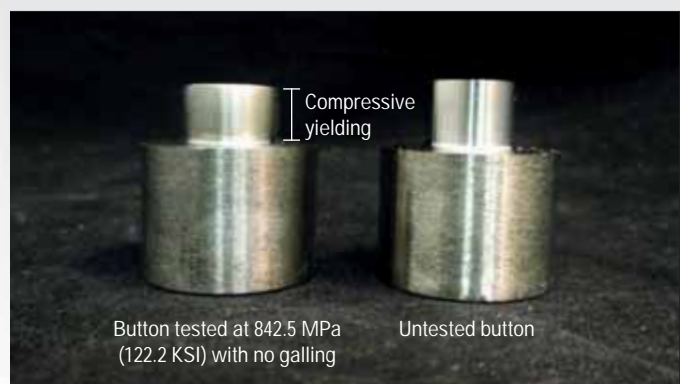


Fig. 3 Photo of AISI 316 button tested at 842.5 MPa (122.2 KSI) resulting in compressive yielding; yet no galling was observed.