In the SPOTLIGHT

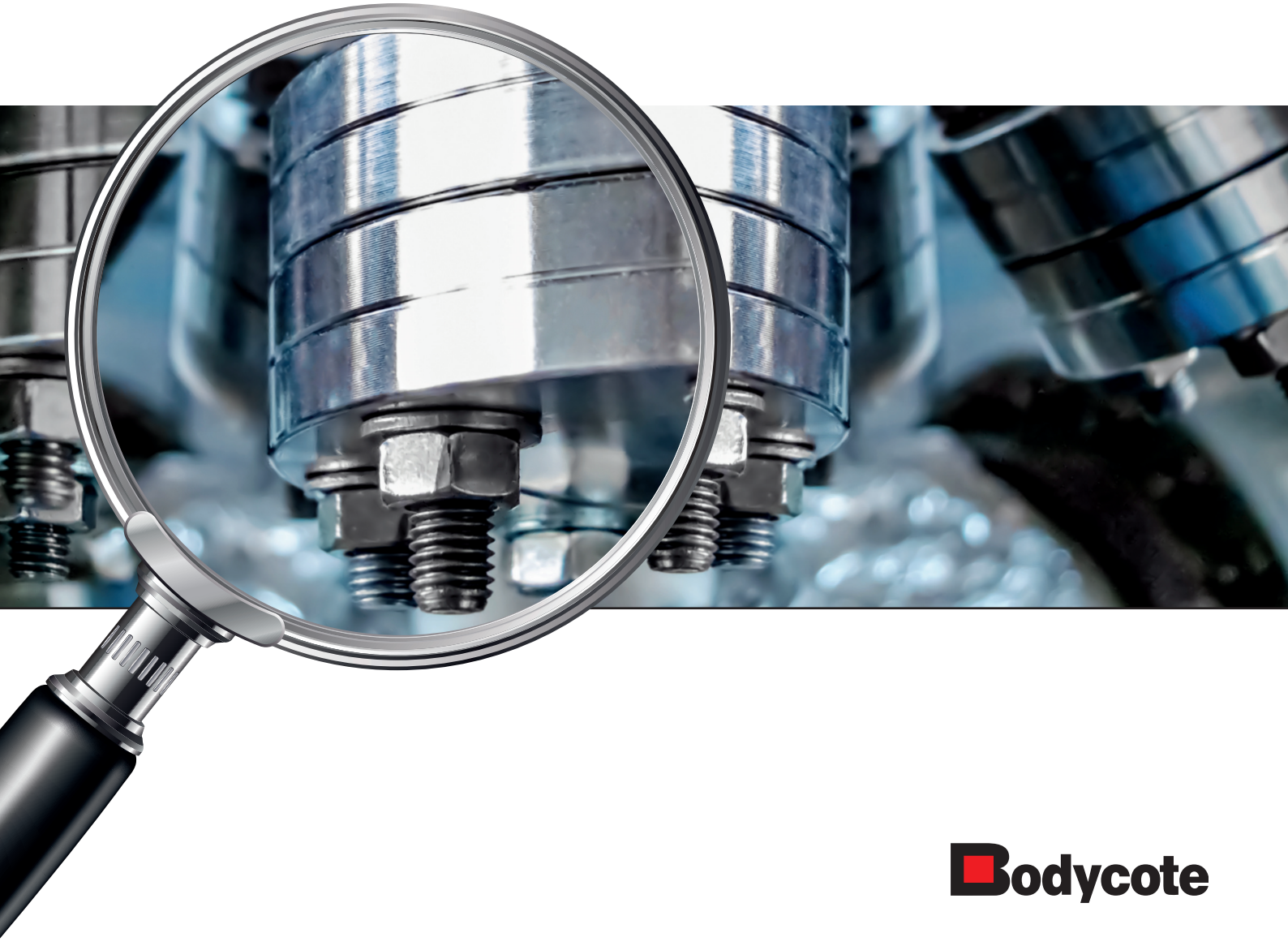
S³P IN FASTENER APPLICATIONS

ELIMINATES GALLING

SAFE AND REPEATABLE TORQUE

RE USABLE STAINLESS FASTENERS

IMPROVES FATIGUE STRENGTH



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S³P – Specialty Stainless Steel Processes
S³P in Fastener Applications

Kolsterising® – Improved wear and galling resistance for stainless steel

Stainless steel fasteners are commonly used in corrosive environments for their superb corrosion resistance. However, poor galling properties result in strict guidelines when placed in use without the aid of lubricants. Bodycote's S³P processes, featuring Kolsterising®, are proprietary processes developed to alleviate this problem by significantly increasing the surface hardness (typically >1 000 HV) thereby improving the mechanical performance of such alloy systems whilst maintaining their natural corrosion resistance. As a result, a more capable and reliable fastener can be designed, exhibiting improved galling resistance, wear resistance, and fatigue strength.

Kolsterising® improves safety and minimises risks

Kolsterising® treatments have been shown to eliminate galling for stainless steel alloys. For example, the galling resistance of treated AISI 316 coupons was evaluated per ASTM G98 – "Standard Test Method for Galling Resistance of Materials". This test demonstrated that Kolsterising® significantly improved the threshold galling stress beyond the material's yield strength capability. The following results show how this simple lab test translates to fastener applications.

A modified version of ASTM G98 testing was conducted with ½"-13 (ASTM F593G 316S/S) stainless steel nuts and bolts. With the aid of a calibrated torque gun, 100+ installs were performed with threads examined every ~25 cycles. A recommended dry torque of 54ft-lbs was applied and if no galling occurred then the torque was increased. In the untreated condition visible thread damage was observed at the initial torque value of 54ft-lbs (40% of yield), becoming progressively worse until complete seizure of the fastener system occurred at 108ft-lbs (80% of yield). For the S³P treated condition no thread damage was observed, even in torque to yield conditions (135ft-lbs). These results demonstrate that Kolsterising® can significantly improve the clamp load consistency of stainless steel fasteners. Figure 1 compares the integrity of the threads after testing for the treated and untreated condition.

Further studies have been performed to better understand the deterioration of threaded interfaces through sequential loadings[1]. This study assessed the impact that multiple loading cycles have on the friction and clamp load of B8M Class 1, B8M Class 2 and Hastelloy® C-276 fasteners. It was concluded that fasteners treated with Kolsterising® outperformed standard fasteners by eliminating adhesive wear. For example, untreated Hastelloy® C-276 fasteners displayed significant scatter with respect to friction and the resulting clamp loads as a function of loading cycles, see Figure 2. For the Kolsterised Hastelloy® C-276 fasteners the stable behaviour provides the user with a more reliable system.

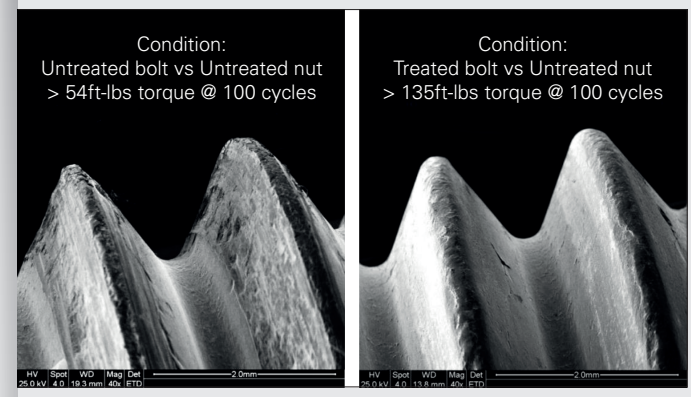

Fig. 1 Comparison of untreated and treated (Kolsterising®) stainless steel threads; Left: significant adhesive wear occurred after a torque of 54ft-lbs (73 Nm) was applied. Right: no galling, with 135ft-lbs (183 Nm) torque applied.

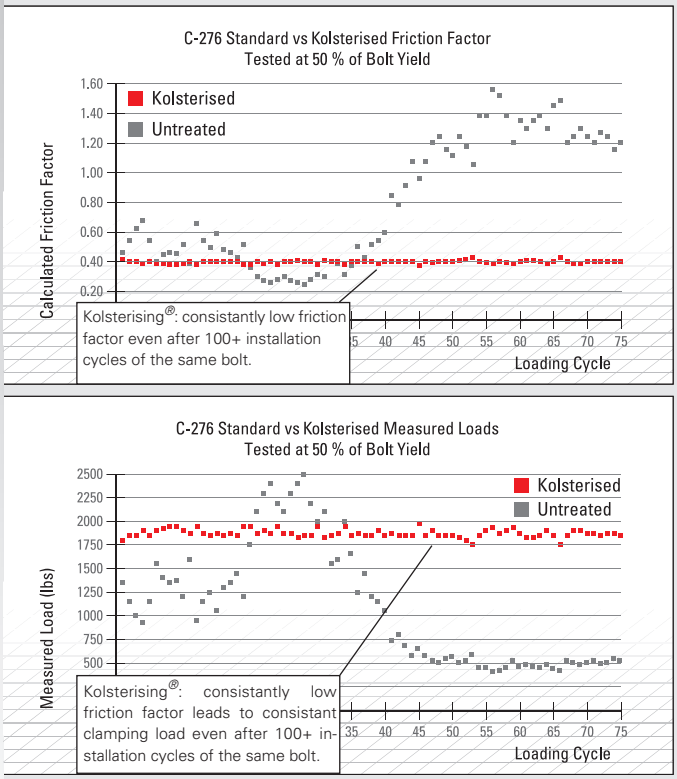

Fig. 2 These plots compare the friction factors and measured loads using Hastelloy® C-276 fasteners in the untreated condition and those treated with Kolsterising®. It can be seen in the above charts that in the Kolsterised condition the friction factor remains constant and therefore the resulting load achieved is unaffected. Comparing this to the untreated fasteners, it can be seen that repeated loading causes the friction factor to increase and the resulting load to decrease indicating adhesive wear and galling of the thread has occurred.

[1] K. Clark (2017), The Effects of Low Temperature Carbon Diffusion Treated Fasteners on Thread Galling Resistance, 2017 ASME Vessels and Piping Conference, Hawaii, 2017.

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