

UNPRECEDENTED GALLING RESISTANCE OF 316L AFTER EXPANITE SURFACE HARDENING

Defined in the standard as "a severe form of wear characterized by localized, macroscopic material transfer, removal or formation of surface protrusions when two solid surfaces experience relative sliding under load", galling, or adhesive wear, is a pervasive problem for stainless steels, of which the soft 300 series are notoriously prone. In an on-going effort to increase its database of engineering data, Expantite® recently conducted the ASTM G98 Standard Test Method for Galling Resistance of Materials on AISI 316L, with and without Expantite surface treatment.

ASTM G98 standard test for galling resistance

This standardized test involves a cylindrical button which is rotated 360° against a stationary block under normal force. After rotation, the contact surfaces are visually inspected for galling. The load is gradually increased until galling is observed, thereby establishing the threshold galling stress. The table below lists the extent of galling observed after a test with increasing load on both, self-mated native surface (untreated) and self-mated SuperExpantite® hardened AISI 316L (1.4404).

Surface hardening with SuperExpantite

SuperExpantite20 (NC) process was used in this study to demonstrate the excellent improvement in galling resistance achievable with Expantite surface hardening solution. This can be achieved thanks to the increase of surface hardness by up to 10 times, while maintaining or even enhancing corrosion resistance of AISI 316L. The SuperExpantite (NC) process family consists of two main steps. First is ExpantiteHigh-T that anneals the core material and provides increased hardness up to 1mm depth, relative to the core. The second step, ExpantiteLow-T creates a conversion layer of expanded austenite (solid solution of interstitially dissolved large amounts of nitrogen atoms that occupy octahedral holes of the FCC lattice) which provides a surface hardness of 1200HV. The hardened case depth can vary from 10µm through 15µm and 20µm up to 30µm, depending on the Expantite product. The hardness profile of an alloy EN 1.4404 (AISI 316L) treated with SuperExpantite20 (NC) is shown in the Figure 1.

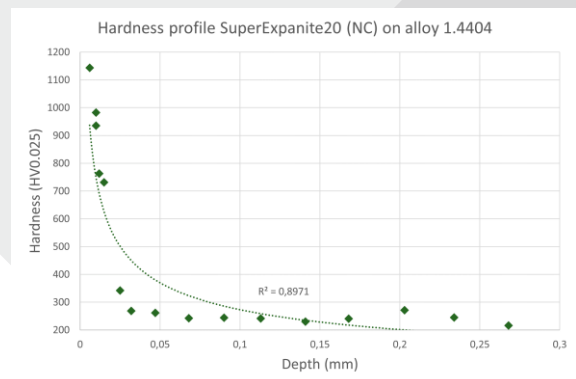


Figure 1: Hardness profile SuperExpantite20 (NC) on alloy 1.4404 (fitted power curve to guide the eye).

Galling mitigated beyond Yield strength.

The test results are summarised in Table 1. In Figure 2 the photos demonstrate the remarkable galling resistance afforded by SuperExpantite proprietary surface hardening technology. In the picture on the top, untreated 316L surfaces can be seen with severe galling under relatively low normal stresses in the range of 3.4-13.8MPa (0.5-2.0ksi). In a mating couple

Table 1: ASTM G98 test results.

Pressure (MPa)	Pressure (ksi)	Untreated surface	SuperExpantite® treated surface
3.4	0.5	Minor	None
7	1	Major	None
14	2	Major	None
34	3	Major	None
276	40	Major	None

with two SuperExpanite-treated surfaces of the same alloy (shown in the bottom picture), galling is almost completely mitigated beyond the yield strength of the material (at contact pressure of 276MPa or 40ksi)! The visible marks are simply an effect of polishing of the test surfaces.

Unprecedented solution to your galling problems.

Steven Budinski, owner of Bud Labs (Rochester, NY), where the test was conducted remarked, "I've never seen such a solution to galling of 316L in my many years of tribology testing". The patented process that produced such results is known as SuperExpanite.

Improve your results with SuperExpanite.

Our unique treatment is suitable for a wide range of austenitic-, ferritic-, martensitic and duplex stainless steels, as well as some Ni-based superalloys. Expanite's innovative and environmentally conscious surface hardening technology is based on cutting-edge research, therefore, your parts can be treated with extremely short lead times – a few days – which is previously unseen within surface hardening of stainless steel.

About Expanite

Expanite was founded in 2010 by leading experts in material and surface hardening from the Technical University of Denmark. The company has its head office in Hillerød near Copenhagen and service centres and licensees in the USA, Germany, Korea, and China. Expanite's DNA is based on sustainable solutions to extend the life of components made of stainless steel, titanium, and other high-value alloys - and the business model allows for license agreements whereby customers may implement the technology in their own production lines. The customers for Expanite's services are found within several industrial sectors, including process equipment for the food and pharma industry, pumps, valves, medical devices, the automotive industry, watch production and many others - everything from large global groups to specialists with a niche focus.

www.expanite.com

Non-treated 316L surfaces



SuperExpanite treated 316L surfaces

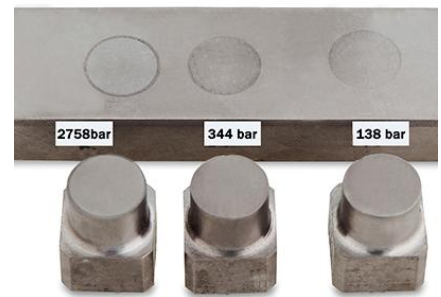


Figure 2: Surface of counterparts after ASTM G98 test for untreated 316L (top) and SuperExpanite® hardened samples (bottom).

