

SIGNIFICANT WEAR REDUCTION BY USING SUPEREXPANITE® HARDENING ON MARTENSITIC STAINLESS STEEL.

Wear is a pervasive problem for stainless steel, - also on martensitic stainless steels and even after vacuum hardening. Thanks to a standard ASTM G133 Standard Test Method for Linearly Reciprocating Ball-on Flat Sliding Wear, the resistance of materials can be quantified. The almost 50 times reduction in wear for martensitic stainless steel with the SuperExpanite® surface hardening process is truly remarkable and shows that Expanite® is the leading solution to significantly improve the lifetime of your parts and products!

Ball-on-flat sliding wear test (ASTM G133).

The ASTM G133 test geometry involves a pin with a ball shaped tip made of 100Cr6 alloy (hardness above 800HV), sliding in a reciprocating motion with a constant force of 25N, doing a fixed number of strokes with an amplitude of 10 mm at a frequency of 5Hz. After the test has been completed, the resulting wear track is both visually inspected and measured with a profilometer. From this data, values for the depth and volume of the wear track can be gathered. In this case, two solutions with martensitic stainless steel were tested, one with standard vacuum hardening (total length of 54m) and one with SuperExpanite10 (NC Cryo) hardening (for a total of 100m).

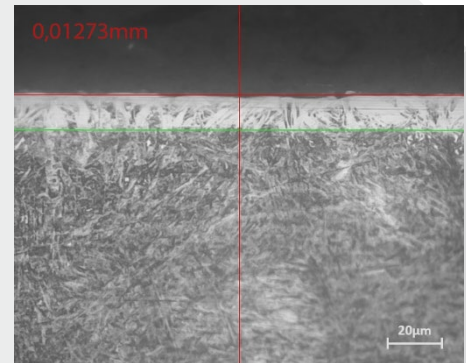


Figure 1: Microphotograph of SuperExpanite®10 (NC Cryo) on alloy 1.4021 (x40 magnification).

Specialized solution for demanding applications.

High performance materials require high performing solutions. The SuperExpanite10 (NC Cryo) is a special surface treatment developed for martensitic alloys. The process consists of three steps: ExpaniteHigh-T that provides increased hardness up to 1mm depth, a sub-zero treatment ensuring homogenous martensitic structure and an ExpaniteLow-T, that creates in-situ a hardened 10µm thick layer of expanded austenite (see Figure 1.) with a surface hardness of around 1200HV. However, this step is also responsible for tempering of the core material. The hardness profile for SuperExpanite10 (NC Cryo) treated alloy 1.4021 can be seen in Figure 2. The average core hardness after treatment was measured at 625HV1. A drop in hardness of the underlying ExpaniteHigh-T treated material starts to show up above 800µm and reaches the core hardness values at around 1.4mm.

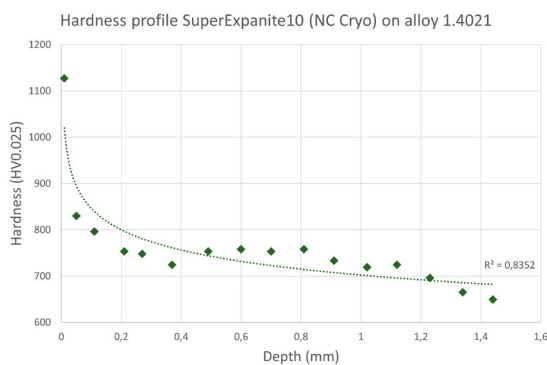


Figure 2: Hardness profile SuperExpanite10 (NC Cryo) on alloy 1.4021 (fitted power curve to guide the eye).

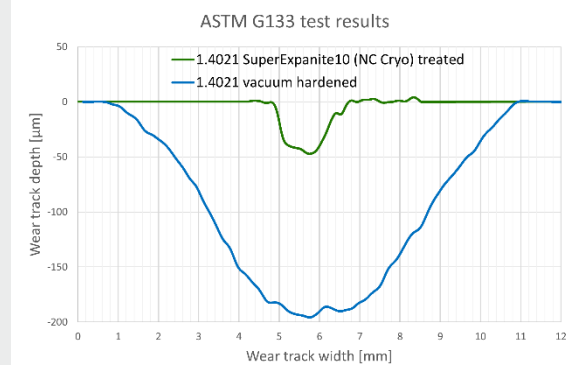


Figure 3: Benefit of applying SuperExpanite® (smoothing: Gaussian filter, cut off 0.08mm)

Significant increase in lifetime of your parts.

Cross-sections of wear tracks can be seen as profiles shown on the graph in Figure 3. The results obtained from testing SuperExpanite treatment applied on a martensitic 1.4021 alloy show approximately 4 times shallower wear mark (at almost twice the sliding distance), as compared to a standard vacuum hardening. This in turn means that the specific wear rate, a material property that takes into consideration the differences in total sliding distance, was reduced almost 50 times (see Table 1)!

The wear track obtained after the test can be seen in Figure 4. The reddish hue is a result of fretting corrosion, where reciprocal motion and wear causes removal of fine particles of a 100Cr6 ball bearing, and elevated temperatures increase oxidation kinetics.



Figure 4: Wear track on the flat test block after ASTM G133 wear test. Alloy 1.4021 treated with SuperExpanite10 (NC Cryo) against 100Cr6 ball bearing.

Table 1: Mean wear rates measured on wear tracks.

Hardening process	Mean specific wear rate (mm ³ /N.m)	Specific wear rate reduction
Vacuum hardening	7,4·10 ⁻³	47,5 times
SuperExpanite®	1,6·10 ⁻⁴	

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.

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