NITREG®-S NITRIDING OF STAINLESS STEEL

CAPABILITIES, PROCESS CONTROL & RESULTS

WHAT IS IT?

General Description of Nitreg®-S

Both the basics of nitriding in general, and the Nitreg® technology in particular, have been described elsewhere. Assuming that the reader is familiar with these concepts, we can now explore the key aspects of nitriding of stainless steel, in a potential-controlled process.

Stainless steels respond to nitriding differently than other ferrous alloys, and there are also significant differences within the stainless group as well. In fact there are still engineers, metallurgists and a number of heat treaters who do not even know that stainless steels can be nitrided. The primary reason for this is that depending on the chemistry of the steel it will behave differently with respect to the kinetics of layer formation, and it is a rather difficult process to control. In other words, unless you know what you are doing you may end up with nothing, or too little, or too much case depth or white layer, or even damaged parts.

Nitreg®-S is a process in which any stainless steel may be nitrided, with complete control over the formation of nitrided layers.

Piston Ring Expanders, AISI 304 Steel

ALTERNATIVES

What Alternatives May Be Considered and Why

With the very high surface hardness achievable on stainless steel, there are not very many alternatives. Designers will normally consider one of the following options:

- Nitralloy for wear applications, or
- tool steels (e.g., H13) for wear and fatigue.

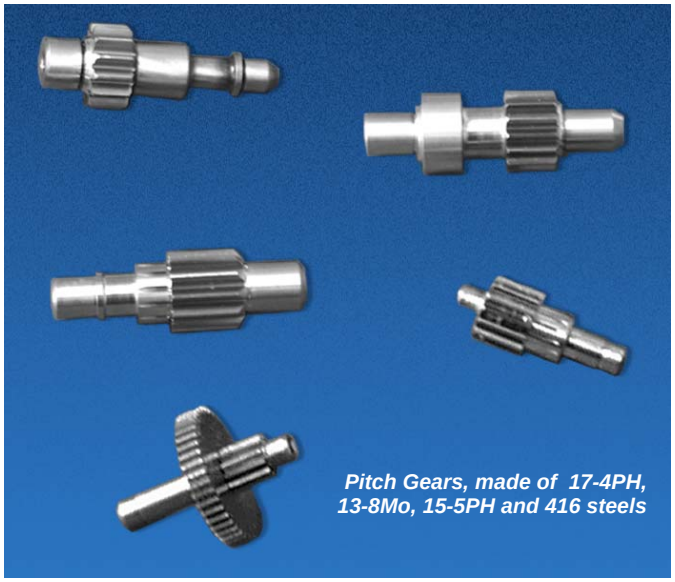
Both of these materials reach very high surface hardness levels when nitrided correctly. In terms of applicable nitriding technologies, plasma (ion) nitriding, described in a separate brochure, may also be used in some situations.

WHY NITRIDING?

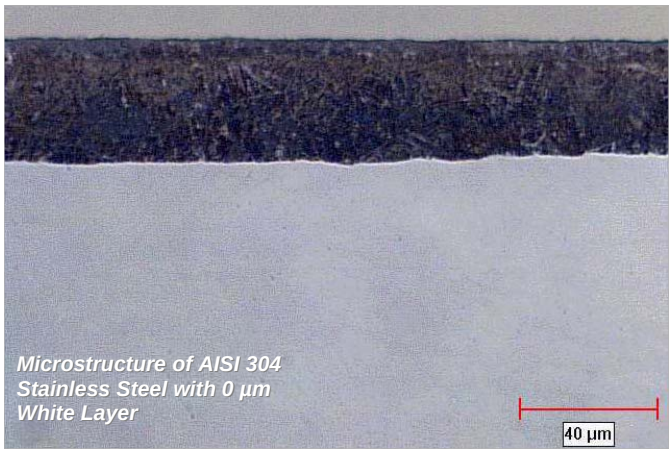
Reasons to Nitride Stainless Steels

Stainless steels are nitrided for only one reason – to increase the components surface hardness, thus enhancing their wear and fatigue resistance. However, a better question to ask is why would anyone select a stainless steel to make a component that will then be nitrided. Here are some plausible answers:

- non-magnetic properties,
- resistance to corrosion, chemicals and/or heat (see the RESULTS section for comments on corrosion resistance),
- availability in a particularly user-friendly form (sheet, casting, etc.),
- casting, stamping, forming or machining characteristics,
- exceptional ability to develop an extremely hard nitrided case.



Pitch Gears, made of 17-4PH, 13-8Mo, 15-5PH and 416 steels



Microstructure of AISI 304 Stainless Steel with 0 µm White Layer

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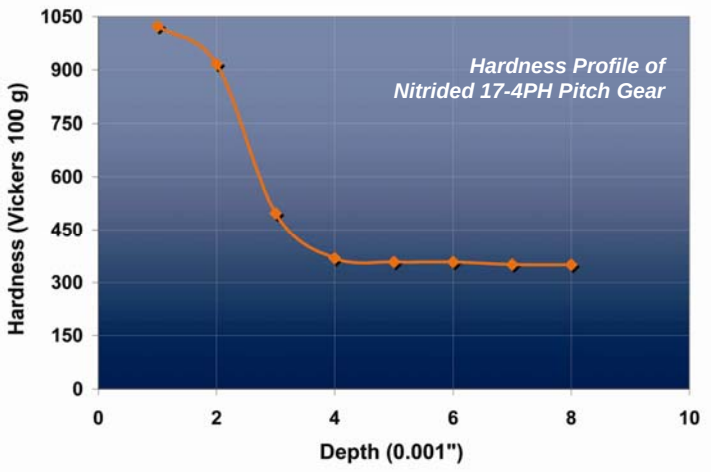
HOW IS IT CONTROLLED?

Characteristics Controlled in the Nitreg®-S Process

In the Nitreg®-S nitriding process the following aspects of the process can be controlled:

- diffusion is the same as in any other well run, high quality nitriding process – it is a function of temperature and time in a suitable atmosphere,
- ability to produce a diffusion case with zero white layer, or a layer of specific thickness
- the process is controlled primarily through:
  - ► proper sequence of stages
  - ► gas mixtures in individual stages of the process,
  - ► temperatures,
  - ► Nitriding potential for control of the white layer formation.



WHAT ALLOYS CAN BE TREATED?

Examples of Applications Suitable for Nitriding

The process is applicable to all stainless steels (e.g., 303, 422, 17-4PH, 13-8Mo, A286, as well as high nickel alloys). Typical applications will include: gears, gear-shafts, valve stems, plates, latches, pins, lock or actuator components, racks and pinions, levers, etc.

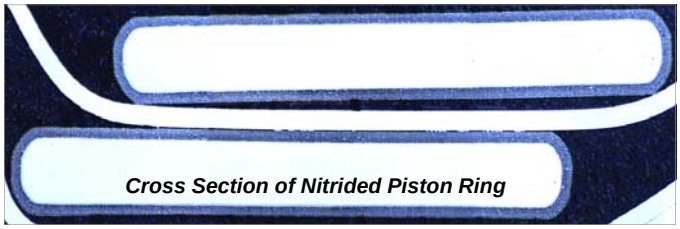
RESULTS

Control of Properties

The most significant characteristic of the Nitreg® family of nitriding technologies is our ability to control the development of the diffusion case separately from the compound (white) layer. Some find it hard to believe, but we are able to produce any case depth combined with any white layer thickness, within the ranges described below.

In nitriding of stainless steel it is extremely important to understand the risks in specifying a deep case or a thick compound layer. Stainless steels develop extremely hard nitrided layers, due to their alloy content, primarily chromium. Therefore a reasonable specification will rarely exceed a 0.006" (150 µm) case, and the white layer should generally be within the zero to 0.0004" (10 µm) range. Should these be exceeded, there is risk of damage due to the layer's inherent brittleness.

Users must also understand that nitriding (any nitriding, regardless of the process) may produce some loss of corrosion resistance. We have developed methods of minimizing the effect, an important issue in certain applications.



WHY NITREX?

Reasons for Selecting Nitrex to Be Your Subcontractor

Nitriding tradition and experience in the Nitrex's team of engineers and scientists stretches back continuously through three generations all the way to 1950. Our team never backs away from even the most challenging nitriding or nitrocarburizing application.

Ask us for an advice about which nitriding method is better suited to your situation. If your drawing calls for "ion", or "plasma", or any other nitriding we are at your service.

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