



# NITREG®-C Potential-Controlled Nitrocarburizing

## Surface Hardening Technology for Wear Resistance

### WHAT IS NITROCARBURIZING?

#### General Description

Nitrocarburizing is a technique derived from nitriding and it is frequently referred to as "FNC" (ferritic nitrocarburizing). It is a surface or case hardening process whereby nitrogen is diffused into the surface of components made of ferrous alloys, by exposing the metal to a liquid or gaseous medium carrying nitrogen and carbon. This could be molten salts, gaseous ammonia or ionized nitrogen gas, with an addition of carbon compounds. The process may be conducted within a temperature range of 450-650°C (approximately 840-1200°F), although nitrocarburizing is usually carried out at around 580°C (approximately 1075°F).

The hardening effect is produced by nitrogen forming hard nitrides with iron, chromium, aluminum, and certain other elements in the alloy, with the presence of carbon in the processing medium ensuring good stability of various nitride phases and promoting the highest possible hardness. Steels with a relatively low carbon content benefit from this process most, while the effects on steels containing more than 0.4% C are similar to those obtained in nitriding.

Nitrocarburizing should not be confused with carbonitriding, a completely different high temperature process derived from carburizing. Carbonitriding is described in a companion brochure insert "Carburizing & Carbonitriding".

Various methods of nitriding are described in our brochure insert "Nitreg® - Potential-Controlled Nitriding". Most of the text of that brochure is applicable to nitrocarburizing, and such descriptions will not be repeated here. However, differences and information particularly applicable to nitrocarburizing will be emphasized.



### NITROCARBURIZING?

#### Reasons to Use It

Primarily low carbon steels are nitrocarburized to dramatically increase their resistance to wear. In some cases corrosion resistance and appearance of the steel surface may be improved at the same time. In most cases the treatment is applied as a final manufacturing operation, or as one of the last few steps.

### WHAT IS NITREG®-C?

#### Potential-Controlled Nitrocarburizing

Nitreg®-C is a state-of-the-art nitrocarburizing method, derived from the renowned Nitreg® potential-controlled nitriding processes and built on the principles of:

- control of nitriding potential,
- modern equipment design with superior performance and reliability,
- automation and computerized controls, and high precision control devices and instrumentation,
- ease of operation and fool-proof nature of operating the equipment,
- know-how reflected in thousands of process setups, with very precise repeatability of results.

Synchro rings made from low carbon micro alloyed steel



Main requirement called for more than 80% of the  $\epsilon$ -phase present in white layer. Results of X-ray diffraction tests showed  $\epsilon$  content to be 97- 98%.

### HOW IS IT DONE?

#### Equipment & Process

In the Nitreg®-C process the following aspects of the process and the results can be controlled:

- to **maintain the appropriate nitriding potential** in each stage, the process is controlled automatically through:
  - a) a sequence of stages with appropriate parameters,
  - b) gas mixtures and flows,
  - c) temperatures;
- in addition the following system functions are controlled:
  - a) pressure in the furnace,
  - b) functioning of valves, flow measuring devices, heating, cooling, etc.,
  - c) alarms and automatically executable emergency procedures,
  - d) data collection;
- no operator involvement is required at any time during the process,
- ability to produce compound ("white") layers composed of predominantly  $\epsilon$ -phase nitrides, with the most advantageous wear properties.



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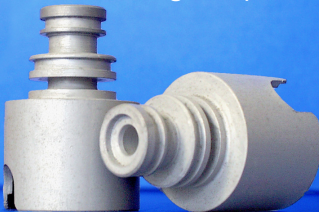
### NITREG®-C?

#### Reasons to Use Nitreg®-C

The reasons to use Nitreg®-C in preference of any other nitrocarburizing method are as follows:

- complete control of nitriding potential, with assured repeatability of results,
- major improvement in control of the surface chemistry over conventional gas or salt treatment,
- uniformity of results regardless of parts positioning in the furnace, including almost total lack of sensitivity to any contact between the parts, or between the parts and the racking system or baskets,
- ability to reach the highest possible values of surface hardness,
- no distortion, and minimal and predictable growth,
- superior wear properties.

**Housings (12B10 grade free machining steel)**



**Camshafts (grey cast iron)**



Customer Specification: consistent & uniform white layer on entire surface; Housings 25µm (0.0010"); Camshafts 11µm (0.0004")

**Gas Spring Rods after 560 hrs in salt spray (ASTM B117)**



◀ Untreated

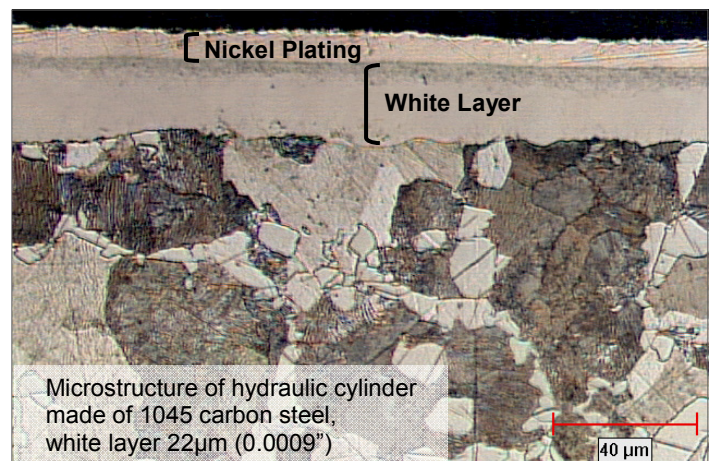
◀ Nitriding only

◀ NITREG®-C & ONC®

### SPECIFICATIONS & RESULTS

#### Discussion of Applicable Specifications & Achievable Results

The most applicable industry-wide specification is AMS 2759/12, the recently issued standard for the aerospace industry. It defines very specific nitriding and carburizing potentials and their effect on porosity in the white layer, which may have various positive or negative effects on certain aspects of wear characteristics. Nitreg®-C may be operated to meet all the requirements of AMS 2759/12, with independent control of nitriding and carburizing potentials. The process is capable of meeting all results-oriented nitrocarburizing specifications achievable by any nitrocarburizing process currently available on a commercial basis.



Microstructure of hydraulic cylinder made of 1045 carbon steel, white layer 22µm (0.0009")

### 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 advice about which nitriding method is better suited to your situation. If your drawing calls for any nitrocarburizing, we are at your service.

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