



NITREX GROUP

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# COMMUNICATOR

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IN FRONT LINE OF HEAT TREATING TECHNOLOGIES

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## Editor's Note

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Since nobody's complaining I will press on with expressing my own subjective views on a variety of subjects that touch our company in some fashion. In my last editorial I dared to prophesize that the world would continue to move on, more or less as before. This is not as difficult as it seems. Indeed not much has ever changed in this respect. As unfortunate as it is, wars or smaller clashes erupt here and there from time to time, natural catastrophes destroy the lives, literally and figuratively, of large groups of people, and various other forms of suffering affect everybody, sooner or later. However, this is as true today as it was five years ago, or five thousand years ago, and it will also be true next year, and in the next century. The means of dealing with crises may change, and today the media make sure that the worst examples of such tragedies are shown in full color on our HDTV sets. But in spite of the undeniable fact that such suffering is real, and even though it is sometimes difficult not to despair seeing it so vividly, life still goes on in a multitude of positive ways. How does that happen? How can we contribute?

At first glance it may seem insane to think that any of us can have a meaningful influence on the world as a whole. But in fact we can, by making thousands of small decisions every day. As a company, i.e., a group of people scattered around the world but trying to work in unison, we influence the world a great deal. Every company has a mission statement, either expressed in writing or simply existing in the spirit of the actions of the people involved. We also have a written mission statement but I will not quote it here; it is redundant from the point of view of what I am trying to say. In the end I believe that every company, and in fact every person in the world should really have the same mission statement.

The thought can be expressed using many different words, and I will not attempt to refine mine in any way, but the essence of it should be: "perform actions that make life better for everybody (including yourself) and produce a reasonable profit". Whereas the first part of the statement is intuitively obvious, the profit bit may confuse some of my readers. However, if you fail to make a profit (which, by the way, need not necessarily be in the form of money), or if you do not consider your own well-being consistently, you can't possibly hope to be able to help anybody else, and you will run yourself to the ground.

So, how do we attempt to do it at Nitrex? We try to build the best possible products and perform our services in the best possible manner. Our job is to develop the best processing methods in the realm of heat treating of metals, and to transfer this knowledge and the benefits attached thereto to our service centers and customers. In the process of doing so we earn profits that we may then, as a company and as individuals, invest in worthwhile products and services performed by others. This is how every one of us is in a position to start a chain of activities that ripple gently through the invisible field of human emotions around the world. Let's therefore make wise choices in life because even the smallest of our actions will affect others who, in turn, will reflect such actions back to us in one form or another. The colloquial expression of this thought is – "what goes around comes around". Let's make sure we generate as much good will as we are capable of knowing that events are not a random lottery like some of the ancients may have believed.

All the best to you, as well as your families and friends.

Business News in Brief

Orders & Installations

- Assab Taiwan
- Combustol Brazil
- Hindustan Aeronautics India
- MPC Products USA
- NTN-Bower USA
- Wellman Products Group USA



ASSAB Taiwan

**Second Nitriding System for ASSAB Taiwan ...**

ASSAB Steels Taiwan Co. Ltd, a premier producer of tool steels in the Asia Pacific region, will add in May 2007 a second nitriding system to support its increased heat treating services capabilities for processing extrusion, forging and die-casting dies as well as feed screws. Presently, the company houses a NX-815 system capable of Nitreg® and ONC® treatments. The first is used for improving the mechanical performance of treated parts, and ONC® is for applications that require both enhanced wear and corrosion resistance. With the addition of a second Nitrex system, Assab will increase its daily capacity to approximately 3000 kg (6,600 lbs).



HINDUSTAN Aeronautics India

**Hindustan Aeronautics India to Nitride Fuel Injection Components...**

Nitrex sold its first small-scale nitriding furnace to Hindustan Aeronautics Ltd., an Indian manufacturer of aircraft, helicopters, aeroengines, accessories and avionics. The NX-406 is one of three models available in the series and has a work zone diameter and height of 15 ¾" by 23 ½" (400 by 600 mm) with a 440-lb (200-kg) capacity. The furnace is integrated with the

control system and shares similar design features as our large-scale furnaces, such as light ceramic fiber insulation for efficient heating, a double-wall Inconel retort, a recirculation turbine for uniform temperature distribution, and an automatic lift cover mechanism. The equipment will be used for nitriding fuel injection components. Installation is scheduled for May.



Combustol Brazil

**Combustol Expands Nitreg® Nitriding Capacity...**

Combustol's Sao Paulo, Brazil service center has expanded its commercial heat treatment capacity with the addition of a BTQ-669 horizontal batch nitriding furnace. The Nitrex engineered system, which has been on-stream since the start of the year, is equipped with the Nitreg®-C technology for nitrocarburizing pneumatic components for a major automotive supplier. The new furnace was installed alongside two existing Nitrex nitriding pit-type furnaces and will increase Combustol's nitriding/nitrocarburizing capacity to approximately 7500 kg (16,500 lbs) per day.

**Nitrex Supplies Nitriding System in China...**

An American automotive parts manufacturer has recommissioned Nitrex Metal (Montreal, Canada) to supply a fully automated nitriding system for their newly-constructed production facility in China. The company first ordered a Nitrex system for installation in their USA-based plant in 2006, and the follow-on order will help the company to meet increasing global demand for its automotive pump components. The furnace has a usable work zone of Ø 31.5" by 59" H (800 mm x 1500 mm) and a gross loading capacity

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of 3300 lbs (1500 kg). The system is supplied with a fully automated control system, Nitreg® nitriding control technology, and a pre-programmed recipe with optimized process parameters for greater consistency and repeatability. Delivery of the system is scheduled for summer 2007.



**MPC Products Places Order For Nitrex Compact Nitriding System ...**

Nitrex received an order for a compact Nitreg® nitriding system from MPC Products Corp. (Niles, IL), a manufacturer of high performance electromechanical motion control systems for aerospace applications. The NX-409 model is a scaled down version of the heavy-duty industrial line of NX models and is suitable for general aerospace, laboratory and testing purposes, as well as nitriding production on a small scale. The furnace is equipped with a process management system that provides tight control of nitriding processes and excellent repetition of results to ensure compliance to NADCAP requirements. MPC Products will use the Nitrex system to nitride actuator components made from different alloys, ranging from carbon to stainless steels. The system was shipped in April 2007, and its plug-and-play setup will significantly reduce installation time and cost.

**NTN-Bower USA Doubles Its Nitriding Capacity...** Nitrex completed the start-up of a second controlled nitriding system for NTN-Bower, a manufacturer of precision roller bearings. The new NX-1220 installation is designed to provide fully automatic process control of nitriding. Identical to the first unit, installed and

successfully operating since April 2005, the follow-on order will double the nitriding capacity of the NTN-Bower plant in Macomb, Illinois. The investment also allows the company to bring the thermochemical process in-house for better control over cost, quality, and turnover. A main feature of the system is the upgrade from individual controls to the NPM Global package, a software utility that allows secure remote access to the furnace control system. Users with full or individually-assigned access can monitor, configure and control the equipment from a remote location.



**Wellman Products Upgrades Nitriding Furnace With Process-Electronic Controls ...**

Process-Electronic (Montreal, Canada) was selected to modernize the controls of a nitriding furnace housed in the Tulsa, OK facility of Wellman Products Group (WPG), a manufacturer of friction materials, stampings, and powder metal parts. The hardware/software retrofit package includes a Protherm 400 controller, an ammonia analyzer, and preprogrammed nitriding processes as well as non-typical recipes for a combination of nitriding and sintering processes. As part of the upgrade, the new controls will enhance the reliability and repeatability of the nitriding process, enabling less skilled operator involvement than previously possible with the manual method, and equally improve the company's benchmark for product first-pass yield (the percentage of treated plates that successfully complete the nitriding process with no rework). These enhancements will also allow WPG to lower their operational costs because of reduced gas consumption, shorter process times, and the elimination of auxiliary equipment and process gases. Installation and startup were completed the first quarter of 2007.

Business News in Brief

Orders & Installations

- **Bosch Rexroth China**
- **Cincinnati Steel Treating USA**
- **DaimlerChrysler Germany**
- **Hansen Transmissions Belgium**
- **Harms Lohnhärtereie Germany**
- **Thermetco Canada**

**Lights-Out Heat Treating at Bosch Rexroth China...** Process-Electronic GmbH collaborated with furnace OEM Aichelin GmbH to install a plant automation system in a lights-out heat treatment cell destined for Bosch Rexroth in Beijing, China. The automation package consists of the Protherm 9800 production management software, a Protherm 500 controller, an iNS intelligent nitriding sensor with dual H<sub>2</sub>/O<sub>2</sub> detection, oxygen probes, and an ammonia cracker. The Protherm 9800 will coordinate and monitor all operations within the heat treatment cell including process cycles, production scheduling, load movement and status, and also provides full process traceability and reporting facilities. The Protherm 9800 automation solution is adaptable to many furnace applications, and at Bosch Rexroth, it is programmed to supervise a carburizing and nitriding line. The carburizing line comprises three carburizing furnaces, a tempering furnace, a washer, and storage/material handling system. For the second line, Protherm 9800 will control four horizontal nitriding furnaces, a pre-oxidation furnace, a washer and storage/material handling equipment. Integration, implementation and commissioning of the automation system were completed in April.

**New Furnace Controls for DaimlerChrysler Hardening Line...** Process-Electronic GmbH partnered again with Wilhem Alte GmbH, a German manufacturer of industrial furnaces, to supply DaimlerChrysler Berlin with a continuous furnace line equipped with Process-Electronic's control system for hardening bolts and gears of passenger car engines used in the Mercedes-Benz and Smart model series. The furnace is fully automated using a PLC-based system comprised of the Protherm 600 for real-time supervision and accurate process control. The furnace is also tied into the Protherm 9000 plant automation structure, which was implemented several years ago and currently consists of 6 chamber furnaces as well as material handling and storage systems. Furnace start-up and its integration to the automation platform were completed in fall 2006.

**Hansen Transmissions Upgrades Shop Floor Automation...** Process-Electronic GmbH supplied Hansen Transmissions with new furnace controls and a plant floor automation upgrade for its gearbox manufacturing and assembly plant in Edegem, Belgium. The order includes a Protherm 300 controller for automatic process control of a new carburizing pit furnace and its implementation into the existing Protherm 9000 plant supervision and automation framework. This is the 12th furnace integrated in recent years to the company's totally automated production site for treating heavy gears. At the same time, the Protherm 9000 was upgraded with a hot standby system to provide fail-safe back-up protection if the primary production server fails. In anticipation of such a failure, the system will automatically switchover to a redundant server, circumventing potential disruptions and costly production downtime. Protherm 9000 employs a scalable structure, which can accommodate an increase in the number of heat treating equipment that Hansen Transmissions adds to its network.

**Commercial Heat Treater Adds 17th Furnace to Automation System...** Process-Electronic GmbH was awarded a contract by Harms Lohnhärtereie GmbH, a commercial heat treatment company located in Germany, to supply process controls for a carburizing furnace that will be used for heat treating large-sized gears. The Protherm 400 controller ensures improved process reliability and will be fully integrated into the existing plant automation architecture, a Protherm 9000 system that presently contains 17 pit furnaces for carburizing, annealing, gas nitriding and plasma nitriding. In addition to new control instrumentation, the contract also included PLC software, gas and electrical panels, as well as support engineering services.

**CST Taps PE for Automation of Nitriding/Nitrocarburizing Furnace...** Cincinnati Steel Treating Co. automated a nitriding / ferritic nitrocarburizing furnace using Process-Electronic process controls at its Cincinnati, Ohio heat treating facility. The automation upgrade included the modernization of a gas-fired pit furnace

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with new instrumentation and hardware such as a gas control panel, gas analyzer, furnace exhaust and heat tracing system, and smart safety system for overheat protection. Furnace controls are based on a Protherm 500 controller pre-programmed for nitriding and ferritic nitrocarburizing processes. The controller is connected to a Protherm 9800 SCADA software that will monitor and supervise the automatic nitriding / FNC cycles remotely, optimizing the furnace's performance and availability. The overhaul results in an automated system able to repeat processes without operator involvement, optimize process and fuel gas usage, and provide the customer with full process traceability and quality control.

**Thermetco Uses HT Tools for Simulation of Carburizing...**

Thermetco Inc. (Montreal, Quebec) has acquired HT Tools, a powerful simulation

tool from Process-Electronic, to design and optimize carburizing processes. HT Tools will significantly reduce Thermetco's lead time for process development, replacing time-consuming calculation analysis and trials to design processes for large-scale gears. The company also chose the ultra-precise CS 87 oxygen sensor to improve the accuracy of real-time process control of its new pit carburizing furnace. The CS 87 delivers low drift performance and is characterized by a patented self-cleaning mechanism that ensures accurate signal detection by keeping the contact between the zirconium dioxide and external electrode permanently clean. As a result, the sensor has no need for periodic maintenance or calibration. Its modular design makes component replacement easy and, at the same time, reduces costly production downtime.

Commercial Service Center News

**Longest Nitrider Installed (Ohio, USA)...**

Our longest (or deepest, if you like) nitriding furnace has been installed at a special facility in Ohio, run by our Nitrex-Michigan team. The furnace capable of Nitreg® nitriding is 4.5 m (14.8 feet) deep and can take loads up to 16 tons (35,000 lb). Customers with unique needs looking to nitride components of this size are encouraged to contact Nitrex-Michigan to schedule their work.

**Major Expansion of Nitrex-Indiana...**

There is so much going on at our Nitrex-Indiana facility that it is impossible to describe it within the limitations of a small note. We have completed a building expansion that doubled our floor space, and we are preparing for another addition. We added vacuum hardening with oil quench, vacuum carburizing, and we expanded our Nitreg® and plasma nitriding capability by installing additional systems. And last but not least, we have achieved NADCAP certification. It is hard to believe that this plant has been in operation for less than four years.



**Further Growth at Nitrex-Chicago...**

Nitrex-Chicago has transformed itself during the past eighteen months into a major player in nitriding. In addition to the well-established conventional and vacuum heat treating, we now have six nitriding furnaces of various sizes. This plant now offers nitriding, nitrocarburizing and ONC® on a rapidly growing scale and we are thankful to our customers for fuelling that expansion.



Surface Improvement Technologies

**PART 4...** So far in our mini-course on heat treating we discussed various methods of nitriding, and then we covered most of the basic concepts dealing with case depths. The latter was a general discussion applicable not only to nitriding but also to carburizing or, as a matter of fact, to any surface hardening method. This time we will discuss nitriding and carburizing by pointing out key differences and similarities between the two groups of technologies.

First, it must be pointed out that there exist other surface improvement processes such as induction hardening, boronizing, shot peening, plating, etc. All of these are extremely interesting, and we will discuss some of them in due course. However, most components made today requiring surface treatment are either carburized or nitrided, and it is natural to deal with these two first. Confusion concerning the differences between these two methods is also a motivating factor for me to want to explain some of the basic principles.

I am sometimes surprised when people look at carburizing and nitriding as processes similar in nature and in the end result, and attempt to take properties obtained by one and specify the same requirements for the other. The similarities between them are in fact very superficial as can be seen in the follow in short list:

- they are both heat treating processes conducted at elevated temperatures;
- in both there is diffusion of something into the material; and
- they produce a hardened surface.

Once we realize that this is the end of similarities, we enter the realm of very significant differences, and this is what this short chapter will now endeavor to clarify.

The first major difference is the substance we are diffusing into the metal, and presumably everybody knows that. In carburizing we have carbon atoms (or carbon with some nitrogen in carbonitriding), and in nitriding we have nitrogen (or nitrogen and some carbon in nitrocarburizing).

The second major difference is that due to the nature of the hardening process, which will be explained momentarily, the temperature of the process is completely

different. Carburizing is generally conducted in temperatures ranging from 850-970°C (1560-1778°F), while most nitriding cycles are set up between 450-620°C (842-1148°F). As everyone can see immediately the respective ranges not only do not overlap at all, but they are far apart, as the difference between the high end temperature for nitriding and the low end in carburizing is very large - approximately 230°C (414°F).

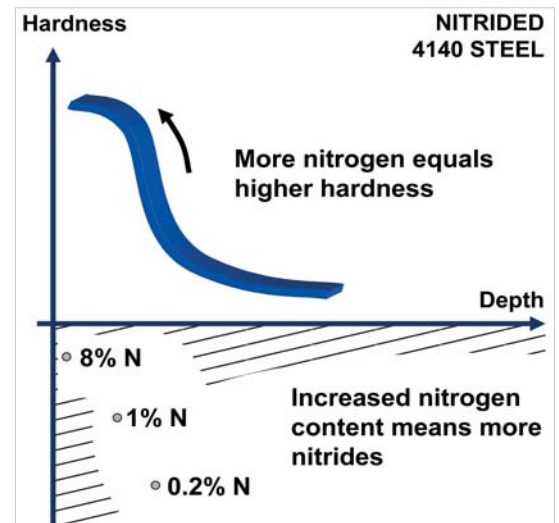
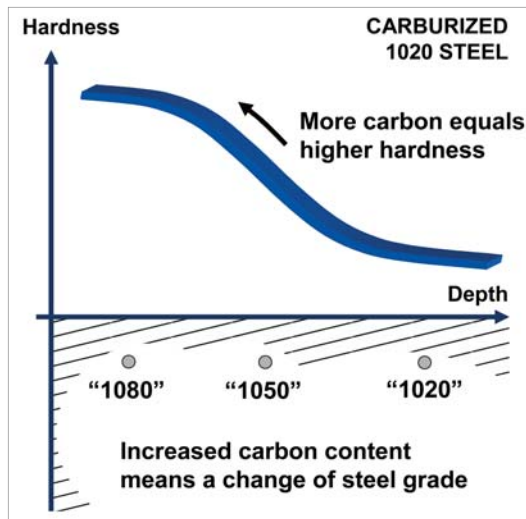
The nature of the hardening process is the third and also the most significant difference, and the matter is explained in a slightly more elaborate manner.

**Nature of Carburizing.** Steel is an alloy of iron and carbon, with various amounts of additional elements. Scientists have accumulated a vast body of knowledge how to adjust the amounts of such alloying elements to our advantage, and the properties achieved on some high alloy steels are indeed amazing. However, manufacturers generally want to make parts out of steels that are cheap and easy to form or machine. This requirement is met beautifully by plain low carbon steels, but there is a problem. These materials are very soft and, if slightly better mechanical properties are needed additional treatment must be performed. In such applications the only practical methods available on an industrial scale are carburizing, further described below, and nitriding, which will be discussed in the paragraph that follows.

So now we are prepared to grasp the concept of carburizing. In this process we are literally capable of changing the type of steel near the surface of the part, by enriching it with carbon. When we start with a steel containing only 0.2% of carbon (e.g., 1020), and subject it to carburizing, we may end up with 0.8% of carbon on the surface, thereby achieving an almost miraculous transformation from 1020 to 1080 steel, a much better grade. The latter can now be quenched and tempered and the surface of the part made of inexpensive soft material is now harder, and therefore more valuable. A chart is included to illustrate the point.

A perceptive reader will realize that carburizing is primarily used on low alloy steels with a relatively low carbon

Surface Improvement Technologies



content, where an increase in such carbon content will improve the material's ability to be surface-hardened.

**Nature of Nitriding.** In this process we do not change the basic chemistry of the steel in the same way as in carburizing. We only enrich the surface with nitrogen but the alloy is still basically the same. The increased hardness comes from the formation of nitrogen compounds with iron and certain other alloying elements, such as aluminum or chromium. These nitrides, which are much harder than the steel, are distributed most densely near the surface, where the hardness is therefore the highest. The enclosed sketch shows the qualitative relationship between nitrogen concentrations and the resulting hardness levels. The steel is still 4140 but with minute quantities of nitrogen compounds (nitrides).

Because of the nature of the process nitriding is applicable to virtually all ferrous alloys including carbon, alloy and stainless steels, as well as cast irons. Our readers may now become interested in what hardness levels and other characteristics can be achieved on these various materials. In my next installment of this mini-course we will specifically address that issue. At some time in the future we will also talk about duplex methods where two (or more) processes are performed in sequence, i.e., some combination of carburizing, nitriding, induction hardening, etc.

I am looking forward to continuing our discussion on these subjects in our next newsletter. Meanwhile, as always, your questions or comments can be sent to [chris.morawski@nitrex.com](mailto:chris.morawski@nitrex.com).

New Product




**C-Detect** is a new, nondestructive testing tool from Process-Electronic used to quickly and accurately verify the carbon content of carburizing atmospheres. Measurement is performed on shim stock, a thin iron foil that is exposed to the furnace atmosphere, extracted, and placed in the C-Detect

receptacle to quantify the real carbon content. Results are then used to adjust the carbon potential of the furnace control instrumentation in order to improve the performance and reliability of the carburizing process. C-Detect's uniqueness lies in its ability to provide accurate readings regardless of shim handling and its surface condition. Gloves are not mandatory, since fingerprints, dust, soot and oxidation will not affect results. The C-Detect also comes available with a custom receptacle for flat or rolled shim stock having a maximum thickness of 0.05 mm (0.002 in).

Upcoming Events

**THERM PROCESS** Düsseldorf, Germany  
June 12-16, 2007



Nitrex - Stand # 5D19  
Process-Electronic - # 5D20

**ASM Heat Treat Show** Detroit, MI, USA  
September 17-19, 2007  
Stand #1908

**63. HK 2007** Wiesbaden, Germany  
October 10-12, 2007

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New Publications



NXH Continuous Nitriding/  
Nitrocarburizing Furnace

**NXH Continuous Line...** 4-page brochure introduces new series of continuous nitriding / nitrocarburizing furnaces for high-volume output. This heavy-duty furnace line is available in 2 standard work sizes, 24" width by 24" height (609 by 609 mm) or 36" by 36" (915 by 915 mm), with custom lengths from 36-72" (915-1830 mm) and a load capacity of 1100-4400 lbs (500-2000kgs). Its flow-through mode enables productivity to increase by 70% compared to large-scale batch furnaces. The modular design allows the combination of a number of process modules for a customized multi-stage operation that meets a wide variety of applications and heat treating requirements. Available cooling options include turbo cooling, rapid gas cooling, and liquid quench. The NXH furnace is capable of a continuous unmanned three-shift operation using PROTHERM 9800, a production management software package by Process-Electronic.

**Atmosphere Sensors and Controls...** In this paper, Process-Electronic examines the influence of atmosphere on surface characteristics of parts and describes the concept of atmosphere potentials for carburizing and nitriding processes. Various types of sensors and methods for measuring the atmosphere potential are presented; and the principle of operation, advantages and disadvantages of each are also detailed.

**Simplifying Shim Stock Analysis...** This technical paper focuses on C-Detect, a new shim stock method for accurately measuring the carbon content in carburizing atmospheres. Its principle of operation, hardware, calibration, and measuring results are presented.