WWW.NITREX.COM

NITRIDING & NITROCARBURIZING
Turnkey Systems | Technologies | Complete Solutions
WHAT’S A NITREX TURNKEY SYSTEM?

A Nitrex turnkey nitriding system is much more than a standard furnace with controls. It’s a comprehensive solution that starts with a client and application assessment, equipment proposal and design, manufacturing, process testing and recipe proofing, continuing to logistics, onsite installation, training and commissioning to plant integration, and after-sales value-added services. This turnkey approach means an integrated nitriding system that delivers superior quality and reliability year after year, while optimizing the performance and cost efficiency of the application.

**FURNACE, CONTROLS AND SOFTWARE**
Based on a detailed analysis of the client’s requirements and project, our expert team tailors the optimal solution.

**TECHNOLOGY & PROCESS DESIGN**
Nitrex metallurgists develop a unique process based on the requirements of the application, then proof the recipe in our test laboratory.

**FILL IN THE GAPS**

**STARTUP, INTEGRATION AND TRAINING**
Nitrex pre-stages and tests the system in its own facility to shorten the installation time at the customer. During and after commissioning, training is included that covers operation, maintenance, and calibration procedures, as well as technology transfer.

**AFTER-SALES SERVICES**
Our portfolio of maintenance and support services includes on-site troubleshooting and new process development, as well as service contracts to ensure that equipment operates optimally while minimizing unnecessary downtime and costly repairs.
SMALL-SCALE BATCH PROCESSING

The multipurpose NXK series of nitriding / nitrocarburizing systems is an economical and dependable choice for use in small scale processing as well as for general laboratory/testing/process development purposes.

- Minimal space requirements
- Short startup period
- Low operating costs for specialized and/or low volume production

### STANDARD SIZES *

<table>
<thead>
<tr>
<th>MODEL</th>
<th>DIAMETER</th>
<th>HEIGHT</th>
<th>LOAD CAPACITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>NXX-409</td>
<td>15¾” / 400mm</td>
<td>35½” / 900mm</td>
<td>660lbs / 300kg</td>
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<td>NXX-412</td>
<td>15¾” / 400mm</td>
<td>47½” / 1200mm</td>
<td>880lbs / 400kg</td>
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<td>NXX-812</td>
<td>31½” / 800mm</td>
<td>47½” / 1200mm</td>
<td>2200lbs / 1000kg</td>
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*Most popular sizes are shown. Please contact Nitrex for other standard and non-standard furnace sizes.

### BATCH-TYPE FURNACES FOR SMALL TO HIGH VOLUME APPLICATIONS

The heavy-duty NX Pit-Type and NXH Front-Loading furnaces provide flexibility for a wide range of applications. By incorporating multiple controlled heating zones, temperature uniformity inside the retort is +/-5°C (9°F) or better.

<table>
<thead>
<tr>
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<th>DIAMETER</th>
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</thead>
<tbody>
<tr>
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<td>NX-620</td>
<td>23½” / 600mm</td>
<td>78¼” / 2000mm</td>
<td>2600lbs / 1200kg</td>
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<td>NX-1015</td>
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<td>59” / 1500mm</td>
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<td>NX-1020</td>
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<td>78¼” / 2000mm</td>
<td>5500lbs / 2500kg</td>
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<tr>
<td>NX-1025</td>
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<td>98½” / 2500mm</td>
<td>6600lbs / 3000kg</td>
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<td>78¼” / 2000mm</td>
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<td>98½” / 2500mm</td>
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<td>61” / 1550mm</td>
<td>177” / 4500mm</td>
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Batch-Type Furnaces for Small to High Volume Applications

These furnaces are designed to have fast heat-up rates and a uniform temperature throughout the load. Optional internal cooling systems dramatically reduce cooling times, shortening total cycle time and maximizing furnace usage.

<table>
<thead>
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<th>LOAD CAPACITY</th>
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<td>35½&quot; / 900mm</td>
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<td>3300 lbs / 1500kg</td>
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<tr>
<td>DIMENSIONS</td>
<td>NXL-9918</td>
<td>35½&quot; / 900mm</td>
<td>31½&quot; / 800mm</td>
<td>71&quot; / 1800mm</td>
<td>3330 lbs / 1500Kg</td>
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</tbody>
</table>

Furnaces Engineered for Continuous Operation

NXL series of multi-chamber continuous furnaces uses multiple process modules as a means of increasing the system’s capacity and adaptability to technological demands. The NXL is offered in standard or custom sizes and configurations to suit unique needs in terms of part dimensions, productivity as well as metallurgical requirements.

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Optional Auxiliary Equipment

- Furnace Rack & Basket Sets
- Rack Lifting Device
- Accelerated Cooling System
- Exhaust Neutralizing Equipment
- Closed-Loop Water Cooling System
The Nitrex Process Control System is a product of extensive research and development in process automation. Our design philosophy is to simplify control by using program capabilities to execute nitriding or nitrocarburizing processes in an automatic, self-adjusting and operator independent manner.

The Nitrex controller is bundled with NITREG® technologies, an industry-proven process that delivers individually customized recipes for different applications and materials with optimum results. More information about NITREG® on page 8.

The Nitrex Process Control System is optimized to monitor and regulate all furnace functions, nitriding/nitrocarburizing cycles, alarms, and maintenance conditions.

The system consists of 3 distinct sections:
- A Nitrex process controller with I/Os
- A gas panel with atmosphere analysis, flow and pressure measuring transducers, including the H2Smart™ and mass flow controllers
- An electrical panel with a SCR/SSR controller for each heating zone

The uniqueness of this system lies in its ability to control the Nitriding ($K_N$), Carburizing ($K_C$) and Oxidizing ($K_O$) potentials of the atmosphere in a continuous fashion. Such true process control means an automatic correction of flows and ratios of the inlet process gases, ensuring that the desired potential settings of the atmosphere are maintained. This type of control takes into account variations of the active surface of treated parts.

The process control system operates via user friendly, menu-driven software, which assists and helps the operator in the selection of process cycles, equipment calibration, and troubleshooting. The desired cycle is selected from a library of NITREG® cycles designed and pre-tested by Nitrex. Once the cycle is selected, the computer takes over further operations until parts are ready for unloading.

What’s an H2Smart™?

H2Smart™ is at the heart of the Nitrex process control. It ensures accurate measurement of hydrogen in nitriding and nitrocarburizing atmospheres. Its unique design with a variable output integral pump allows the set sampling flow rate to be automatically maintained. A flow control circuit complete with pump saturation warning and flow alarm insure reliable sampling and accurate readings.
PROCESS CONTROL SOFTWARE

NPC PROCESS CONTROL PROGRAM

The operator interfaces with the Nitrex Control System through a single control panel consisting of a monitor and keyboard. The user friendly, menu-driven Nitrex NPC software assists the operator in executing the necessary commands with respect to the nitriding process and other related functions.

The user interface contains all relevant information on the furnace, processes, jobs, and stages. It graphically displays process variables such as temperature, flows, power output, nitriding potential, as well as the actual status of the nitriding process and the system equipment. This allows the operator to easily monitor the nitriding system.

What does it do?

NPC monitors and controls the following parameters and operating functions:

- Furnace heating functions such as process temperature, and overheat control with automatic emergency procedures
  - Atmosphere composition and flow for a particular cycle
  - Nitriding atmosphere ratios
  - Nitriding Potential $K_n$ (dissociation rate for customer defined cycles)
  - Temperature for each process stage
  - Gas pressure inside the retort
  - Gas recirculation
  - Execution of the cooling stage and shutdown
  - Cooling water
  - Process safety features

How do I use it?

From the single-point user interface, an operator can:

Select, schedule and start a job
- Abort a job as per user request
- Automatically abort a job in case of crucial errors in the system
- Resume interrupted job by emergency procedure
- View list of current alarms and acknowledge alarms
- Modify process parameters prior to initiating a process
- Modify process parameters of current running job
- View and print LOG files
- View and print graph of selected process variables (temperature, pressure, etc.) for a selected job
EXHAUST GAS NEUTRALIZER LINES

Nitrex firmly believes in building environmental friendly systems that encourage the protection of nature. Our two lines of neutralizers are designed to eliminate residual ammonia and/or other pollutant gases while minimizing NOx emissions. The INS series is designed for nominal effluent atmosphere flows ranging between 11-106 cfm (5-50 l/min). For higher flows up to 2120 cfm (1000 l/min) and for more stringent environmental control, the high efficiency IN series is recommended.

FEATURES & BENEFITS:
• Economic solution / Low operating costs
• Low NOx / Low emissions
• Compliance with environmental regulations
• Improved furnace and process reliability
• Connectivity to furnace controls

NPM is a software package that allows users to remotely interact with their Nitrex heat treating systems equipped with NPC heat treating program.

KEY FUNCTIONS:
• View Nitrex heat treating systems equipped with NPC™ and connected to NPM™
• View and acknowledge alarms
• Start / abort / resume jobs
• View and print LOG reports
• View / Print Real Time Graphs
• Modify the Process Library
• Modify parameters of currently running jobs
• Create new users / Modify user access levels

From the Process Builder window, users can modify the setup of an existing process, adding or deleting process stages, set points, atmosphere composition, process times, and much more.
THINK NITREG® WHEN WEAR, FATIGUE & CORROSION MATTER...

NITREG® NITRIDING

NITREG® represents a family of potential-controlled gas nitriding technologies. This technology enables the creation of individually customized processes for different parts, applications and materials offering optimal results. The most significant characteristic of NITREG® and its derivative technologies is the ability to produce various configurations of the nitrided layer tailored to enhance wear, fatigue or corrosion resistance.

NITREG® Potential-Controlled (K_n) Nitriding also helps to:
• Eliminate closed nitride networks in the diffusion zone
• Prevent over-nitriding and distortion of treated parts
• Produce stable results from one load to another

NITREG®-C NITROCARBURIZING

NITREG®-C is a nitrocarburizing process with K_n and K_c control that incorporates simultaneous diffusion of nitrogen and carbon into the steel surface.
• Quick formation of white layer on low-carbon unalloyed steel
• Low operational costs by utilizing economic gas compositions
• Stable ε-phase content in most types of steels

NITREG®-S FOR STAINLESS STEELS

NANO-S™ is a surface hardening process that improves the wear and galling resistance of stainless steel components without affecting the inherent corrosion resistance. It diffuses nitrogen and/or carbon into the surface, creating a S-Phase structure that provides extremely high hardness.

NANO-S™ reduces frictional wear and improves the operating efficiency of ball valves.

NITREG®-C NITROCARBURIZING

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• Quick formation of white layer on low-carbon unalloyed steel
• Low operational costs by utilizing economic gas compositions
• Stable ε-phase content in most types of steels

ONC® IN-PROCESS OXIDATION

ONC® is an in-process post-nitriding or post-nitrocarburizing oxidation process with oxidation potential (K_o) control that has the dual effect of enhancing wear and corrosion resistance, while producing an attractive black finish on metal parts of various grades of steel. The process produces two distinct microstructure zones: the first is a white layer tailored to the requirements of the application and material, and the second, formed above the white layer, is a 1-2 μm [0.00004-0.00008"] complex oxide surface layer with added anti-corrosion properties.

Brake piston on right treated with ONC® shows first corrosion spot after 400 hours in the salt spray chamber test per ASTM B117. Part on left treated by competitive process and exposed to salt spray for an equal amount of time shows 60% of the surface area corroded.

NITREG®-S FOR STAINLESS STEELS

NITREG®-S is a special nitriding technology with a proprietary de-passivation stage that removes oxides off alloying elements to allow nitriding of the metal to take over.

NITRIDABLE MATERIALS:
• Carbon steels
• Alloy steels
• Cast irons
• Cast steels
• Stainless steels
• Nickel alloys
• Steel-based high density powder metals
• Titanium alloys
Precision Nitriding for Your Critical Specs

CRANKSHAFTS
High performance automotive and aircraft engine crankshafts are nitrided for better fatigue resistance and wear properties on bearing journals.

FUEL INJECTORS
Nitriding is the appropriate method for improving the wear resistance of small cross-section parts or those that easily lose their shape. A good example of such a part is the fuel injector, which requires a high wear resistant surface necessary to prevent abrasion by a high-velocity fuel stream.

SHAFTS (STAINLESS STEEL)
Shafts made of stainless steel or nickel based alloys require vacuum hardening and tempering, frequently followed by nitriding.

GEARS
Nitriding gears for applications ranging from heavy-duty machinery to small automotive accessories enables lower manufacturing costs. For one customer, this meant eliminating costly finishing operations needed after carburizing.

Our commitment to R&D and close relationships with our customers from a variety of industries allows us to continuously perfect our technologies and develop proper nitriding / nitrocarburizing processes for many applications.

The following are just some examples.

SHAPS
Properties of small shafts exposed to atmospheric conditions and/or other corrosive environments are frequently treated in an in-process post-nitriding oxidizing treatment. Such components have excellent wear and corrosion properties, as well as an attractive appearance.

ALUMINIUM EXTRUSION DIES
Extrusion dies are nitrided and re-nitrided several times to extend their die life. Nitriding parameters are adjusted to the expected die duty cycle resulting in significant cost reductions and virtual elimination of unscheduled press shutdowns.

FORGING/FORMING DIES
Forging and forming dies made of tool steels, alloy steels, cast steels or cast iron are frequent visitors in a heat treating shop. Dies are vacuum hardened and tempered, flame hardened, flood-welded, and nitrided, as applicable, for better life.

PISTON RINGS
Nitrided piston rings show high surface hardness at elevated temperatures, and good sliding wear resistance with a low coefficient of friction.
The P-SERIES is a new addition to the Nitrex portfolio of nitriding / nitrocarburizing systems and is designed primarily for commercial heat treating companies. It takes advantage of the best-of-class Nitrex nitriding / nitrocarburizing furnaces and features flexible controls based on United Process Controls’ PROThERM™ controllers, which are capable of running the most advanced user-configured recipes with % Diss, K_n, K_c, and K_o setpoints to meet AMS 2759/10 and 2759/12† specifications. PROThERM™ controllers are feature-rich and offer easy connectivity to the PROThERM™ 9800 Production Management Software or to third party SCADA systems. The integrated recipe builder allows the user to design a recipe by configuring process parameters such as % Diss, K_n, K_c, K_o, temperature, atmosphere mixtures, furnace pressure and more.

The P-Series opens up new vistas for expert users looking to leverage and support their in-house recipe development and process design capabilities.

FURNACE
Horizontal and vertical standard models with a load capacity of up to 1500 kg (3330 lb) and 10,000 kg (22,000 lb) respectively for a broad range of applications. Furnaces are designed to have fast heat-up and cooling rates, as well as uniform temperature and atmosphere throughout the work zone. By incorporating multiple controlled heating zones, temperature uniformity inside the retort is +/-5°C (9°F) or better.

PROCESS CONTROL
The PROThERM™ controller monitors and regulates all furnace functions, nitriding / nitrocarburizing cycles with % Diss, K_n, K_c, K_o setpoints, alarms, and maintenance tasks. The integral H2Smart™ sampling system ensures extremely accurate measurement of hydrogen in the process atmosphere, thereby achieving precise control of processes.

AUXILIARY EQUIPMENT
A range of optional auxiliary equipment is available to enhance the P-Series capabilities and process efficiencies.

† Depending on the options selected
SOLUTIONS TO OFFSET HIGH OPERATING COSTS

EQUIPMENT INTEGRATION AND PLANT AUTOMATION SOLUTIONS ARE USED INCREASINGLY TO ENHANCE PERFORMANCE AND PRODUCTIVITY AS A WAY TO OFFSET HIGH OPERATING COSTS.

This advanced level of automation minimizes setup and throughput time, optimizes workflow, prevents costly operational errors associated with manual handling of parts or loads, and achieves the highest level of quality in a cost-effective manner.

Nitrex nitriding systems are designed to integrate seamlessly with existing production lines or automated manufacturing facilities. When a Nitrex system becomes part of an automated manufacturing environment, operational efficiency is further enhanced, maximizing equipment usage and yielding a lower production cost per piece. When configured to operate in a fully automated environment, loads are transferred automatically by PLC-controlled charge cars guided by a laser positioning system. This enables high volume production with continuous 3-shift “lights-out” operations and no operator involvement.

For the highest level of operational control Nitrex proposes United Process Controls’ Protherm 9800. It offers an overview of your heat treating operations, full automation and capabilities for interfacing with higher-level resources and planning systems included in your Business Management System. Your heat treating shop becomes visible, transparent and interactive for all your key people.

This software package delivers everything to optimize the performance and efficiency of a heat treatment plant operating with a wide variety of furnaces as well as automatic handling machinery. By combining process control, equipment integration, and automation capabilities, the Protherm 9800 provides a comprehensive approach to plant-wide supervisory control and management.