INTEGRATED TURNKEY SYSTEMS

What’s a 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.

Logistics & Project Management
Our knowledge of import and export procedures, and know-how in handling special cargo, enables us to ensure stress-free delivery of projects. Project managers coordinate and execute client projects right from the start through to final acceptance, communicating with the client on an on-going basis about the status and progression of their project.

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.

PRE-ENGINEERED AND CUSTOM FURNACES

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.

<table>
<thead>
<tr>
<th>Fully Integrated Package</th>
<th>Working Zone Dimensions</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Standard Sizes</th>
<th>Model</th>
<th>Diameter</th>
<th>Height</th>
<th>Load Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NXK-409</td>
<td>15⅛” / 400 mm</td>
<td>35½” / 900 mm</td>
<td>660 lbs / 300 kg</td>
</tr>
<tr>
<td></td>
<td>NXK-412</td>
<td>15⅜” / 400 mm</td>
<td>47¼” / 1200 mm</td>
<td>880 lbs / 400 kg</td>
</tr>
<tr>
<td></td>
<td>NXK-609</td>
<td>23⅜” / 600 mm</td>
<td>35½” / 900 mm</td>
<td>1300 lbs / 600 kg</td>
</tr>
<tr>
<td></td>
<td>NXK-612</td>
<td>23⅛” / 600 mm</td>
<td>47¼” / 1200 mm</td>
<td>1700 lbs / 800 kg</td>
</tr>
<tr>
<td></td>
<td>NXK-812</td>
<td>31¼” / 800 mm</td>
<td>47¼” / 1200 mm</td>
<td>2200 lbs / 1000 kg</td>
</tr>
</tbody>
</table>

† Note: Most popular sizes are shown. Please contact Nitrex for other standard and non-standard furnace sizes.

AMS 2750D Compliant
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.

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>
<tr>
<th>Standard Sizes</th>
<th>Model</th>
<th>Diameter</th>
<th>Height</th>
<th>Load Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NXL-9912</td>
<td>36” / 900 mm</td>
<td>36” / 900 mm</td>
<td>48” / 1200 mm</td>
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<td></td>
<td>NXL-9918</td>
<td>36” / 900 mm</td>
<td>36” / 900 mm</td>
<td>72” / 1800 mm</td>
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</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.

<table>
<thead>
<tr>
<th>Standard Sizes</th>
<th>Model</th>
<th>Width</th>
<th>Height</th>
<th>Length</th>
<th>Load Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NX-1015</td>
<td>24” / 600 mm</td>
<td>59” / 1500 mm</td>
<td>48” / 1200 mm</td>
<td>2200 lbs / 1000 kg</td>
</tr>
<tr>
<td></td>
<td>NX-1020</td>
<td>24” / 600 mm</td>
<td>79” / 2000 mm</td>
<td>48” / 1200 mm</td>
<td>2600 lbs / 1200 kg</td>
</tr>
<tr>
<td></td>
<td>NX-1015</td>
<td>32” / 800 mm</td>
<td>59” / 1500 mm</td>
<td>48” / 1200 mm</td>
<td>3300 lbs / 1500 kg</td>
</tr>
<tr>
<td></td>
<td>NX-1020</td>
<td>32” / 800 mm</td>
<td>79” / 2000 mm</td>
<td>48” / 1200 mm</td>
<td>3850 lbs / 1750 kg</td>
</tr>
<tr>
<td></td>
<td>NX-1025</td>
<td>32” / 800 mm</td>
<td>98” / 2500 mm</td>
<td>48” / 1200 mm</td>
<td>4400 lbs / 2000 kg</td>
</tr>
<tr>
<td></td>
<td>NX-1215</td>
<td>48” / 1200 mm</td>
<td>59” / 1500 mm</td>
<td>48” / 1200 mm</td>
<td>4400 lbs / 2000 kg</td>
</tr>
<tr>
<td></td>
<td>NX-1220</td>
<td>48” / 1200 mm</td>
<td>79” / 2000 mm</td>
<td>48” / 1200 mm</td>
<td>4400 lbs / 2000 kg</td>
</tr>
<tr>
<td></td>
<td>NX-1225</td>
<td>48” / 1200 mm</td>
<td>98” / 2500 mm</td>
<td>48” / 1200 mm</td>
<td>4400 lbs / 2000 kg</td>
</tr>
<tr>
<td></td>
<td>NX-1230</td>
<td>48” / 1200 mm</td>
<td>118” / 3000 mm</td>
<td>48” / 1200 mm</td>
<td>4400 lbs / 2000 kg</td>
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<tr>
<td></td>
<td>NX-1625</td>
<td>61” / 1550 mm</td>
<td>98” / 2500 mm</td>
<td>61” / 1550 mm</td>
<td>13200 lbs / 6000 kg</td>
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<td>NX-1630</td>
<td>61” / 1550 mm</td>
<td>118” / 3000 mm</td>
<td>61” / 1550 mm</td>
<td>15400 lbs / 7000 kg</td>
</tr>
<tr>
<td></td>
<td>NX-1635</td>
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<td>138” / 3500 mm</td>
<td>61” / 1550 mm</td>
<td>17600 lbs / 8000 kg</td>
</tr>
<tr>
<td></td>
<td>NX-1645</td>
<td>61” / 1550 mm</td>
<td>177” / 4500 mm</td>
<td>61” / 1550 mm</td>
<td>22000 lbs / 10000 kg</td>
</tr>
</tbody>
</table>
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 control system is programmable and logic based and is integrated with NITREG® family of technologies, which consists of individually customized recipes for different applications and materials with optimum results. More information about NITREG® on page 7.

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 is 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.

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:
1) an industrial process computer with integrated I/O’s,
2) a gas panel with atmosphere analysis, flow and pressure measuring transducers, including the H2Smart™ and mass flow controllers, and
3) an electrical panel with a SCR/SSR controller for each heating zone.

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.

What’s H2Smart™?
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 Windows® XPE-based 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 KN (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

Key development tools available with NPC include the:
- Process Builder which allows authorized users to modify existing process parameters or to create new processes altogether; and
- User Permission Manager which allows the administrator or User Manager to control access to the system and to configure the environment for particular users or groups of users. Each user has a list of permissions assigned. The User Manager uses this permission list to control the user's access to certain features of the system.
Nitrex furnaces integrated into a production environment

**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 cfh (5-50 l/min). For higher flows up to 2120 cfh (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

![Model IN-1000 Shown](image)

**INTEGRATION, AUTOMATION, AND OPTIMIZATION...**

Equipment integration and plant automation solutions are increasingly used to enhance performance and productivity as a way to offset high operating costs. 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. 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.

![Fully automated heat treating cell](image)

**NPM PLANT MANAGER SOFTWARE**

**NPM GLOBAL**

NPM is a powerful software package that allows users to remotely interact with their Nitrex equipment.

**KEY FUNCTIONS**
- View Nitrex Systems connected to the NPM computer
- View and acknowledge alarms
- Abort / resume jobs
- View and print LOG reports
- View / Print Real Time Graphs
- Modify Process Library
- Modify parameters of currently running jobs
- Create new users / Modify user access levels
- Run process simulation and much more

![Diagram of NPM System](image)
NITREG® FAMILY OF POTENTIAL-CONTROLLED TECHNOLOGIES

NITREG® represents a family of potential-controlled gas nitriding technologies. This technology enables 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 nitried layer tailored to enhance wear, fatigue or corrosion resistance.

NITREG® potential-controlled (Kn) nitriding also helps to:
- eliminate closed nitride networks in the diffusion zone;
- prevent over-nitriding and distortion of treated parts;
- and produce stable results from one load to another.

Vickers indentations (load of 30 kg) on 4340 steel, nitrided to same specification.

Conventional nitriding process  NITREG® nitriding process

ONC® IN-PROCESS OXIDATION

ONC® is an in-process post-nitriding or post-nitrocarburizing oxidation process with oxidation potential (Ko) 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, which is 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®-C NITROCARBURIZING

NITREG®-C is a nitrocarburizing process with Kn and Kc 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 AND NANO-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.

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.

Nitridable Materials

- carbon steels
- cast irons
- stainless steels
- steel-based high density powder metals
- alloy steels
- cast steels
- nickel alloys
- titanium alloys