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NITRIDING & NITROCARBURIZING

Turnkey Systems | Technologies
| Complete Solutions

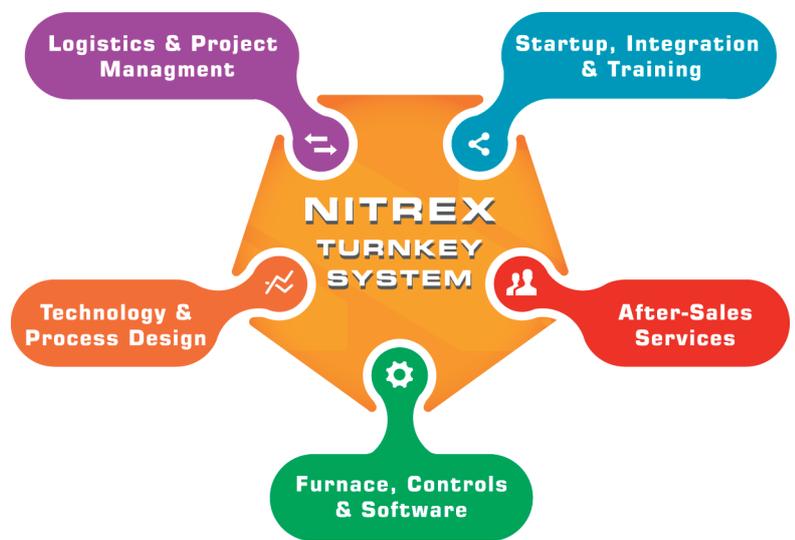


WHAT'S A NITREX TURNKEY SYSTEM?

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.

🚚 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.

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.

Fully Integrated Package

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



STANDARD SIZES*	MODEL	DIAMETER	HEIGHT	LOAD CAPACITY
WORKING ZONE DIMENSIONS	NXK-409	15¾" / 400mm	35½" / 900mm	660lbs / 300kg
	NXK-412	15¾" / 400mm	47¼" / 1200mm	880lbs / 400kg
	NXK-609	23½" / 600mm	35½" / 900mm	1300lbs / 600kg
	NXK-612	23½" / 600mm	47¼" / 1200mm	1700lbs / 800kg
	NXK-812	31½" / 800mm	47¼" / 1200mm	2200lbs / 1000kg

*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.

STANDARD SIZES*	MODEL	DIAMETER	HEIGHT	LOAD CAPACITY
WORKING ZONE DIMENSIONS	NX-615	23½" / 600mm	59" / 1500mm	2200lbs / 1000kg
	NX-620	23½" / 600mm	78¾" / 2000mm	2600lbs / 1200kg
	NX-815	31½" / 800mm	59" / 1500mm	3300lbs / 1500kg
	NX-820	31½" / 800mm	78¾" / 2000mm	3850lbs / 1750kg
	NX-825	31½" / 800mm	98½" / 2500mm	4400lbs / 2000kg
	NX-1015	39" / 1000mm	59" / 1500mm	4400lbs / 2000kg
	NX-1020	39" / 1000mm	78¾" / 2000mm	5500lbs / 2500kg
	NX-1025	39" / 1000mm	98½" / 2500mm	6600lbs / 3000kg
	NX-1215	47¼" / 1200mm	59" / 1500mm	6600lbs / 3000kg
	NX-1220	47¼" / 1200mm	78¾" / 2000mm	8400lbs / 3800kg
	NX-1225	47¼" / 1200mm	98½" / 2500mm	9900lbs / 4500kg
	NX-1230	47¼" / 1200mm	118" / 3000mm	11570lbs / 5250kg
	NX-1625	61" / 1550mm	98½" / 2500mm	13200lbs / 6000kg
	NX-1630	61" / 1550mm	118" / 3000mm	15400lbs / 7000kg
	NX-1635	61" / 1550mm	137¾" / 3500mm	17600lbs / 8000kg
	NX-1645	61" / 1550mm	177" / 4500mm	22000lbs / 10000kg

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.



STANDARD SIZES*	MODEL	WIDTH	HEIGHT	LENGTH	LOAD CAPACITY
WORKING ZONE DIMENSIONS	NXH-669	23½" / 600mm	23½" / 600mm	35½" / 900mm	1300lbs / 600kg
	NXH-6612	23½" / 600mm	23½" / 600mm	47¼" / 1200mm	1700lbs / 800kg
	NXH-9812	35½" / 900mm	31½" / 800mm	47¼" / 1200mm	2200lbs / 1000kg
	NXH-9818	35½" / 900mm	31½" / 800mm	71" / 1800mm	3330lbs / 1500Kg

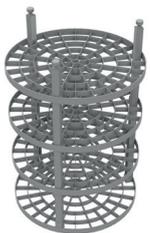
FURNACES ENGINEERED FOR CONTINUOUS OPERATION

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.



STANDARD SIZES*	MODEL	WIDTH	HEIGHT	LENGTH	LOAD CAPACITY
WORKING ZONE DIMENSIONS	NXL-9912	35½" / 900mm	35½" / 900mm	47¼" / 1200mm	3300 lbs / 1500kg
	NXL-9918	35½" / 900mm	35½" / 900mm	71" / 1800mm	3950 lbs / 1800kg

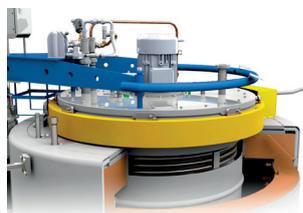
OPTIONAL AUXILIARY EQUIPMENT



Furnace Rack & Basket Sets



Rack Lifting Device



Accelerated Cooling System



Exhaust Neutralizing Equipment

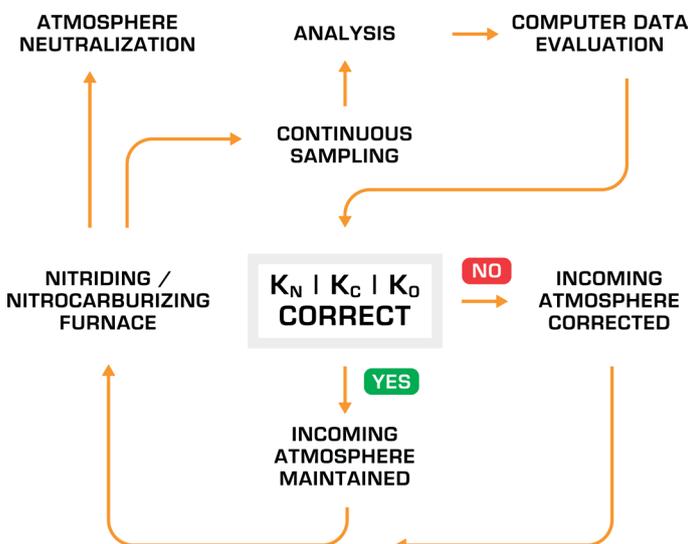


Closed-Loop Water Cooling System

PROCESS CONTROL SYSTEMS

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/O's
- 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™?



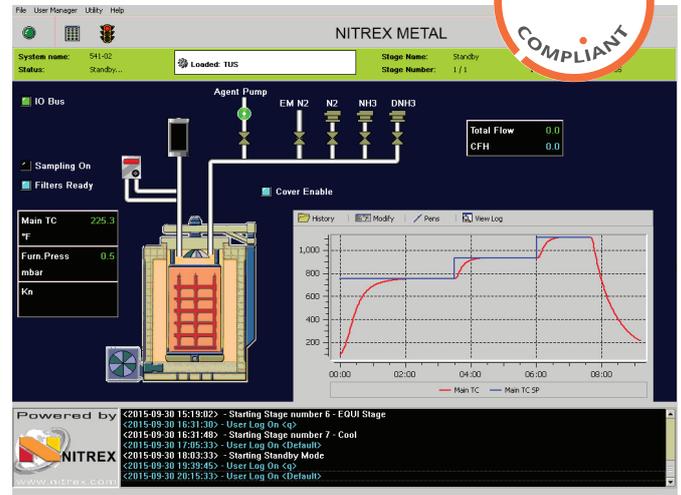
H2Smart™ is at the heart of the Nitrex process control. It ensures accurate measurement of hydrogen in nitriding and nitrocarburizing atmospheres. Its unique design with a variable output integral pump allows the set sampling flow rate to be automatically maintained. A flow control circuit complete with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

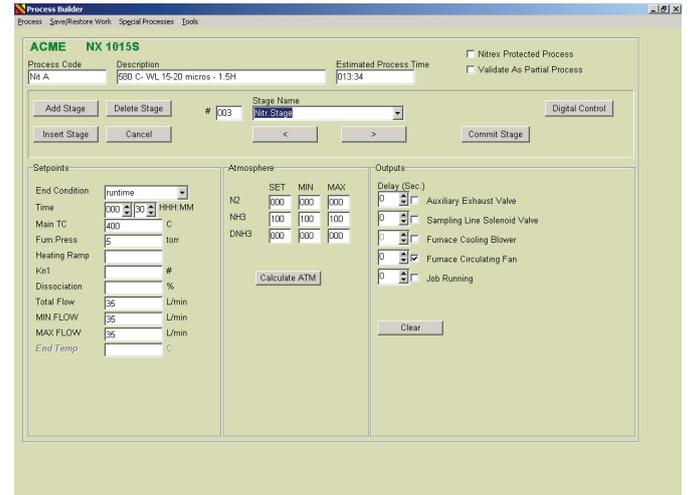
From the single-point user interface, an operator can:

- 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

Key Development Tools

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.



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.

EXHAUST GAS NEUTRALIZER LINES



Model IN-1000

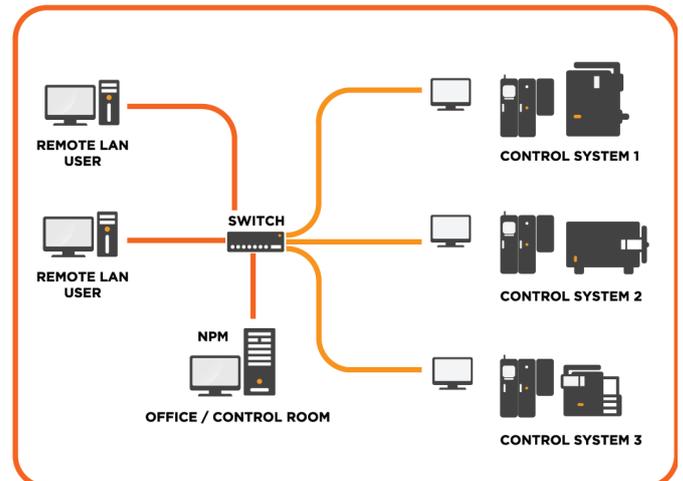
Nitrex firmly believes in building environmental friendly systems that encourage the protection of nature. Our two lines of neutralizers are designed to eliminate residual ammonia and/or other pollutant gases while minimizing NOx emissions.

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

NPM REMOTE ACCESS SOFTWARE PACKAGE



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



THINK NITREG® WHEN WEAR, FATIGUE & CORROSION MATTER...

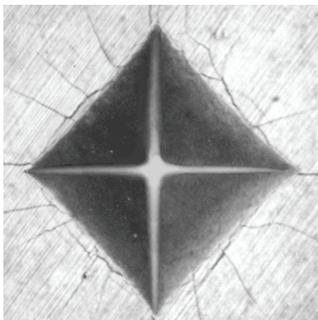
NITREG® NITRIDING

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.

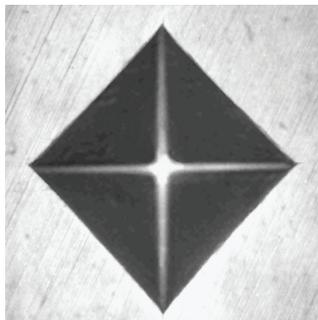
NITREG® Potential-Controlled (K_N) Nitriding also helps to:

- Eliminate closed nitride networks in the diffusion zone
- Prevent over-nitriding and distortion of treated parts
- Produce stable results from one load to another

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



Conventional nitriding process



NITREG® nitriding process

NANO-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

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

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.

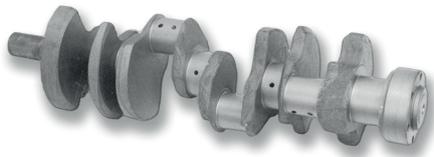
NITRIDABLE MATERIALS:

- Carbon steels
- Cast irons
- Stainless steels
- Steel-based high density powder metals
- Alloy steels
- Cast steels
- Nickel alloys
- 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.



Front Half Shafts for
Aircraft Engine

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.



Timing Gears

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.

SHAFTS

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.



Appearance of ONC®-treated
automobile wiper axles

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.



P-SERIES Nitriding/Nitrocarburizing System with United Process Controls' PROTHERM™ Process Controller

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_r} , 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_r} , K_C , K_{O_r} 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.



P-SERIES AT A GLANCE

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 $\pm 5^\circ\text{C}$ (9°F) or better.

PROCESS CONTROL

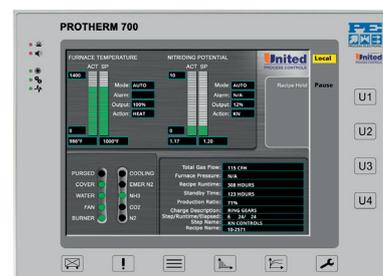
The PROTHERM™ controller monitors and regulates all furnace functions, nitriding / nitrocarburizing cycles with % Diss, K_{N_r} , K_C , K_O setpoints, alarms, and maintenance tasks. The integral *H2Smart™* sampling system ensures extremely accurate measurement of hydrogen in the process atmosphere, thereby achieving precise control of processes.



NXP series system with pit furnace

AMS
2759/10
2759/12

COMPLIANT



SCADA
connectivity

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

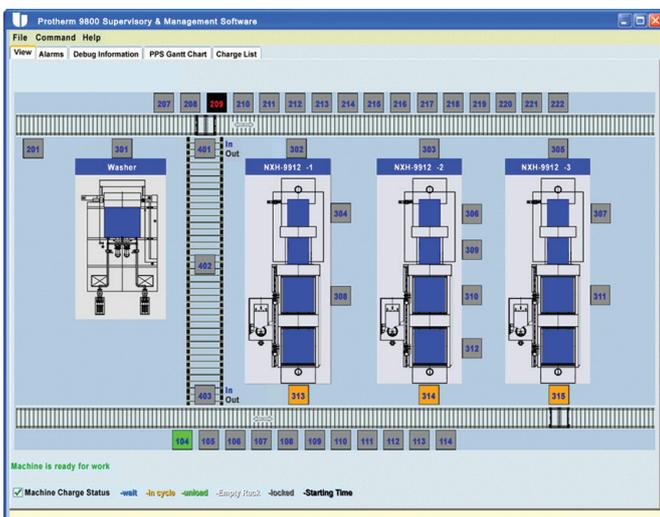
EQUIPMENT INTEGRATION AND PLANT AUTOMATION SOLUTIONS ARE USED INCREASINGLY TO ENHANCE PERFORMANCE AND PRODUCTIVITY AS A WAY TO OFFSET HIGH OPERATING COSTS.

NITREX SYSTEMS INTEGRATED INTO A PRODUCTION ENVIRONMENT



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.

OVERVIEW SCREEN OF A FULLY AUTOMATED LIGHTS-OUT PRODUCTION CELL



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



AUTOMATION AND HIGHER-LEVEL INTERFACING

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.



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