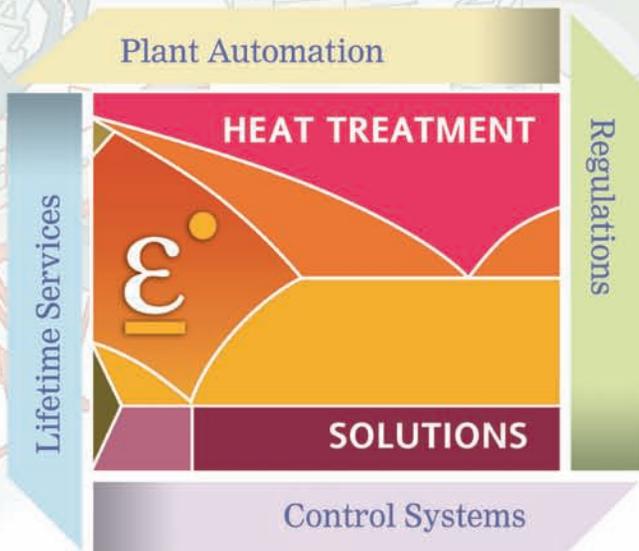
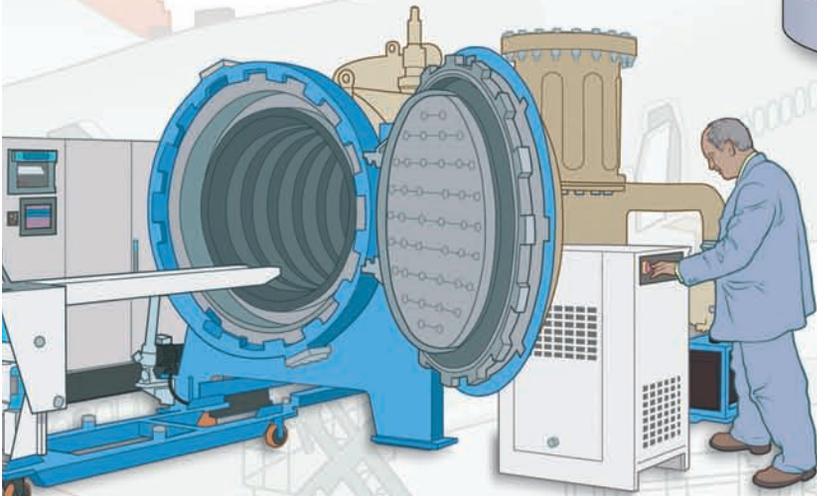
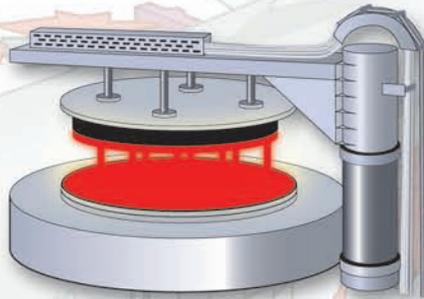
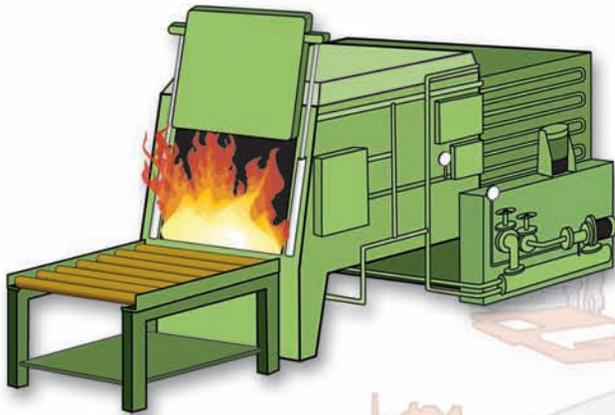


EUROTHERM® HEAT TREATMENT SOLUTIONS

Gas Nitriding

CONTROL SOLUTIONS FOR
NITRIDING FURNACES



Nitriding Solutions

Gas Nitriding is a case hardening process whereby nitrogen is introduced into the surface of a solid ferrous alloy by holding the metal at a suitable temperature in contact with a nitrogenous gas, usually ammonia. Quenching is not required for the production of a hard case. The nitriding temperature for all steels is typically between 495 and 565°C.

WHY EURO THERM?

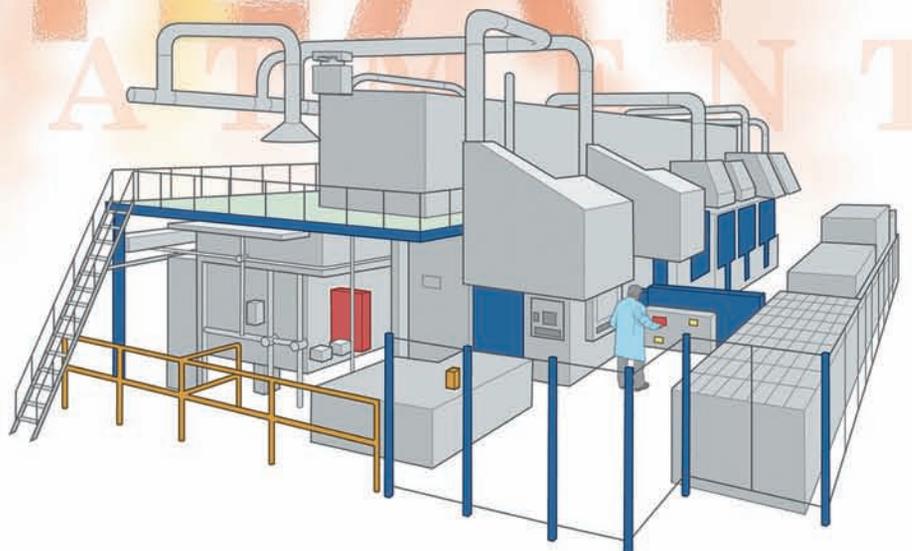
- 3504 Process Controller with flexible I/O
- Dual Loop PID Control
- Setpoint Programmer offering up to 50 Programs
- Recipe Management
- Eurotherm world renowned control algorithms for temperature control
- Advanced Nitriding atmosphere control strategies to control Kn (Np) or % Dissociated Ammonia (%NH₃)
- Seamless integration with the 6000 Series Paperless Graphic Recorders

Eurotherm delivers control solutions for Nitriding furnaces to meet stringent regulatory demands including AMS2750 Revision D, TS16949 and CQI-9. A Eurotherm solution delivers;

- Dual Loop control (Furnace Temperature and Nitriding Atmosphere control) including full recipe program control, incorporating program events (i.e. Nitrogen purge).
- The system is supplied, as a control panel and sample filter, for installation by the customer, involving the minimum of electrical wiring and sample line plumbing, thus reducing the system cost.
- Long life, reliable and stable hydrogen sensor when compared to infra-red systems.
- Nitriding control either, % Dissociated Ammonia or Nitriding Potential Kn or Np
- Simple Hydrogen sensor calibration routines.
- Extended life sampling system, with user selectable sample pump start temperatures.



HEAT TREATMENT

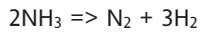


THE PROCESS

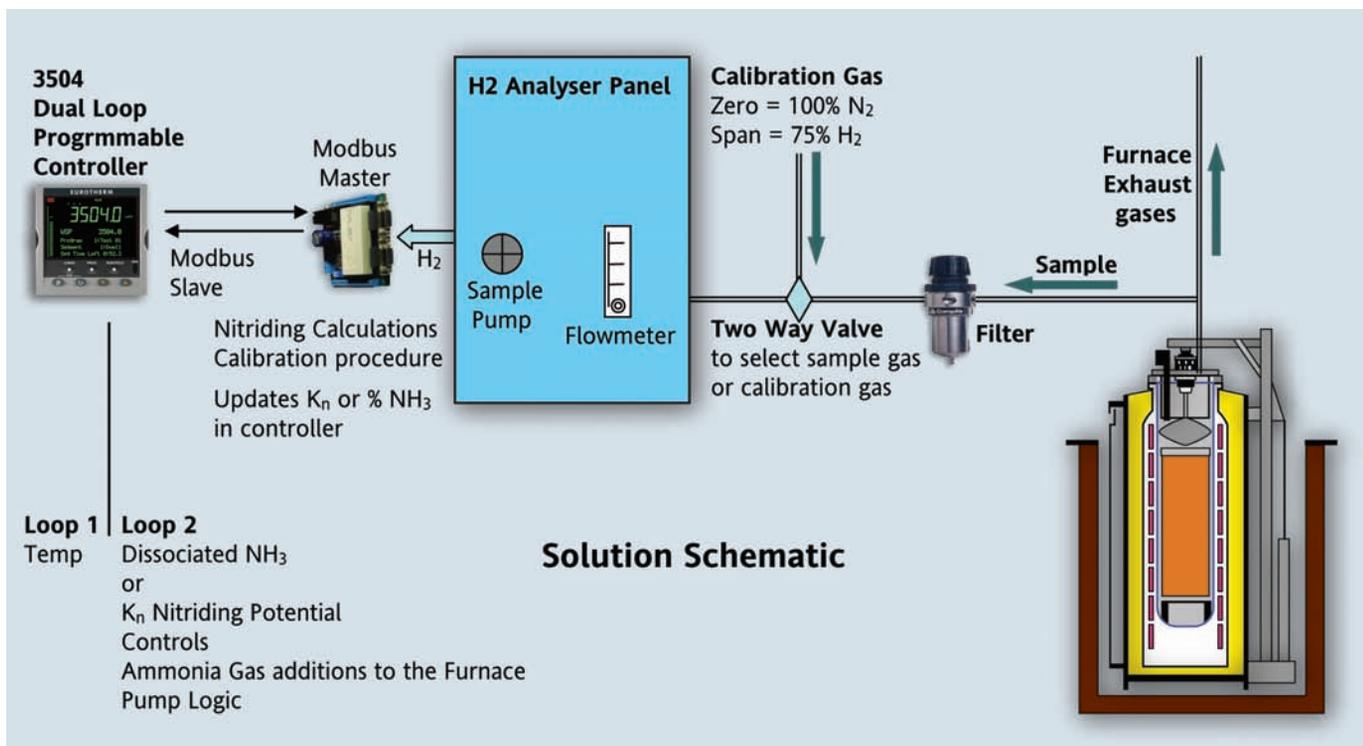
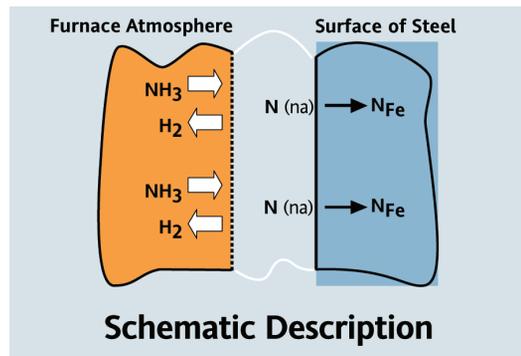
Nitriding is a surface-hardening heat treatment that introduces nitrogen into the surface of steel while in contact with a nitrogenous gas, usually ammonia. Nitriding is typically carried out in the temperature range of 495° to 565°C, while the steel is in the ferritic condition. The formation of nitrides in the nitrided layer provides the increased hardness. Because nitriding does not involve heating into the austenite phase field and a subsequent quench to form martensite, nitriding can be accomplished with a minimum of distortion and with excellent dimensional control. Quenching is not required for the production of a hard case.

Nitrided steels are generally medium-carbon (quenched and tempered) steels that contain strong nitride-forming elements such as aluminium, chromium, vanadium, and molybdenum.

When ammonia (NH₃) is introduced into a furnace it dissociates according to the following reaction to produce nascent (monatomic) nitrogen at the surface of the steel component:



The nascent nitrogen diffuses into the surface and exists as dissolved nitrogen or as iron nitrides. Nitrogen has partial solubility in iron. It can form a solid solution with ferrite at nitrogen contents up to about 6%. At about 6% N₂ a compound called gamma prime (γ'), with a composition of Fe₄N is formed. At nitrogen contents greater than 8%, the equilibrium reaction product is ε compound, Fe₃N. Nitrided cases are stratified. The outermost surface can be all γ' or a mixture of gamma prime and epsilon, this layer is referred to as the 'compound' or 'white' layer. Such a surface layer may be undesirable, and is so brittle that it may spall in use, often it is removed by subsequent machining operations. Tight control of the nitriding potential can control the amount of white layer. Below this surface layer there is solid solution strengthening from the nitrogen in solid solution this is sometimes referred to as the 'diffusion' layer and completes the total case depth.



Nitriding Control Solution

- SIMPLE to build using pre-defined building blocks
- SCALABLE solution fits the requirements of any plant
- The most ACCURATE atmosphere control solution available

Nitriding control by % NH₃ dissociation is the normal primary process control parameter. However, control using the Nitriding Potential, KN, is becoming more popular and is specified by some authorities.

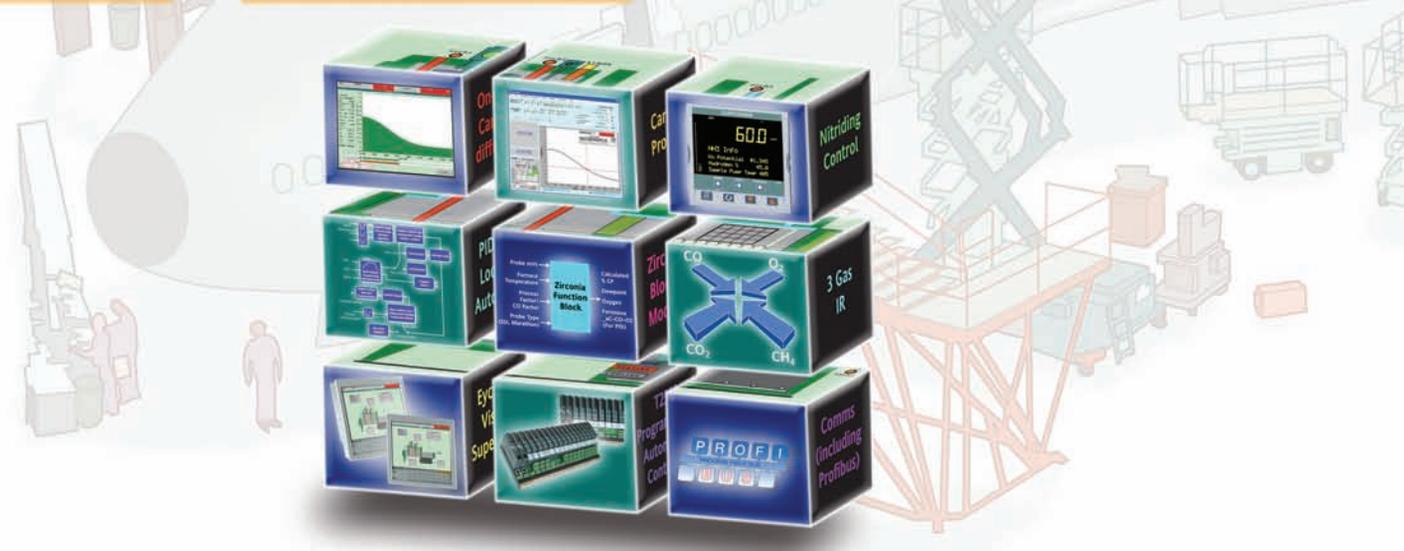
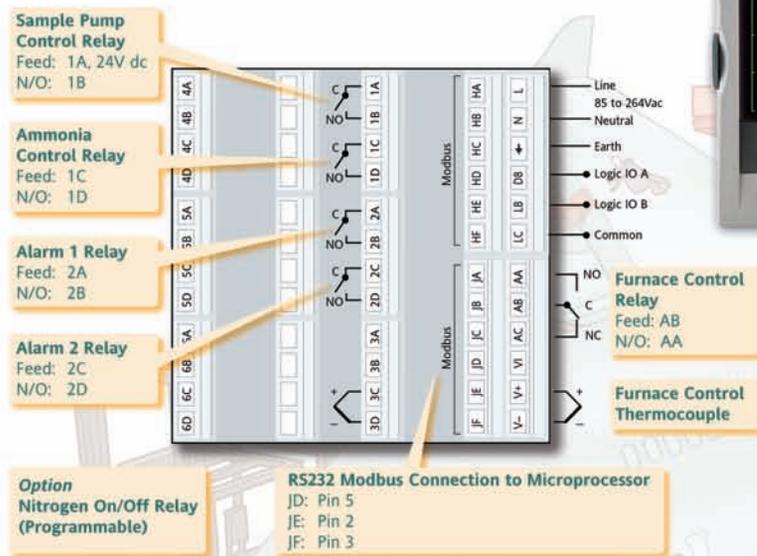
$$\text{Nitriding Potential, KN} = p\text{NH}_3/p\text{H}_2^{3/2} \quad (\text{Range } 0.1 - 30)$$

The principal reasons for Nitriding are:

- To obtain high surface hardness.
- To increase wear resistance.
- To improve fatigue life.
- To improve corrosion resistance (except for stainless steels).
- To obtain a surface that is resistant to the softening effect of heat at temperatures up to the Nitriding temperature.

Dual Loop Programmable Controller

The 3504 offers much more than just temperature control, advanced features and options make them capable of furnace control, providing flexible I/O options to control and measure a multitude of processes – temperature, carbon potential many more. Specialist function blocks, recipe selection, Setpoint programmers, maths, logic, timer functions along with flexible communications options are just a few examples of what makes these instruments a key part of any process solution.



Informative Displays

The 3504 provides clear visualisation of messages and data to ensure operators get the information they need about the process condition. They provide, clear, complete text information with a custom message facility, along with help text for each controller function. The 3504 also includes as standard user defined displays offering views onto the process that are best suited to the operation of the furnace.

User Inputs

Sample Pump Temp 405

This value is used to determine the temperature at which the sample pump will be active. The sample pump is normally switched on during the furnace ramp when ammonia is admitted, typically around 400°C. The intention is to only sample the furnace atmosphere when it is necessary to do so, in order to minimise the ingress of water vapour and particulates into the sample system.

H2 Span Value 70

This is the span value for the Hydrogen gas, typically 75% H₂

Zero Cal 0

Used during the sensor calibration procedure. Normally N₂ is passed through the sensor, when the readings become stable; the Zero Cal value is changed by the user to '1'. This in turn initiates zero calibration of the sensor. Upon successful calibration the Zero Cal value is returned to '0'.

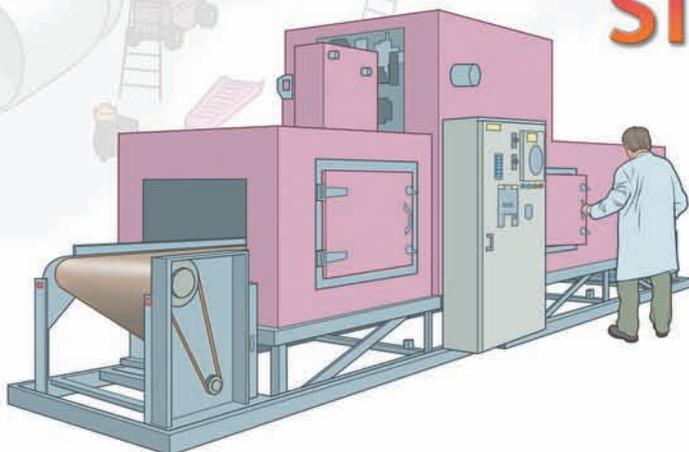
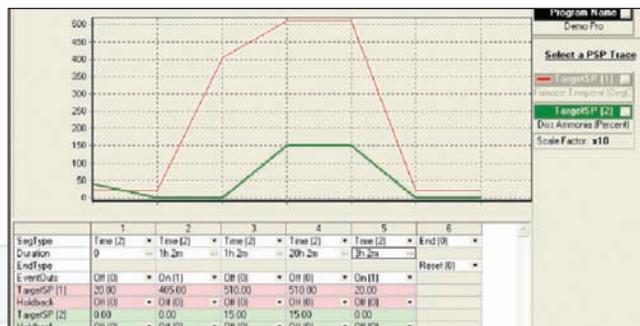
Span Cal 0

As with Zero Cal, Span Cal is used during the sensor calibration procedure. In this instance span calibration gas, (75% H₂), is passed through the sensor. Once the readings have stabilised, the Span Cal value is set to '1' by the user initiating span calibration of the sensor. Upon successful calibration the Span Cal value is returned to '0'.



Setpoint Programming

An impressive Ramp/Soak programmer is available in the 3504. The ability to store up to 50 different programs, each with dual channel capability makes it ideal for applications such as Heat Treatment furnaces – where often more than one variable needs to be profiled. The 3504 has functionality not normally found in a product of this class and its flexibility in being able to interact with other function blocks makes it a very powerful choice.

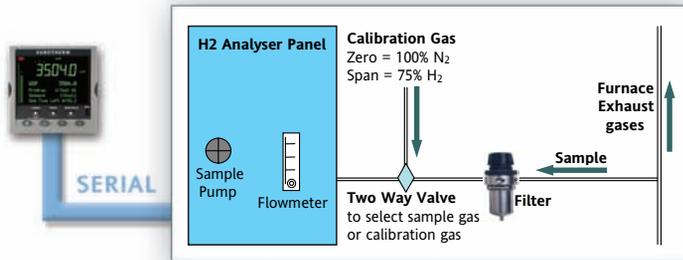


**SIMPLE
SCALABLE
ACCURATE**

Scope of Supply

The Nitriding solution from Eurotherm includes the following components;

- A Dual PID loop 3504 Process controller configured for either %NH₃ or Nitriding Potential.
- Hydrogen Sensor and Hydrogen Gas analyser
- A free mounting stainless steel Filter



3504
 TC input for furnace temperature controller
 On/Off temperature control output
 Clone file for either Kn or % dissociation
 Interface to Hydrogen Analyser panel
 On/Off Ammonia flow control output
 Sample pump control relay output
 2 alarm outputs

HYDROGEN ANALYSER PANEL
 Panel enclosure with mains isolator
 H2 sensor
 Sample pump
 Enclosure safety purge connections
 Microprocessor for calibration routines and communication to controller
 Sample line filter
 Sample line flowmeter

ORDER CODE

1	2	3	4	5
HT-				

1 Basic Product
HT- Heat Treatment Solutions

2 Controller Type
1 3504 for %NH ₃ Dissociation
2 3504 for Nitriding Potential (Kn/Np)

3 Options 1
0 None
1 Thyristor Control Output
2 Flow meter Control Output (4-20mA)
3 Flow meter Control Output (0-10V dc)
4 Thyristor & Flow meter Control O/P (4-20mA)
5 Thyristor % Flow meter Control O/P (0-10V dc)

4 Options 2
0 None
1 Nitrogen On/Off

5 Communications Protocol
N None
-T Modbus TCP
-S Modbus Serial

TEMPERING
HOMOGENISATION

A57102
Nadcap

HARDENING

QUENCHING

ANNEALING

TS16949

RPS953

HEAT TREATMENT

NORMALISING
ALUMINISING

CARBURISING

INDUCTION HARDENING

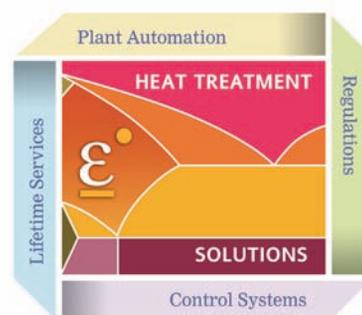
SINTERING

NITRIDING

HIPping

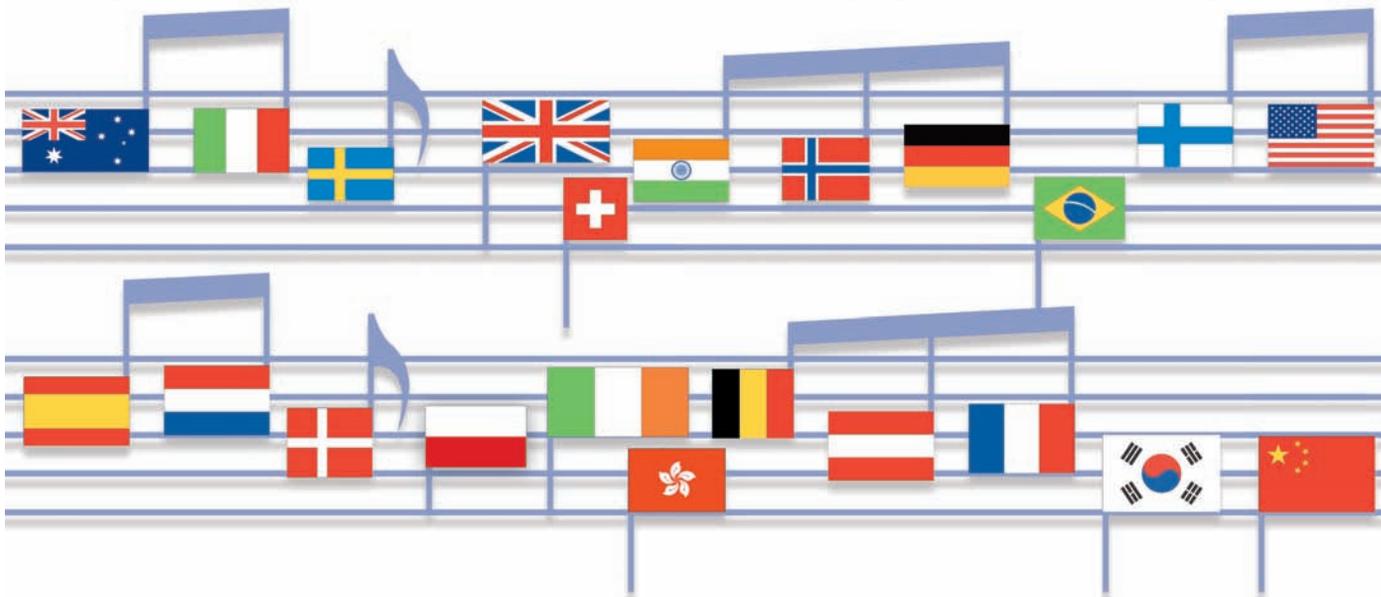
NITRO-CARBURISING CARBO-NITRIDING

AMS2750D



Eurotherm: International sales and service

Understanding and providing local support is a key part of Eurotherm business. Complementing worldwide Eurotherm offices are a whole range of partners and a comprehensive technical support team, to ensure you get a service you will want to go back to.



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