

# Expertise to Improve Heat Treatment Process Efficiency

**Eurotherm®**

## Standardized Heat Treatment Solutions

Flexible solutions for process and energy optimization, leveraging precision control, high integrity data management and next generation IoT technologies



[eurotherm.com/heatreat](http://eurotherm.com/heatreat)

Life Is On

**Schneider**  
Electric

# Focus on Heat Treatment Performance Drivers

Every heat treatment shop aspires to similar industry-standard performance targets, and when driven successfully, profit margins of over 20% can be achieved. Conversely, poorly performing plants can become a drain on financial resources, increasing the risk of delivering losses.

## Key Drivers Include:

- **High Furnace/Oven Utilization and Optimum Load Density** - necessary to maximize revenue per cycle
- **Tailored Process Design** - can command higher product/service market values
- **Furnace Management** - key for delivering high process performance and consists of Lean Manufacturing, Energy Management and Regulatory Management

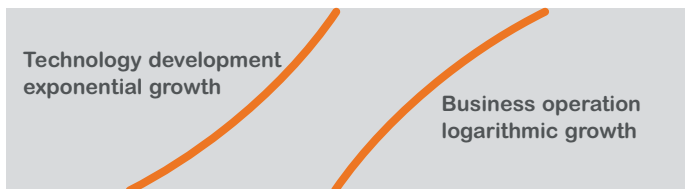
## Vanishing Experience

In many western economies, there is evidence to suggest that a significant proportion of the existing labor pool is nearing retirement age and there is insufficient new talent in the pipeline to fill semi-skilled or skilled manufacturing jobs.

When a company lacks key skilled personnel on a production line, increased cycle-times, equipment downtime, waste product and staff overtime can impact productivity, efficiency, quality and costs. Customer satisfaction can also be affected due to longer lead times, unreliable delivery and poorer quality.

## Technology Divide

Installing more automation helps to fill the skills gap. As a guide, Eurotherm recommends control upgrades at a maximum interval of 10 years to ensure heat treaters benefit from technological improvements.



## New Versus Refurbished Furnaces

Experience shows that new equipment from a reputable manufacturer, even with minimal maintenance and warranty support should operate reliably for several years. Partially refurbished equipment can cost 1/3 or less compared to a new build (dependent on age/condition) but without warranty protection can have reliability issues in a much shorter period of time. We therefore recommend that new control panels be fitted in refurbished equipment, to help improve reliability as well as meet the latest safety and efficiency standards.

## Cost Structure

In demanding environments and a challenging market place it is increasingly important to optimize the cost structure of your heat treatment operation. Commercial (sub-contract) heat treatment facilities are typically able to apportion costs to the heat treatment function more accurately than larger in-house (captive) heat treatment departments.

A typical US commercial heat treatment business averages \$5m in sales revenue. Major cost improvement categories are outlined below, along with example costs as a percentage of sales revenue.



Labor 20%



Energy & Consumables 20%



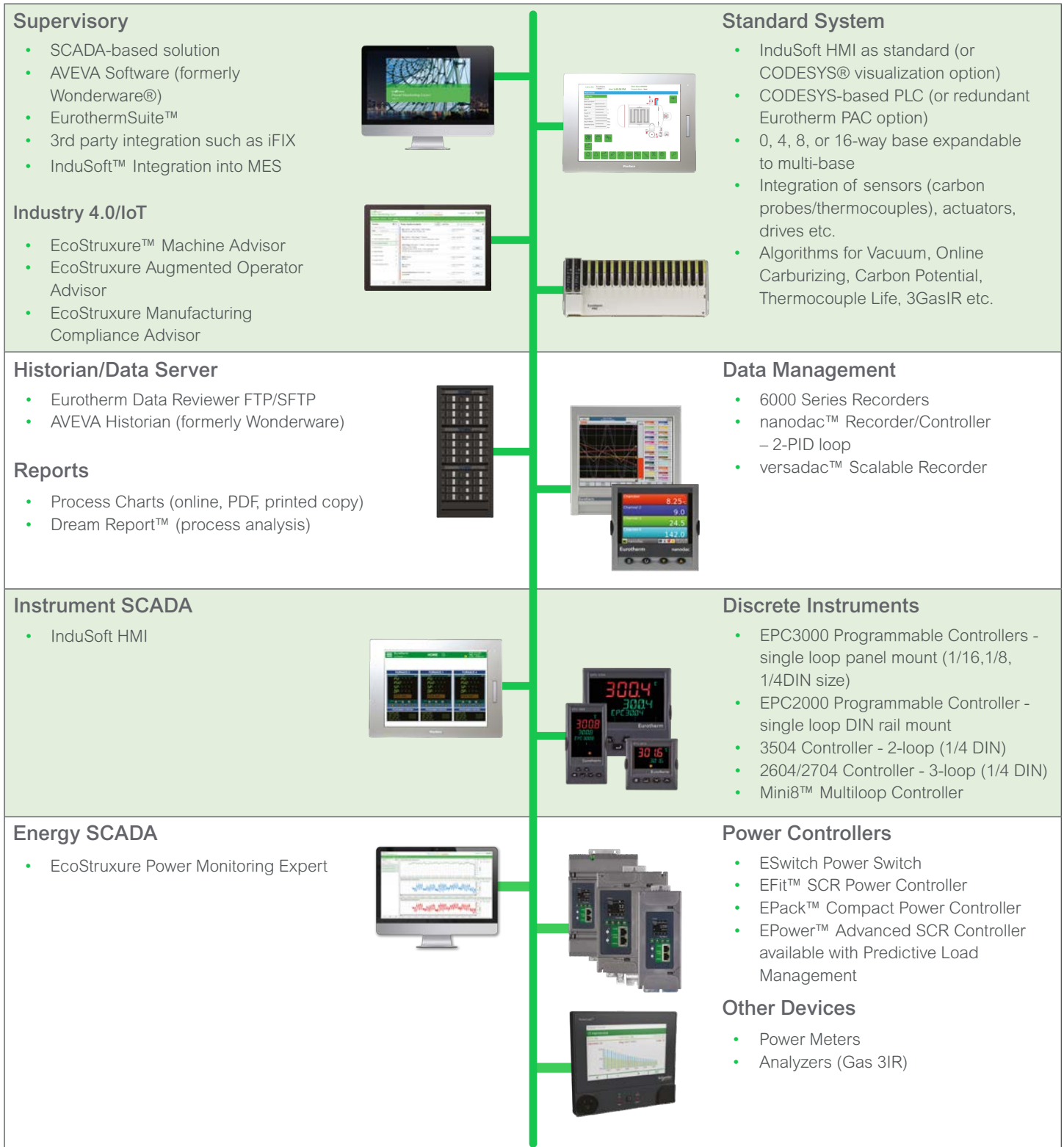
Maintenance 10%



Quality & HSE Regulation 5%

# Flexible Furnace Automation Solutions

Solutions designed specifically for heat treatment support lean manufacturing, energy and regulatory management, while aiding furnace utilization and planning. Eurotherm standard systems are EcoStruxure-ready. EcoStruxure™ is Schneider Electric's open IoT-enabled system architecture and platform.






# Standardized Solutions

Designed for standard heat treatment applications to reduce engineering time and costs, and improve process performance.



## Tailored Furnace Systems

- InduSoft HMI as standard (or CODESYS visualization option)
- CODESYS based PLC (or redundant Eurotherm PAC option)
- 0, 4, 8, or 16 -way base, expandable to multi-base
- Integrate sensors (carbon probes/thermocouples), actuators, drives etc.
- Available as individual instruments, application kits, control cabinet supply and full turn-key enterprise solutions (leveraging global engineering teams)

Vacuum Furnace	Autoclave	Sealed/Batch Quench Furnace
		
<b>Control Inputs</b>		
<ul style="list-style-type: none"> <li>• Furnace/load thermocouples</li> <li>• Low/high vacuum gauge</li> <li>• Additional analog inputs</li> <li>• Digital inputs for sequencing</li> </ul>	<ul style="list-style-type: none"> <li>• Pressure</li> <li>• Air Temperature</li> <li>• Vacuum</li> <li>• High/low part thermocouples</li> <li>• Part thermocouple</li> </ul>	<ul style="list-style-type: none"> <li>• Carbon probe with internal thermocouple</li> <li>• Furnace thermocouple</li> <li>• Additional thermocouple inputs</li> <li>• Digital inputs for sequencing</li> </ul>
<b>Control Outputs</b>		
<ul style="list-style-type: none"> <li>• Roughing pump</li> <li>• High vacuum gauge on/off</li> <li>• Diffusion pump</li> <li>• Furnace heaters</li> <li>• End of cycle/partial pressure alarm</li> <li>• Additional analog outputs</li> <li>• Digital outputs for sequencing</li> </ul>	<ul style="list-style-type: none"> <li>• Vacuum pumps</li> <li>• Pressure control</li> <li>• Furnace heaters</li> <li>• End of cycle</li> <li>• Additional analog outputs</li> <li>• Digital outputs for sequencing</li> </ul>	<ul style="list-style-type: none"> <li>• Carbon gas enrichment/air dilution control</li> <li>• Sooting alarm and probe clean control</li> <li>• Furnace heater output</li> <li>• Quench chamber heater output</li> <li>• Additional thermocouple outputs</li> <li>• Digital outputs for sequencing</li> </ul>
<b>I/O Expansion</b>		
<ul style="list-style-type: none"> <li>• Additional I/O racks</li> <li>• 3rd Party PLC or I/O</li> </ul>	<ul style="list-style-type: none"> <li>• Additional I/O racks</li> <li>• 3rd Party PLC or I/O</li> </ul>	<ul style="list-style-type: none"> <li>• Additional I/O racks</li> <li>• 3rd Party PLC or I/O</li> </ul>
<b>Control Functions</b>		
<ul style="list-style-type: none"> <li>• Auto-tuning PID Sets</li> <li>• Vacuum Algorithms</li> <li>• Setpoint Programming</li> <li>• Data Recording</li> <li>• Batch Management</li> <li>• Thermocouple Life Algorithm</li> </ul>	<ul style="list-style-type: none"> <li>• Auto-tuning PID Sets</li> <li>• Vacuum Algorithms</li> <li>• Setpoint Programming</li> <li>• Data Recording</li> <li>• Batch Management (part database)</li> <li>• Thermocouple Life Algorithm</li> </ul>	<ul style="list-style-type: none"> <li>• Auto-tuning PID (6 Sets)</li> <li>• Algorithms for 3GasIR (enhanced carbon control), Online Carburizing, Carbon Potential Thermocouple Life and more</li> <li>• Setpoint Programming</li> <li>• Data Recording</li> <li>• Batch Management</li> </ul>

# Standardized IoT Solutions

Designed to enhance furnace management for improved operational efficiency.

Reduce downtime, optimize furnace utilization, track KPIs, simplify data access and be ready for an audit using EcoStruxure™ Advisor apps and services. EcoStruxure, open, inter-operable, IoT-enabled system architecture and platform connects best-in-class operational technology (OT) solutions with the latest in information technology (IT) to unlock trapped value in your operations and leverage the true potential of the Internet of Things.

## EcoStruxure Industry 4.0/IoT Solutions

- EcoStruxure Machine Advisor
- EcoStruxure Augmented Operator Advisor
- EcoStruxure Manufacturing Compliance Advisor



EcoStruxure Machine Advisor	EcoStruxure Augmented Operator Advisor	EcoStruxure Manufacturing Compliance Advisor
		
Feature Overview		
<ul style="list-style-type: none"> <li>• Track machines in operation</li> <li>• Monitor performance data</li> <li>• Fix exceptional events</li> <li>• Reduce support costs</li> </ul>	<ul style="list-style-type: none"> <li>• Superimpose real-time data and virtual objects onto cabinet, machine or plant</li> <li>• Fast access to information</li> <li>• Reduce errors through guided procedures</li> </ul>	<ul style="list-style-type: none"> <li>• A digital service testing and approval platform</li> <li>• Manage asset testing and calibration compliance more efficiently</li> <li>• Aids plant equipment utilization</li> <li>• Fast access to test documentation via QR codes when needed</li> </ul>

## EcoStruxure Manufacturing Compliance Advisor

A cloud-hosted digital services platform designed to reduce costs, increase productivity and be audit-ready, with a robust asset testing and approval process.

### Minimize Testing Costs

Flexible and collaborative, role-based service delivery enables cost effective planning and performing of asset tests. Simplify data collection, approval and work-flow through centralized test and compliance management.

### Increase Test Productivity

Reduce test errors and re-testing of assets with dedicated work-flows and prescribed work instructions. Avoid production disruptions and furnace downtime by efficiently managing complex test schedules.

### Be Audit Ready

Efficiently manage compliance requirements and enjoy online access to your data from PCs and smart devices. Access audit compliance documentation such as calibration certificates, via a QR Code label located on the equipment.

Experience a free trial of EcoStruxure Manufacturing Compliance Advisor:

[eurotherm.com/compliance](http://eurotherm.com/compliance)

# Energy Management Solutions

How much does your furnace cost to run? Monitoring and managing energy usage provides the data needed to calculate the energy used by individual furnaces, per hour, by weight or by batch.



## Energy SCADA

- EcoStruxure Power Monitoring Expert can continuously analyze, troubleshoot and make informed decisions on your water, air, gas, electric and steam use
- Automatically collects data and presents it as meaningful actionable information via an intuitive web-interface
- Complements the functionality of a process-based SCADA system

## Advanced Power Control

In electrical furnace heating systems, random zone firing has the potential to draw large peaks of electrical power from the supply when multiple zones fire simultaneously. Not only can this impact energy costs, but in the worst-case scenario it can exceed the maximum capacity of the individual transformers or the main power supply, causing an electrical power outage. Predictive Load Management strategies and advanced SCR firing technology in EPower SCR controller help minimize energy costs and prevent power outages by balancing and limiting peaks in electricity demand.



## EPower Advanced SCR Power Controller

- Predictive Load Management Load Sharing and Load Shedding Strategies help to reduce energy costs and the risk of power outages
- Advanced SCR firing modes help to lower energy costs through reduced harmonics and improved power factor
- Automatic transformer load tap changing strategy aids smooth power control and reduced maintenance
- Provides energy usage data for KPIs such as true power, apparent power and power factor



## EPack Compact SCR Controller

- Compact design for smaller cabinets
- Highly adaptable via flexible software upgrades



## Power Control Improvement Systems




Lower energy costs through reduced harmonics, improved power factors and efficient design. Reduce peak demand charges via load sharing and load shedding technology.

Power systems are available as:

- Individual SCR/Thyristors
- Engineered power panel solutions
- Packaged with transformers for a complete power-supply solution (VRT -Variable Reactance Transformer replacement)

# Potential Energy Savings

There are many areas of opportunity to reduce gas and electricity usage in a heat treatment plant. Here are some focus areas and potential savings that can be gained through improvement activities.

Activity Area	Saving Potential	What to Watch
		
<b>Heat Generation Opportunities (Gas)<sup>1</sup></b>		
<ul style="list-style-type: none"> <li>Control air-to-fuel ratio</li> <li>Preheat combustion air</li> <li>Oxygen-enriched combustion air</li> <li>Fuel conditioning</li> </ul>	<ul style="list-style-type: none"> <li>5-25%</li> <li>15-30%</li> <li>5-25%</li> <li>5-10%</li> </ul>	<ul style="list-style-type: none"> <li>Combustion air leaks downstream of the control valve</li> <li>Linkage condition leading to poor fuel/air mix</li> <li>Excess oxygen in the exhaust gases</li> <li>Flame instability</li> </ul>
<b>Heat Transfer Opportunities (Gas)<sup>1</sup></b>		
<ul style="list-style-type: none"> <li>Improve heat transfer with advanced burners and controls</li> <li>Improve heat transfer within a furnace</li> </ul>	<ul style="list-style-type: none"> <li>5-10%</li> <li>5-10%</li> </ul>	<ul style="list-style-type: none"> <li>Higher than necessary operating temperature</li> <li>Exhaust stack temperature</li> </ul>
<b>Enabling Technology Opportunities (Gas)<sup>1</sup></b>		
<ul style="list-style-type: none"> <li>Install high turndown combustion systems</li> <li>Use programmed heating temperature setting for part-load operation</li> <li>Monitor and control exhaust gas oxygen, unburned hydrocarbon, and carbon monoxide emissions</li> <li>Maintain furnace pressure control</li> <li>Ensure correct sensor locations</li> </ul>	<ul style="list-style-type: none"> <li>5-10%</li> <li>5-10%</li> <li>2-15%</li> <li>5-10%</li> <li>5-10%</li> </ul>	<ul style="list-style-type: none"> <li>Frequent and avoidable furnace starts and stops</li> <li>Long periods of idle time between batches</li> <li>Extended periods of low-capacity furnace operation</li> <li>Sagging and distorted piping insulation</li> <li>Higher than necessary operating temperature</li> </ul>
<b>Resistance Heating System Opportunities (Electric)<sup>2</sup></b>		
<ul style="list-style-type: none"> <li>Improve control systems. Precise application of heat at the proper temperature for the correct amount of time</li> <li>Clean heating elements</li> <li>Improve insulation</li> <li>Match the heating element more closely to the geometry of the part being heated</li> </ul>	<ul style="list-style-type: none"> <li>5-15%</li> <li>5-15%</li> <li>5-15%</li> <li>5-15%</li> </ul>	<ul style="list-style-type: none"> <li>Frequent and avoidable furnace starts and stops</li> <li>Long periods of idle time between batches</li> <li>Extended periods of low-capacity furnace operation</li> </ul>

<sup>1</sup>Adapted from U.S. DEPARTMENT OF ENERGY: Improving Process Heating System Performance – A Sourcebook for Industry (Third Edition)

<sup>2</sup>Based on Eurotherm internal case-studies



# Data Management (Electronic Records) and Regulations

Eurotherm data acquisition and management solutions help heat treaters meet their regulatory requirements throughout the data life-cycle, through provision of high accuracy temperature measurement, and features that aid high data integrity, reliable archiving, storage, review, and user management.



Chart Record Review



Annotation Review



Process Record PDF

	<b>Electronic Record and Instrumentation Requirements</b>	<b>AMS2750E Pyrometry Standard Clause</b>	<b>CQI-9 Heat Treatment System Assessment Clause</b>
Tamper Evident	Records unalterable without detection	3.2.7.1.1	3.2.6
Record Playback	Source data unalterable in reviewing tool	3.2.7.1.2	
Records in Readable Form	Accurate complete records for inspection, review and copying	3.2.7.1.3	
Record Review	Evidence of record reviews in electronic or printed format	3.2.7.1.3.1	
Protection of Records	Retrieval of accurate records throughout retention period	3.2.7.1.4	
System Access	Authorization methods of record access	3.2.7.1.5	
Field Test Instruments	Temperature Uniformity Survey and System Accuracy Test instrument accuracy	Table 3 Field Test Instrument (SAT/TUS)	Table 3.2.1 Field Test Instrument (SAT/TUS).
Control, Recording Instruments	Control, monitoring and recording instrument accuracy	Table 3 Control, Monitoring or Recording Instruments.	Table 3.2.1 Control, Monitoring or Recording Instruments.
T/C, Calibration, SATs, TUS	Thermocouples, calibration and tests	3.1.1.4 Thermocouple Usage 3.1.2 Sensor Calibration. 3.2.5 Instrument Calibration 3.4 SATs 3.5 TUS	3.1 Thermocouple Calibration and Use. 3.2.4 Instrumentation Calibration 3.3 SAT. 3.4 TUS. Process Table Tests



# High Integrity Data Management Solutions

## Data Management

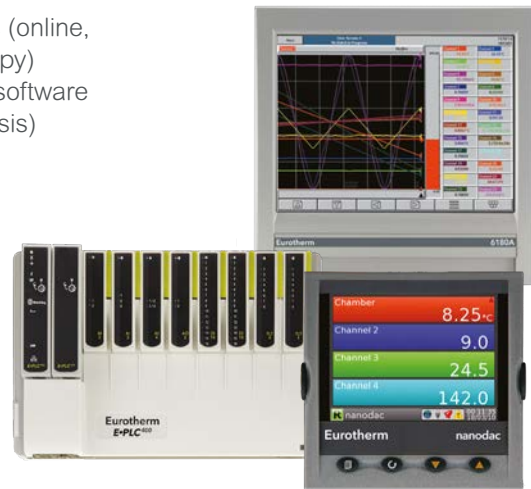
- E+PLC/T2750 PAC controllers
- 6000 Series Recorders
- nanodac 2-PID loop recorder/controller
- versadac scalable recorder

## Reporting

- Process Charts (online, PDF, printed copy)
- Dream Report software (Process Analysis)

## Historian/Data Server

- Eurotherm Data Reviewer FTP/SFTP
- AVEVA Historian (formerly Wonderware)



## Eurotherm Solutions

Eurotherm 6000 series recorders, nanodac recorder/controller, versadac scalable recorder, E+PLC controller and T2750 PAC controller create write-once, read-only data records in a tamper-evident binary file format with the file extension .UHH.	Tamper Evident
Eurotherm Data Reviewer software utility enables playback of the data in an easy to examine trend format. The source data is recorded in a tamper-evident file format.	Record Playback
Eurotherm Data Reviewer along with Dream Report software can generate accurate copies of records in human readable and electronic form, suitable for inspection, review and duplication.	Records in Readable Form
Eurotherm Data Reviewer has an embedded annotation function to provide evidence that the record was reviewed – this review then becomes a part of the permanent record. The record can be printed as a PDF file (for electronic review) or a hard-copy for physical marking to verifying review.	Record Review
Eurotherm Data Reviewer is a 2nd generation software utility that also accepts Eurotherm .UHH file formats created 15+ yrs ago. Redundant archiving of the source data provides additional retention assurance. 6000 series recorders support secure FTP when transferring data to Eurotherm Reviewer. Eurotherm 'Store and Forward' feature automatically backfills data to servers if communications are temporarily lost.	Protection of Records
Eurotherm Data Reviewer and 6000 series recorders have an optional User Management feature that can be used to manage password access.	System Access
Eurotherm 6000 TUS Recorders with special CJC block offer fast-acting accuracy to meet +/-0.6°C(+/-1°F) or +/-0.1% of reading, whichever is greater.	Field Test Instruments
Thermocouple inputs in the following Eurotherm controllers have been tested for input drift to maintain the accuracy required between calibration periods. For example: T2750 PAC and E+PLC (AI2/AI8 modules), nanodac recorder/controller, EPC3000 controller and EPC2000 controller, offer input accuracy +/-1.1°C (+/-2°F) or +/-0.2% of reading, whichever is greater.	Control, Recording Instruments
Thermocouple life algorithms are available in Eurotherm 6000 series recorders, T2750 PAC and E+PLC controller. Test and Task Management are available in Eurotherm Manufacturing Compliance Advisor, Eurotherm 6000 TUS Recorders, and TUS Report Solution.	T/C, Calibration, SATs, TUS

# Heat Treatment Expertise



## Upgrade Equipment at a Pace That Suits Your Budget

Features can be added to improve control when needed, such as:

- Advanced setpoint profile control
- PID autotune for optimized heating/cooling rates
- Overshoot inhibition - cutback function
- “Guaranteed Thermal Soak”- holdback function
- Specific cooling algorithms
- Automatic alarm strategies and reporting
- Automatic transformer load tap changing for multi-tap single phase transformers - provides reduced harmonics and improved power factors that help to lower energy costs
- Energy metering and monitoring - understand energy costs, benchmark the process and make improvements

## Eurotherm Regulatory Expertise

Our highly respected and knowledgeable global heat treatment sales team includes members of industry-standards committees, involved in both heat treatment standard development and balloted voting decisions. As well as having a PRI (Performance Review Institute) Trainer on staff, many of our engineers are trained on the AMS2750 Pyrometry standard giving our wider team a deep understanding of the industry, its processes and regulatory requirements.

## Eurotherm Customer First Services

Experienced engineering teams provide localized support in all major regions, covering:

- Project delivery
- Calibration
- Accreditation
- Temperature Uniformity Surveys (TUS)
- Energy Surveys
- Efficiency Optimization
- Cyber Security Surveys
- Training

## Eurotherm help over 65% of Nadcap sites in Europe with their accreditation challenges

*Challenge: Provide control of a small furnace through to plant wide automation, using technology that grows with your needs.*

Hoosier Spring selected Eurotherm to further improve control and data acquisition in their internal Heat Treatment department. The 3504 advanced temperature/process controller provided enhancements to their temperature control, while the AeroDAQ Data Management Solution provided high integrity data acquisition with thermocouple life monitoring, to meet AMS2750E requirements.

*“We designed a software solution in the 3504 controller that allowed us to manage the temperature recovery and prevent overshoot without cooling the furnace down before loading. Thus allowing greater production throughput.”*

President – Leading Control & Engineering Service Company

*“With our old manual process limitations, I was concerned we’d lose our accreditation. Now I never worry about finding the right records when I need them.”*

Quality Manager – Leading Aerospace Manufacturer

## "We work with all of the Top 10 global Furnace/Oven OEMs"

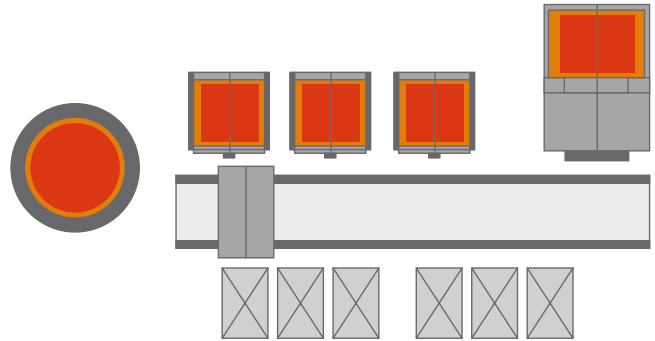
Global Heat Treatment Business Development Manager – Eurotherm by Schneider Electric

# Efficiency at Every Level

## Enterprise/Plant Solutions

Supervisory solutions utilize process and energy SCADA, plus reporting technology to help meet regulatory needs and enable efficient operation.

- Improve load density for better furnace utilization
- Optimize energy usage to reduce costs
- Be prepared for audits through digitized regulatory management



## Furnace Solutions

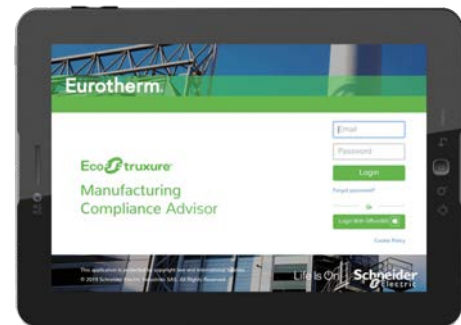
Advanced control and data capture help meet the specific needs of:

- Vacuum Furnaces
- Autoclaves
- Sealed Quench/Batch Integral Quench Furnaces and more...



## Operator Solutions

- A single platform used across multiple types of furnace/oven solution helps to reduce the learning curve
- Bringing information and/or procedures right into the hands of the operator through the use of augmented reality and IoT technology.



## Solutions designed to aid an overall cybersecurity strategy, covering:

- Policies and procedures
- Network separation and segmentation
- System access controls
- Device and system hardening
- Monitoring and maintenance



Discover how to get more from your heat treatment operations

[eurotherm.com/heatreat](https://eurotherm.com/heatreat)

Life Is On

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sales representative



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