Expertise to improve heat treatment process efficiency

Eurotherm®

Flexible solutions for process and energy optimization, leveraging process control, high integrity data management and next generation IoT and Industry 4.0

Strategic partner to Furnace and Oven OEMs, providing global expertise across the industry

eurotherm.com/heattreat

WATLOW®
Powered by Possibility

Heat treatment solutions

We are your strategic partner for precision temperature control, thermal power management, and data management for increased efficiency and resiliency towards a sustainable future.

Maximize throughput

To maximize throughput, you need fast-acting reliable, and repeatable precision control. We have developed specific Heat Treatment control algorithms for temperature, atmosphere, vacuum, and energy management. Examples include; autotune for quick setup of temperature instruments, repeatable cycles with recipe and setpoint management, and reliability though input accuracy and drift control.

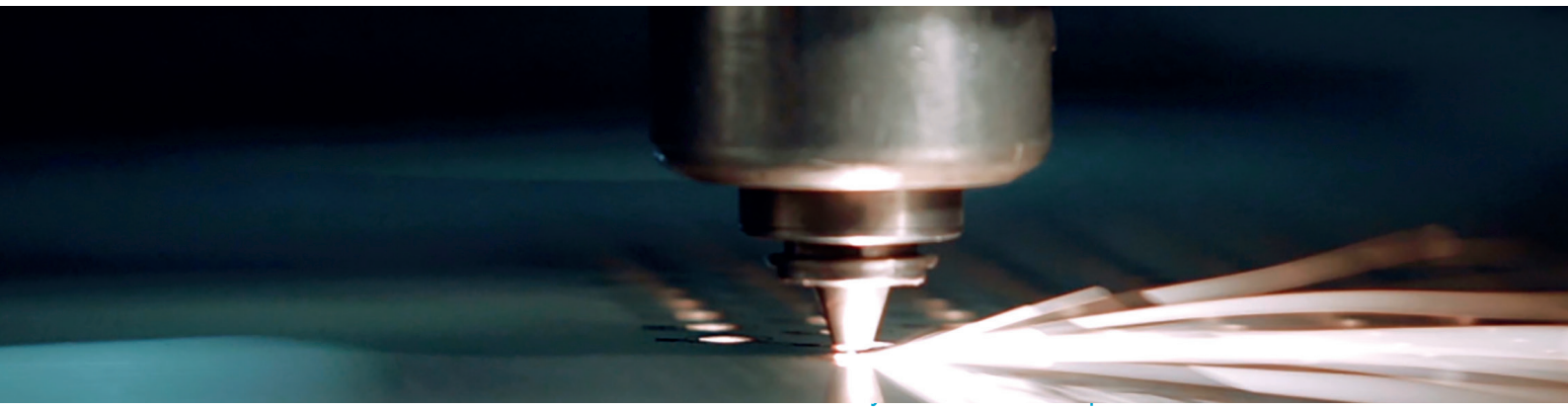
Quality control

To avoid quality issues at the end of the line – it needs to be designed in. With this in mind, our temperature controllers and recorders, and data acquisition instruments are designed to exceed the accuracy requirements of the major specifications (AMS2750 and CQI).

This gives you confidence from furnace start-up and first calibration through to many repeat calibrations during the life of your furnace or oven. We also believe data captured and protected at source gives you the best chance of internal quality control and eases meeting external regulatory requirements. Our pyrometry solutions brochure covers this in detail.

Energy management

As part of a sustainably focused global corporation, we understand our role in helping our customers protect the planet's valuable resources. Heat Treatment is an energy-intensive industry, and we help by reducing overall energy use and lowering harmful emissions by providing the latest power control technology and standardized advanced power supplies.



frustrated with dealing with temperature control issues and tired of unreliable instrumentation?

- Striving to increase furnace output
- Under pressure to reduce quality costs and facing regulatory pressures to meet industry standards (AMS2750, CQI)
- Challenged to achieve sustainability and energy goals
- Digitally transforming from Industry 3.0 to Industry 4.0
- High furnace/oven utilization and optimum load density – necessary to maximize revenue per cycle
- Tailored process design – can command higher product/service revenue
- Furnace management – key for delivering high process performance
  – Lean manufacturing
  – Energy management
  – Regulatory management

Flexible furnace automation solutions

Solutions designed specifically for heat treatment support lean manufacturing, energy and regulatory management, while aiding furnace utilization and planning. Eurotherm control and data recording solutions are IoT ready, providing a data integrity layer within open IoT platform system architectures and aiding the digital transformation to Industry 4.0 technology

Supervisory system

SCADA Solutions for Furnace/ Oven, Production Line, Enterprise requirements.

Historian/Data server

Data Reviewer/historian to suit Furnace/Oven, Production Line, Enterprise requirements.

Industry 4.0/IoT

Furnace/Oven, Production Line, Enterprise requirements.

Standard system

Expandable PLC with size options for HMI.

Data management

Data Recorders. Front Panel and DIN rail mount options.

Discrete instruments

1/16, 1/8 & 1/4 DIN single and multiloop PID controllers.

Energy SCADA

Power monitoring software

Power controllers

Power Switches, Compact Power Controllers and Advanced SCR Power Control

Other devices

Power Meters, Analyzers (Gas 3IR), Carbon/Oxygen Probes.

Standardized solutions

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

Tailored furnace systems

- SCADA, HMI and IoT solutions 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
		
Control inputs		
• Furnace/load thermocouples • Low/high vacuum gauge • Additional analog inputs • Digital inputs for sequencing	• Pressure • Air Temperature • Vacuum • High/low part thermocouples • Part thermocouple	• Carbon probe with internal thermocouple • Furnace thermocouple • Additional thermocouple inputs • Digital inputs for sequencing
Control outputs		
• Roughing pump • High vacuum gauge on/off • Diffusion pump • Furnace heaters • End of cycle/partial pressure alarm • Additional analog outputs • Digital outputs for sequencing	• Vacuum pumps • Pressure control • Furnace heaters • End of cycle • Additional analog outputs • Digital outputs for sequencing	• Carbon gas enrichment/air dilution control • Sooting alarm and probe clean control • Furnace heater output • Quench chamber heater output • Additional thermocouple outputs • Digital outputs for sequencing
I/O expansion		
• Additional I/O racks • 3rd Party PLC or I/O	• Additional I/O racks • 3rd Party PLC or I/O	• Additional I/O racks • 3rd Party PLC or I/O
Control functions		
• Auto-tuning PID Sets • Vacuum Algorithms • Setpoint Programming • Data Recording • Batch Management • Thermocouple Life Algorithm	• Auto-tuning PID Sets • Vacuum Algorithms • Setpoint Programming • Data Recording • Batch Management (part database) • Thermocouple Life Algorithm	• Auto-tuning PID (6 Sets) • Algorithms for 3GasIR (enhanced carbon control), Online Carburizing, Carbon Potential • Thermocouple Life and more • Setpoint Programming • Data Recording • Batch Management

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

- Power monitoring software 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
Heat generation opportunities (gas)[1]		
• Control air-to-fuel ratio • Preheat combustion air • Oxygen-enriched combustion air • Fuel conditioning	• 5-25% • 15-30% • 5-25% • 5-10%	• Combustion air leaks downstream of the control valve • Linkage condition leading to poor fuel/air mix • Excess oxygen in the exhaust gases • Flame instability
Heat transfer opportunities (gas)[1]		
• Improve heat transfer with advanced • burners and controls • Improve heat transfer within a furnace	• 5-10% • 5-10%	• Higher than necessary operating temperature • Exhaust stack temperature
Enabling technology opportunities (gas)[1]		
• Install high turndown combustion systems • Use programmed heating temperature • setting for part-load operation • Monitor and control exhaust gas oxygen, • unburned hydrocarbon, and carbon • monoxide emissions • Maintain furnace pressure control • Ensure correct sensor locations	• 5-10% • 5-10% • 2-15% • 5-10% • 5-10%	• Frequent and avoidable furnace starts and stops • Long periods of idle time between batches • Extended periods of low-capacity furnace • operation • Sagging and distorted piping insulation • Higher than necessary operating temperature
Resistance heating system opportunities (electric)[2]		
• Improve control systems. Precise application of heat at the proper temperature for the correct amount of time • Clean heating elements • Improve insulation • Match the heating element more closely to the geometry of the part being heated	• 5-15% • 5-15% • 5-15% • 5-15%	• Frequent and avoidable furnace starts and stops • Long periods of idle time between batches • Extended periods of low-capacity furnace operation

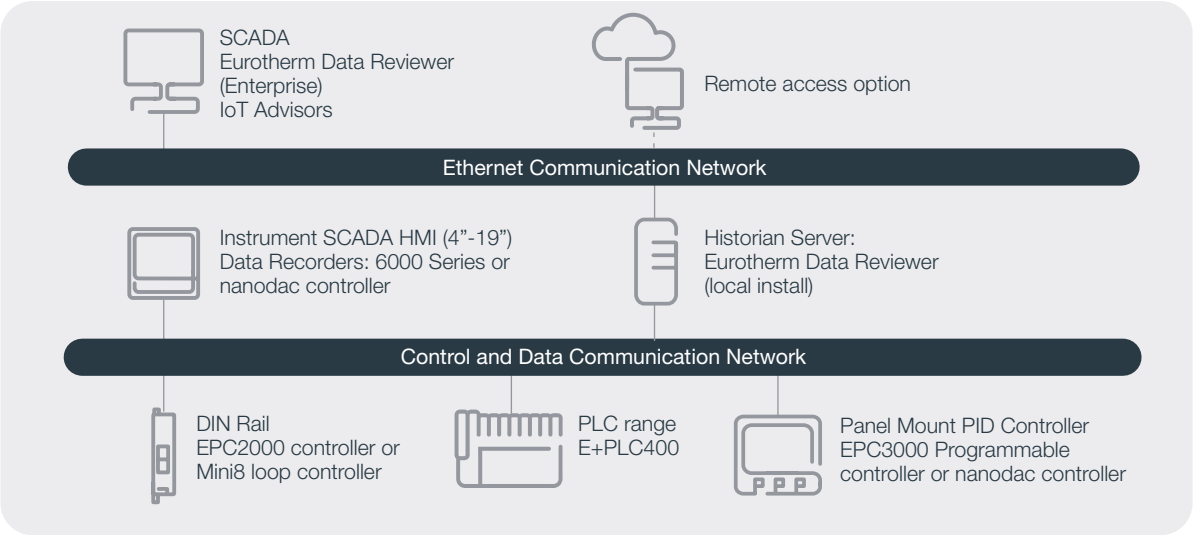
[1]Adapted from U.S DEPARTMENT OF ENERGY: Improving Process Heating System Performance – A Sourcebook for Industry (Third Edition)

[2]Based on Eurotherm internal case-studies

Instrumentation to help meet AMS2750 & CQ19

When subject to the necessary field calibration, the following instruments manufactured by Eurotherm are suitable for use in aerospace (Nadcap/AMS2750) and automotive (IATF16949/CQI9).

Example architecture



Control or recording (AMS2750 table 7)

Calibration to meet ±2.0°F or ±1.1°C or ±0.2% of temperature, whichever is greater (+/-2.0°C (+/-4.0 °F) CQI9 4th Ed. Table P3.2.1).

Type	Eurotherm instrument	Model numbers
Control	EPC2000 programmable controller	All models
	2000 series controller	2704 and 2604
	EPC3000 programmable controller	EPC3016, EPC3008, and EPC3004
	3000 series controller	3200 series and 3500 series
	Mini8® loop controller	With enhanced thermocouple board (ET8)
Control and recording	nanodac™ recorder/controller[1]	All models
	E+PLC400[1]	E+PLC400[1]
	PAC system hardware	T2550[1] and T2750[1]
Recording	6180 AeroDAQ1 and 6000 series graphical recorder	6100XIO[1], 6100[1], 6180XIO[1], and 6180A[1]
	versadac™ scalable data recorder[1]	All models
	Eycon™10/20 visual supervisors[1]	All models

Field test instruments (CQI9 4thEd. Table P3.2.1 AMS2750 Table 7

6000 series graphical recorder, model numbers: 6100A TUS and 6180A TUS with external CJC and fast-acting accuracy to meet ±1.0°F or ±0.6°C or ±0.1% of temperature, whichever is greater. Test instruments are digital and meet minimum readability 1.0°C and 1.0°F (CQI9 4thEd. P3.2.2.1 AMS2750 3.2.2.2).

[1]Devices for use in data acquisition (AMS2750 3.2.4). Simple Network Time Protocol (SNTP) is available in the 6000 series graphical recorder, nanodac recorder/controller, PAC system hardware (model numbers T2550, T2750), PLC system hardware (E+PLC400) and Eycon 10/20 visual supervisors to provide digital synchronization to help meet recording timing accuracy.

All control, recording, and over-temperature instruments shall be digital (by 2022-06 AMS2750 3.2.3.1 and by 2023-06 CQI9 4th Ed. P3.2.1). At least one controlling, monitoring, or recording instrument for each furnace zone shall have a minimum readability of 1.0°C and 1.0°F for digital instruments (CQI9 4th Ed. P3.2.2.2). All digital recording instruments shall have a minimum readability of 1.0°C and 1.0°F (by 2022-06 AMS2750 3.2.3.2).

High integrity data management solutions

Data management

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

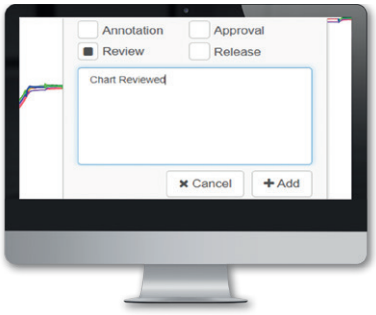
Reporting

- Process charts (online,
- PDF, printed copy)
- Process analysis
- 6000 series recorder

Historian/data server

- Eurotherm Data Reviewer FTP/SFTP
- Historian and reporting server

Chart record view



Annotation view

Process record PDF

Electronic records	AMS2750 clause	CQ19 4th Ed clause	Eurotherm solutions
Tamper-resistant	3.2.4.2a	P3.2.6	Records unalterable without detection. 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.
Record payback	3.2.4.2b	P3.2.6	Source data unalterable in reviewing tool. 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-resistant file format.
Records in readable form	3.2.4.2c	Section4 job audit	Accurate, complete records for inspection, review, and copying. Eurotherm Data Reviewer software can help generate accurate copies of records in human-readable and electronic form, suitable for inspection, review, and duplication.
Record review	3.2.4.2d	Section4 job audit	Evidence of record reviews in electronic or printed format. 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 verify review.
Protection of records	3.2.4.2e	IATF16949-2016 defines retention periods	Retrieval of accurate records throughout the retention period. 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 files to Eurotherm Data Reviewer. Eurotherm 'Store and Forward' feature automatically backfills data to servers if communications are temporarily lost.
Hardware and software operation	3.2.4.2f		Operate throughout retention period (min. 5 years). The Eurotherm established obsolescence program ensures both hardware and software are supported throughout stated retention periods.
System access	3.2.4.2g		Authorization methods of record access. Data acquisition products have an optional user management feature that can be used to manage password access.
Software revisions	3.2.4.2		Eurotherm Data Reviewer software revisions do not impact process parameters. Setpoint cycle revisions in PLC's or programmers can be controlled by authorized access and quality procedures. Eurotherm control products have passcode protection on configuration. Eurotherm Data Reviewer operates independently to cycle setpoint programmers and will not impact process parameters on revision updates.

Heat treatment expertise

Eurotherm application expertise

- Control algorithms for temperature, atmosphere, vacuum, and energy management
- Electrical power control
- Furnace/oven process control and sequencing
- Recipe and setpoint management
- Batch entry and management
- Data historian and reporting
- Alarm management
- Plant and machine SCADA with customized operator interfaces
- Augmented reality
- Predictive maintenance
- Remote monitoring
- OEM support
- Compliance: AMS2750, CQI9, calibration, TUS,
- SAT
- System lifecycle (SLA) and cybersecurity support services
  - Project delivery
  - Calibration
  - Accreditation
  - Temperature Uniformity Surveys (TUS)
  - Energy Surveys
  - Efficiency Optimization
  - Cyber Security Surveys
  - Training

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 helps a significant number of Nadcap sites globally to overcome 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 AMS2750 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**

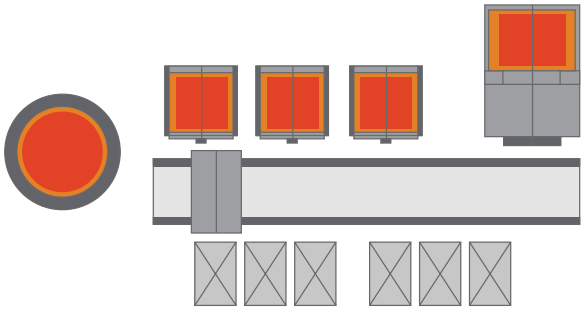
> *"We work with all of the Top 10 global Furnace/ Oven OEMs"*
>
> **Global Heat Treatment Business Development Manager – Eurotherm**

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.

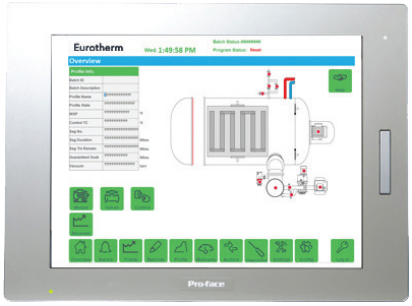
- Improve load density for better furnace utilization
- Optimize energy usage to reduce costs
- Be prepared for audits through digitized regulatory management



Furnace solutions

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

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



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

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INVESTORS IN PEOPLE

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