



## Optimizing efficiency and regulatory compliance

### Atmosphere carburizing control solutions

Meeting the requirements of industrial heat treatment standards is easier with both accurate control of the furnace temperature, and carbon potential of the atmosphere.

Choose from a range of control solutions designed to help you achieve:

- Surface hardness specifications
- Case-depth profile from carbon enrichment
- Conforming microstructure

Optimize cycle times, and record the process to meet heat treatment data regulations.

Applicable heat treatment standards

AMS2750E  
CQI-9 Issue 3  
AMS2759

[eurotherm.co.uk/heattreat](http://eurotherm.co.uk/heattreat)

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**Eurotherm.**  
by Schneider Electric

# Atmosphere carburizing control

Carbon control and integrated carburizing systems



## Products at a glance

### EPC3000 process controllers, ideal for carbon control

Associated products:

- Carbon probe with internal temperature sensor
- 6100/6180 data recorder

### nanodac™ recorder/controller, ideal for carburizing control

Features:

- Setpoint programming
- Inbuilt trend and tamper resistant data recording

Associated products:

- Carbon probe

### E+PLC<sup>400</sup> with E+HMI, ideal for advanced carburizing control systems

Features:

- Setpoint programmer
- Inbuilt trend and tamper resistant data recording
- Optional 3gasIR atmosphere control
- Optional model-based control (online diffusion)
- IIoT (Industrial Internet of Things) ready
- Easily integrated with 3<sup>rd</sup> party PLCs (hybrid system)

Associated products:

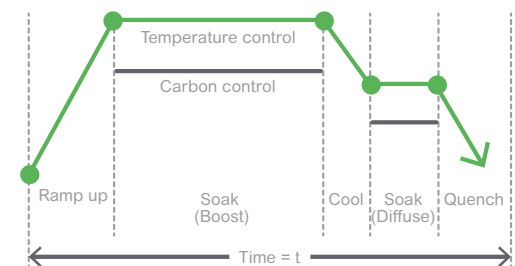
- Carbon probe

## Eurotherm carburizing cycle overview

### Carbon control

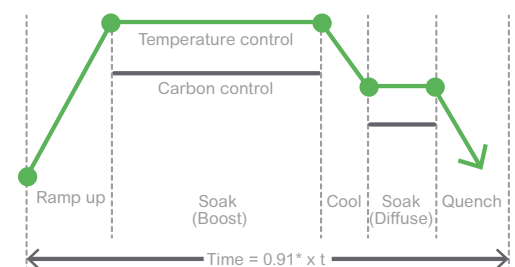
Provides single-setpoint carbon probe control by translating mV input into carbon % value. Supports probes from several common vendors. Serial and Ethernet-based communications allow remote setpoint to be sent to the controller.

### Carburizing control



Provides multi-setpoint control via a setpoint program for temperature and carbon control loops. Higher carbon % values can be set for the boost segment, typically 1.0-1.2%, and lower carbon for the diffuse segment, typically 0.7-0.9%.

### Advanced carburizing system



\*Typical cycle time reduction of 9%

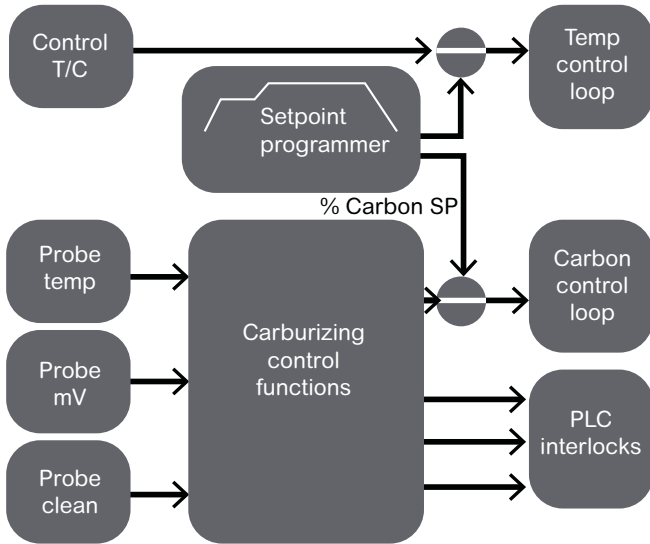
Setpoint control as above, enhanced with 3gasIR control to optimize probe readings, and model-based online diffusion control to reduce case-depth variability. Boost and diffuse segment times are optimized based on the model.

Please refer to the back page for a control solutions summary and an overview of our integrated systems and engineering services capability.

\* Based on typical savings seen in retrofit applications where standard carburizing control (not real-time) was previously used.

# Control system overview

## Features and functions



Control system overview

## Specialized functions for carburizing control

### T/C block

The thermocouple linearization function block converts the mV input reading and cold junction temperature into a temperature output. It also provides scaling, low pass filtering, offset and manual-override capabilities.

### Autotune PID control

Provides a channel output to control a process variable (PV), using a precision PID control algorithm designed by Eurotherm. Autotune is included, as well as a 'cutback' feature to control overshoot behavior. A gain scheduling feature is available for adding extra PID tuning sets, to help maintain tight control at different setpoints.

### Thermocouple life\*

Derives the working lifespan of thermocouples in days or number of times used, under different ranges of operating temperature. The block monitors usage times and temperatures, and indicates whether the thermocouple is still valid for use according to the AMS2750E standard.

### Setpoint programmer

Each part of the process is divided into an appropriate segment (for example, ramp, soak, cool etc.) Within each segment, appropriate variables can be set (carbon%, time, ramp rate etc.)

### Carbon potential

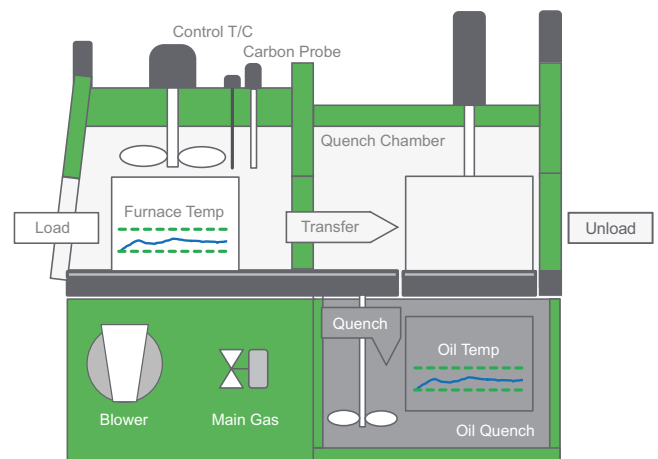
Provides calculation of the furnace atmosphere's carbon potential, probe cleaning algorithm and soot notification. Includes probe linearization for several common vendors.

### 3GASIR (enhanced carbon control) \*

Utilizes CO, CO<sub>2</sub> and CH<sub>4</sub> readings from an infrared gas analyzer, in combination with furnace temperature readings. Calculates appropriate probe adjustment/compensation factors to provide accurate carbon potential value.

### Carbon diffusion (online carburizing) \*

Mathematically models the diffusion of carbon from a carbon enriched atmosphere into steel within a furnace. Case depth targets are set and the model calculates the carbon profile of the steel (percentage of carbon against depth) in real time. Allows optimization of the heat treat cycle by stopping as soon as complete.








Typical carburizing furnace layout, visualized in the E+PLC<sup>400</sup> with E+HMI

\* Available in E+PLC only

# Carbon control and integrated carburizing systems

Example solutions dependent on I/O options

| HMI options  | Discrete control examples   |   | System control examples   |   |   |
|--|---|---|---|---|---|
|  | Carbon control  | Carburizing control   | Advanced carburizing control  |   |   |
| <b>Standard</b><br>7" E+HMI<br>13" E+HMI<br><br><b>Optional</b><br>4 – 19" panels available, contact local Eurotherm office for availability |  |  |  |  |  |
|  | EPC3000   | nanodac   | E+PLC <sup>400</sup><br>0 module base <sup>1</sup>                                | E+PLC <sup>400</sup><br>4 module base   | E+PLC <sup>400</sup><br>8 module base   |
| Typical control inputs (dependent on optional I/O board or module selection)   |   |   |   |   |   |
| Carbon probe with internal thermocouple  | ✓   | ✓   | Dependent on customer specified I/O   | ✓   | ✓   |
| Furnace thermocouple   | -   | ✓   |   | ✓   | ✓   |
| Additional thermocouple inputs   | -   | ✓   |   | -   | ✓   |
| Digital inputs for sequencing  | 8   | -   |   | 16  | 32  |
| Typical control outputs (dependent on optional I/O board or module selection)  |   |   |   |   |   |
| Carbon gas enrichment/air dilution control   | ✓   | ✓   | Dependent on customer specified I/O   | -   | ✓   |
| Sooting alarm and probe clean control  | ✓   | ✓   |   | -   | ✓   |
| Furnace heater output  | - <sup>2</sup>  | ✓   |   | ✓   | ✓   |
| Quench chamber heater output   | ✓   | ✓   |   | ✓   | ✓   |
| Additional analog outputs  | -   | -   |   | -   | ✓   |
| Digital outputs for sequencing   | 8   | -   | 16  | 32  |   |
| Typical I/O expansion  |   |   |   |   |   |
| Expansion over Ethernet communications   | mini8/microPLC  | mini8/microPLC  | Eurotherm, Schneider Electric or 3 <sup>rd</sup> party I/O                        |   |   |
| Typical control functions  |   |   |   |   |   |
| Autotuning PID   | ✓   | ✓   | ✓   | ✓   | ✓   |
| Extra PID sets   | 2   | 3   | 6   | 6   | 6   |
| Carbon control algorithms  | ✓   | ✓   | ✓   | ✓   | ✓   |
| Carburizing algorithms   | -   | ✓   | ✓   | ✓   | ✓   |
| Setpoint programming   | Basic   | Basic   | Advanced  | Advanced  | Advanced  |
| Data recording   | -   | ✓   | ✓   | ✓   | ✓   |
| Batch management   | -   | ✓   | ✓   | ✓   | ✓   |

<sup>1</sup>E+PLC<sup>400</sup> with any number of modules from zero upward can be used to create a hybrid advanced carburizing control system, in combination with Schneider Electric, Eurotherm and 3rd party PLCs.

<sup>2</sup>Heater output only available if carbon control (gas enrichment/air dilution) is not used.

Product I/O options shown are for example only. Contact your local Eurotherm sales representative to discover the most suitable solution for your process.

Scalable integrated systems and services, from single machine to enterprise solutions, including:

- Power control (SSR/SCR) and process control
- Data management, alarm management and supervisory systems
- System design, engineering and installation
- Calibration and maintenance services

[eurotherm.co.uk/contact](http://eurotherm.co.uk/contact)

[eurotherm.co.uk/systems](http://eurotherm.co.uk/systems)

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