Meeting the requirements of industrial vacuum heat treatment standards is easier with accurate control of temperature and vacuum pressure.

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

- Surface/core hardness requirements
- Conforming microstructure
- High quality finish

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

Applicable heat treatment standards
AMS2750E
CQI-9 Issue 3
AMS2769
Vacuum heat treatment control
Vacuum pump sequence and integrated control systems

Products at a glance

2704VC, ideal for vacuum control
Features:
• High vac / low vac control
• Furnace temperature control
• Setpoint programming
Associated products:
• 6100/6180 data recorder

E+PLC100, ideal for vacuum heat treatment (HT) control
Features:
• High vac / low vac control
• Furnace temperature control
• Load thermocouple inputs
• Setpoint programming
• Inbuilt trend and tamper resistant data recording

E+PLC400 with E+HMI, ideal for advanced vacuum HT systems
Features:
• High vac / low vac / partial pressure control
• Furnace temperature control
• Load thermocouple inputs
• Quench gas control (gas type/pressure)
• Setpoint programming
• Inbuilt trend and tamper resistant data recording
• IIoT (Industrial Internet of Things) ready
• Easily integrated with 3rd party PLCs (hybrid system)

Eurotherm vacuum cycle overview

Vacuum control
Provides multi-setpoint control via a setpoint program and sequencing of the vacuum pumping system, with bumpless transfer between low vac and high vac gauges.

Vacuum HT control
Provides multi-setpoint control via a setpoint program and sequencing of the vacuum pumping system, with temperature cycles.

Advanced vacuum HT system control
Setpoint control as above, plus leak-rate detection and pumping-time systems to aid the optimization of cycle-times. This IIoT ready system also allows enhancement with predictive maintenance functionality.

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

Features and functions

Specialized functions for vacuum HT 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 or 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.

Vacuum input
Converts raw electrical measurements into vacuum pressure values. It also supplies a gas calibration factor for non-N₂ type atmospheres, low pass filtering, offset, and manual override. Provides vacuum gauge linearization for several common vendors, as well as user defined linearization capability.

Gauge switch
Allows for smooth (bumpless) switching between a “low” vacuum gauge, such as a Pirani gauge, and a “high” ionization type such as an inverted magnetron or Penning gauge.

Pump-down timer
Optimizes vacuum cycle time by alerting operators to a controller detected event or leak in the vacuum system. It can be configured to signal an alarm if a particular vacuum pressure has not been reached in a given amount of time.

Leak rate
Implements a leak test strategy for a vacuum chamber, using industry standard leak-rate methodology.

Typical vacuum furnace layout, visualized in E+PLC

*Available in E+PLC only
Vacuum sequence and integrated control systems
Example solutions dependent on I/O options

<table>
<thead>
<tr>
<th>HMI options</th>
<th>Discrete control</th>
<th>System Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7” E+HMI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13” E+HMI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optional</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 – 19” panels available, contact local Eurotherm office for availability</td>
<td>2704VC</td>
<td>E+PLC400 4 module base¹</td>
</tr>
</tbody>
</table>

**Typical control inputs (dependent on optional I/O board or module selection)**

<table>
<thead>
<tr>
<th></th>
<th>Vacuum control</th>
<th>Vacuum heat treatment control</th>
<th>Advanced vacuum heat treatment control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Furnace thermocouple</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Low vacuum gauge</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>High vacuum gauge</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Load thermocouple</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Program start</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Additional thermocouple inputs</td>
<td>Dependent on optional I/O</td>
<td></td>
<td>32</td>
</tr>
<tr>
<td>Additional analog inputs</td>
<td></td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Digital inputs for sequencing</td>
<td>2</td>
<td>16</td>
<td>32</td>
</tr>
</tbody>
</table>

**Typical control outputs (dependent on optional I/O board or module selection)**

<table>
<thead>
<tr>
<th></th>
<th>Vacuum control</th>
<th>Vacuum heat treatment control</th>
<th>Advanced vacuum heat treatment control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roughing pump</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>High vacuum gauge on/off</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Diffusion pump</td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Furnace heater</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>End of cycle/partial pressure alarm</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Additional analog outputs</td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Digital outputs for sequencing</td>
<td></td>
<td>16</td>
<td>64</td>
</tr>
</tbody>
</table>

**Typical control functions**

<table>
<thead>
<tr>
<th></th>
<th>Vacuum control</th>
<th>Vacuum heat treatment control</th>
<th>Advanced vacuum heat treatment control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autotuning PID</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Extra PID sets</td>
<td>2</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Vacuum algorithms</td>
<td>Basic</td>
<td>Advanced</td>
<td>Advanced</td>
</tr>
<tr>
<td>Setpoint programming</td>
<td>Basic</td>
<td>Advanced</td>
<td>Advanced</td>
</tr>
<tr>
<td>Data recording</td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Batch management</td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

¹E+PLC400 with any number of modules from zero upward can be used to create a hybrid advanced vacuum heat treatment control system, in combination with Schneider Electric, Eurotherm and 3rd party PLCs.

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  eurotherm.co.uk/systems**

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