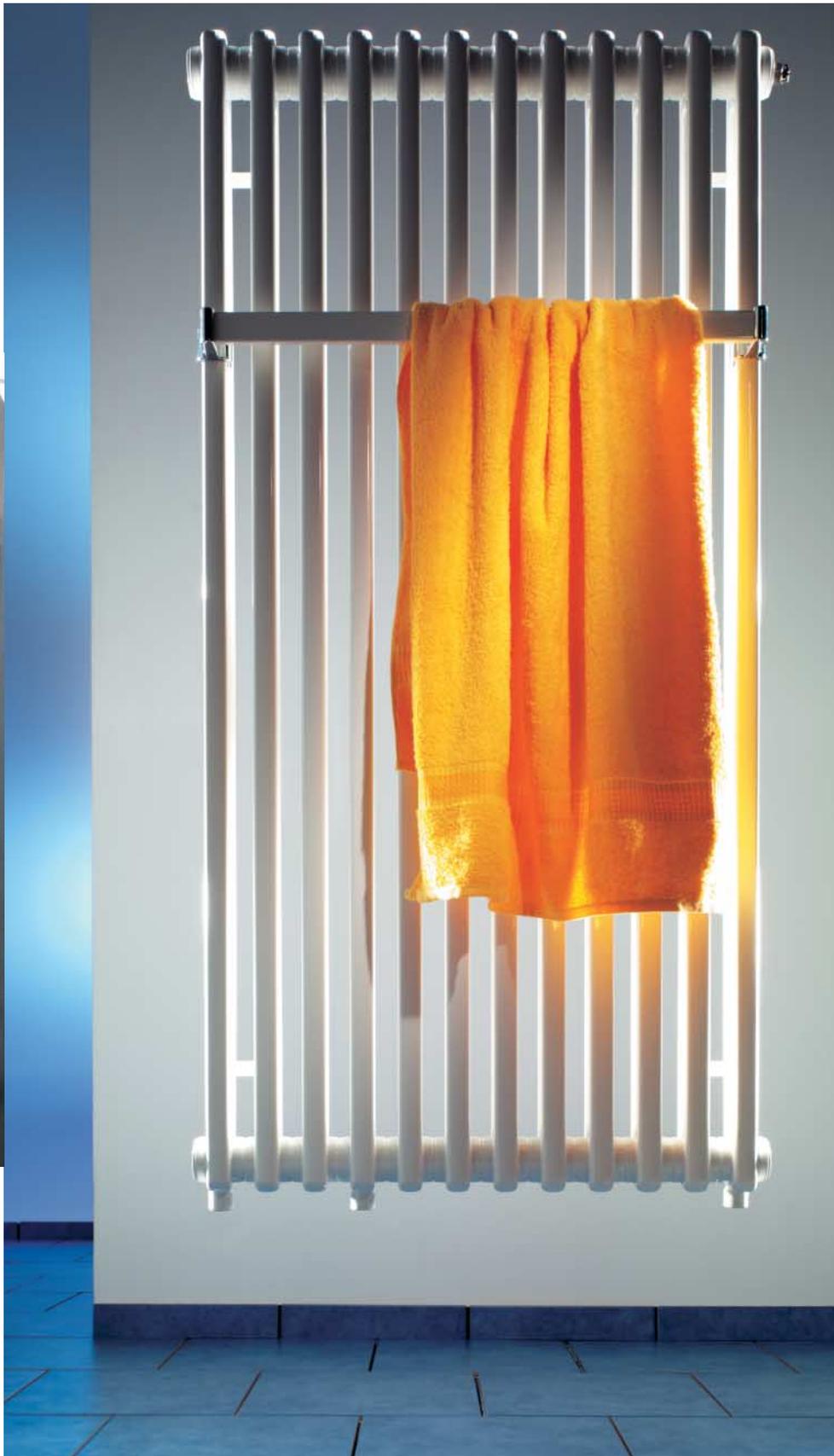**Delta radiators: TwinCAT CNC controls laser welding system**

Delta Laserline combines state-of-the-art technology and appealing design with maximum comfort: no protruding welding burrs inside or outside, no welding residues in the radiator. Uniform laser welding ensures long product life and high-quality appearance.

High-tech production for high-quality radiators

➤ Demand for exclusive and unique household designs now applies to virtually every visible part of a home – today even radiators are part of the "make-over" trend. Radiator pipes with a D-shaped design from German company, Delta Radiatoren GmbH are optimized not only for function, but also to meet modern aesthetic requirements. The radiators are fully laser-welded in order to avoid ugly weld seams or welding residues. Delta's production lines use PC-based CNC technology from Beckhoff for the precision laser welding process.

All cutting and welding processes within the radiator production line are laser-based. The benefits of laser technology include almost unlimited flexibility, fully automatic changeover to any radiator type with extremely short set-up times and outstanding quality. The exacting requirements for the radiator production process necessitate automation technology that offers maximum performance. Delta commissioned the local company Lemuth Laseranlagen und Sondermaschinen GmbH to develop a solution for the task. The company had already been using TwinCAT and Beckhoff automation solutions successfully for years. "A crucial argument for Beckhoff was the fact that only a single software environment with an integrated concept is required," Uwe Büttner, who is responsible for the system's controls, said.

Benefits of open control architecture

The main criteria for the choice of Beckhoff technology were flexibility, high production speed and full integration of the laser technology with the fieldbus technology. All control tasks are dealt with via TwinCAT and a uniform control platform including:

| Positioning and complex movements of servo axes in point-to-point and CNC mode;
| specification of set values for the lasers via the fieldbus with optical fiber technology or I/O interface;
| integration of the I/Os of the production line and
| provision of the user interface.

"For the visualization we use our own, Delphi-based interface. The required communication interfaces are provided by TwinCAT without additional cost," Uwe Büttner said. "Since Beckhoff uses Industrial PCs as the hardware platform, no special hardware components for remote maintenance are required. Standard PC technology, such as an ISDN or analog modem and a networked ISDN router can be used. The use of an integrated hardware and software concept proved to be a great success right from the start."

TwinCAT CNC enables welding of any contour

"The core of the system is formed by 10 high-performance C6140 Industrial PCs that act as control interface for the laser equipment," Dr. Henry Driesel, project manager at Delta, explained. "We use three CO_2 lasers for internal and external welding and cutting of the tubes. Four solid-state lasers are used for special welding tasks. The control technology enables the lasers to be controlled via fieldbus interfaces or via a simple I/O level. Furthermore, TwinCAT enables synchronized reading and writing of all required process values from a PLC program."

The movement of the welding axes is controlled from the data contained in the construction drawings via transformation. TwinCAT CNC enables machine axis control in PTP positioning mode and CNC control of axes with spline interpolation. Depending on the CNC path velocity, the Trumpf laser is assigned a proportional set value for the required laser power.

Cutting of pipes with 2 kW CO_2 lasers

The thin-walled pipes with round or D-profile are processed in a cutting center and made available in the required lengths for further processing. The infeed to the cutting section is servo-controlled, with a feed velocity of 4.5 m/s. The cut itself is only 0.1 mm wide, with a pipe length precision of 0.1 mm. Due to clamping on both sides during cutting, edges are avoided during application or removal of the laser. The cut surface is clean and burr-free. The special cutting process also leaves no shavings. Additional reworking, such as washing and drying for the purpose of removing shavings is not required and the cut sections can be processed further without intermediate steps.

The lasers are controlled via digital and analog signals. The short cycle time of the PLC enables direct specification of the laser power via an analog I/O interface.

Synchronized transfer of all signals

A fieldbus cycle that is synchronized with the PLC run time deals with all signals that are not time-critical. The time-critical signals are synchronized and transferred via fast Beckhoff optical fiber modules. The analog set values for the required laser power are transferred with a cycle time of 0.5 ms.

"All signals are available to the programmer centrally via the process image. Complex system wiring is no longer required and ultimately eliminated as a source of faults during system installation and commissioning," Dr. Driesel said, highlighting the benefits of the new control system. "Recording of the process values via the integrated TwinCAT Scope View oscilloscope software helps our experts in their efforts to optimize the production processes. In the past, complex measurement installations were required for this purpose."

High production output and optimization of production times and costs

The optimized system generates almost no waste. The master computer dealing with process planning sends the complete production plan containing the batches to be cut to the machine. Cutting can be optimized both via the process planning program or directly via the system control. Any cutoffs from large cut lengths are reused for shorter sections.

In terms of its equipment and performance, the new pipe cutting system from Lemuth is positioned between the familiar, simple saw cutting systems and highly complex processing centers. The combination of CAM and CNC on a common software basis enables improved processing times and minimization of project design times, coupled with low hardware and software costs. The Ethernet interface in the Industrial PC is used for communication with the controllers and for programming. Once again, additional costs for special communication processors are avoided.

→ Lemuth Laseranlagen und Sondermaschinen GmbH **www.lemuth.com**
→ Delta Radiatoren GmbH **www.delta-radiatoren.de**