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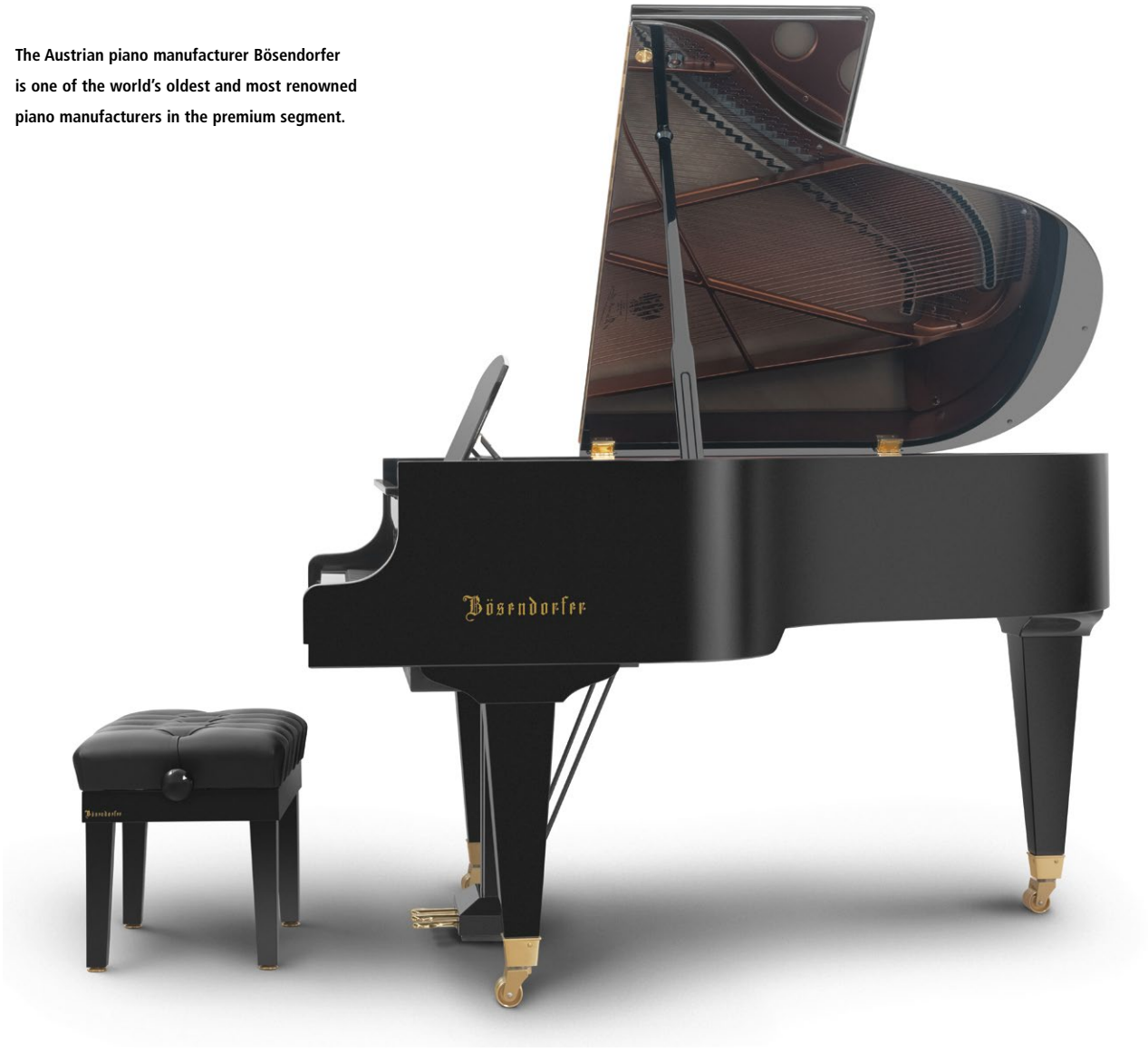
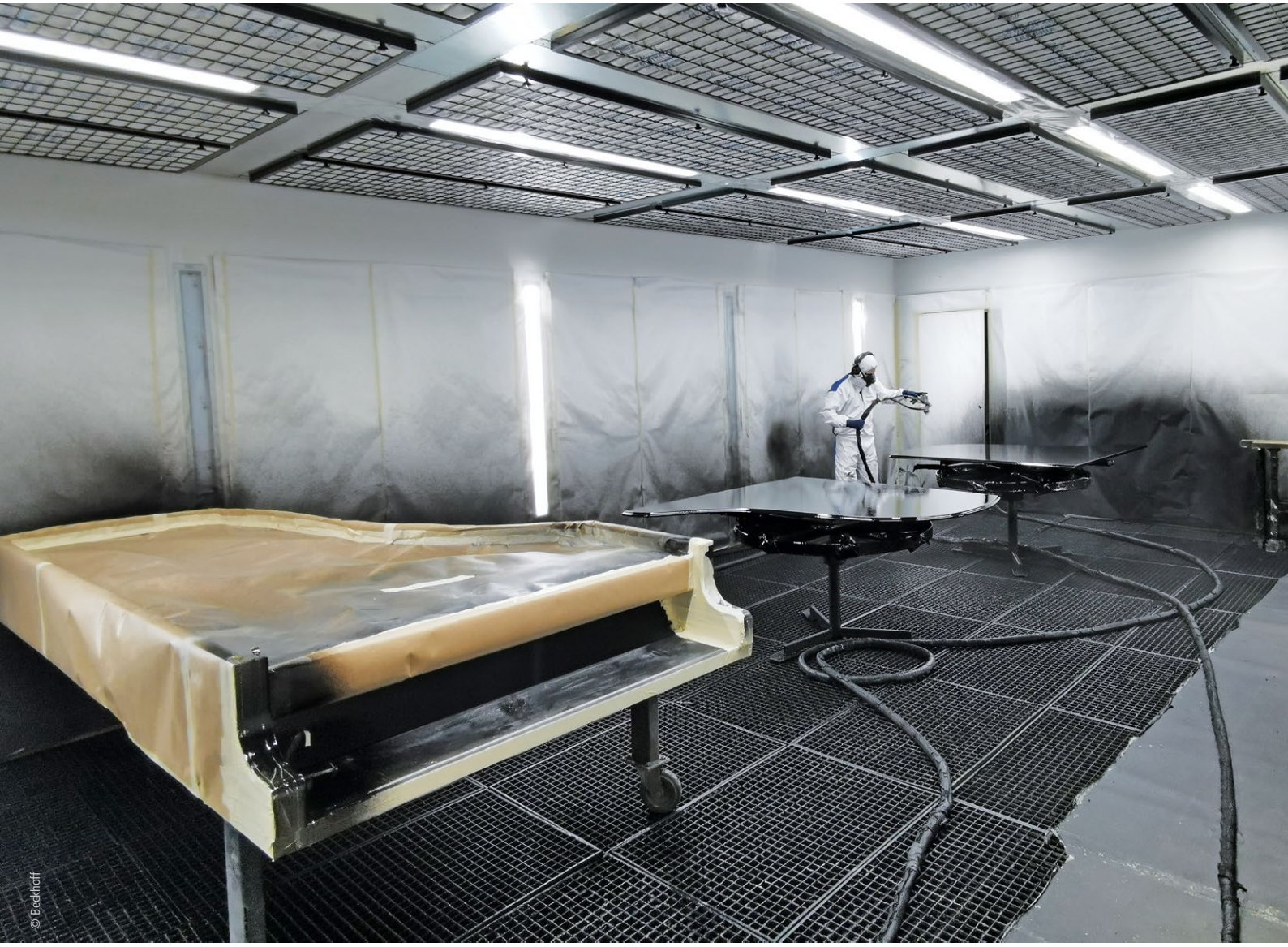


PC-based control for varnishing plant at Bösendorfer piano factory

Flexible plant architecture and modular control concept increase quality and save energy

Austrian piano manufacturer Bösendorfer in Wiener Neustadt is one of the world's oldest and most renowned piano manufacturers in the premium segment. With the aim of reducing the large amounts of energy required to varnish its grand pianos, Bösendorfer opted for a modern varnishing plant from Austrian manufacturer Berkmann. In addition to optimizing the process sequences and improving the quality of the varnished surface beyond its already high level, the energy consumption was reduced by 75% in the new plant. PC-based control from Beckhoff enables efficient control, visualization and lighting.



The grand pianos are still varnished by hand, something that requires a great deal of skill and experience.

Founded in 1828, the Viennese piano manufacturer Bösendorfer is now part of the Yamaha Group. Working in line with the construction principle that is so characteristic of Bösendorfer, the sound body is made predominantly of solid resonant spruce wood. Around 27 weeks of working time – not taking into account wood drying and rest periods between the individual production steps – go into completing a grand piano. Its final touch is the glossy surface made of a high-quality polyester or polyurethane paint.

Polyester paint is very demanding to process. For optimum results, it requires a constant room temperature of 25 °C (±0.5 °C) and a humidity level of 45 to 50%. In addition, the air must be extracted from the varnishing area at a defined speed to prevent paint particles from the spray mist from being subsequently deposited on the varnished surface. "Up to eight polyester layers are applied to create the brilliant surface of Bösendorfer grand pianos: the blacker the varnish, the less light is scattered and the more refined the visual appearance," emphasizes Thomas Broukal, technical and manufacturing director at Bösendorfer.

When deciding on a new plant, Bösendorfer's primary concern was to set new standards in its efforts to protect the environment and reduce energy consumption. "This is the largest investment we have made in our company's history, but the reduction in energy consumption of up to 75% means that the plant will quickly pay for itself," states Thomas Broukal.

More plant design freedom

Berkmann Lackieranlagen, the company commissioned to create the new plant, had already installed its predecessor some 30 years ago. "However, the process logistics of the new varnishing facility are based on a completely new concept," explains Rainer Berkmann, head of sales and technology. The equipment control center, which houses the ventilation units, filter system, and heat recovery and generation system, was housed separately from the factory hall in a separate building. This created spacious workstations in the varnishing area as well as a preparation workstation and drying rooms. The varnish storage and preparation areas were also integrated into the plant concept.

Rainer Berkmann, head of sales and technology at Berkmann Lackieranlagen; Thomas Broukal, technical and manufacturing director at Bösendorfer Klavierfabrik; and Ralph Schmoll, technical manager at Berkmann Lackieranlagen (left to right)

"Our workflows have been optimized as a result, and this has also had a positive impact on the surface quality of the varnish. We have significantly fewer rejects in production and the quality has been improved even more as there is less contamination. This is another advantage when it comes to the profitability of the new plant, as it is another area in which we are cutting costs," says Thomas Broukal. "This new, modular plant concept has been built on a foundation of PC-based and EtherCAT-based control technology from Beckhoff, which is able to cover large distances with ease," adds Rainer Berkmann.

Sustainable and cost-effective

Significant energy savings have been achieved through intelligent temperature control using the TwinCAT Controller Toolbox, the use of well water for cooling, and heat recovery from the varnishing area's exhaust air. Once the air has been preconditioned using these methods, all that remains is to bring it to the room temperature required for the varnishing process. If the actual temperature cannot be maintained by the dynamic 250 kW wood heat generator, district heating from the city is switched on. "The energy savings are a colossal benefit, especially during the cold season. With heat recovery, we not only save 75% of the costs associated with heating, but we also reduce carbon emissions by 75%. We're talking about 70,000 m³ of air per hour that needs to be heated – so that means savings amounting to several hundred kilowatt-hours of energy per hour," explains Thomas Broukal.

"The highlight of the plant is the elimination of thermal afterburning of the exhaust air from the varnishing area, something that was previously associated with extremely high gas consumption and CO_2 pollution," states Rainer Berkmann. "But it's not just its ecological footprint and high-quality surfaces that make the new varnishing plant such a winner: it also features optimized lighting technology in the spray rooms and improved noise protection, both of which meet the highest standards in terms of occupational safety conditions."

Open, modular control technology enhances flexibility

"Thanks to the modular I/O system from Beckhoff, we didn't have to use long, complex thermocouple cables to bridge the 60 m distance between the control cabinets, which was created by separating the equipment control center from the varnishing areas. Instead, we were able to network everything using fiber optics – with EtherCAT as the communication protocol. Aside from some minimal adjustments in the software, this planning change only required the use of two modules: the CU1521 media converter and the EK1501 EtherCAT Coupler with multi-mode fiber optic," states Ralph Schmoll, technical manager at Berkmann Lackieranlagen. "This flexibility is the great advantage of PC-based control technology, as it allows any number of additional functions to be added to the control system at any time."

"As we kept moving forward in bringing the plant to life, the customer made repeated changes and additions that meant we had to extend our control concept after it had been completed," explains Ralph Schmoll. "It was also important for Bösendorfer to make energy metering efficient by putting the right energy measurement practices in place. In addition, we installed twice as much lighting as

was originally planned," says Thomas Broukal. In total, two and a half times as many I/O terminals were installed in the final version of the control system than the initial plan had contained. "With EtherCAT and free programming according to IEC 61131-3, we never had to worry at any point when implementing the project that we would hit the limits of the control system's design. It will also be easy to expand the system in the future using EtherCAT," says Ralph Schmoll, adding: "The long-term availability of Beckhoff control components gives our customers the necessary planning security for such a large investment. Even if changes are made to the plant in the future, there won't be any need to switch to a different system."

Controlling the temperature, speed, and volume of the supply air or exhaust air in the varnishing booth is no mean feat: Exceptional precision is required to create a high-quality coat of varnish, and the physical parameters need to be maintained at the same time. The central control system for the varnishing plant consists of a C6015 ultra-compact industrial PC, EtherCAT as the communication system, analog and digital EtherCAT Terminals, and a TwinCAT 3 PLC. The TwinCAT HMI visualization operates on the CP690x economy built-in control panel.

Advanced user-friendliness

The plant is operated via the CP690x control panel outside the varnishing booth. The visualization was implemented using the HTML5-based TwinCAT HMI software. This web technology makes it possible to access the plant's operating functions from any PC or mobile device via a simple web browser within the company.

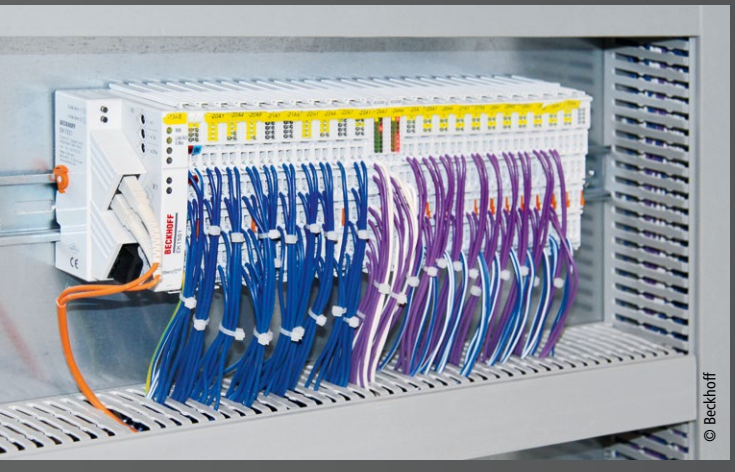
"The user interface is self-explanatory and easy for the operator to use," Ralph Schmoll explains. It allows the varnishing technician to select from pre-installed functions, such as applying one to eight layers of varnish, drying, or finishing. The air supply, temperature, and speed are programmed for each individual layer of varnish. The user interface has been extended to include a range of new functions compared to the predecessor plant, such as a complete process display showing every sensor and every plant and process parameter. Alarms and trend recording have also been integrated and can be used for purposes such as optimizing and performing maintenance on the varnishing plant. "The operator can also intervene directly in the process, which is a huge advantage over the previous plant," says Ralph Schmoll.

In addition, the lighting throughout the floor can be operated via the CP690x control panel. "Even the lighting for non-hazardous areas – that is, the normal building lighting – runs through the HMI," adds Ralph Schmoll. "Thanks to the freely programmable control system, the plant plus the lighting can be switched off with a single switch via the PLC. Alternatively, all the plant functions can be switched using pushbuttons in the varnishing booths. This makes things more efficient and brings flexibility to the work that employees have to complete."

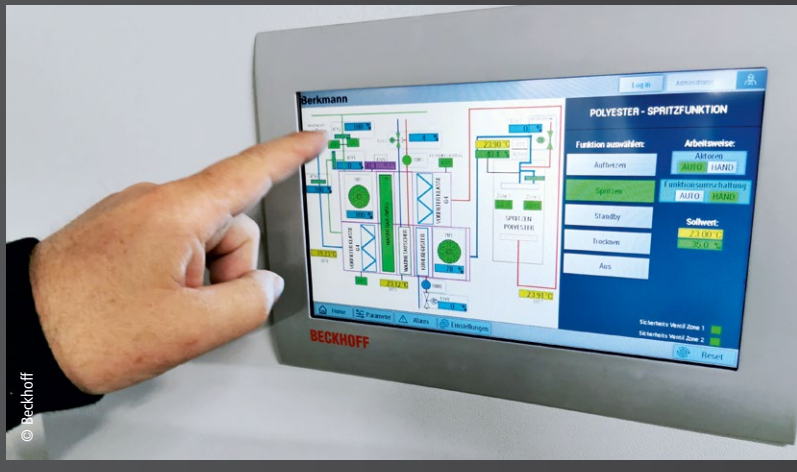
"The Bösendorfer piano factory is a wonderful example of how tradition in craftsmanship and state-of-the-art technology complement each other in forward-looking production," emphasizes Frederike Beckhoff, assistant to the Beckhoff management. "I am the proud owner of a Bösendorfer grand piano, which my grandfather gave me as a gift when I was born. The fact that our control technology is helping us increase the quality of our high-gloss surfaces and the energy-efficiency of the varnishing process is something I am really delighted about."

More information:

www.berkmann.eu
www.boesendorfer.com/en
www.beckhoff.com/building
www.beckhoff.com/entertainment-industry



The modular I/O system from Beckhoff does not impose any limits on expansions or modifications, and can easily be added to further down the line.



The Beckhoff CP690x built-in touch panel provides a clear, convenient location from which to visualize and operate the varnishing plant using the HTML5-based TwinCAT HMI.