

Open and modular: The Beckhoff control platform ensures optimal results in high-end additive manufacturing applications

## Maximum speed and repeatability for 3D printing

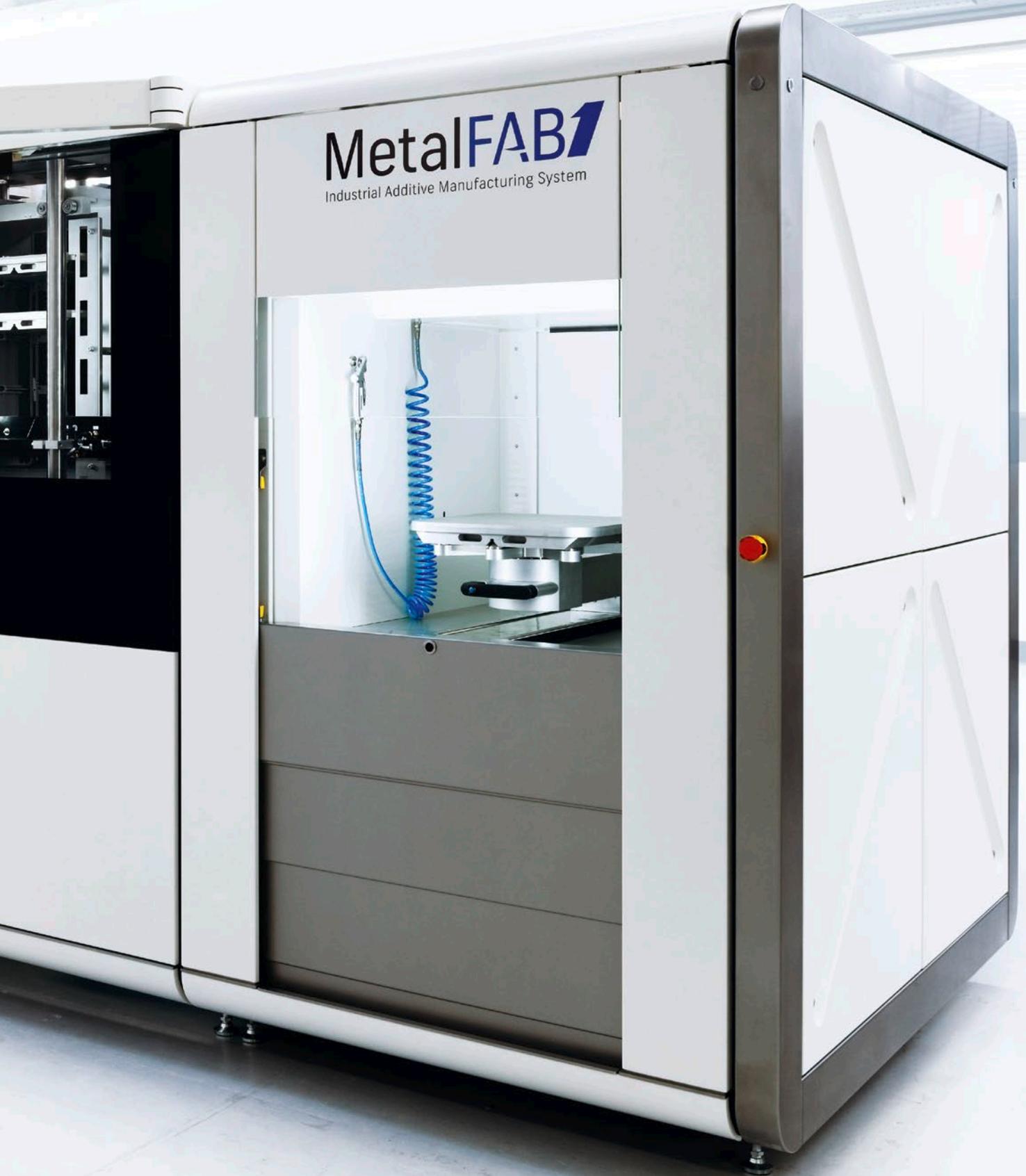
With the development of the MetalFAB1 system, Dutch startup company Additive Industries took a major step toward the efficient industrial utilization of 3D printing processes. In addition to printing modules, the modular system for additive manufacturing with metallic materials also includes a heat treatment unit and a storage module. This ensures significant increases in productivity, flexibility and repeatability, according to Additive Industries. The end use application options are varied and range from aerospace and the semiconductor industry to the food industry. For drive and control technology, the company places its trust entirely in a PC-based control solution from Beckhoff.



The MetalFAB1 from Additive Industries is a 3D printer for high-end applications. This system can be equipped with up to four printer modules, with different optional modules for further processing of the workpieces.

# MetalFAB1

Industrial Additive Manufacturing System





MetalFAB1 control cabinet with automation components from Beckhoff. (left to right) Jurjen Verhoeff, Account Manager at Beckhoff Netherlands and Mark Vaes, CTO at Additive Industries



A heat exchanger produced with the 3D printing method

The success of 3D printing is based, above all, on the high degree of design freedom it provides. Due to the fact that workpieces are built up layer by layer, even products with complex shapes can be produced economically, which otherwise could only be realized with additional processing steps. "The challenge, however, is to continually increase the speed and repeatability of our 3D printers," points out Mark Vaes, CTO at Additive Industries. "3D printers that can accomplish series production tasks very quickly and with the highest precision are particularly sought-after in high-end manufacturing applications such as in aerospace, for example. Our response to these demands is the MetalFAB1." The faster production made possible by this new machine type is, above all, due to the fact that the individual process steps have largely been integrated and automated. The entire machine control is based on EtherCAT, including transitions from one process step to the next. "That means we are way ahead of the competition. In many existing 3D printer solutions, these process steps are still carried out manually. In the MetalFAB1, we were able to reduce manual labor to a minimum," explains Mark Vaes.

#### **Modular system configuration for more flexible application options**

The modular design of the MetalFAB1 is just as important as its speed and repeatability. The basic version consists of three modules: the control module, the printer itself and the exchange module, which acts as an interface for the

operator. It is also used to feed in new plates and unload the finished products. The standard configuration can be extended to include up to 11 modules. "By adding different modules, we can easily increase printing capacity and add various post processing steps. The configuration we tested at pilot customers consisted of six modules," says Mark Vaes. "This extended version included an optional second Additive Manufacturing (AM) core for the printing process. By adding up to maximum four AM cores enables to print with different materials simultaneously," explains the CTO. "For example, a product made of steel can be manufactured in one chamber, while a component can be printed with titanium powder in another chamber. Through optional implementation of a heat treatment unit, the component can automatically pass through the next process step, where the internal stress generated during the printing processes are reduced. This is followed by an optional storage module for empty build plates and finished products and, finally, the HMI."

#### **CX2040 Embedded PC as the central control platform**

"We made the decision to use a Beckhoff PC-based control solution back in 2014," says Mark Vaes. "This control system was required to meet the high industrial demands for robustness, speed, functionality, standardization and costs. Another important argument in favor of the PC Control platform was EtherCAT. The fast communication system meets our requirements with regard to the speed and determinism of the entire system. It also provides added benefits as



Optional MetalFAB1 storage module for storing workpieces

an industrial standard that is known and accepted around the world. Last but not least, we prefer a supplier that can offer a comprehensive portfolio of control solutions. This enables us to reduce to a minimum the number of third-party components used to build our controllers.”

The centralized control hardware used by Additive Industries for the MetalFAB1 is a CX2040 Embedded PC running TwinCAT 3 automation software and the EtherCAT I/O terminals. The CX2040 also acts as the motion control system for the 15 axes on the MetalFAB1. Each of the optional modules of the 3D printer is equipped with a compact CX9020 Embedded PC as its own controller.

Further information:

[www.additiveindustries.com](http://www.additiveindustries.com)

[www.beckhoff.nl](http://www.beckhoff.nl)

## 3D printing with MetalFAB1

The 3D printing process of the MetalFAB1 is based on the “Powder Bed Fusion” principle. Also called powder bed laser melting, this is a process that starts by applying a thin layer of metal powder, such as titanium, to a plate. A laser travels across the powder bed at high speed, fusing the powder with high precision. When a layer is completed, the plate moves downwards, and the powder application and laser fusion process is repeated. To increase the production capacity, the MetalFAB1 can be equipped with up to four lasers or Additive Manufacturing modules. In addition to titanium and aluminum, Additive Industries uses other print materials, including steel and nickel alloys. After the printing process, the excess powder has to be removed from the process chamber, which poses a significant challenge due to the complex workpiece shapes. The MetalFAB1 fully automates this step for user convenience. Once the printing process is complete and the powder has been removed automatically, the component enters the heat treatment module, where the residual stress is reduced. The finished product is then transferred to the storage module. Since all production steps are automated, no operator intervention is required.