EMO 2019: 3D printers from TRUMPF offer sustainable production process for heat-resistant materials

Heat-resistant material Inconel® easy to machine using 3D printing // TruPrint 3000 3D printer is the perfect choice for making power generation components // TRUMPF presents gas compressor impeller for drones and vane segment for aircraft at EMO

Ditzingen / Hannover, September 17, 2019 – At EMO Hannover, the world's leading metalworking trade fair, TRUMPF demonstrated how 3D printing is improving manufacturing processes for heat-resistant materials. These materials often consist of the nickel-based alloy Inconel®, which can withstand temperatures of up to 1,000 degrees Celsius without deforming. Inconel® is used in applications such as gas turbines, combustion engines and heating systems, but it is difficult to machine using conventional methods. Milling tools often get stuck, snap off or lose their edge. At EMO 2019, TRUMPF demonstrated how Inconel® parts can be produced faster, cheaper and at higher levels of quality using 3D printing.

3D printing saves time, materials and tools

Unlike material removal methods such as milling and turning, a 3D printer does not waste material, because it only uses the amount of powder that actually needs to be melted to create the part. Virtually no manual post-processing is required, which significantly reduces tool costs. What's more, 3D printing achieves higher levels of quality by making it easier to create complex geometries. For example, it greatly simplifies the process of fabricating internal cooling channels that increase a component's performance and service life. "Heat-resistant materials play a key role in many industries, including aerospace and the power generation sector. We're hoping that the applications we showcased at EMO will encourage companies from those sectors and job shops to start using this technology," says Volkan Düğmeci, a member of the industry sector management team for aerospace at TRUMPF Additive Manufacturing.

The TruPrint 3000 3D printer that TRUMPF presented at EMO is the perfect choice for traditional applications that involve Inconel®. Featuring a cylinder-shaped build chamber measuring 40 centimeters by 30 centimeters, the TruPrint 3000 can fabricate multiple parts at the same time. The system also offers solutions for automated quality assurance such as powder bed monitoring and melt pool monitoring. “This is an important value-adding factor in industries with high product reliability standards, such as the aerospace sector,” says Düğmeci. Machining Inconel® using conventional techniques is difficult and costly. Tool costs are high because cutting tools wear out quickly when milling Inconel®. In some cases, this has a knock-on effect on quality, because the milling machine may not detect a worn cutting tool. Part manufacturers also waste considerable quantities of material. Components made from Inconel® – such as turbine blades and gas compressor impellers – tend to be complex. Milling machine operators often have to remove up to 80 percent of the raw material to create the required shape. With Inconel® retailing at around 100 euros per kilogram, this incurs significant costs.

Two examples of how TRUMPF has improved production of heat-resistant parts using 3D printing:

1. Fast and resource-efficient: gas compressor impellers

One of the parts TRUMPF showcased at EMO was a 3D-printed gas compressor impeller made from Inconel®. It is used to operate postal delivery drones and model aircraft as well as in small-scale turbines. “This impeller is a good example of how we can harness the strengths of 3D printing in Inconel® machining,” says project manager Andreas Margolf from TRUMPF Additive Manufacturing. Conventional manufacturing methods are time-consuming and resource-intensive. It takes a total of eight days to mill the part from a block of Inconel®, including post-processing, and the tool costs are high. Part manufacturers also waste considerable quantities of material. with over 80 percent of the raw material ending up as chip waste. TRUMPF has significantly improved the manufacturing process using its TruPrint 3000 3D printer. The system can build three impellers simultaneously on the printer platform. The total time required to

produce each piece is just four days, including post-processing. The milling machine is only required for post-processing, which reduces material loss to less than 20 percent. 3D measurements have shown that the printed gas compressor offers the same level of quality as the original.

2. Lower costs and shorter delivery times: vanes for aircraft

TRUMPF was commissioned by Toolcraft to optimize an aircraft guide vane segment for 3D printing. The vane drives the flow of air and exhaust gas through the engine. It consists of 16 curved blades arranged in a circle around a common axis. Due to the complex geometry of this annular configuration, the material removal process takes 15 hours. The operators have to carry out lengthy programming work to ensure that the milling machine produces the vane blades correctly. It takes three passes through the milling machine to obtain the final form, and a total of 85 percent of the raw material is removed in this process. Tool costs are also high – the tool costs for nickel-based alloys tend to be some 40 percent higher than for conventional steels. 3D printing is significantly more efficient in this case. The TruPrint 3000 system from TRUMPF can build six vanes in a single pass. The printing time per piece is reduced to just six hours, and only minimal post-processing is required on the milling machine. These lower tool and material costs reduce the overall cost by 20 percent. Stefan Auernhammer, who heads up metal laser melting at the company Toolcraft, argues that 3D printing is particularly beneficial for spare parts and small batches. “When it comes to difficult-to-machine materials such as nickel-based alloys, spare parts made by conventional means are generally getting more expensive. In contrast, the cost of 3D printed parts is continuing to fall. Another advantage is that we can deliver the finished parts faster, which is often a decisive factor for customers.” 3D printing also offers an opportunity to make further improvements to the vane. For example, it could conceivably be used to incorporate hollow structures into the blades in order to increase the component’s cooling effect.

TruPrint 3000
The TruPrint 3000 3D printer from TRUMPF is the perfect machine for making power generation components. TRUMPF is showcasing this machine at EMO 2019, the world's leading metalworking trade fair.

3D-printed gas compressor impeller
Using 3D printing, TRUMPF fabricated the impeller for a gas compressor in just half the time it would normally take to produce.

Vane for aircraft
TRUMPF was commissioned by Toolcraft to 3D print a vane used in aircraft engines. Total cost savings: 20 percent.

■

About TRUMPF

The high-technology company TRUMPF offers production solutions in the machine tool and laser sectors. It is driving digital connectivity in manufacturing industry through consulting, platform and software offers. TRUMPF is the world technological and market leader for machine tools used in flexible sheet metal processing, and also for industrial lasers.
In 2018/19 the company – which has about 14,500 employees – achieved sales of 3.8 billion euros (preliminary figures). With over 70 subsidiaries, the TRUMPF Group is represented in nearly all the countries of Europe, North and South America, and Asia. It has production facilities in Germany, France, Great Britain, Italy, Austria, Switzerland, Poland, the Czech Republic, the USA, Mexico, China and Japan.

For more information about TRUMPF go to www.trumpf.com

Press contact:

Ramona Hönl
Media Relations, Spokesperson Additive Manufacturing
+49 7156 303-31251
Ramona.Hoenl@trumpf.com

TRUMPF GmbH + Co. KG, Johann-Maus-Straße 2, 71254 Ditzingen, Germany

[Further information, e.g. link to website, customer magazines, contact etc.]