July 2020

Swiss Rotary Table Technology

NEWSLETTER

Non-productive time reduced by 90 %

AM-LOCK

With AM-LOCK, pL LEHMANN has developed a zero-point clamping system for 3-D printing that is characterized by flexibility, precision and process stability. Images: pL LEHMANN

AM-LOCK zero-point clamping system – Segmentation of the printing platform, preheating up to 500 °C, seamless postprocessing to the finished part

pL LEHMANN introduces its AM-LOCK zero-point clamping system for additive manufacturing / AM. What is special: It can be used throughout the entire process chain - from preparation through the actual 3-printing to postprocessing in the form of machining, measuring, annealing up to 650°C, etc. The result: AM-LOCK ensures a smooth and considerably faster manufacturing process. This accelerates the entire process and lowers process costs significantly.

Generative manufacturing processes are on the verge of a breakthrough. Of the many different technologies available for metal parts, it appears that, in addition to powder deposition welding (LMD or DED) and the selective laser sintering process (SLS), selective laser melting (SLM) and powder bed-based laser melting (LMF) will catch on.

However, an additive manufacturing process that can be used on an industrial scale is not enough. Hansruedi Lehmann, Managing Director of the family-owned Swiss company pL LEHMANN, explains: «Additive Manufacturing must be embedded in a manufacturing environment where data and material exist in a balanced flow. Existing capacities have to be leveled. Automation is not worthwhile everywhere. Our special AM-LOCK zero-point clamping system that can be used throughout the process allows efficient manual operation and at the same time can be automated at any time.»

In addition, he refers interested parties to the software partner CADS Additive, which has developed AM-LOCK plug-ins for various systems, thus allowing seamless data flow. «Combin-

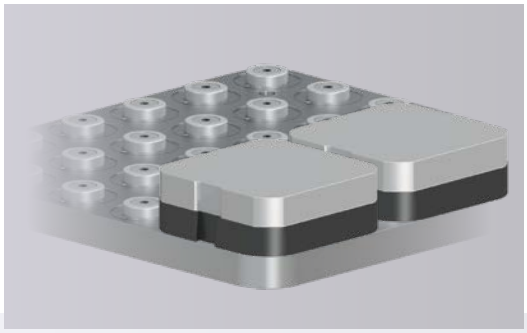
ing our AM-LOCK system and the software tools accelerates production of metal parts by means of 3-D printing. In addition, costs are lowered and part quality is improved», points out Lehmann.

AM in industrial use

Additive manufacturing processes are able to produce three-dimensional objects directly from powder material and a 3-D CAD data set layer by layer. Compared to material removal processes such as machining or EDM, manufacturing layer by layer opens up entirely new design possibilities that contribute to function optimization and function integration. Highly complex, extremely lightweight yet stable structures can be created with AM machines. Moreover, AM allows production of small lot sizes at reasonable piece part costs and in this way individualization of products. At the same time, AM machines are also used for series production.

Before being used, parts produced via AM usually need to undergo postprocessing. Supporting structures need to be removed and machining operations performed so that certain surfaces satisfy precision and surface quality requirements. Sometimes, subsequent heat treating, measurements and coatings are required.

Until now, however, transferring the AM system to other machines and equipment was a time-consuming operation that needed to be done manually, presenting an obstacle to economical series production. pL LEHMANN has developed a solution to this problem: the additive-capable AM-LOCK zero-point and positioning system that fits on common AM machines from Coherent, Concept Laser, DMG MORI, EOS, Renishaw, SLM Solutions, Trumpf, etc. and which can be used with no changes on machining centers, etc.



The patented «Thermo-Lock» positioning and clamping principle is the primary AM-LOCK element for the AM machine.

System consisting of grid plate a segment plates

On the additive side, the AM-LOCK zero-point clamping system from pL consists essentially of grid plates and the segment pallets resting on them. The grid plate, which is mounted on the platform of the AM machine, contains numerous centering pins in a compact 50 mm grid (On-top version). Alternatively, the pins can be incorporated directly into the platform (Built-in version). The segment pallets, which are available in various versions and sizes, can be positioned as necessary on this grid system.

Segment pallets consist of two parts: an easily exchangeable substrate plate made of aluminum, steel or titanium, and a base plate with a hole pattern for zero-point clamping on the grid plate. That several segment pallets in the AM machine can be combined on one grid plate is especially beneficial. The provides the opportunity to produce different parts in a single job. For postprocessing (annealing, measuring, x-raying, EDM, machining, etc.), the segment pallets can then be transferred individually to the next required process and clamped there on the AM-LOCK chuck directly or by means of adapter clamping pins on various zero-point clamping systems from Schunk, Erowa, AMF, System 3R, etc. without losing the zero point.

Ideal clamping device for the AM machine

There are many different zero-point clamping systems on the market. The AM-LOCK clamping system from pL LEHMANN, however, is quite special, since it ensures continuity of additive manufacturing of parts in every form of postprocessing. The primary AM-LOCK element for the AM machine is the patented «Thermo-Lock» positioning and clamping principle.

In a 50 mm grid, the Thermo-Lock grid plate holds numerous 6 mm high pins that ensure play-free clamping based on the different thermal expansion in relation to the mounting holes. Specifically, this means that the segment pallets are unclamped at temperatures below 70°C and clamped on the Thermo-Lock grid plate at temperatures from 80°C to 100°C. Via this thermomechanical clamping, the geometric arrangement of the pins ensures a self-centering that guarantees a reliable repeat accuracy of ±0.005 mm.

In the unclamped state, the Thermo-Lock grid plate is cleaned by blowing air over it. This is followed by a cleaning and presence check using pressure monitoring by blowing argon, which is frequently used in the AM process, through the grid plate and pins from below. If the back pressure is low, this means that argon is flowing between the pins and segment pallet: the pallet is not resting on the surface underneath and is not clamped. If the back pressure is high, the pallet is held securely; it is clamped and 3-D printing can start.

Beneficial thermal response

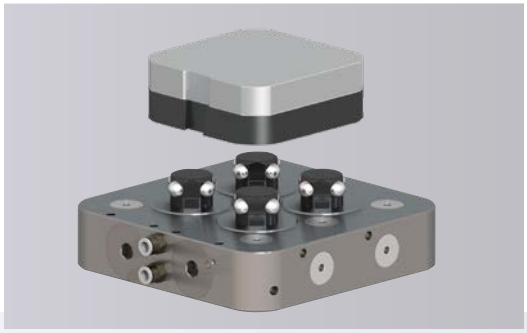
The AM-LOCK system functions essentially also without a heating system. The fit clearance of between 0.015 mm and 0.025 mm already provides a repeat accuracy in the range of +/- 0.01 mm without Thermo-Lock, always well below the printing accuracy of the machine. If heating is present on the machine, AM-LOCK offers an additional benefit: the low height and large contact area ensure fast, uniform heating of the entire system. Computer simulations and measurements have shown that after as little as 500 s following the start of heating there is an almost identical temperature across the substrate plate, like that on the lifting platform. These results confirm the extremely fast heating and the very good distribution of heat throughout the system.

Additional benefits: Since neither the grid plate nor the segment pallet in the Thermo-Lock system has physically moving parts, neither compressed air nor oil is needed for actuation, nor are there any seals. As a result, seals cannot fail nor can mechanical parts become jammed. Thanks to the thermomechanical principle, no electricity or compressed air is needed. In addition, thanks to highly heat-resistant materials, the system function up to 500°C.

Ball-Lock for the machining center or for heat treating

For zero-point clamping in the machining center or on a measuring machine, etc., pL LEHMANN offers the QUATTRO and UNO chucks, which are based on the Ball-Lock system developed by pL LEHMANN. These grid plates clamp with up to 40 kN either manually or pneumatically, allowing high cutting performance.

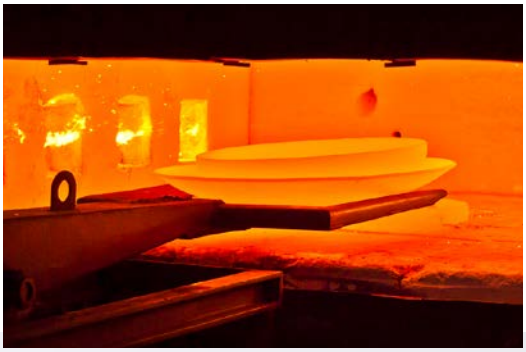
As the name indicates, the QUATTRO chuck (dimensions of 150 x 150 x 34 mm) have four clamping pins, while the UNO has only one. Both chucks are easy to mount on the machine table, easy to clean and essentially maintenance-free.



For zero-point clamping in the machining center or on a measuring machine, etc., pL LEHMANN offers the QUATTRO (shown) and UNO chucks, which are based on the pL LEHMANN Ball-Lock system.

The Ball-Lock chucks generate a clamping force of up to 40 kN so that high cutting performance is possible.

Since AM-LOCK pallets are heat-resistant up to 650°C – tests confirm this – printed parts can proceed directly to heat treating without having to be separated from the pallet beforehand.



AM-LOCK pallets are heat-resistant up to 650°C. Printed parts can thus be transferred from the pallet directly to the annealing oven with prior separation.

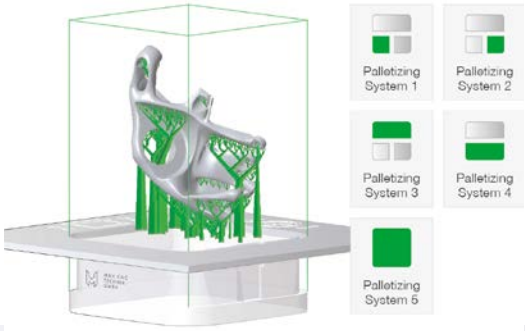
Adaptable to all common zero-point clamping systems

Moreover, users of the AM-LOCK system can continue to use a variety of already existing third-party zero-point clamping systems for postprocessing. pL LEHMANN offers appropriate adapters for this. Suitable clamping pins are already available for Schunk, Erowa, System 3R, AMF, Lang, Gressel and Zeroclamp.

Manual and robot grippers for safe removal of the hot segment pallets are available as additional accessories. The AM RoboGrip is a pneumatically actuated parallel gripper with fingers that fit precisely in the trapezoidal slots in the pallets. It features a standard interface for commercially available robots and handling devices.

Custom software plug-in

Appropriate software complements the AM-LOCK hardware from pL LEHMANN: the AM-LOCK Configurator from CADS.Additive, which is currently available as a plug-In from ANSYS and CREO. It provides the digital basis for establishing the segmentation of the printing area using the different pallets available and for optimizing the support structures for subtractive post-processing. Pallet zero points and grid hole spacing are then taken into account automatically. Even the processes required downstream can be prepared with the AM-LOCK Configurator – provided that interfaces for customer-specific third-party software components are available.



The AM-LOCK Configurator from CADS.Additive is the software developed for AM-LOCK.

The pL LEHMANN company, ...

... the Swiss manufacturer of CNC rotary tables and other components for metal machining,, is an experienced machinery manufacturing company whose rotary and tilting axes have proven themselves in production for over 40 years. In addition to these products, which often make three-axis drilling and milling machines into more productive four- or five-axis machining centers, you can also find a variety of workpiece clamping systems in the product line.

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