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3D-Printing Success Story

INCREASED TOOL LIFE AND PROCESS SECURITY

through optimized coolant supply



SERIAL PRODUCTION COMPONENT

innovative design and repeatable manufacturing

Part Data

Designation:	Additiv Manufactured Grooving Tool
Industry:	Machining Industry
Material:	1.2709
Layer Thickness:	50 μm
Build Time:	1d 12h 12min (full load, 154 pieces)
Machine:	SLM°280 Twin



SLM[®]280

Current Situation

ARNO Werkzeuge: Modern cutting

ARNOWerkzeuge develops tool systems used for holding cutting tool inserts. Material can be saved in grooving operations by reducing groove width, provided process reliability and tool life remain the same. To achieve this, the tool system, especially the overhang length, must be as short and therefore as rigid as possible. The cooling system must also function smoothly to remove

chips despite the narrow groove and to reduce thermal stresses. To manufacture a targeted cooling lubricant supply to the cutting insert, internal flow-optimized, nozzle-shaped channel structures are necessary with the required accuracies, diameter ranges and outlet nozzles.

Innovations with Selective Laser Melting

SLM® experts enable new designs for optimzed performance

ARNO patented the "coolant under the swarf" cooling system on their ACS1 to guide coolant directly along the insert seat and into the cutting zone for efficient parting off, grooving and groove turning. For the ACS2 design, ARNO turned to the Additive Production department at Rosswag Engineering to achieve what could not be created by conventional methods. The additive manufacturing experts at Rosswag developed innovative internal cooling channels that, in addition to the coolant hole at the insert seat, also delivers coolant underneath the tool flank. Targeted cooling of not only the cutting area, but also from below the tool flank of the insert significanly increases tool life, on average 300% compared to recess turning without the targeted ACS design, thanks to reduced tool wear.

The flow-optimized design of the internal channels, patented by Rosswag Engineering (ACS4 version), ensures an improved coolant supply compared to punctual cooling. The tapered coolant hole provides an injection effect and the triangular shape of the hole



Fig. 1: With the ACS2, cutting areas and tool flanks are cooled



Fig. 2: Triangular hole delivers coolant to the tool flank

provides cooling of the complete edge. This counteracts the thermal expansion of the cutting tool to reduce local overheating. Not only is the service life of the tool increased as the result of the design optimized by Rosswag, but the quantity of coolant used in comparison to flooding is reduced due to the targeted supply. In the grooving process, the targeted and optimized coolant supply also supports small chips, leading to a reduction of process interference from as chip jams in the groove.

The internal channels and their tapered structures, produced with the required accuracies, diameter ranges and with a triangular outlet nozzle can only be manufactured using the SLM® technology. The 30mm x 60mm x 3mm component is manufactured on the SLM®280 at Rosswag GmbH, an exclusive partner of SLM Solutions. "The SLM® machine achieves unique added value, above all with regard to the cost-effectiveness and functionality of cutting tools," stated Gregor Graf, Head of Engineering at Rosswag Engineering. With their established history in metalworking and process development, Rosswag was able to combine design services with a manufacturing facility featuring three SLM®280 machines to exclusively produce the ACS2

model in serial production - printing thousands of parts each year to be sold from stock by ARNO.

To further advance the innovative solutions they provide to customers, ARNO and Rosswag have already developed the next ACS4 prototype model featuring four coolant holes for cooling of the complete insert. In addition to the main channel and hole to cool the tool flank, an additional channel with holes on either side of the insert ensures effective cooling of the cutting tool from all sides, a design patented by Rosswag Engineering.



Fig. 3: ACS4 Arno Cooling System (ACS4) with four outlet nozzles

Rosswag GmbH

With over 200 employees, Rosswag GmbH is a family-run company and one of the world's leading providers of open die forging products up to 4.5 t unit weight and manufactured within the company using an integrated process chain. Their in-depth knowledge of production and testing processes is reflected through high quality end products used under great loads in the aerospace industry or power engineering sector.

The Rosswag Engineering division, established in 2014, supplements the product portfolio with engineering services and innovative production processes. The integration of the selective laser melting additive manufacturing process enables the production of function-optimized, metallic parts. Material science and material technology expertise acquired over decades, together with the integrated, company-internal process chain, forms the basis for developing and expanding the future-oriented sector. The integrated Additive Production department expanded in 2017 to include company-internal metal powder manufacturing for material development.



Summary

Additively manufactured grooving tool

- Flow-optimized coolant hole geometry produced with selective laser melting
- Improved chip removal and increased process security due to optimized coolant supply
- 300% service life increase of cutting tools through innovative design with integrated internal features
- Manufactured in serial production at Rosswag Engineering using SLM® technology and available from as an end-use product from ARNO Werkzeuge



Fig. 4: Grooving tool complete (left) and cut in half displaying internal channels to deliver coolant to the tooling insert

ARNO-Werkzeugbau

ARNO-Werkzeugbau is a manufacturer of high-quality cutting tools for turning, grooving, drilling and milling. The company's many years of experience in the sector of cutting technology, coupled with constant further development of existing tools – with simultaneous research into new materials – enables ARNO to present outstanding tools year after year. New materials require research and development as do the requirements for constantly increasing processing speeds. There is a need to improve and develop modular tool systems that can resist the forces present on cutting plates and tool holders.

The use of "ARNO grooving modules" with the ARNO Cooling System (ACS) helps to reduce the on-going tool costs in the cutting process through an optimized coolant supply and to ensure a reliable cutting process.



SLM Solutions - Technology Pioneers, Innovation Leaders

SLM Solutions helped invent the laser powder bed fusion process, was the first to offer multi-laser systems and all selective laser melting machines offer patented quality, safety and productivity features. Taking a vested interest in customers' long-term success in metal additive manufacturing, SLM Solutions' experts work with customers at each stage of the process to provide support and knowledge-sharing that elevate use of the technology and ensure customers' return on investment is maximized. Optimal paired with SLM Solutions' software, powder and quality assurance products, the SLM® technology opens new geometric freedoms that can enable lightweight construction, integrate internal cooling channels or decrease time to market.

A publicly traded company, SLM Solutions Group AG focuses exclusively on metal additive manufacturing and is headquartered in Germany with offices in China, France, India, Italy, Russia, Singapore and the United States and a network of global sales partners.













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