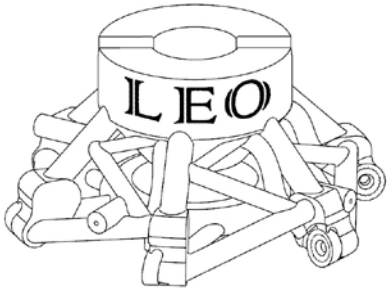
FACULTY OF MECHANICAL ENGINEERING
UNIVERSITY OF WEST BOHEMIA

REGIONAL TECHNOLOGICAL INSTITUTE



New trends in AM (Metal Additive Manufacturing) Inovation of the cutting tools

Miroslav Zetek, Ivana Zetková, Tomáš Bakša et al./ 27.3.2019

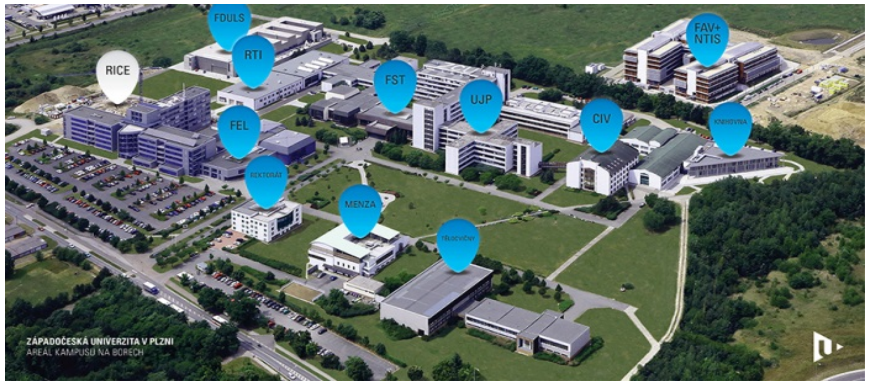
Introduction

University of West Bohemia in Pilsen (UWB) - Czech Republic

Faculty of Mechanical Engineering

Regional Technological Institute (RTI) – Laboratory of the Experimental Machining

- new building of RTI
- 11 laboratories and testing rooms
- over 120 scientists and staff



Introduction

Main research programs of RTI

Research and development of modern vehicles and driving systems

Research and development of production machines and their modernization

Research and development of forming technologies

Research and development of machining technologies

11 laboratories

Virtual Prototyping

Manufacturing Technology Planning

Forming Laboratory

Machining Laboratory

Laboratory of Experimental Machining - Additive Manufacturing

Experimental Methods for Mechanical Engineering

Strength and Fatigue Life Testing

Vehicle Components Testing

Mechanical Testing

Metallography

Metrology

Introduction

Grinding

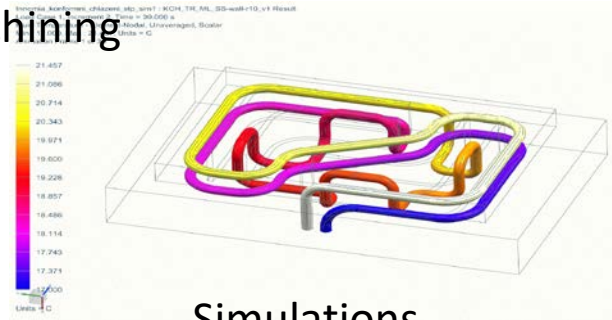
Machining

Surface monitoring

Laser micromachining and modification

Additive manufacturing

Surface modification

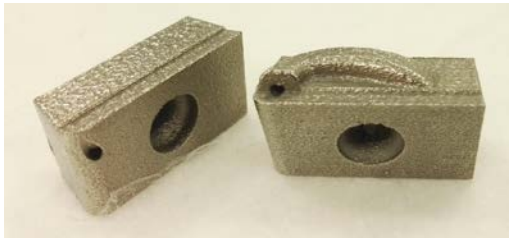


Simulations

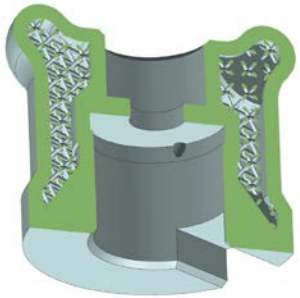
Material analysis

Introduction

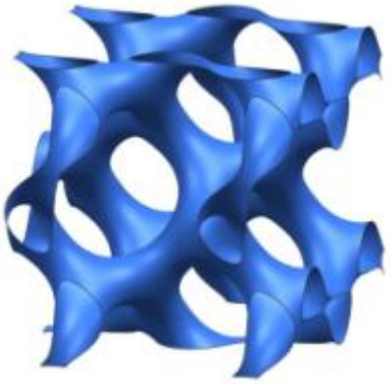
Volume
AM

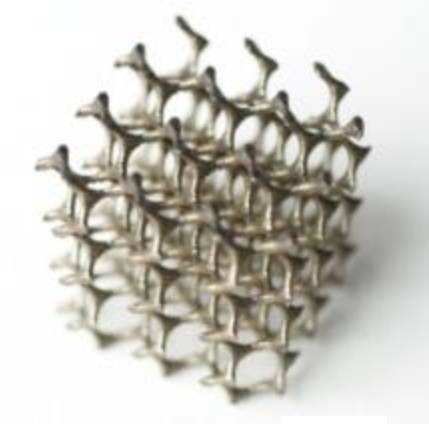


EOS M290 - Maraging Steel (MS1)
Inconel 718
Stainless steel 316L



Lattice
structure

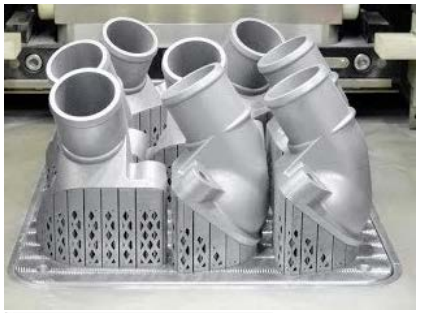




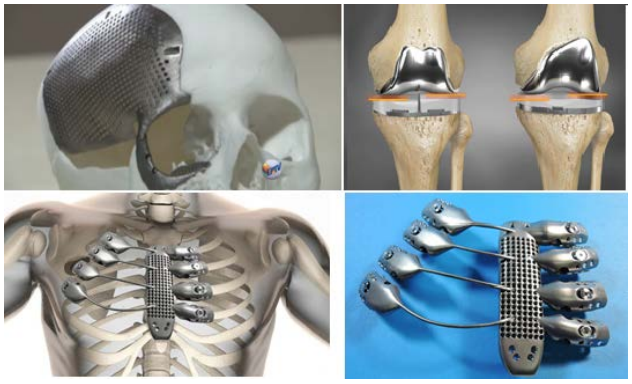
Additive Manufacturing

Aircraft

Automotive



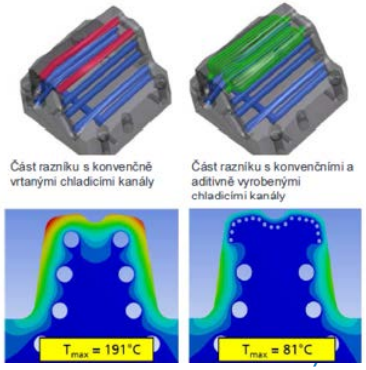
Medicine



Cutting tools

Mold and die

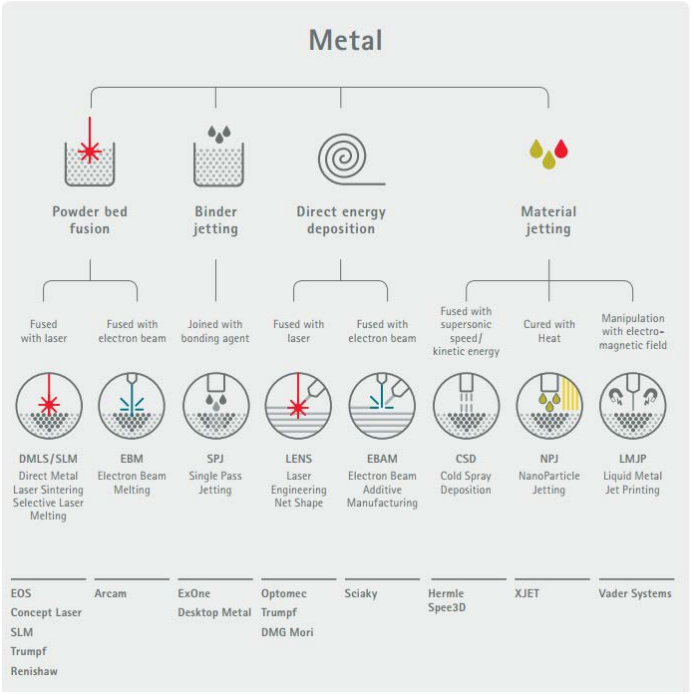
Zdroj: Fraunhofer IWU



Additive Manufacturing

Ref.: European AM Xcellence Days 2018 – Adrian Keppler_What_does_digitalization_mean_for_Additive_Manufacturing

Additive Manufacturing



Terminology

Designation	Title
ISO / ASTM52900 - 15	Standard Terminology for Additive Manufacturing – General Principles – Terminology

Test Methods

Designation	Title
F2971 - 13	Standard Practice for Reporting Data for Test Specimens Prepared by Additive Manufacturing
F3122 - 14	Standard Guide for Evaluating Mechanical Properties of Metal Materials Made via Additive Manufacturing Processes
ISO / ASTM52921 - 13	Standard Terminology for Additive Manufacturing-Coordinate Systems and Test Methodologies

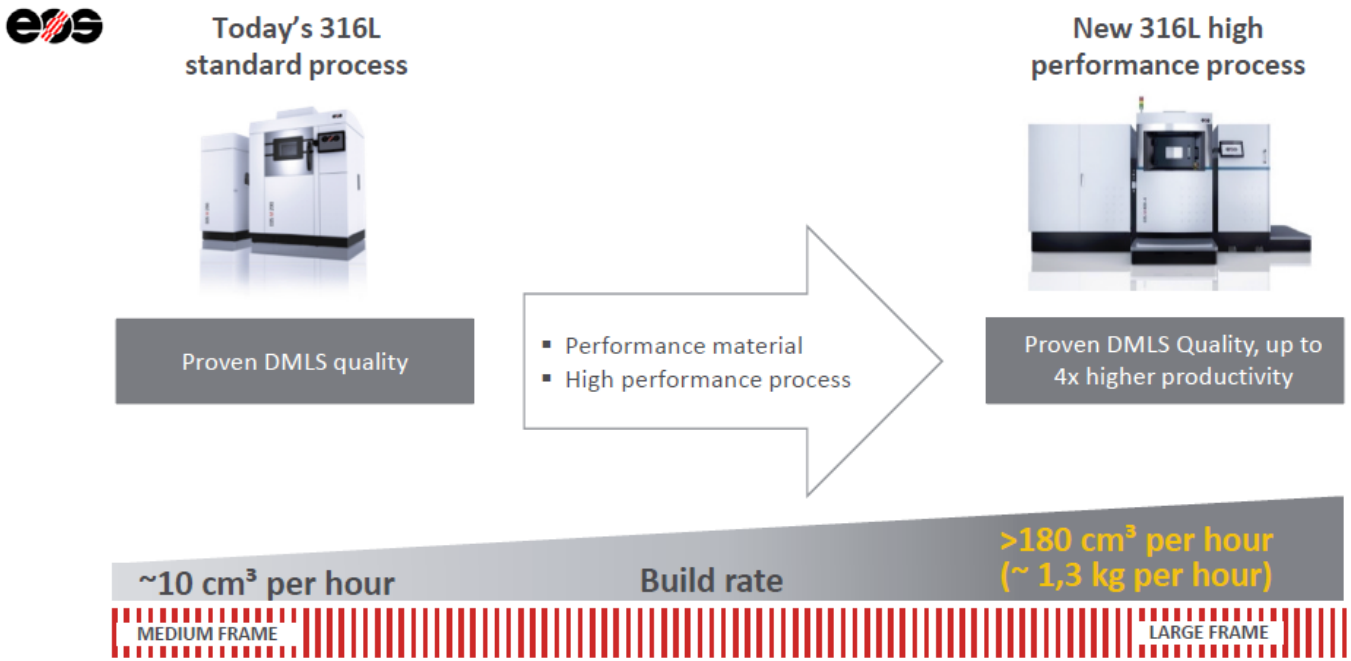
Design

Designation	Title
ISO / ASTM52915 - 16	Standard Specification for Additive Manufacturing File Format (AMF) Version 1.2
ISO / ASTM52910 - 18	Additive manufacturing — Design — Requirements, guidelines and recommendations

Materials and Processes

Designation	Title
F2924 - 14	Standard Specification for Additive Manufacturing Titanium-6 Aluminum-4 Vanadium with Powder Bed Fusion
F3001 - 14	Standard Specification for Additive Manufacturing Titanium-6 Aluminum-4 Vanadium ELI (Extra Low Interstitial) with Powder Bed Fusion
F3049 - 14	Standard Guide for Characterizing Properties of Metal Powders Used for Additive Manufacturing Processes
F3055 - 14a	Standard Specification for Additive Manufacturing Nickel Alloy (UNS N07718) with Powder Bed Fusion
F3056 - 14e1	Standard Specification for Additive Manufacturing Nickel Alloy (UNS N06625) with Powder Bed Fusion
F3091 / F3091M - 14	Standard Specification for Powder Bed Fusion of Plastic Materials
F3184 - 16	Standard Specification for Additive Manufacturing Stainless Steel Alloy (UNS S31603) with Powder Bed Fusion
F3187 - 16	Standard Guide for Directed Energy Deposition of Metals
F3213 - 17	Standard for Additive Manufacturing – Finished Part Properties – Standard Specification for Cobalt-28 Chromium-6 Molybdenum via Powder Bed Fusion
F3301 - 18a	Standard for Additive Manufacturing – Post Processing Methods – Standard Specification for Thermal Post-Processing Metal Parts Made Via Powder Bed Fusion
F3302 - 18	Standard for Additive Manufacturing – Finished Part Properties – Standard Specification for Titanium Alloys via Powder Bed Fusion
F3303 - 18	Standard for Additive Manufacturing – Process Characteristics and Performance: Practice for Metal Powder Bed Fusion Process to Meet Critical Applications
F3318 - 18	Standard for Additive Manufacturing – Finished Part Properties – Specification for AlSi10Mg with Powder Bed Fusion – Laser Beam
ISO / ASTM52901 - 16	Standard Guide for Additive Manufacturing – General Principles – Requirements for Purchased AM Parts

Additive Manufacturing



EOS M 400-4&
400 x 400 x 400 mm

Concept Laser X LINE
800 x 400 x 500 mm

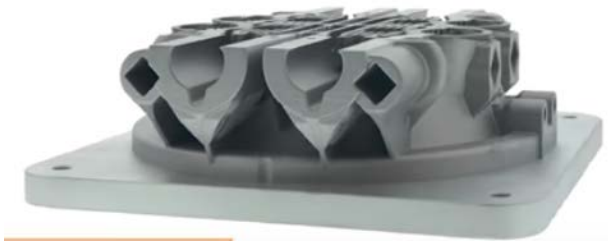
SLM®500
500 x 280 x 365mm

SLM®800
500 x 280 x 850 mm
171cm3/h

RENISHAW
RenAM 500Q

Building time: 19 hour

1 laser

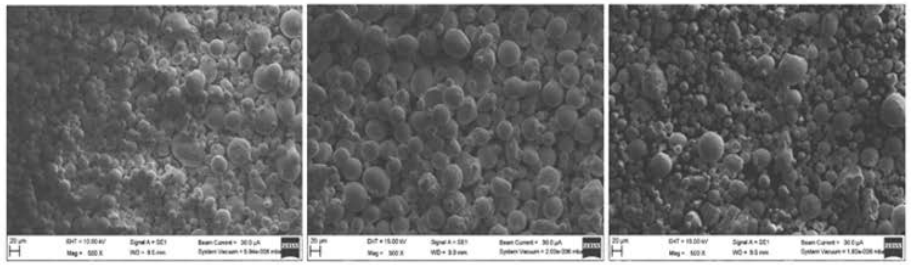


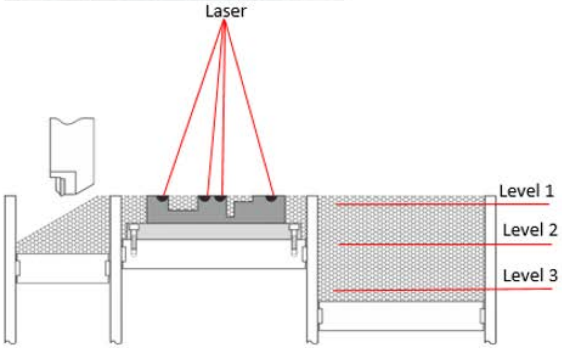
2 laser

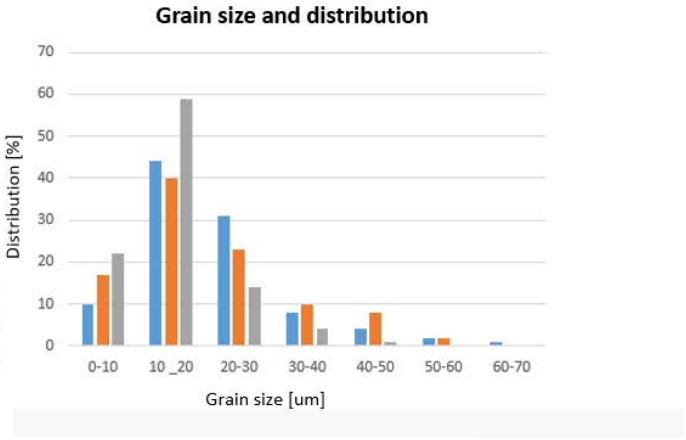
4 laser

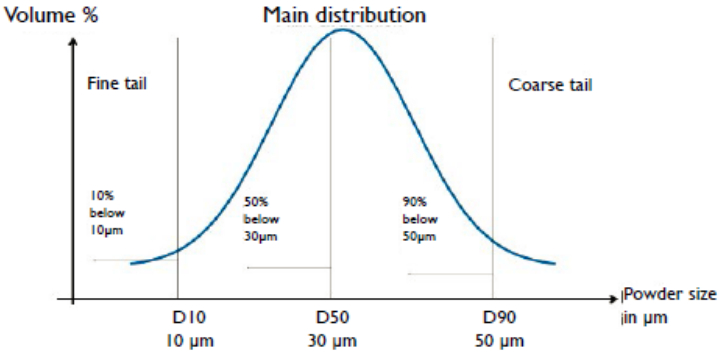
Ref.: European AM Xcellence Days 2018 – Adrian Keppler_What_does_digitalization_mean_for_Additive_Manufacturing; https://slm-solutions.com/en/products/machines/slmr800; https://www.renishaw.com/en/metal-additive-manufacturing-3d-printing-systems--37011

Powder handling





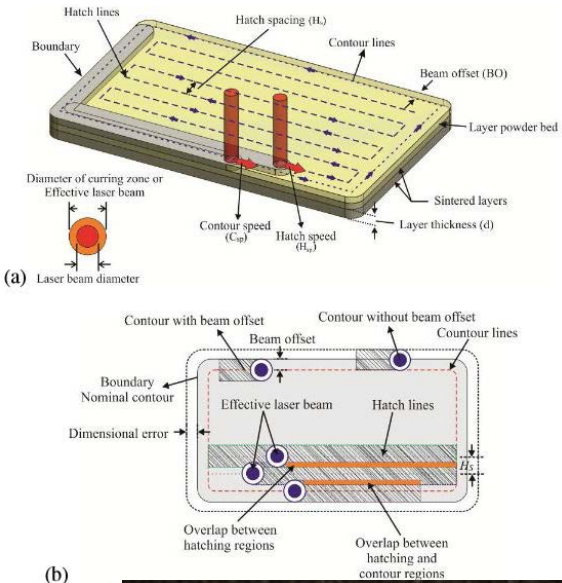


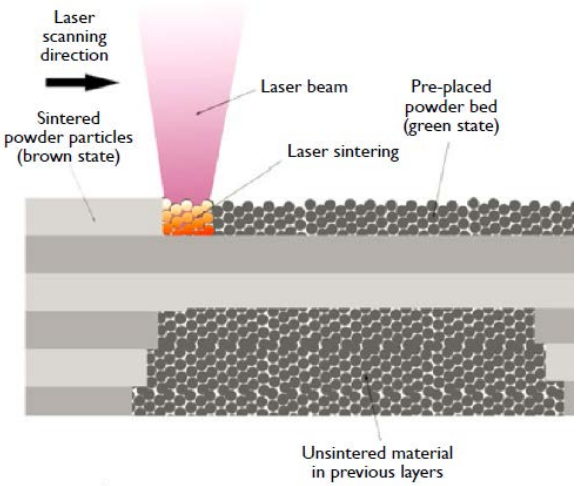


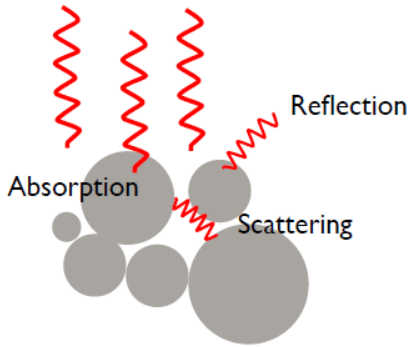
Powder handling

Ref.: https://www.eos.info/material-management-metal?_scrivito_display_mode=view&_scrivito_workspace_id=published; Renishaw_EN-Brochure-Metal-Additive-Manufacturing-Screen.pdf

Quality of AM



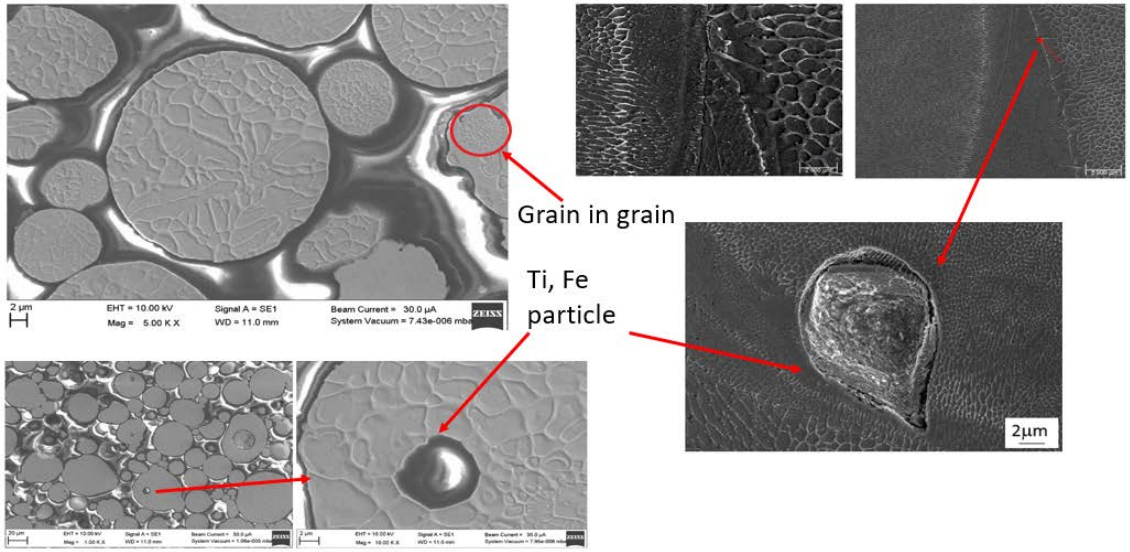




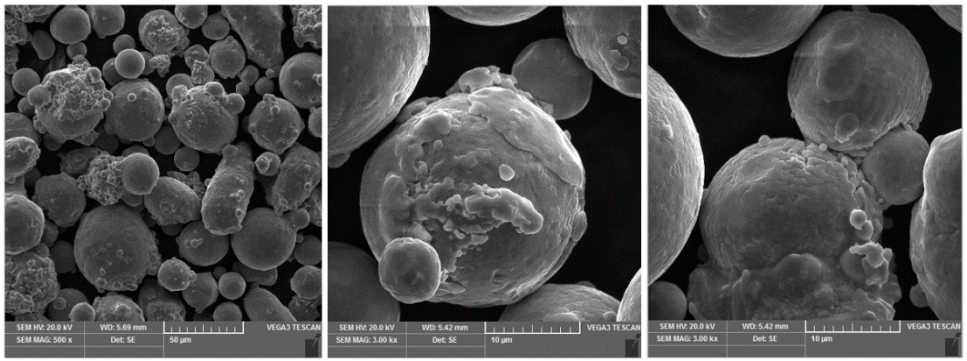
The interactions of laser with powder particles

Quality of AM

MS1

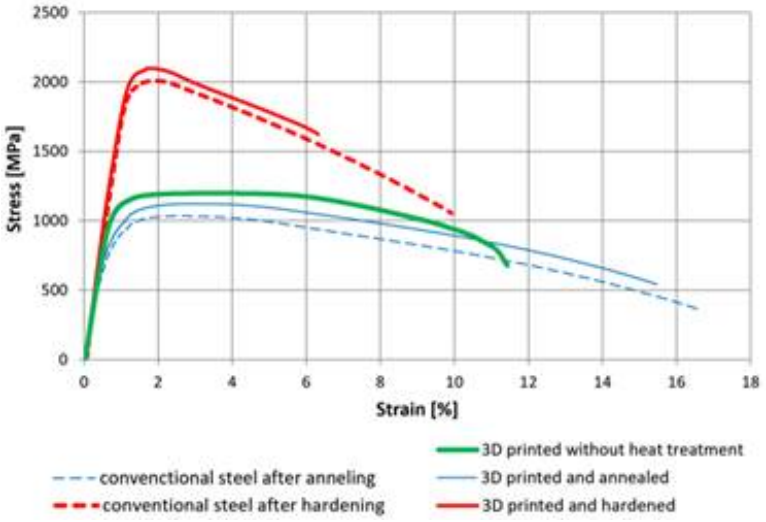


Inconel 718

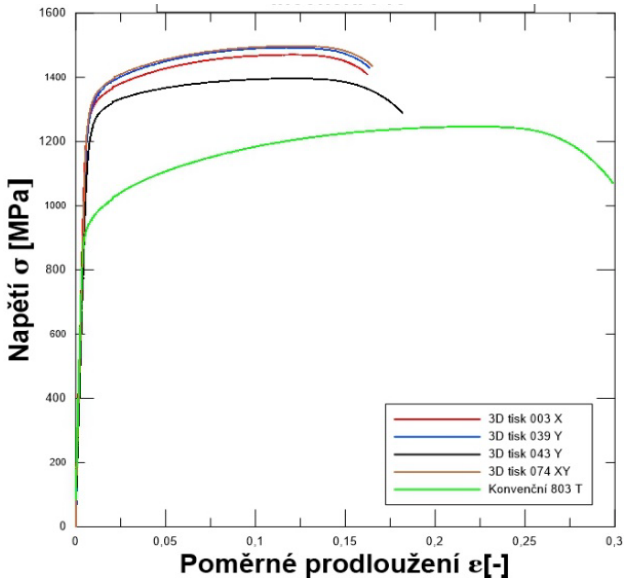


Static load

MS1

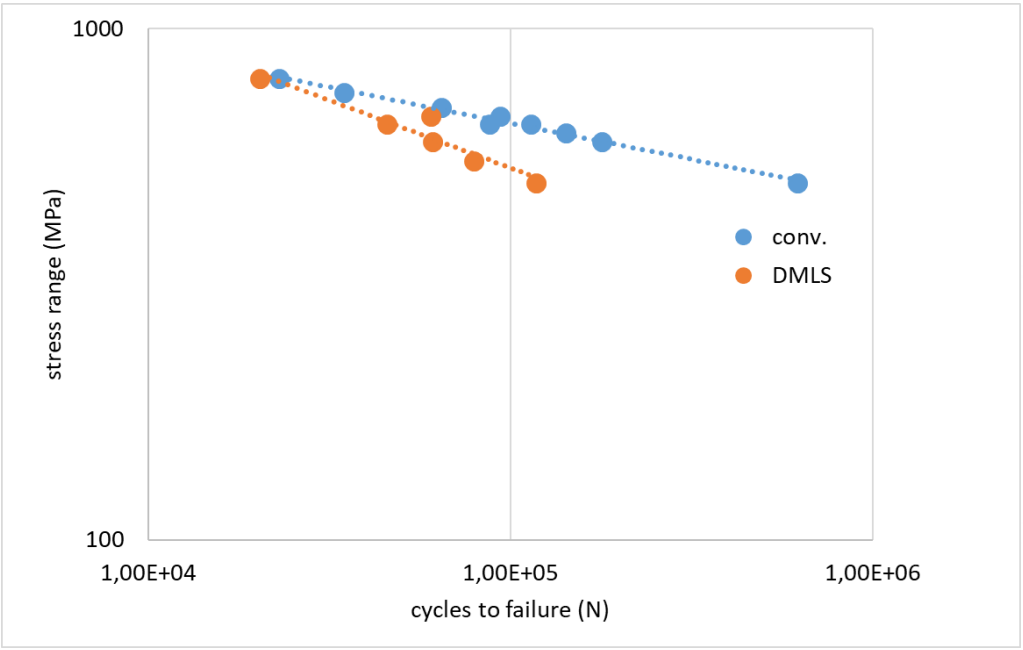


IN 718

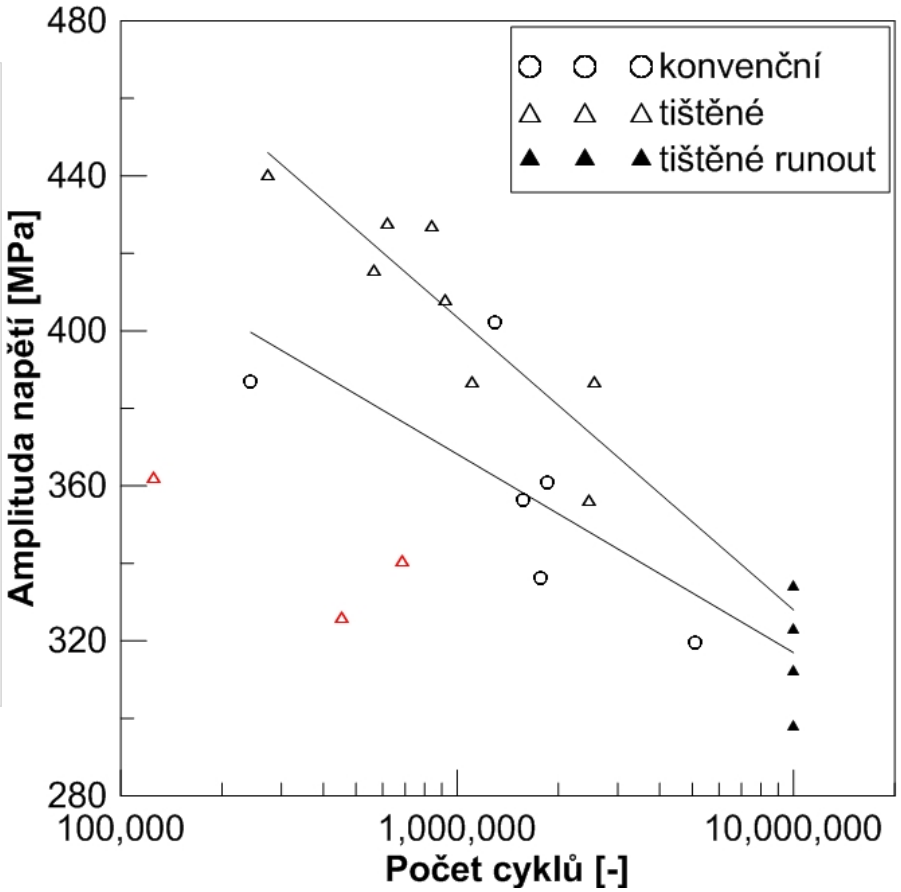


Dynamic load

MS1

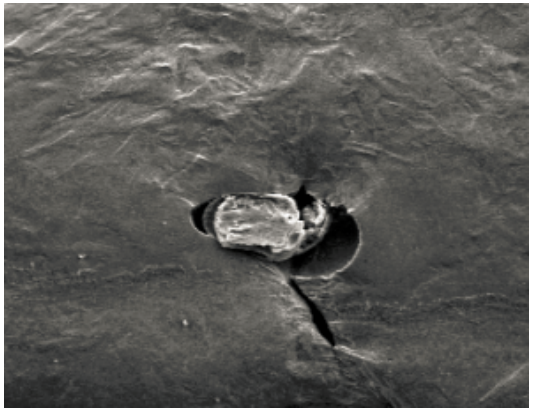


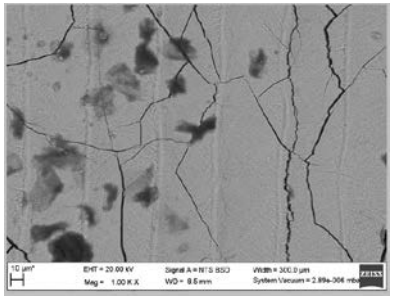
IN 718

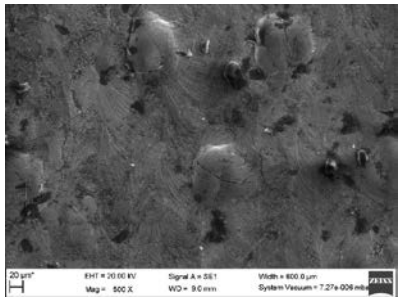


Defects – pores, cracks, inclusion

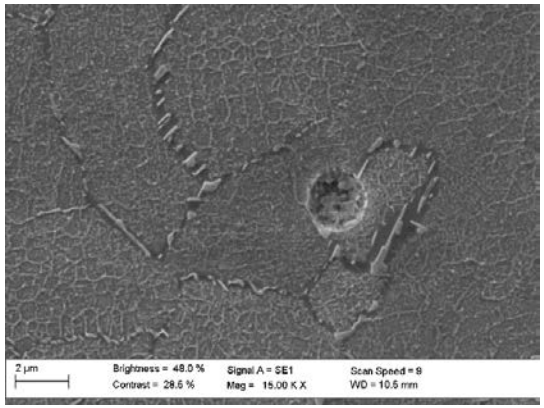
MS1

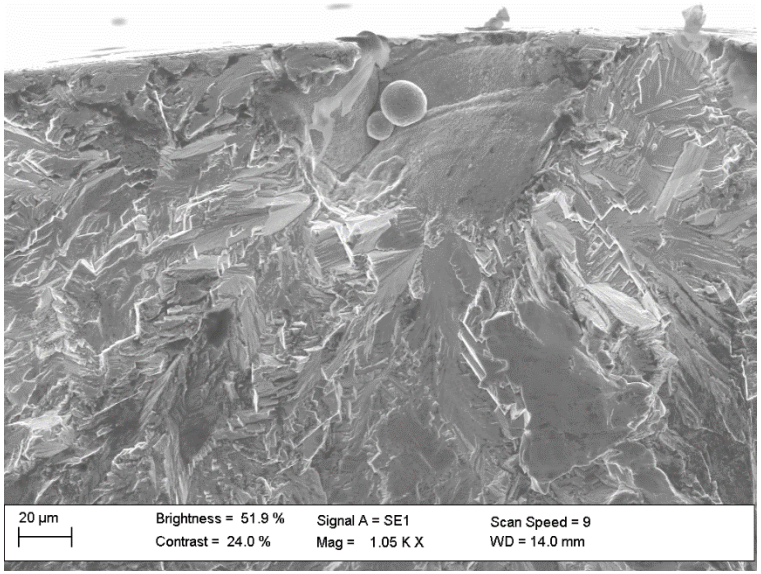






IN 718





Cutting tools

KOMET GROUP

SANDVIK Coromant

More than…

80%

REDUCED WEIGHT

compared to conventional 390

Up to…

200%

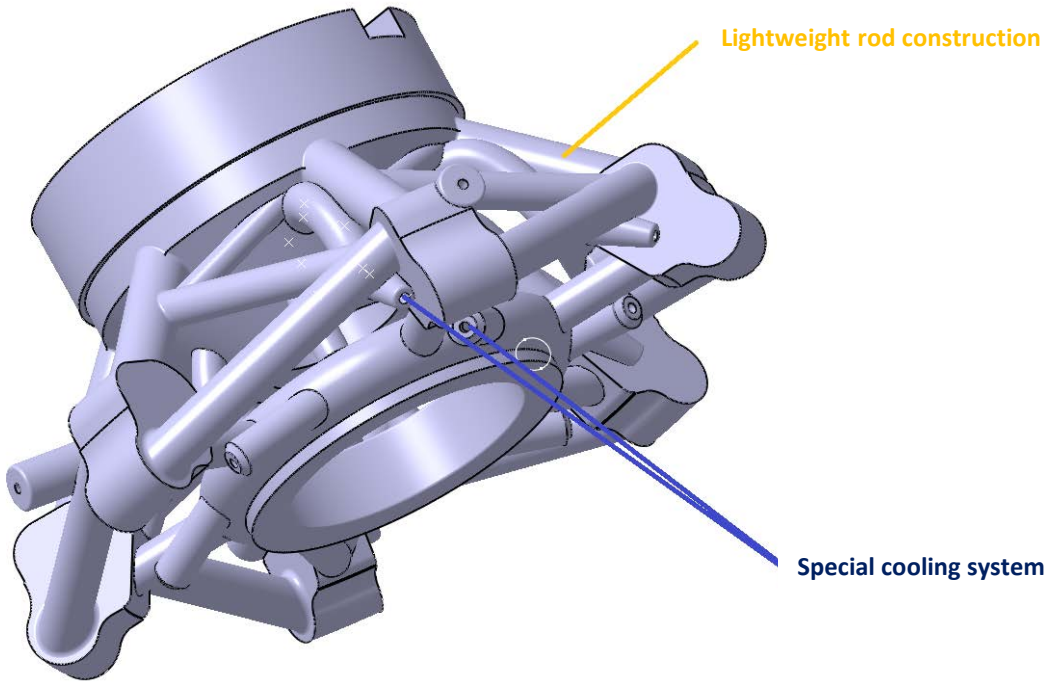
INCREASED PRODUCTIVITY

SECO

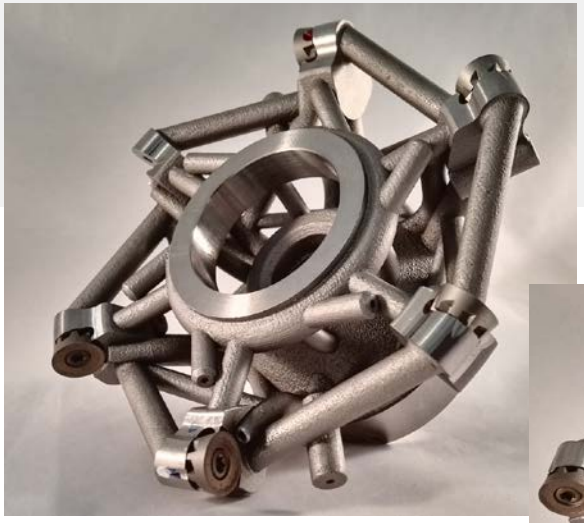
MAPAL

Motivation

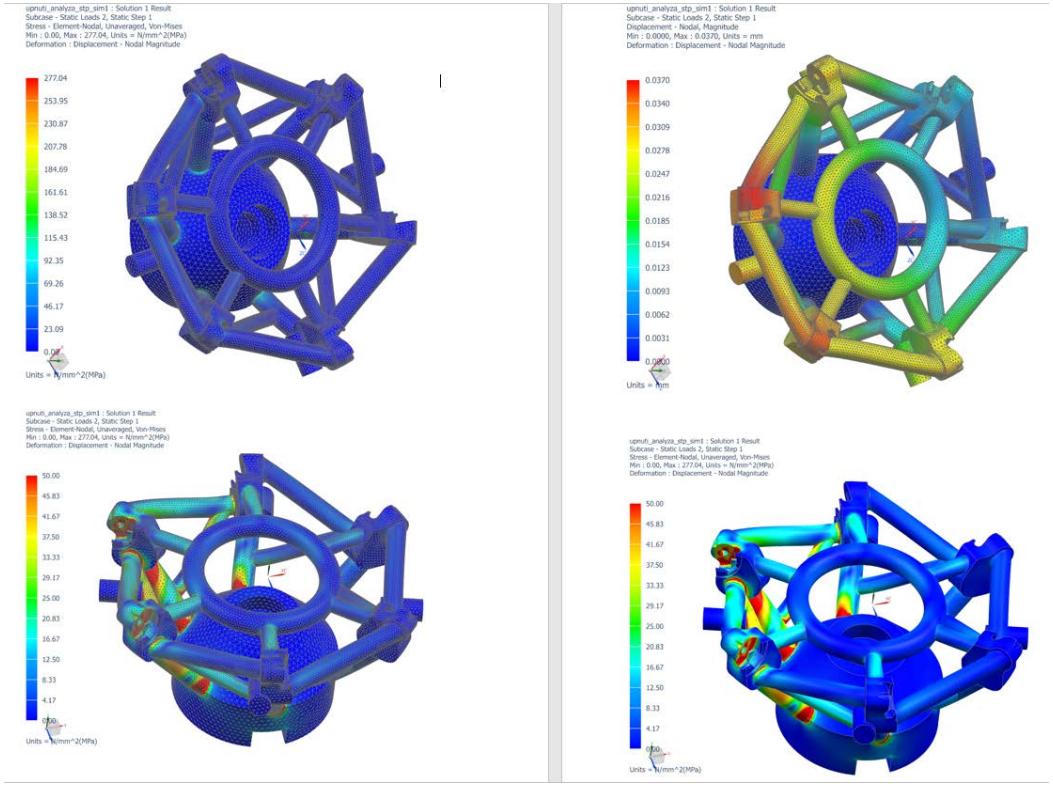
Requirements:
- High kinematics
- Lifetime
- Intensive cooling
- High productivity
- Durability of tools
- Variability



New generation

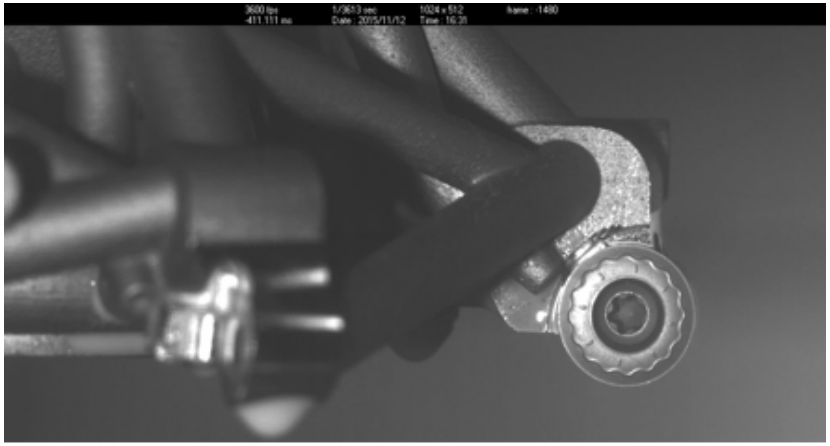


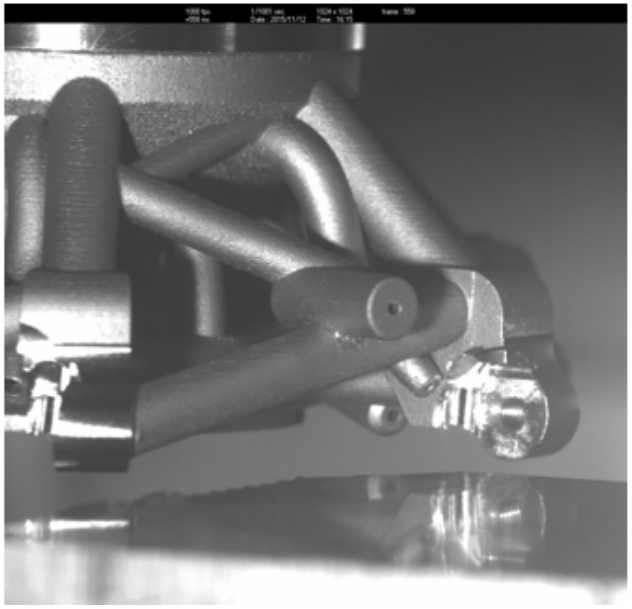
Patented solution



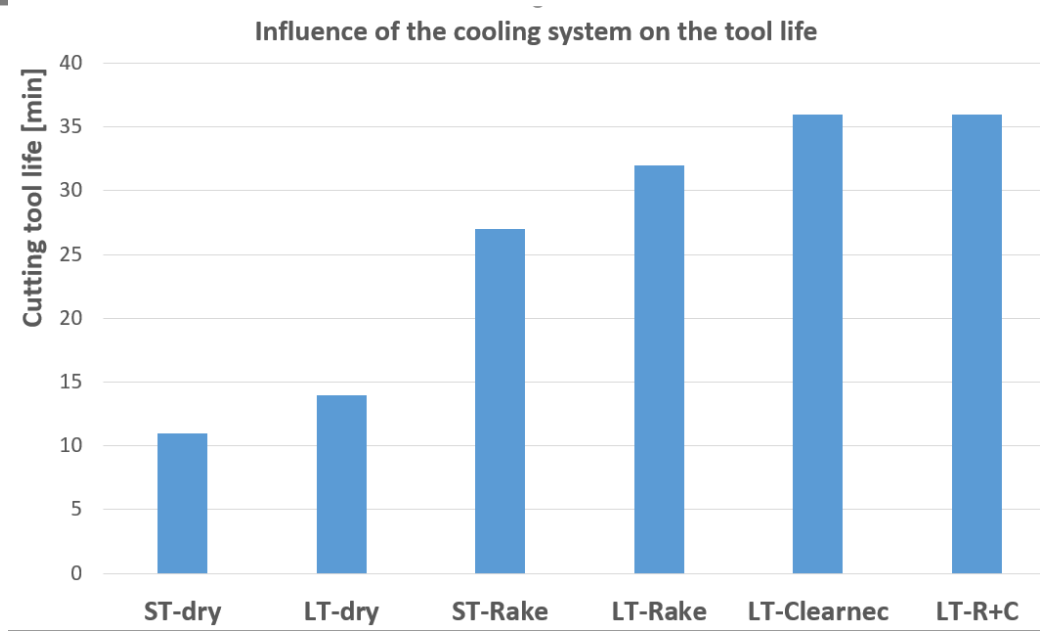
Tool diameter: 125 mm
Tool weight: **1,01 kg**
(standard more than 3kg)
Special cooling system
for rake and clearance face
High cutting stability
Higher surface quality
Usable for HSC and ultra speed machining

New generation of the milling head



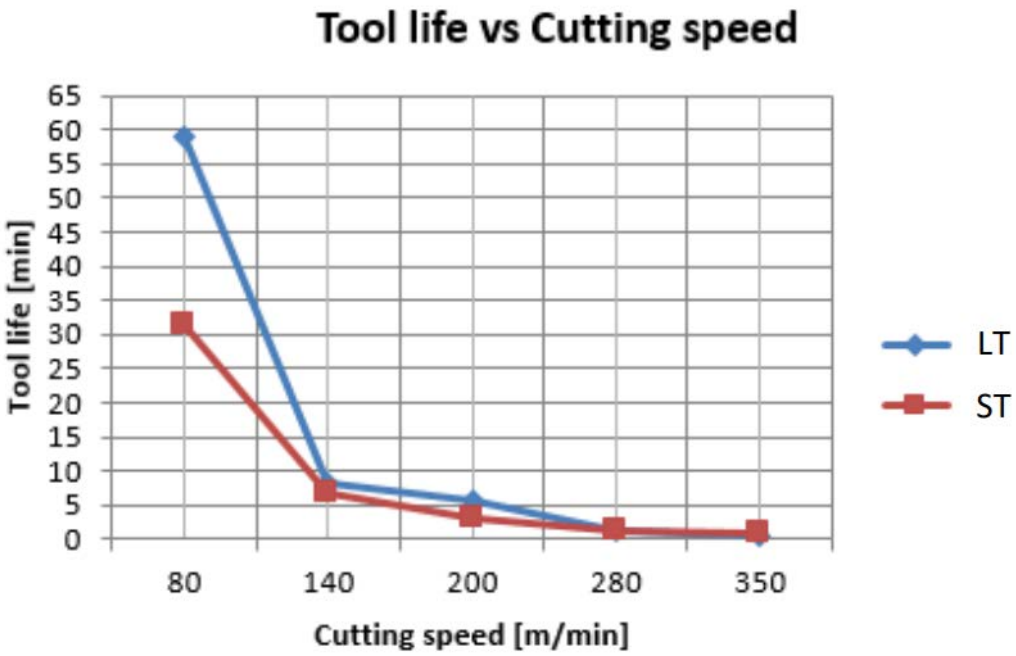


Workpiece: **Inconel 718**
Cutting speed: 60 m/min
Feed per teeth: 0,2 mm
Depth of cut: 0,23 mm



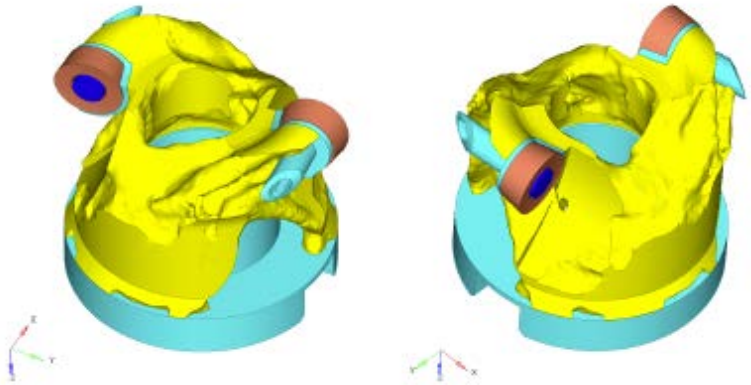
New generation of the milling head

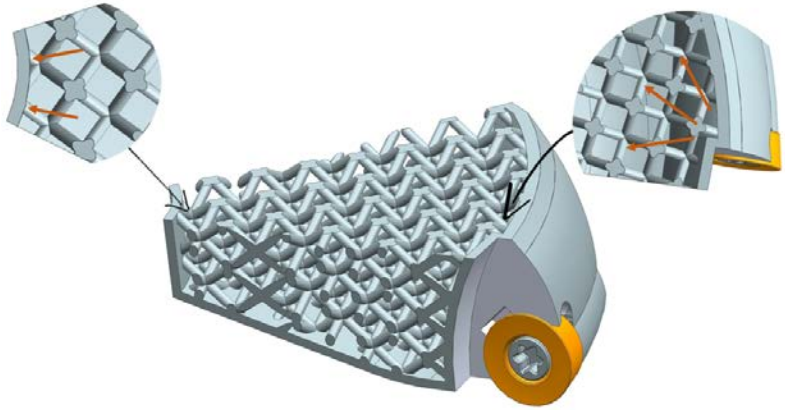
Workpiece:	**1.4301 (ČSN 41 7241)**
Cutting speed:	80, 140, 200, 280, 350 m/min
Feed per teeth:	0,15 – 0,3 mm
Depth of cut:	1 – 2 mm

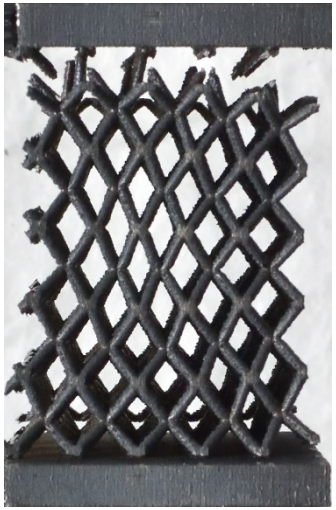


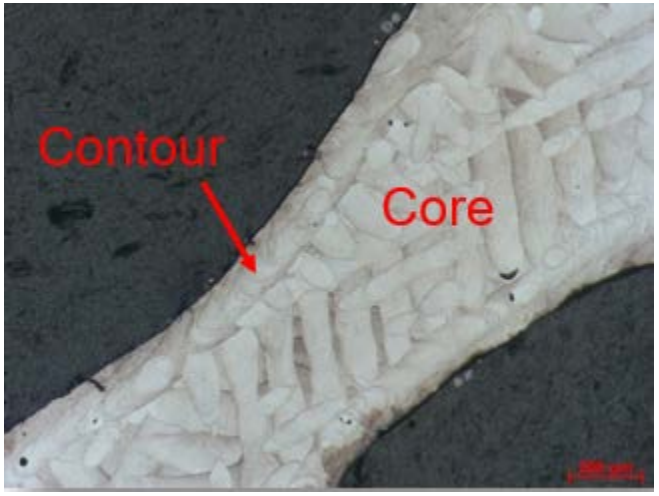
New generation of the milling head

ADVANCED ENGINEERING s.r.o.









Ice machining

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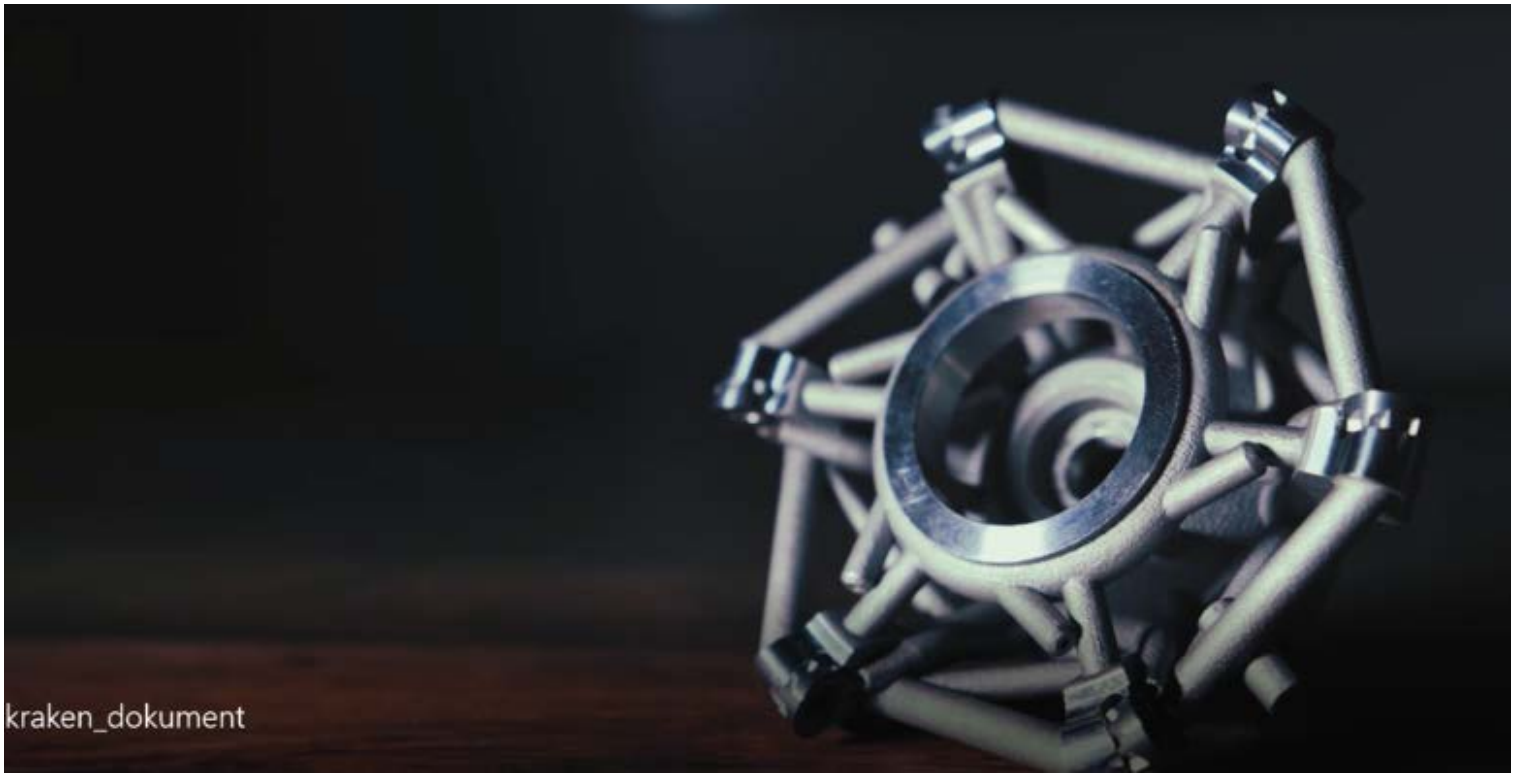

Thank you for your attention!

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