

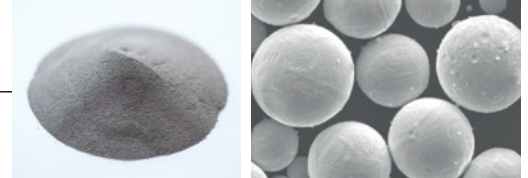
# ADDITIVE MANUFACTURING CENTERS NORTH AMERICA

Offering End-to-End Additive Manufacturing Services - from powder to commercialization.

## STEP 1: Powder

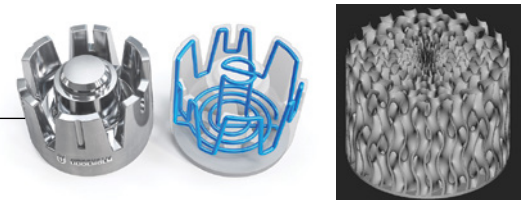
Metal Powder tailored to customer applications (BÖHLER, Uddeholm and other leading providers).

- » Tool steel
- » Stainless steel
- » Nickel, cobalt, titanium, and aluminum based alloys



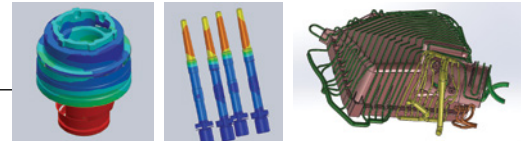
## STEP 2: Design

Design expertise in multiple industries such as Die Casting, Injection Molding, Oil & Gas, Aerospace, Turbomachinery; as an example: conformal cooling applications.



## STEP 3: Simulation

FEA, CFD, heat transfer, plastic molding, metal casting, topology optimization.



## STEP 4: AM Build

- » Laser Powder Bed Fusion
- » Offers both prototyping & serial production
- » Process parameters qualified per customer requirements



## STEP 5: Post Processing

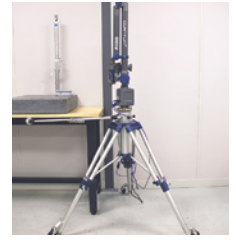
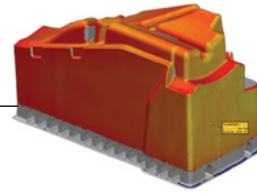
- » Automated de-powdering
- » Baseplate removal via Wire EDM
- » Shot peening
- » Tumbling
- » Abrasive flow machining
- » Electro-polishing



## STEP 6: FARO Arm Inspection

Verify as-built measurements by comparing directly to CAD file. Verification of product quality by performing 3D inspections, dimensional analysis, reverse engineering and more.

- » Accuracy and repeatability  $\pm 25 \mu\text{m}$
- » Scan Rate 300 frames per second



## STEP 7: Heat Treatment: voestalpine Thermo-Tech

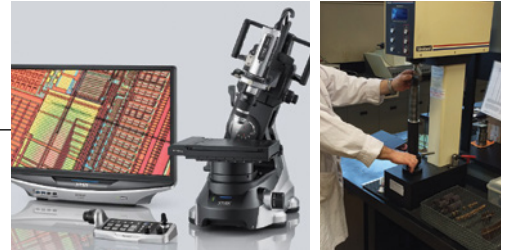
- » Built on centuries of excellence and expertise in metal heat treatment
- » Process controlled in-house to ensure quality - NADCAP accredited
- » Internal R&D capability to develop property sets tailored to customer application



## STEP 8: Material Testing

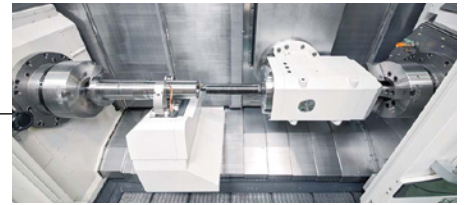
Verify material properties with:

- » Tensile testing
- » Hardness testing
- » Fatigue testing
- » Bending test
- » Charpy impact testing
- » Microstructure inspection
- » High temperature tensile testing
- » Powder morphology



## STEP 9: Finish Machining

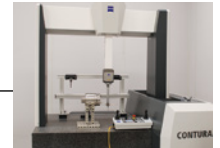
- » Access to the necessary final machining capabilities such as: turning, milling, grinding, polishing
- » Example of in-house capabilities: Nakamura-Tome NTRX-300L for fast, cost-efficient precision machining



## STEP 10: Final Inspection CMM: ZEISS

CONTURA 7 700 x 700 x 600 mm measurement envelope.

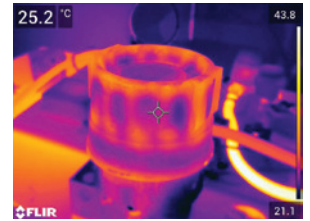
- » Achievable accuracy:  $1.5 + L/350 \mu\text{m}$



## STEP 11: Flow Testing

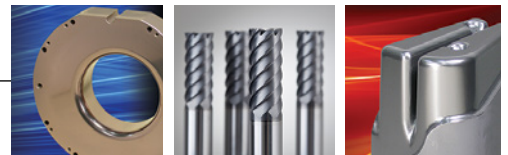
Advanced inspection for internal flow channels

- » Flow rate vs. pressure data (water)
- » Pressurize and hold up to 150 psi
- » Thermal images to confirm channel clearance & function



## STEP 12: Coatings: voestalpine eifeler Coatings

Achieve surface finish requirements with voestalpine eifeler Coatings' latest PVD (physical vapor deposition) coating technology; designed to improve performance and tool life, allowing components to function in environments they otherwise may not be able to operate in.



voestalpine Additive Manufacturing Centers

T. +1 (800) 665-8335

Email: amc-nam@voestalpine.com

www.voestalpine.com/hpm/usa/en/am

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ONE STEP AHEAD.