

# AM Solutions – High Pressure Die Casting

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TUDOKSAD 2019

Koray Arslan / Uddeholm

# Agenda

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- » Tooling Approach
- » AM Approach
- » AM Case Studies / Success Stories

# Agenda

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» **Tooling Approach**

» AM Approach

» AM Case Studies / Success Stories

# Tooling Approach



**TOOL STEEL IS OUR D.N.A.**

World leader  
in tool steel  
production  
and services  
since decades!

# Products & Services

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Tool steel

High-speed steel

Valve steel

Special engineering  
steel

Powdermetallurgical  
materials

Special steels

Nickel-based alloys

Titanium alloys

*in all product forms*

# Tooling Approach Products & Services – Value Added Services

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Warehousing



Heat Treatment



Saws



Machining



Coating



Additive Manufacturing

# Tooling Approach



**AM – MISSING LINK TO A  
FULL SOLUTION PROVIDER**

World leader  
in tool steel  
production  
and services  
since decades!

# Agenda

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» Tooling Approach

» **AM Approach**

» AM Case Studies / Success Stories



Don't try to use AM for parts which are dedicated to other manufacturing technologies!

AM is only economical if you can **add value** to the part!

# voestalpine ADDITIVE MANUFACTURING APPROACH

## SOLUTION PROVIDER ALONG THE VALUE CHAIN FOR POWDERS & PARTS

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### Customer Consulting

Alloy Development

Powder  
Production

Design &  
Simulation

3D-Parts  
manufacturing

Heat  
Treatment &  
Coating

Ready to use  
3D Part

Uddeholm

Voestalpine Additive Manufacturing Centre



Uddeholms AB,  
Hagfors, Sweden  
(AM powder  
production)

# Powder productions

# Powder Production

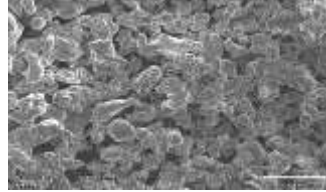
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## Atomizing

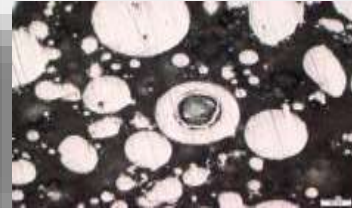
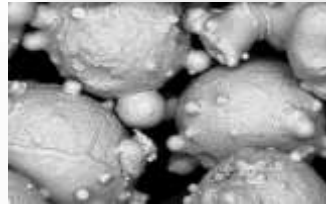
# Powder Production



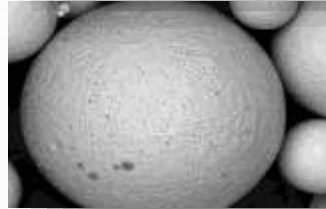
Water  
atomization



**Gas  
atomization**

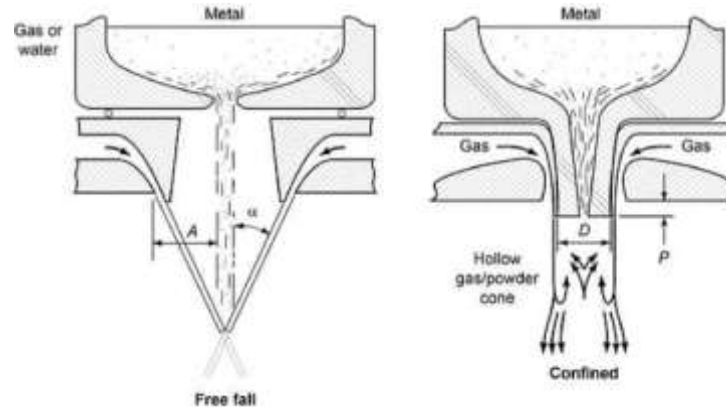


Plasma  
atomization



# Gas Atomization

- Free fall or Close coupled (confined)

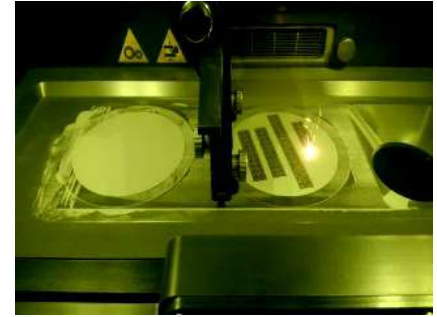
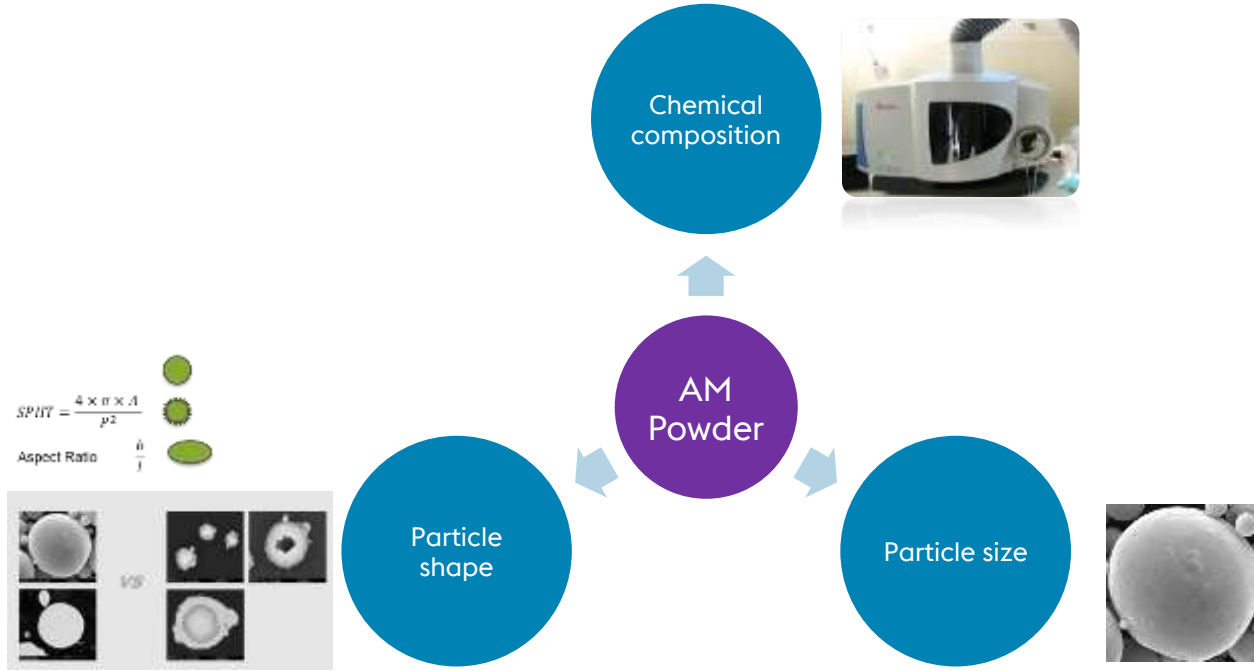




**voestalpine High Performance Metals – Region International**

**voestalpine**  
ONE STEP AHEAD.

# Powder Production





# Powder Production

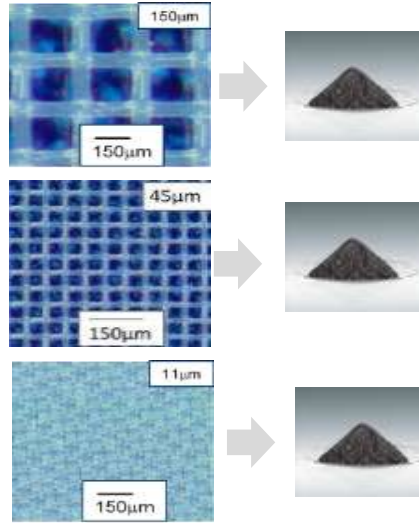
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## Sieving

# Sieving Technology



2 Step Sieving unit



different  
nylon sieve  
sizes

## Powder sizes:

- 15 – 45 microns  
PBF Technology
- 45 – 150 microns  
DMD Technology

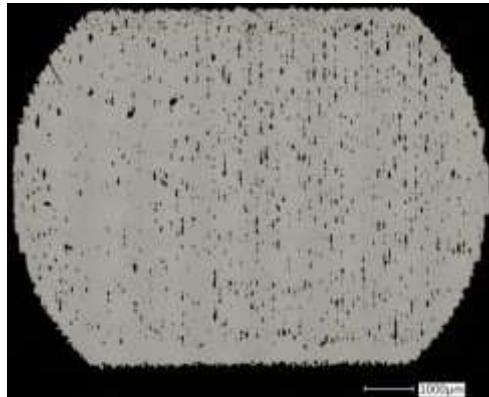
# Powder Quality

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## Quality level

# TECHNICAL ADVANCES – MATERIAL PROPERTIES

Several years ago

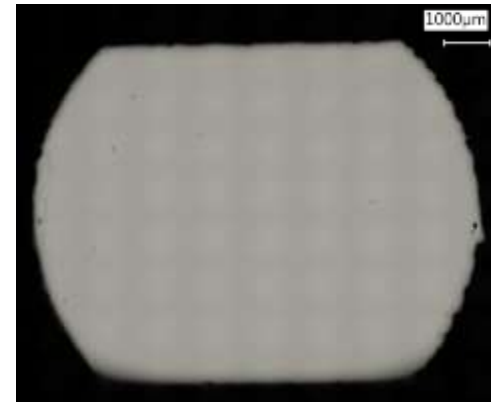


Density ~95%

Technical progress:  
» Laser technology  
» Optics  
» Software  
» Efforts in R&D



Today



Density ~99.95%

# Uddeholm AM Corrax

The first AM-powder made for tooling



# MATERIAL PROPERTIES - UDDEHOLM CORRAX

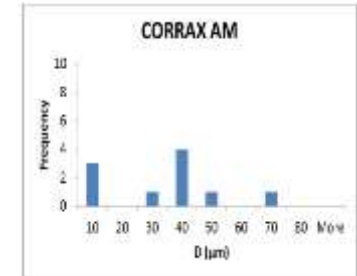
## Mechanical properties

		Modulus [N/mm <sup>2</sup> ]	Yield Strength - Rp0,2 [N/mm <sup>2</sup> ]	Tensile Strength - Rm [N/mm <sup>2</sup> ]
<b>Conventional</b>		200.000	1.600	1.700
<b>AM</b>	Built vertically	200.000	1.640	1.700
	Built horizontally	200.000	1.560	1.650

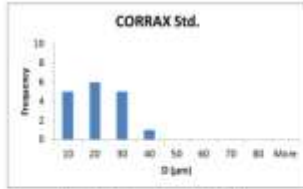
Hardness up to 50 HRC in aged condition and 7,624 g/cm<sup>3</sup> density.

**Mechanical properties similar to conventional material!**  
**Polishability better than conventional material!!**

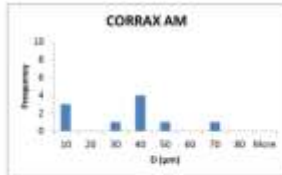
## Polishability



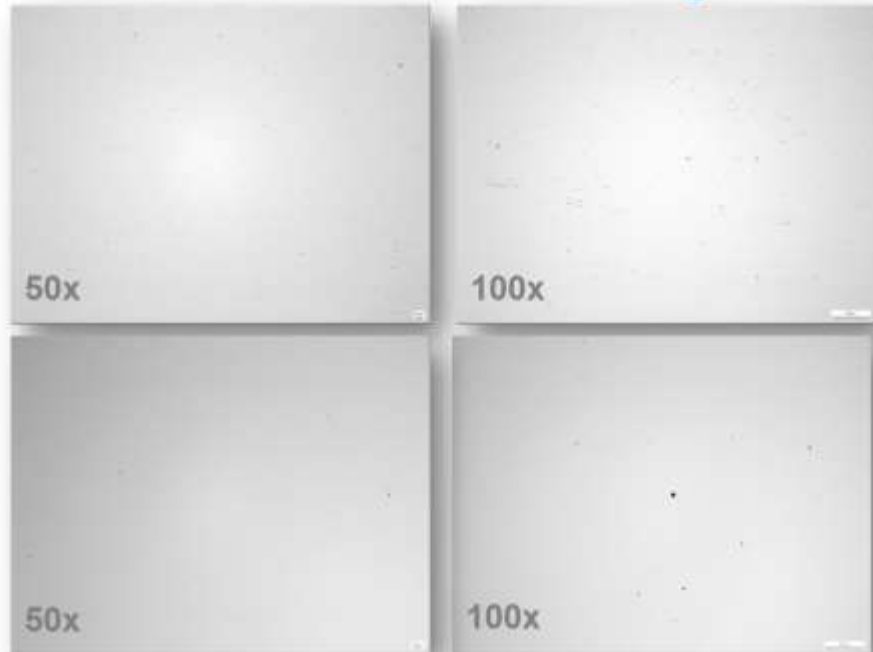
# Polishability



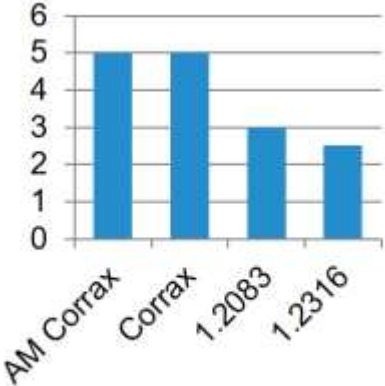
- Mean defect diameter: D 14.86 µm
  - Max 39.2 µm
  - Min 3.3 µm
- Number of defects detected #17
- Density of defects per area 0.85 1/mm<sup>2</sup>



- Mean defect diameter D 27.36 µm
  - Max 82 µm
  - Min 4.7 µm
- Number of defects detected # 10.00
- Density of defects per area 0.50 1/mm<sup>2</sup>



# Corrosion Resistance



AM Corrax has the same corrosion resistance as conventionally produced material



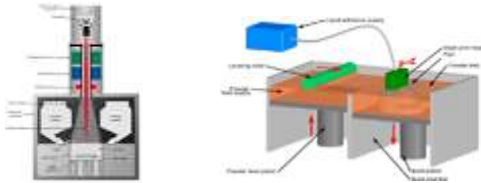
# AM Technologies

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## PBF and DMD

# AM Technologies

## Powder bed fusion



100g / hour

Platform max. 400 x 400 mm

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## Direct Metal Deposition

...with Powder



...with Wire



voestalpine  
ONE STEP AHEAD.

# AM Technologies

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voestalpine  
ONE STEP AHEAD.

# ADDITIVE MANUFACTURING HIGH PERFORMANCE METALS AM NETWORK

## Multiple locations, markets & technologies



## Comment

- AM Centers of Excellence (Innovation centers) around the world
- Powder production in Europe
- To be close to the customer, we create a worldwide footprint for the design and production of parts
- We are focusing on both – powder bed and direct metal deposition
- To build up this network, efficient, strong collaboration & know-how exchange is absolutely essential

» Additive manufacturing is an important step for the transformation from a steel-producing to a technology and capital goods producing company

# voestalpine AM MACHINE & MATERIAL CAPABILITIES

## Laser Beam Melting



EOS M290 x 8



EOS M400 x 2



TruPrint 1000 x 1



SLM 280HL x 1

## Materials

- » Heatvar
- » 1.2709
- » Corrax
- » 17-4 PH
- » Inconel 718 & 625
- » Many more



Renishaw AM400 x 1

## Direct Metal Deposition



TruLaser 7040 x 2



Lasertec 65 3D x 1

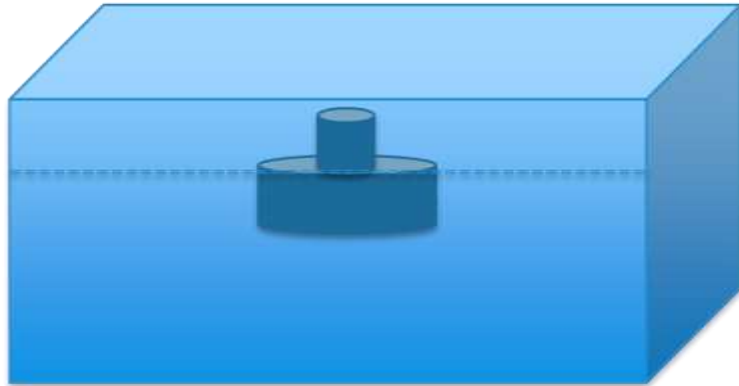
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# AM Technology Setup

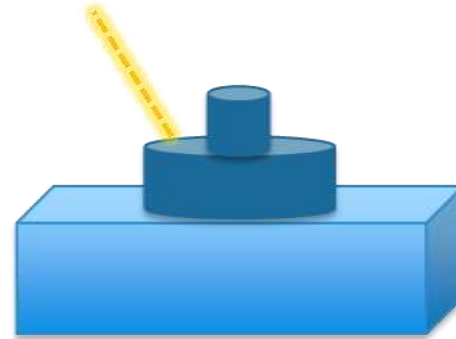
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Software / Hardware

## Subtractive manufacturing

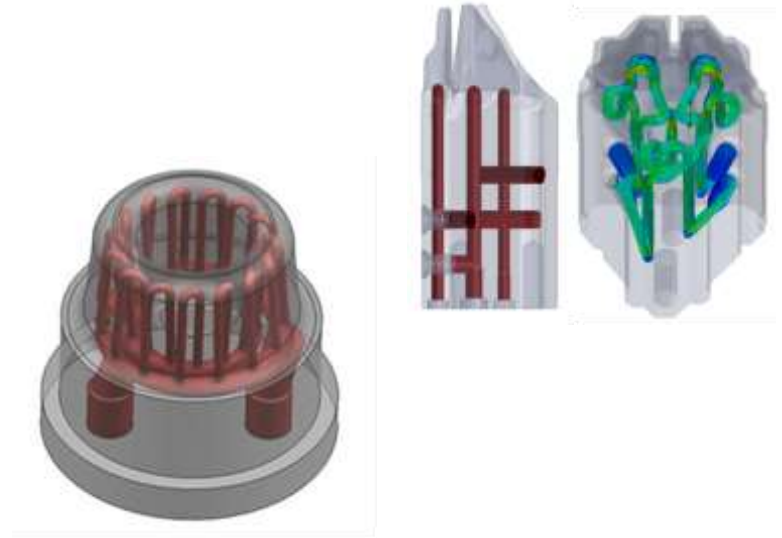


## Additiv manufacturing



# HYBRID MANUFACTURING

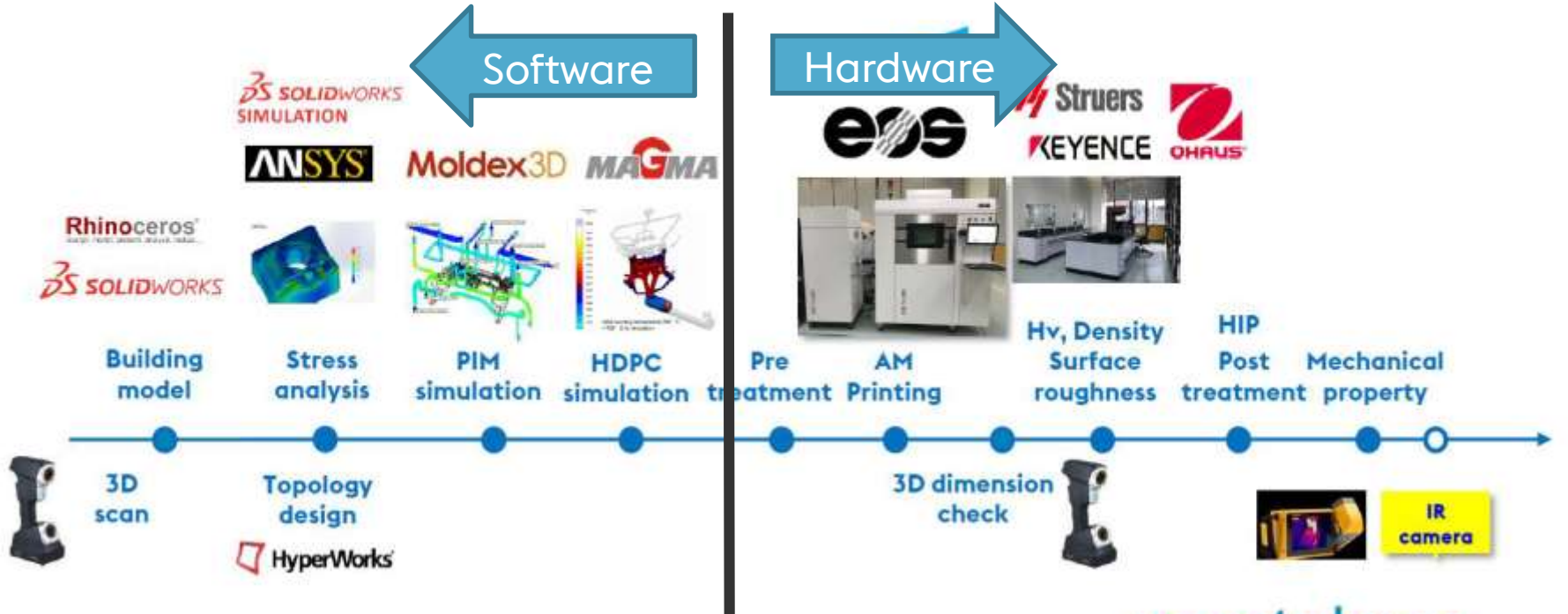
- » Reduction of the AM- volumes to functional area
- » Conventional machining of the remaining parts
- » Reduction of manufacturing costs



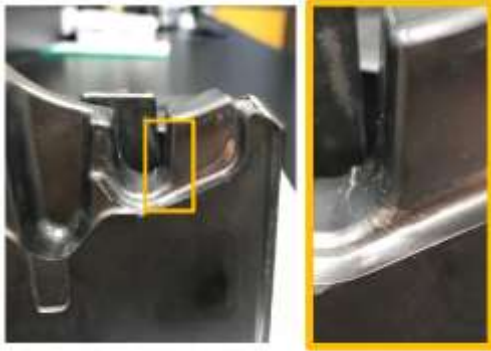
**Consideration needs to be made about the combination of materials**



# AM Capabilities



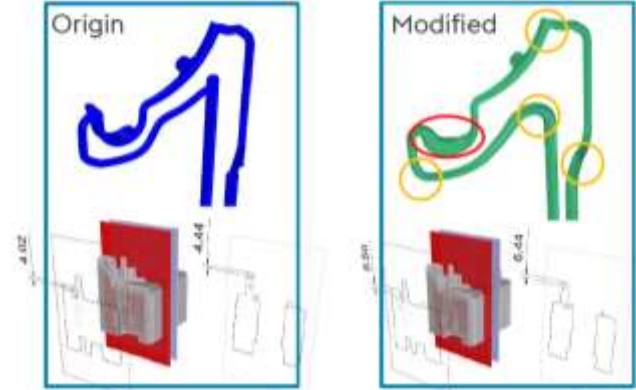
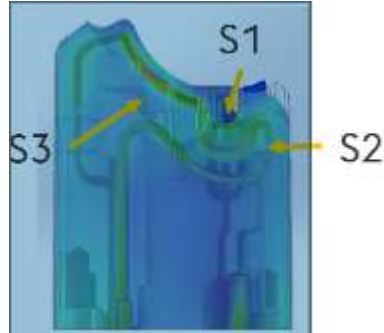
# AM Optimization



1) Stress analysis



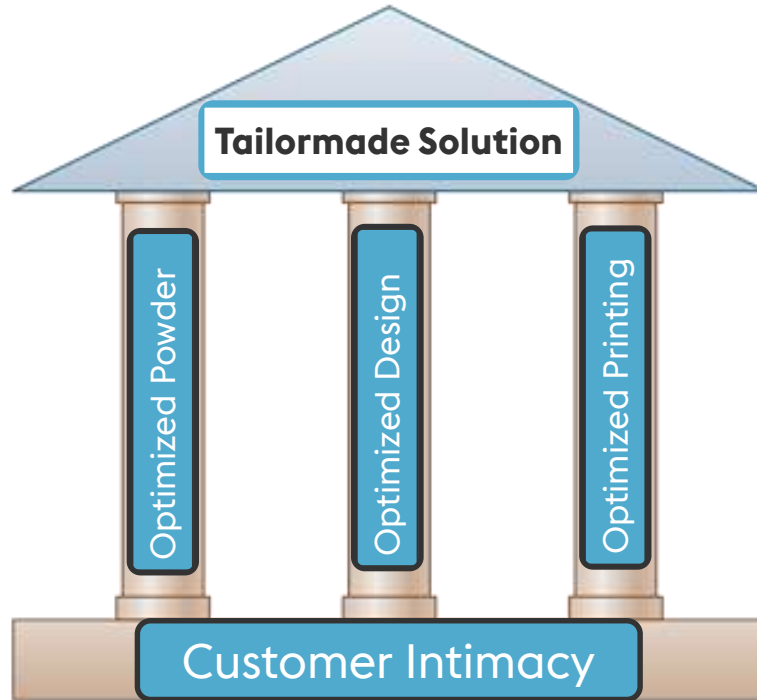
2) Optimized solution



Max. Von Mises stress, MPa	Area		
	S1	S2	S3
Origin	424	-550	504
Modify	337	-260	423
$\Delta S$ (%)	-20%	-53%	-16%

# The 3 pillars of success

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# Agenda

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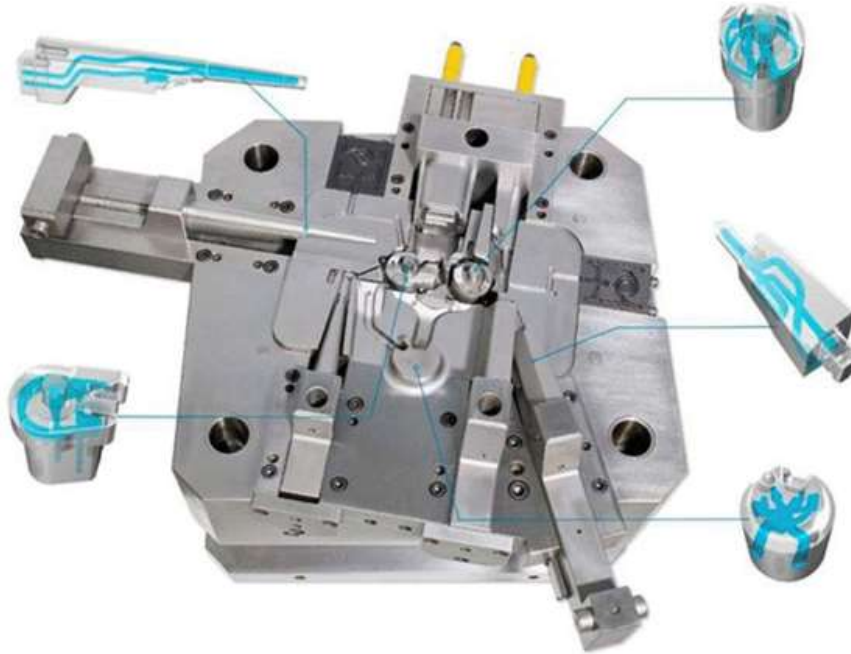
» Tooling Approach

» AM Approach

» **AM Case Studies / Success Stories**

# HPDC - Mold optimization with conformal cooling

Heat attacked slider



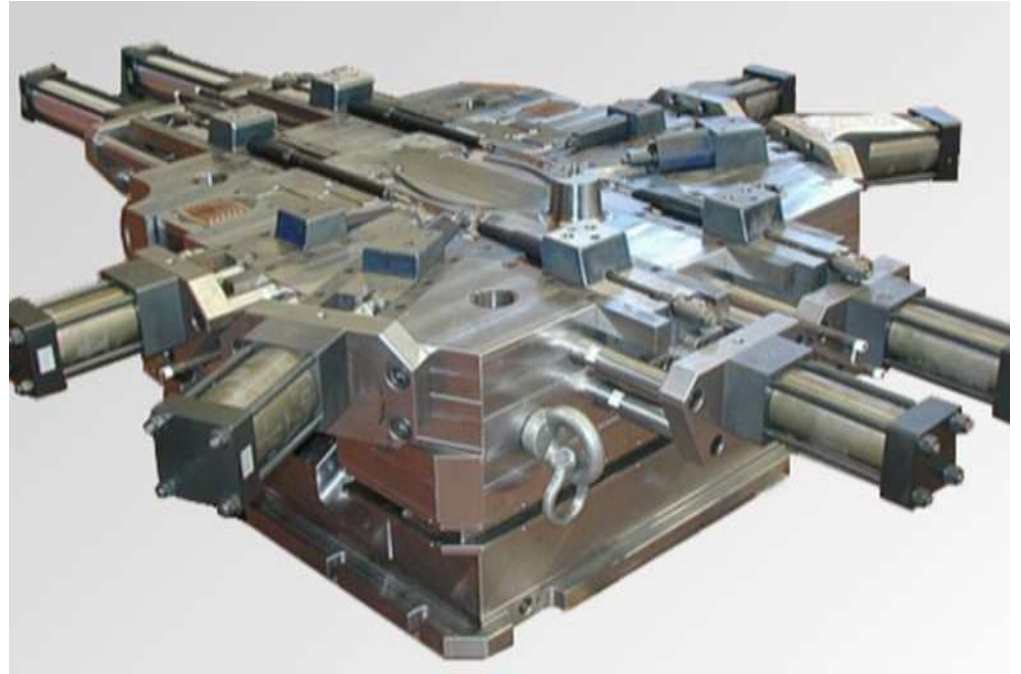
Sub-Inserts

Distributor/Ring

# HPDC – Performance optimization with AM

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- » Scrap rate reduction
- » Part quality improvement
- » Down time reduction
- » Life time improvement
- » Maintenance optimization
- » Cycle time reduction



# HPDC – Distributor



Powder: voestalpine

Reason for AM:

- Cycle time reduction
- Life time improvement

Performance:

Compared to conventional cooled distributor:

**Cycle time: – 2,5 sec.**

**Life time: >200% !!**



# HPDC – Distributor



Powder: voestalpine

Reason for AM:

- Cycle time reduction
- Life time improvement

Performance:

Compared to conventional cooled distributor:

**Cycle time: – 3,0 sec.**

**Life time: >150% !!**





# HPDC – Slider



Reason for AM:

- Life time
- Reduction scrap rate

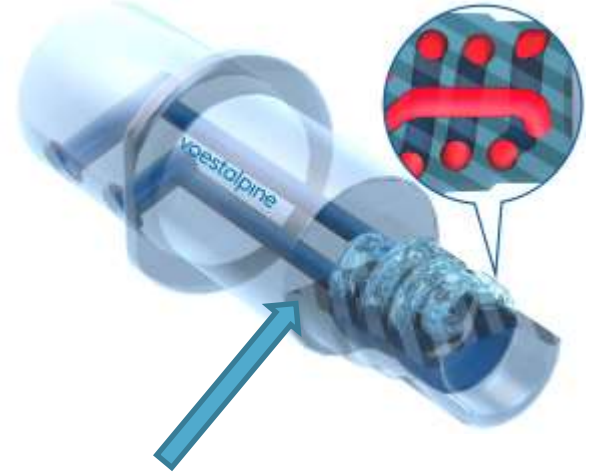
Application:  
Clutch housing – insert

Powder: voestalpine

Performance:

Compared to conventional  
cooled slider:

**>600%!**



Hybrid line

# HPDC – Slider



Application:  
Gear box – sub insert

Reason for AM:

- Reduction scrap rate
- Life time

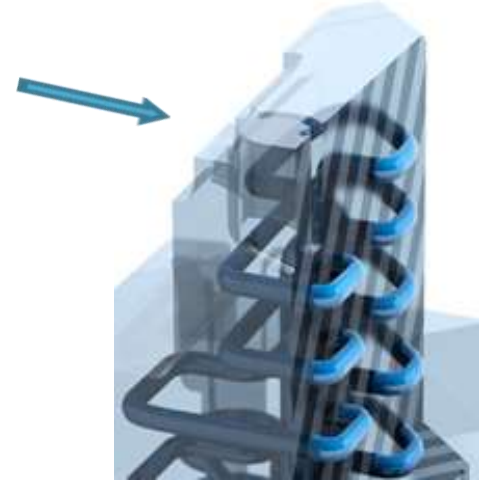
Hot Spot > 350°C  
Soldering problems!

Performance:

Compared to conventional  
cooled slider:

**Scrap rate reduction: - 10 %**

Powder: voestalpine



# HPDC – Sub Insert



Application:  
Pump housing – sub insert

Reason for AM: Powder: voestalpine

- Life time
- Reduction scrap rate

Performance:

Compared to conventional  
cooled sub insert:

**>350%!**



# HPDC – Sub Insert



Application:  
Differential housing – sub insert

Reason for AM:

- Reduction scrap rate
- Core life time

Performance:

Compared to conventional cooled sub insert:

**Scrap rate reduction from 20% to 6%**

Hybrid line

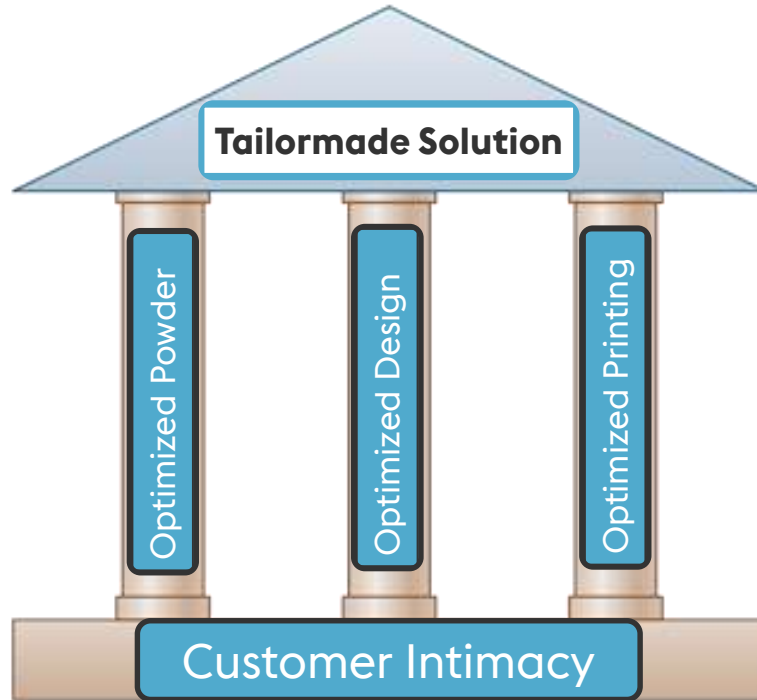


Hot Spot > 370°C  
Soldering problems!

Powder: voestalpine

# The 3 pillars of success

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# voestalpine Tooling Approach



**AM – MISSING LINK TO A  
FULL SOLUTION PROVIDER**

World leader  
in tool steel  
production  
and services  
since decades!

# Thank you

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UDDEHOLM