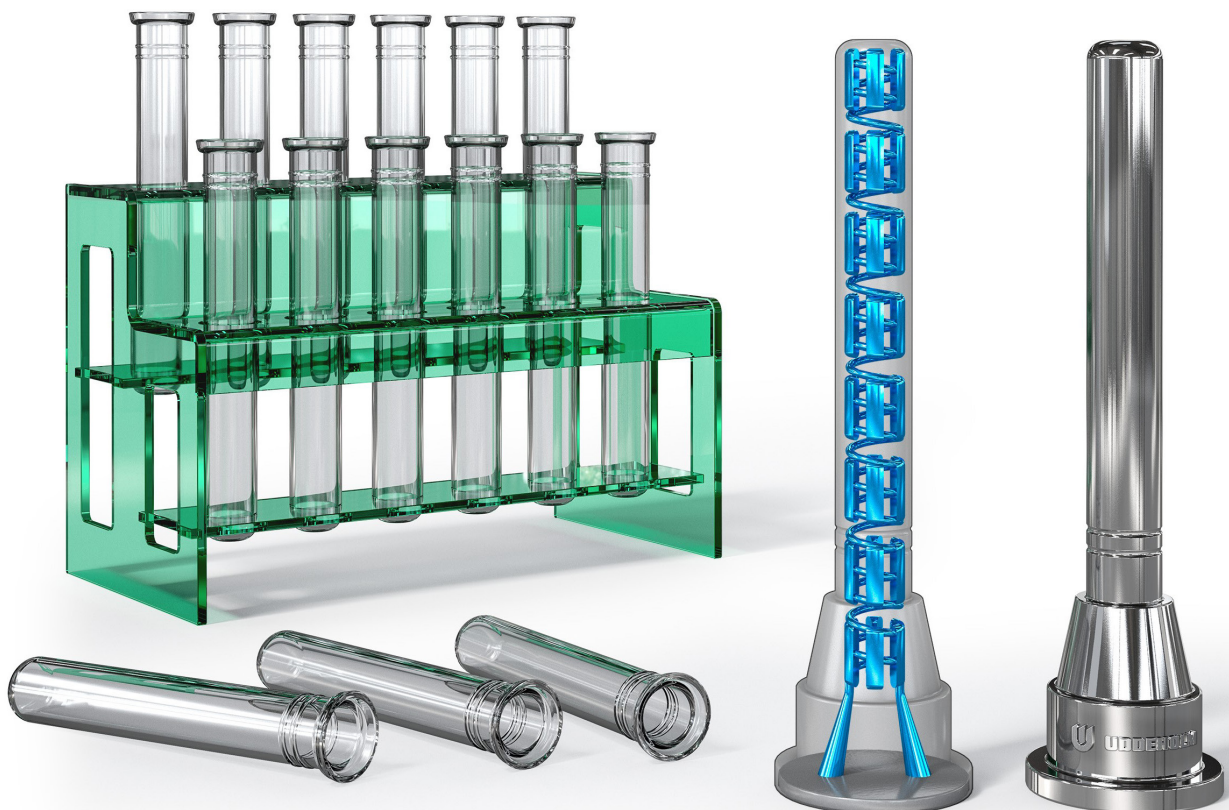


# FROM CONCEPT TO COMPONENT

## ADDITIVE MANUFACTURING

The next era in tooling for the  
Plastic Injection Moulding industry





# A NEW WAY OF MANUFACTURING

## ADDITIVE MANUFACTURING BRINGS VALUE TO YOUR BUSINESS

Additive manufacturing means a new way of manufacturing outstanding tools. For you, it means better business and new possibilities. We are introducing a new perspective through additive manufacturing. It is time to shift focus from technology to customer needs and tooling solutions.

When it comes to manufacturing solutions we aim to be the one leading the way. With over 350 years of experience and market leading metallurgy know-how, we have now taken the next step and applied our knowledge to the latest technology - additive manufacturing.

## BETTER QUALITY, HIGHER PRODUCTIVITY AND SHORTER LEADTIMES

Additive manufacturing, also known as 3D printing, is the process of forming objects by printing layer by layer according to designs using Computer Aided Design (CAD) software. The layer by layer process of additive manufacturing gives opportunities to build geometries that was previously impossible. Both inner and outer geometries can be made for better performance. Whether it is an complicated outer surface, cooling or venting channel, additive manufacturing gives new possibilities in solving your tooling problems.

Conformal cooling simply means that you can manufacture cooling channels where you need it the most in order to take full control of the temperature of your tool. With conformal cooling, you can either cool the tool quicker and reduce cycle time or remove hot spots, which improves the quality of the moulded parts. Both of which are critical for plastic moulding tools.

## A GAME CHANGER

Additive manufacturing enables:

- Building of complex geometries that includes internal features
- Shorter time to market and rapid prototyping
- Combining multiple parts into one
- Generating less waste
- Utilising lightweight lattice designs
- Reducing inventory
- Potential for smart components and integration of functions/sensors



## Uddeholm Corrax for AM in short

- Corrosion-resistant tool steel
- Flexible hardness 34–50 HRC
- Ageing treatment 425–600°C
- Extremely good homogeneity
- Extremely good polishability
- Easy to process by AM technologies



# OPTIMIZED POWDER

## IT ALL STARTS WITH A GOOD POWDER STEEL

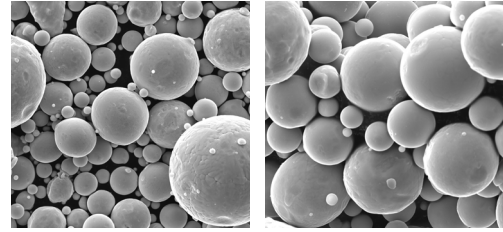
To make a good tool, you need high quality tool steel. Uddeholm has brought more than 350 years of experience into additive manufacturing by investing in the future.

Together with our application knowledge from the tooling industry, this latest investment paves the way for AM powders specifically developed for tooling. With state-of-the-art equipment for AM powder production and highly optimised production processes, we are able to produce properties in our AM powders that are needed for all tooling applications. These include powders with excellent morphology, highest purity & cleanliness in order to meet the ever increasing polishability requirements from the plastic mould industry.

Our long history of developing materials for the plastic injection moulding industry ensures the powders used to print your tooling inserts are of the highest quality and will deliver superior tool life. Our additive manufacturing powders are designed and manufactured by the same experts responsible for our class leading tool steels.

# UDDEHOLM CORRAX FOR ADDITIVE MANUFACTURING

Uddeholm Corrax for additive manufacturing is developed for complex shapes and innovative design in a fast and changing industry. You get all the benefits from our conventional stainless steel grade in the form of an advanced metallurgical powder.



The process and quality control in Uddeholm's powder lab is your reliable guarantee for homogeneity in size and shape. The result is powder with minimal cladding.

## POLISHING

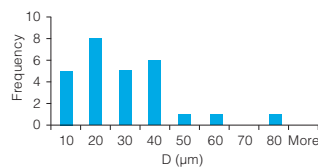
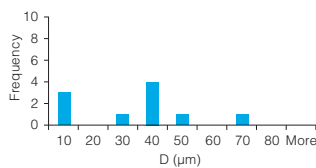
Uddeholm Corrax for AM



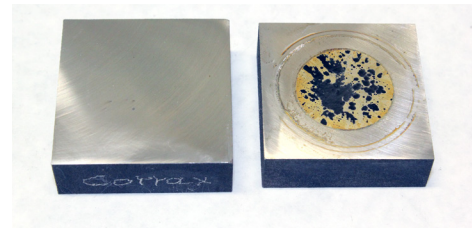
AM 12709



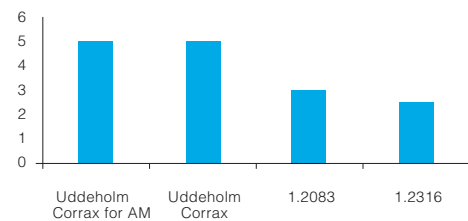
Optical microscope images of polished surfaces and pit density measurements.



## CORROSION RESISTANCE



Uddeholm Corrax for additive manufacturing has excellent corrosion resistance, fully matching the conventionally manufactured Corrax and better than the corrosion resistant standard grades used for plastic moulding.



## MECHANICAL PROPERTIES\*

Tensile Strength Rm (Mpa)	Yield Strength Rp0,2 (Mpa)	Elongation A5 (%)	Modulus of elasticity (MPa)	Impact toughness (J)	Compressive stress (Mpa)
1700	1600	10	200000	20	1800

\*All data at 50 HRC

## TYPICAL ANALYSIS %

C	Si	Mn	Cr	Ni	Mo	Al
0.03	0.3	0.3	12.0	9.2	1.4	1.6

Maximum hardness: 48-50 HRC

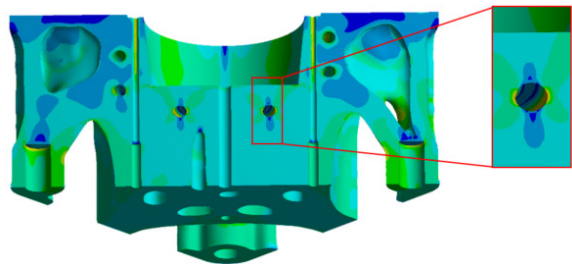
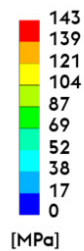
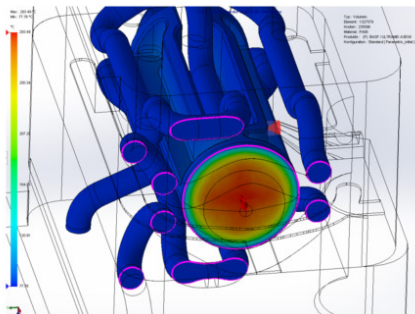
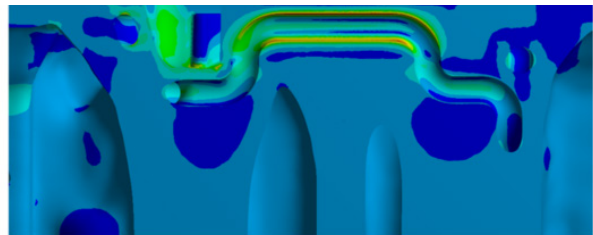
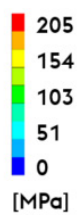
# OPTIMIZED DESIGN

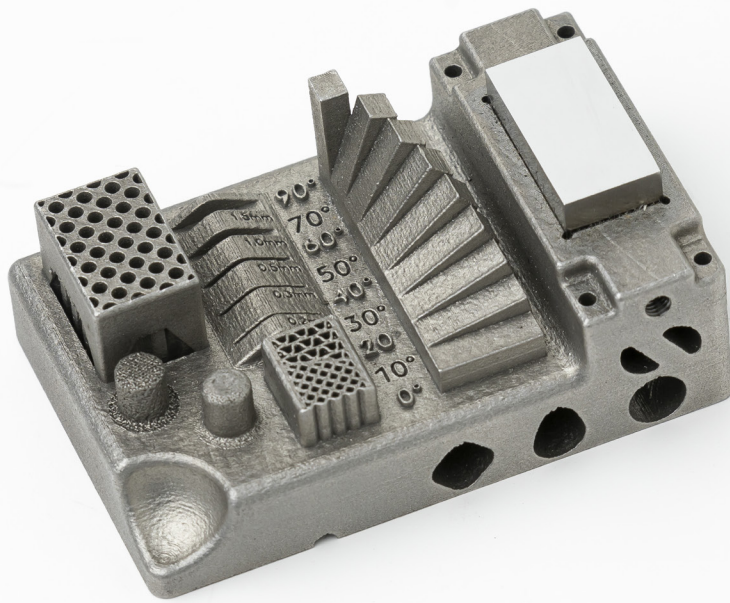
## RIGHT SOLUTION FOR THE RIGHT APPLICATION

Unique tools require unique solutions. We support our customers through a detailed consultation process to develop the right solution for the right application. Supporting the manufacturing process from initial concept through to functional parts, where and when needed, our experts can support your re-designed tools according to the exact requirements of your application.

Additive manufacturing tool design and process simulation go hand in hand. Our additive manufacturing experts generate extensive computer models to help identify potential failure modes and remove these problem areas before they can cause premature tool failure. This process ensures the best possible design solution and is adopted before we print the part.

Our data driven approach to cooling design analysis provides us with the processing parameters and mechanical loads needed to develop detailed computer models of the customer process. This method of optimizing thermal management is essential to ensure the right balance between efficient cooling and the mechanical performance of the tool. This process goes far beyond regular conformal cooling channel design. We provide you with optimized cooling performance.



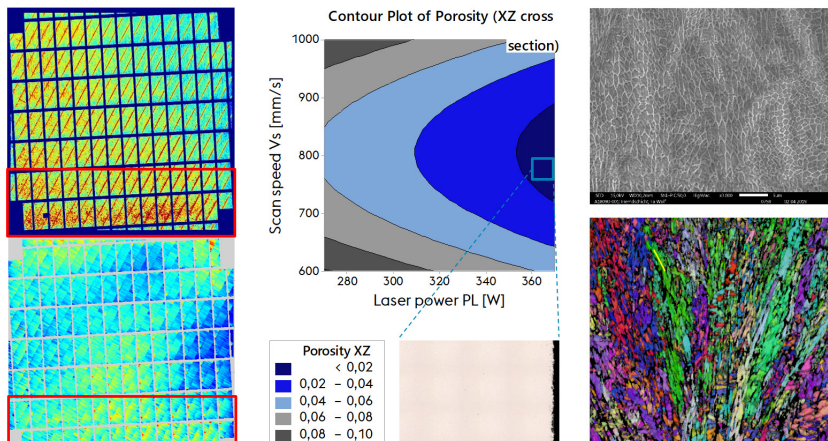


# OPTIMIZED PRINTING

## QUALITY PROCESSING IS THE KEY FOR SUCCESS

We use state-of-the-art tools to continuously improve and refine our internal printing processes. Design of Experiments, Statistical Process Control, and Process Monitoring form the basis of our methodology. Continuous innovation ensures we deliver superior material properties in the most demanding applications. As a result you, our customer, can put parts into service with the highest degree of confidence.

We ensure the highest possible part quality, reliability and consistency by managing every step of the value chain from powder production to the delivery. Whether for a single part order or series production, our quality systems ensure we meet your requirements every time.



Left: Optimisation goal "build zone" detected by process monitoring using EOSTATE Exposure OT (top) and EOSTATE MeltPool (below).

Middle: Design of Experiments for parameter optimisation using contour map of response surface design for porosity (top) and the related metallographic sample after optimisation (below).

Right: Microstructure of AM processed H13-type analysed by SEM (top) and EBSD (below).

# PROVEN CUSTOMER SUCCESS

Our three-pillared approach to additive manufacturing has proven to deliver significant performance improvements to our Plastic Injection Moulding customers across a range of applications.

Our corporate philosophy of treating customers as partners means that we are there for you. More than just selling steel, we provide solutions to overcome any challenges you may encounter.

Please find some examples of the case studies where we have helped to solve our customers problems through our holistic approach.





**APPLICATION: White goods**

- Cycle time / warpage reduction
- Replace Be-Cu

Performance compared to conventional cooled design:

Cooling time: same as Be-Cu insert

Tool life: improved (>200K shots)



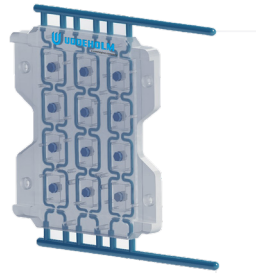
**APPLICATION: Cavity for LED street**

- Quality / optical

Performance compared to conventional cooled design:

Cooling time: improved

Scrap rate: -15%



**APPLICATION: Flat iron - handle**

- Cycle time reduction
- Life time

Performance compared to conventional design:

Cycle time: -2.5 sec.

Life time: + 40% still running



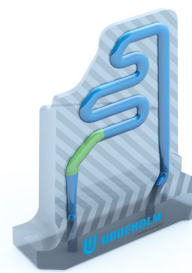
**APPLICATION: Insert for washing machine**

- Cycle time reduction

Performance compared to CuBe inserts:

Cooling time: -12%

Cycle time: -8%



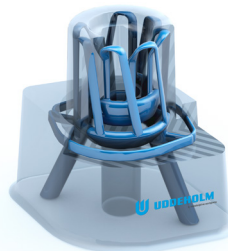
**APPLICATION: Insert for medical container**

- Cycle time reduction

Performance compared to conventional cooled design:

Cooling time: -15%

Cycle time: -8%



# ADDITIONAL SERVICES

## FOR MAXIMUM PERFORMANCE

We offer end-to-end solutions, starting from the metal powder production to engineering design, simulation, prototyping, manufacturing and full spectrum of post processing.

To get the maximum performance of the tool, additional steps are required. With our additional services, we offer you the confidence and efficiency that comes with choosing our high performance tool steel and post processing value-added services.

## MACHINING

We offer a broad range of flexible customer-adapted machining solutions to meet the required specification.

## HEAT TREATMENT

We work with key industrial partners to develop cutting-edge solutions. We have perfected our heat treatment serviced and solutions down to a precision science. It encompasses carefully conducted thermal processing to bring about tool steel properties that matches your needs.

## POLISHING

Our polishing capabilities are crucial for certain tooling applications. We can support with expert advice on how to get the best results for your tools.

## PVD COATING

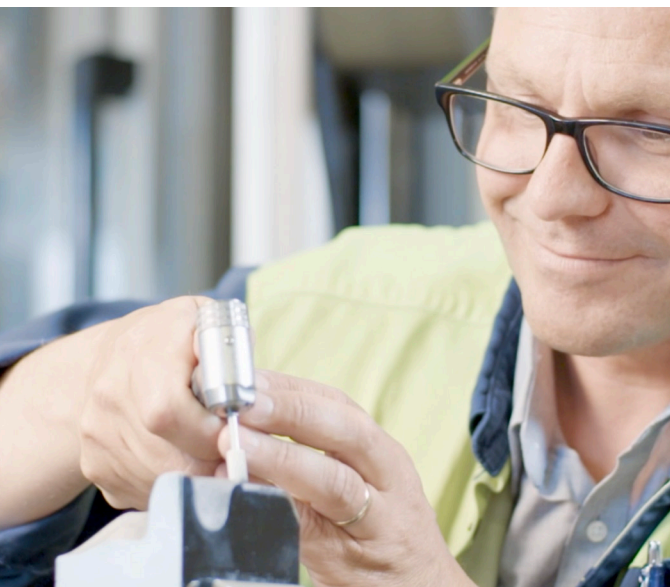
With tailored PVD coating, the hardness, corrosion resistance, high temperature resistance and tribology properties can be modified to resist different surface failures.

We offers leading-edge PVD (Physical Vapour Deposition) technology to achieve improved tool properties and performance.

## LAB TESTING, INSPECTION AND CONSULTANCY

We improve customers' competitiveness by providing testing and analysis as well as consultancy on the usage of the right steel and the treatment required to meet specific tooling needs.

Our support does not end with the delivery of additive manufactured inserts. It goes far beyond that. We are here for our customer all the way. We also do failure analysis if needed or wanted.





Manufacturing solutions for generations to come

# SHAPING THE WORLD

Since 1668 we have been providing a wide range of innovative cutting-edge solutions for our customers in demanding segments. Our dedicated employees work in almost ninety countries and together we deliver improved competitiveness to clients worldwide. Welcome to Uddeholm.

For more information, please visit [www.uddeholm.com](http://www.uddeholm.com)

