



DIGITAL  
METAL®

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# ADDITIVE MANUFACTURING OF SMALL AND COMPLEX PARTS



# RAPID 3D PRINTING FOR YOU

The proprietary technology of Digital Metal® is making great strides into territories previously ruled by conventional manufacturing technologies. High productivity, excellent surface quality and great resolution have brought our 3D metal printing services out of the prototyping phase, and into large series manufacturing. This is what's in it for you.

## ADVANTAGES

- High productivity
- Excellent surface quality
- High resolution
- Serial production
- Mass customisation
- Repeatability



“So far no other metal additive manufacturing technology can match the level of resolution and surface quality provided by Digital Metal.”

BATHSHEBA GROSSMAN, BATHSHEBA SCULPTURE LLC (USA)

## WHAT'S SO GOOD ABOUT IT?

For a start, the process requires no complex or costly tools and keeps waste material down to an absolute minimum. But that's not all. Here are just a few of the other advantages:

### 'IMPOSSIBLE' OBJECTS BECOME POSSIBLE

3D metal printing enables the production of complex objects that would be costly – if not impossible to produce – using conventional methods. This is music to the ears of industrial designers, who can at last unleash their full creativity and explore the new territory that 3D metal printing opens up.

### FAST TRACK FROM CONCEPT TO COMPLETION

In today's fast-paced, competitive environment, producers face ever shorter product life cycles and ever greater product variety. You need new, quicker ways to innovate and get your innovations to market. 3D printing is the answer. With this technology, Digital Metal can take your product from concept to completion in less than two weeks.

### COST-EFFECTIVE PRODUCTION

Not only does 3D metal printing provide a much more cost-effective way of manufacturing complex metal parts, it is also the ideal solution for the production of mass-customised components or flexible serial volumes.

Non-critical metal parts can be hollowed out, thus making them much lighter, which helps solve one of the main challenges of aircraft design.



## WHERE CAN YOU USE IT?

### INDUSTRIAL APPLICATIONS

3D metal printing makes it possible to quickly and cost-effectively produce complex metal components for industrial use. They can be hollow or meshed, with undercuts, ducts, cavities and internal structures. Almost any design, no matter how complicated, is achievable using this technique.

### DENTAL/MEDICAL

Dental/medical 3D metal printing also opens up the possibility of making radically new tools and components designed for optimal functionality instead of complying to the restrictions of traditional manufacturing.

### AEROSPACE

By making lightweight but strong metal components, with hollow or meshed interiors, Digital Metal can also contribute to advances in aircraft design.

### DESIGN

3D metal printing enables a whole new level of creative freedom!



# THIS IS HOW IT WORKS

Are you looking for ways to increase the tolerances, surface finish and resolution of your components, while simultaneously maximising productivity? Then high-precision binder jetting on powder bed might be the solution to what you are looking for.

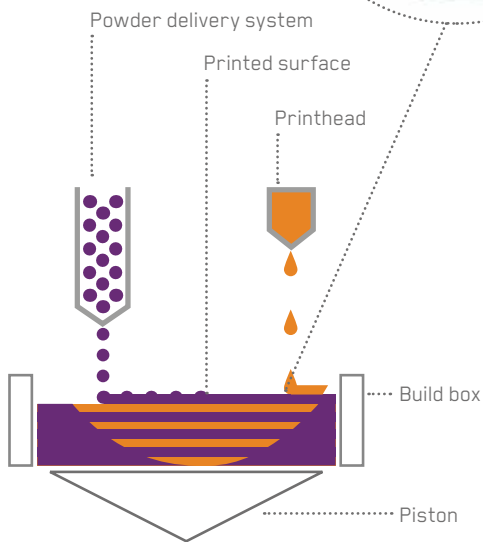


## LAYER BY LAYER

Our process begins with an object described in a CAD file. This is materialised in our 3D printer, which builds the object layer by layer, using metal powder and high-precision binder jetting. Once complete, the object is sintered for strength.

The result? A metal component with high resolution and tolerance. An additional third step can be added to refine surface quality.

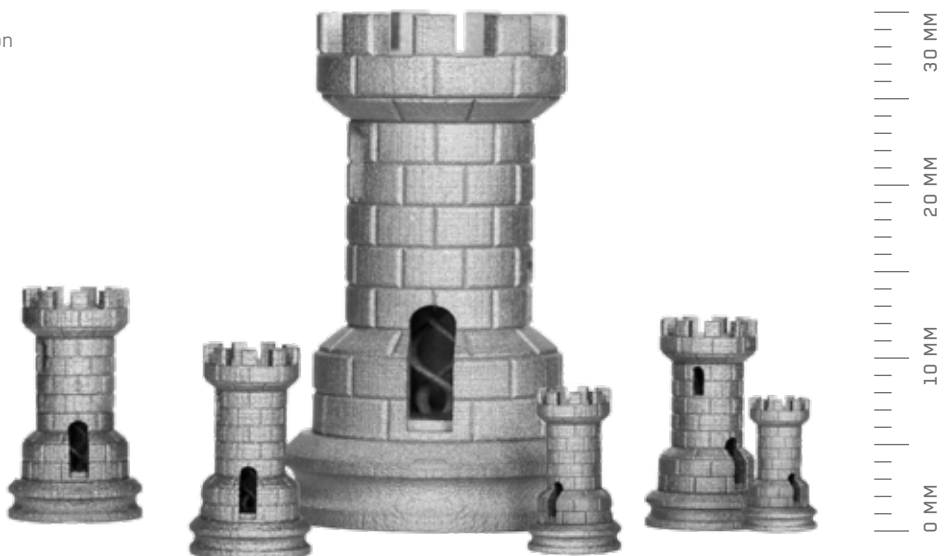
Today, Digital Metal offers components printed in stainless steel or titanium. However, other materials are constantly under development and will be readily available after rigorous testing and approval.



High-precision binder jetting on powder bed

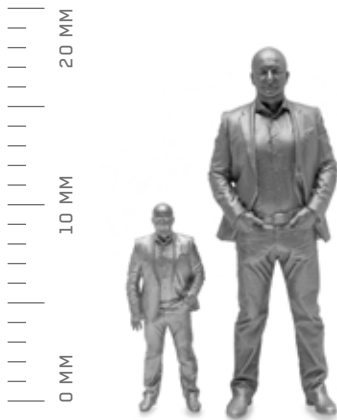


The fine metal powder and high-precision binder jetting technology provide consistent high resolution.



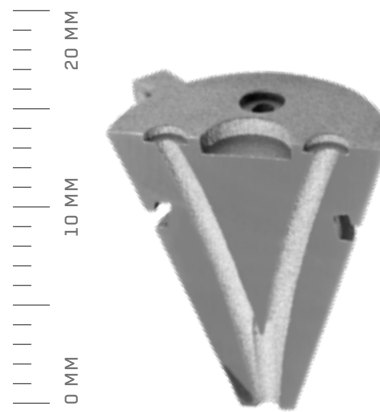
### VARYING HOLE DIAMETER

Due to the very precise process, our proprietary Additive Manufacturing technology Digital Metal, can be used for making parts with extremely fine holes of great dimensional accuracy. This particular sieve adds yet another dimension to precision and customisation: the holes are of variable diameters.



### ITSY BITSY

It may be hard to grasp the small size of this pair of happy twins. Apart from the precision required, our small friends visualise yet another advantage of Digital Metal: high productivity. In just one batch, we are able to manufacture very large numbers of similar, or – even better – dissimilar objects.



### INTERNAL CHANNELS

A major advantage of Digital Metal is the free form design capability offered. Nowhere is this more evident than in the case of internal channels that easily can be utilised to provide complex, optimised internal structures. The average surface roughness of merely Ra 6  $\mu\text{m}$  ensures a good flow in the channels.



### DETAIL ACCURACY

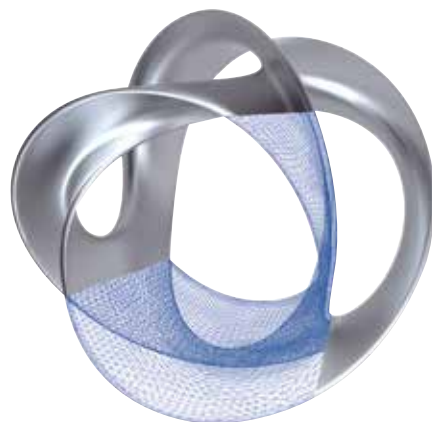
Growing up, this man probably never expected turning into a man of steel, 10 mm tall. However, unlike a well-known super hero, this transformation from human to steel will not pass unnoticed. The very fine detail makes it impossible to keep his true identity safe.

### INTEGRATED DESIGN

The pea of the whistle is not visible, but rest assured – it is in there. In our 3D printing process, the integrated pea is built resting on the surrounding layers of metal powder. Once the powder is removed, prepare yourself to get blown away.

### ADVANCED GEOMETRY

This complex geometry is a prime example of what Digital Metal is all about: making the seemingly impossible possible. Simply put, this is what we call design beyond your imagination.



# SERIAL PRODUCTION OF CUSTOMISED PARTS

In the manufacturing of small and complex components, Digital Metal is a very competitive alternative to conventional mass production technologies. You may also consider the possibility of making every part a unique product.

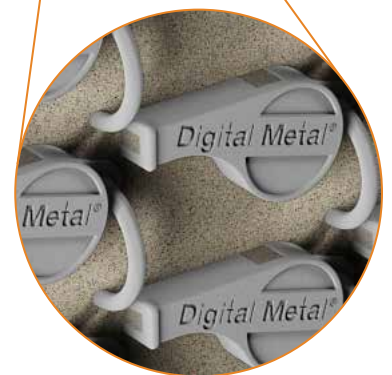
## HIGH-VOLUME PRODUCTION

Small part sizes means there is plenty of room for large numbers of components to be printed simultaneously. This is in particular true for Digital Metal. Our high-precision process does not require any support structures, nor does it involve any heat transfer, which means we are able to pack the build box densely. Required spacing between parts to be printed is less than 1 millimetre. Parts can be placed in several layers on top of each other.

Printing without support structures also minimises post treatment, which speeds up the production process. The high productivity explains why Digital Metal today is one of the first service providers in the world supplying large series of 3D printed products.

## MASS-CUSTOMISATION

There is time to be saved and money to be earned taking a closer look at the flexibility of Digital Metal. Every single part in a batch of components can be custom-made, no matter the number. This opens up for creative thinking and added marketing value as you are able to supply products customised for your market. Consequently, Digital Metal also enables simultaneous printing of different product series in the same production run.





## CAPABILITY

### MATERIAL DATA – TYPICAL VALUES

	Ultimate tensile strength	Yield strength (0.2%)	Elongation	Hardness	
	MPa	MPa	%	HRB	HRC
<b>316L</b>	520	180	50	55	
<b>17-4PH</b>	900	730	6		25
<b>Ti6Al4V</b>	890	790	8		25



### CHEMICAL COMPOSITION (%)

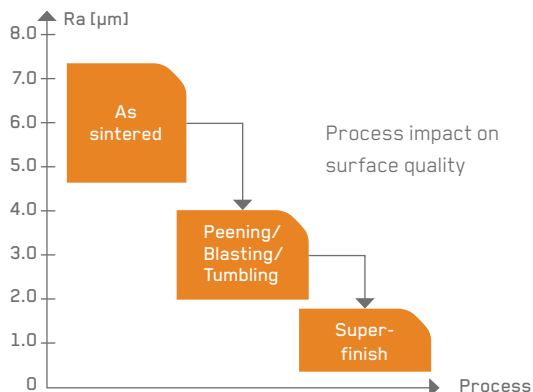
	Fe	Cr	Ni	Mo	Cu	Nb+Ta	Ti	Al	V
<b>316L</b>	Bal	16-18	10-14	2-3	n.a.	n.a.	n.a.	n.a.	n.a.
<b>17-4PH</b>	Bal	15.5-17.5	3-5	n.a.	3-5	0.15-0.45	n.a.	n.a.	n.a.
<b>Ti6Al4V</b>	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	Bal	5-7	3-5

### PROCESS CAPABILITY

Feature	Typical
<b>Density</b>	MPIF standard 35 for MIM 96% for 316L
<b>Geometrical capability</b>	
Maximum length	Preferably < 50 mm
Minimum length	1 mm
Corner R	35 µm
Chamfer	Steps of 35 µm in z direction
Wall thickness	Preferably > 300 µm. Minimum > 150 µm
Resolution	Maximum 35 µm in z direction
Holes	> 200 µm depending on hole length
Productivity	60 cm³/h scaled; 100 cm³/h unscaled
Accepted file formats	STL, STEP

### SURFACE QUALITY

With the Digital Metal technology, an average surface quality of Ra 6 µm can be obtained already without any post processing, while a Ra of >10 µm is typical for other AM processes. Surface quality is important for components with internal channels, as post processing of those surfaces are very challenging. Additional operations can be added on external surfaces to achieve a surface that matches your specific need.



As sintered, an average surface quality of Ra 6.0 µm is achievable.



Peening, blasting and tumbling increase surface quality to an average of Ra 3.0 µm.



Superfinish enables even higher surface quality, around Ra 1.0 µm.



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## PART OF HÖGANÄS GROUP

Digital Metal is part of Höganäs Group, the world's largest producer of iron and non-ferrous metal powders with an annual turnover of approximately 1 BUSD. Nearly 99 per cent of the Group's products are sold on international markets. Höganäs was founded in 1797 and has today 2,500 customers in 75 countries. Headquartered in Höganäs, Sweden, the Group offers more than 1,500 products from 13 production centres situated in all main continents.

Read more about Höganäs at [hoganäs.com](http://hoganäs.com)