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.

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!

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

**THIS IS HOW IT WORKS**

**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.
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 µm ensures a good flow in the channels.

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.

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 mean 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**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Typical Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ultimate tensile strength</strong></td>
<td>MPa</td>
</tr>
<tr>
<td><strong>Yield strength (0.2%)</strong></td>
<td>520</td>
</tr>
<tr>
<td><strong>316L</strong></td>
<td>Bal</td>
</tr>
<tr>
<td><strong>17-4PH</strong></td>
<td>Bal</td>
</tr>
<tr>
<td><strong>Ti6AI4V</strong></td>
<td>n.a.</td>
</tr>
</tbody>
</table>

**CHEMICAL COMPOSITION (%)**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Fe</th>
<th>Cr</th>
<th>Ni</th>
<th>Mo</th>
<th>Cu</th>
<th>Nb+Ta</th>
<th>Ti</th>
<th>Al</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>316L</strong></td>
<td>Bal</td>
<td>16-18</td>
<td>10-14</td>
<td>2-3</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td><strong>17-4PH</strong></td>
<td>Bal</td>
<td>15.5-17.5</td>
<td>3-5</td>
<td>n.a.</td>
<td>3-5</td>
<td>0.15-0.45</td>
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<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td><strong>Ti6AI4V</strong></td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>Bal</td>
<td>5-7</td>
<td>3-5</td>
</tr>
</tbody>
</table>

**PROCESS CAPABILITY**

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

**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.
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 hoganas.com