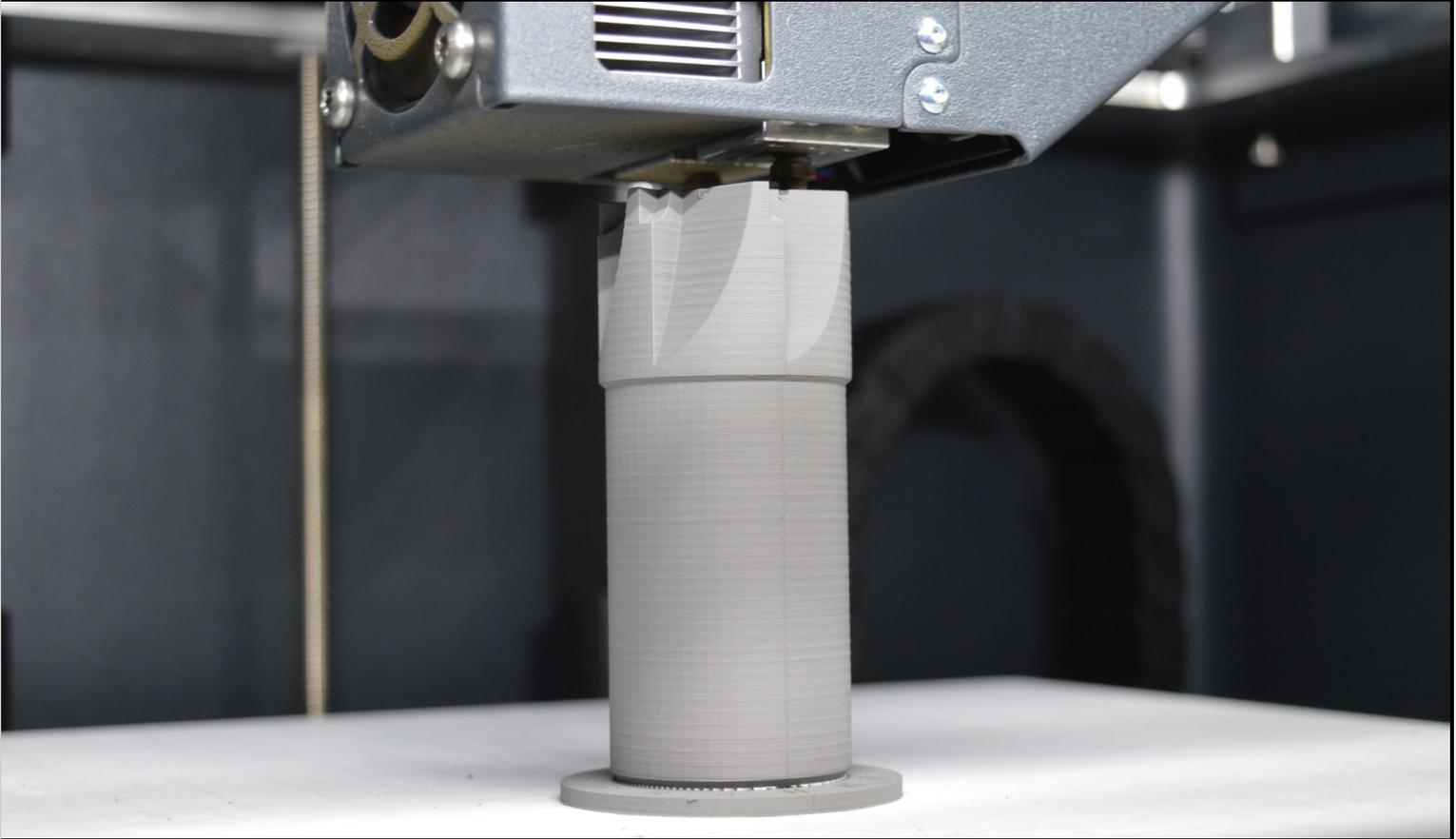


Markforged
Metal X Case Study
by Mark3D UK

GUHRING
The Tool Company



The Guhring Group is a world class manufacturer of precision cutting tools and allied tooling for the engineering & manufacturing industries. With over 8000 employees worldwide and a product range of 1620 products (in 44,000 sizes) they are renowned for being leaders in their field.

Guhring Limited is based in Birmingham, UK, and they employ a team of field technical support engineers, in-house design staff and application engineers who focus on delivering a continuous stream of the very latest in cutting tool technology. Their 'special' tools are designed, developed and manufactured in-house to customers specifications, as quickly as possible.

 **Mark3D**
Print Stronger


Markforged



At a glance

- ✓ 25% saving in cost
- ✓ 75% time saving
- ✓ 60% weight reduction
- ✓ Design freedom
- ✓ New applications
- ✓ Longer tool life



Project Goals

To develop new cutting technology and reduce lead times:

Developing new cutting solutions for some of the world's largest businesses is a demanding job.

As Alan Pearce the PCD Production Supervisor at Guhring UK points out "modern industry is relentlessly working to ever shorter lead times and as we are one of the main partners in their production process, we have to do the same. Therefore anything we can do to shorten the design, development and manufacture of special tools is of benefit to everyone".

Alan goes on to say "We are always looking to reduce the lead times associated with special tooling and we've made good progress over the years. We set ourselves a challenge to outperform our competitors in this area, whilst also trying to reduce the overall cost of the development cycle – which is not a simple task by any means.

Guhring are always looking to improve and 3D printing gave us an opportunity to do so".

Approach

Guhring have split their additive project in to 2 areas, R&D and special tool production.

Alan explains further "The first requirement we identified was for prototyping. We decided to use a 3D printer to help with new concepts and to share our designs. We didn't realise quite how much use we'd get out of this printer and now it's being used to support the UK production facility with jigs and fixtures as well as some custom machine tool parts too".

"Secondly, we wanted to print special cutting tool bodies in metal, which we could integrate in to our normal production process. We had to be able to ship them as part of our overall solution, directly to end users. This was something that we felt would be achievable with the right technology, so we set out to find it".

"Special tools are expensive and have long lead times, so if we could achieve savings in time and tool cost we'd be on to a winner. We also realised that we could make tools with much more complex geometry and increasingly radical coolant pathways".



Materials

17-4 PH Stainless Steel

H13 Tool Steel

A2 Tool Steel

D2 Tool Steel

Inconel 625

Copper

316L Stainless Steel —coming soon

Titanium Ti6Al4V —coming soon

The Metal X



Solution

What was the best solution for Guhring?

Guhring chose to install a Markforged Mark Two composite printer and a Metal X 3D printer in their technical academy.

Initial prototypes are printed using the Mark Two, meaning an engineer can have an accurate representation of the tool in their hands very quickly. This allows the team to discuss the proposed concept at the earliest opportunity and validates their thinking is correct. It's used internally and with customers. Printed with standard settings these prints use a small amount of material and cost a few £'s. It's now possible to perform a dry run on machines with a plastic tool, they are life size and cost very little.

Once a tool has been accepted as a viable solution the design can be verified by printing it in metal. The cutting tips are brazed in to place and it's then attached to a standard holder, so the team can check coolant direction and perform usability trials. Moving forwards all new special tools will be verified by using some sort of 3D printing.



Coolant Paths

Accurate coolant delivery is important to preserve tip life

One of the most important items in any cutting tool is the delivery of coolant and cutting fluids directly to the tips. This has a direct correlation to tip life and thus the number of passes the tool can make.



"Our aim is to increase the period between tip regrinds, this is one of the major requests from our customers" explains Pearce. "We now have tools out on test that have directional apertures, which are aimed exactly at the area where the tip contacts the part. The team here are really excited about the potential this gives us. We can print any aperture we need and route the coolant pathways anywhere through the body".

These techniques will be also be used to help with swarf evacuation too, which is another problem area for machinists.



#1 in Sales, Service, Training, Consumables and Consultancy for Markforged products in the UK

- ✓ Off centre loads
- ✓ High spindle speeds



PCD Cutting Tools

The first tool created on the Metal X was very important to the verification process

Milling cutters operate in harsh environments so the team at Guhring set out a rigorous test plan for the printed tool bodies.

Initially a tool was manufactured with the geometry of a reamer, to accept vertical loads and make small cuts. Testing took place in the Technical Academy and the tool passed with flying colours. Some small modifications were made to the tip geometry and the team then tested some cuts with an off-centre load, to simulate milling. Once again, the tool passed the test.

The team at Guhring have now moved on to create other milling tools, which have also performed well under load. Guhring's ability to create complex geometry has been a real bonus and designs are becoming more imaginative with each tool produced.

"We are working with one particular customer to test a new milling tool concept in a head to head comparison. This tool has been designed to give an ultra-high surface finish on castings. The data coming back shows our printed tools are performing equally as well under high speed and off-centre loads" says Pearce. We'll use this data to further improve our special tools each time we receive it.

Other companies in the Guhring group have also actively taken part in the new initiative – tools have been shipped around Europe and the orders are still coming in. Guhring UK have a growing list of happy customers in and outside of the Group.

There are many different ways to assemble cuttings tool and thus far Guhring have successfully utilized heat-shrink, hydraulic chuck, steerable attachment and mono-block designs.

Once the tool bodies have been printed they go on to be washed and then sintered in-house using the Markforged supplied equipment. Tools are finished using conventional methods such as grinding, brazing the tips in place and wire EDM machining the tips to the correct geometry.

After the manufacturing process is finished every tool is inspected and balanced before it is packaged and dispatched to the customer. Guhring Engineers often attend the initial cutting trials at customer premises.

Lead times on PCD cutting tools has been dramatically reduced by the addition on a metal X in to the production process. It is also now possible for Guhring to deliver low-batch volumes cost effectively.



Ejector Drills

Swarf is a major problem for machinists

If you ask any machinist they will tell you that swarf is a major headache inside finished components. Companies spend thousands of pounds on different solutions to remove it after the machining process. Guhring thought about this challenge somewhat differently.

Using their Metal X printer Guhring have used an in-house design to stop the problem happening in the first place. It is now possible to produce, cost effectively, in low numbers, special tools that 'eject' the swarf out of the main tool body and not down inside the part.

The complex geometry means that coolant pathways which we're once impossible can now be produced inside the tool body as an integral part of the manufacturing process.

The Future

Guhring won't sit on their laurels

Having technology from the future isn't something that Guhring take for granted, they don't sit on their laurels and they are always working on the next new thing.

If you sit down with the management team, they will openly admit they've only just scratched the surface of what they'd like to achieve. Many of them have visions of making ultra-special tools that no one has attempted before with geometry that can only be 3D printed. Imagine being able to able to 3D print special tools quickly, on demand - watch this space!



Mark3D UK Limited

The Innovation Centre
1 Devon Way
Longbridge
Birmingham
B31 2TS

www.mark3d.co.uk

0121 222 5510



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