Technology makes mould and die manufacture plain sailing

The latest machining technology is key to the success of B K Tooling, a small specialised tool making company, producing high accuracy mouldings like components for the innovative Aquapac

"If you took my probes away how could I possibly do these jobs accurately?" – these are the words of Bob Tunks, owner of BK Tooling. His busy company employs just five people, and he cannot emphasise enough how critical technology is to his success. He has one machine tool, a high speed XYZ vertical machining centre, fitted with Renishaw touch and tool setting probes, which he relies on to produce very high quality plastic mould tools and pressure die-cast tools.

"I genuinely believe there is a strong market for tooling produced in the UK. However it is only those companies who totally embrace the technology who will succeed. Here I am talking about good CAD/CAM systems, high speed high accuracy machining centres like the XYZ, and the feedback provided by Renishaw probes to remove the variation from those 'forgotten' manual setting processes. You can't just buy a machine, you have to have the 'extras' to make the best use of it and address all the processes involved. I know there are companies who go half way and see some improvement, but miss out on most of the potential benefits."

Service to improve competitiveness

Mr Tunks continues "I am offering a service you can't get when you order tooling from the other side of the world – rapid turn-around, very high accuracy guaranteed from the start and full involvement with the product design teams here in the UK. We

Aquapacs are used extensively by the yachting community

Bob Tunks with the XYZ HS 1060 high-speed machining centre - he relies on Renishaw touch probes for setting parts accurately, measuring them in-cycle, and for setting tool lengths

The plastic mouldings for the clamp on Aquapacs must be finished to a high standard - 20 µm gaps on the mould tool would result in visible seams or necessitate extra finishing

really do produce the tooling (and I hate using sound bites) 'right first time', while achieving better than 10 µm repeatability on any feature, when compared to the CAD model. There's a misconception that aerospace or automotive components need the most demanding and tightly toleranced machining – mould and die tooling is just as difficult to machine, maybe even more so.

On top of that, I cannot afford for my machine to be wasting time producing scrap – the Aquapac is a perfect example."

Tooling for Aquapac

Aquapacs are recognised as the industry-standard in waterproof protection for valuables such as mobile phones, cameras etc, and are used extensively by, for example, yachtsmen.

The mould tools to produce Aquapac plastic mouldings are multi-part complex machinings that can be taken apart and re-assembled to produce different sizes of clamp. These parts must go together perfectly; a gap of 20 – 30 µm would result in plastic flowing to the wrong places.

"Probing is the only way to achieve better than 10 µm repeatability which cannot be done by craftsmen with hand-tools afterwards" explains Mr Tunks. Initially the metal billet is set on the machining centre using the spindle-mounted probe, then first machining operations are completed, but this is not the end of the story. The billet then has to be removed, rotated and re-set to be perfectly positioned relative to the first machined features, ready for spark erosion. This is where probing proves critical.

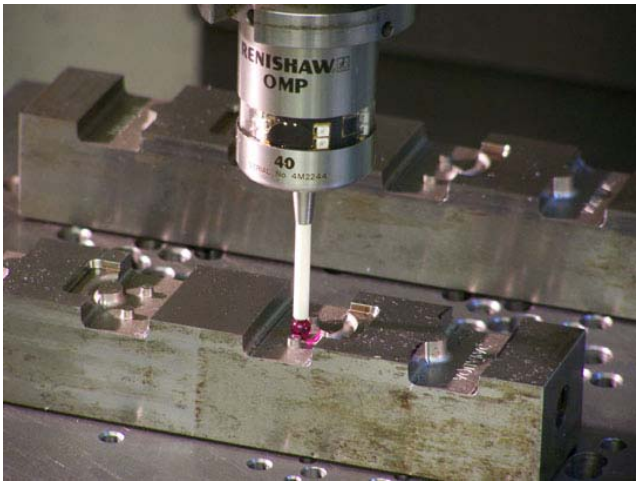
Combining good fixturing and probing

Mr Tunks explains "The fixturing is very good but the reality is that you have to cope with thermal errors and clamping forces as well." A 3R fixturing system is used, which re-positions fixture plates to within 5 µm, but the other factors mean that a rapid probing operation, taking a matter of seconds, ensures machining will be within tolerance.

Tool length setting

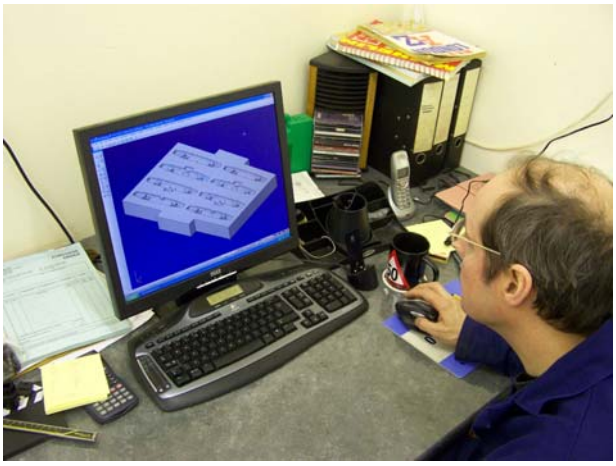
The XYZ machine also has a table-mounted TS27R tool setting probe fitted, which sets tool lengths for all the ball cutters used, at multiple diameters, down to the smallest at Ø0.4 mm. All sizes must be checked for length, which is done on the machine rather than using a pre-setter, taking into account thermal effects such as spindle growth.

The range of cutting tools is limited to about 60 different cutters, with machining programs designed to use this library of tools. Luckily, the machining of mould tools doesn't require processes like drilling and tapping holes, making tooling selection more straightforward.



The spindle-mounted probe is important to re-setting the job when parts are re-positioned

Tool setting on the machine is fast and takes into account thermal effects



The process starts with a CAD model like this one for the Aquapac, which is used to create the machining program

Bob Tunks has had a number of machines fitted with probing - as he says, “even if I had bought a less capable machine I would have had it fitted with probing, all the machines I’ve had in the past have had it.”

A high speed, highly capable machining centre

The latest machining centre is a 12,000 rev/min, 43 m/min rapid traverse XYZ 1060 HS vertical machining centre. “Much of the mould work we do here is complex 3D machining involving a lot of small cuts using radiused or ballnose cutters. However, because I prefer to replace ‘old’ technology rather than simply add to my plant list, I need a machine that can be ‘all things to all men’. I need to rip pockets out of steel bolsters as quickly as I can using carbide-tipped cutters; I need to machine copper and aluminium for EDM electrodes and prototype ‘soft’ tooling; and I need to rough out cores and cavities, and then to finish machine mould tools when they come back in their hardened state. On top of this, I have to be sure that these demands will not affect the accuracy of the machine or, worse, cause a breakdown.

“So it’s not just about spindle speed, it’s about the overall rigidity of the machine, the quality of its build, and the way in which it accelerates and decelerates. The 1060 HS is also equipped with a Siemens 840D ShopMill control that looks ahead to convert a multitude of straight lines into a smooth curve. This machine can drive a 6 mm diameter cutter at 2500 mm/min with a 0.1 mm step-over and produce two halves of a mould tool that fit together perfectly on a three-dimensional split line – that is five times faster than the last machine!”

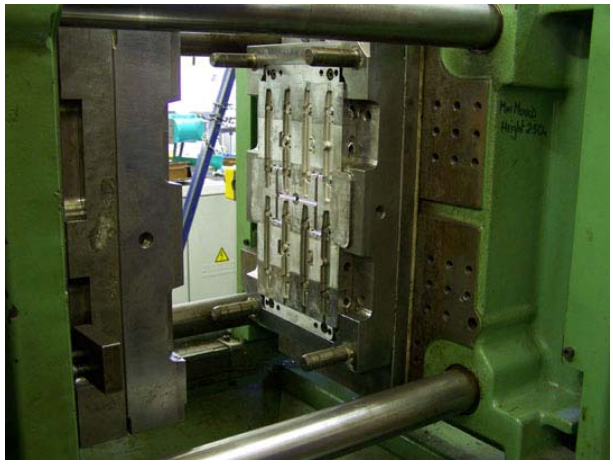
Getting close to the customer

Bob Tunks realises that whatever the type of job, he must interact closely with the designers. As he says “it’s not enough to just take jobs and produce the tooling to spec. I much prefer to be in there at the start and understand how the product will be made, even tell them how the plastic will flow. We also do short runs using the mould tools we produce to prove the process.”

He is optimistic about long term prospects. “People requiring high volumes of moulded components will always tend to go to lower cost economies, but there are others in the UK who may be looking for, say, a high-quality branded plastics box to put their high-value product in and they may only be looking for a couple of thousand mouldings a year. They still need a mould tool and they still want high-quality mouldings. The same is true of UK companies researching possible applications for hybrid metal-replacement materials, who are finding that these materials place much greater demands on the injection moulding process and the skills of the people involved in every stage of that process. These are the types of customer that can benefit most from our expertise.”

The spindle-mounted probe is used to set the Aquapac mould tool for roughing and semi-finishing operations

The same machine tool is also used to machine spark erosion tools, which are used on a spark erosion machine for the finishing operation on the Aquapac mould tool



The finished multi-part tool is proven on BK Tooling’s own injection moulding machine

The finished Aquapac clamp comes straight from the injection moulding machine requiring no further finishing operations