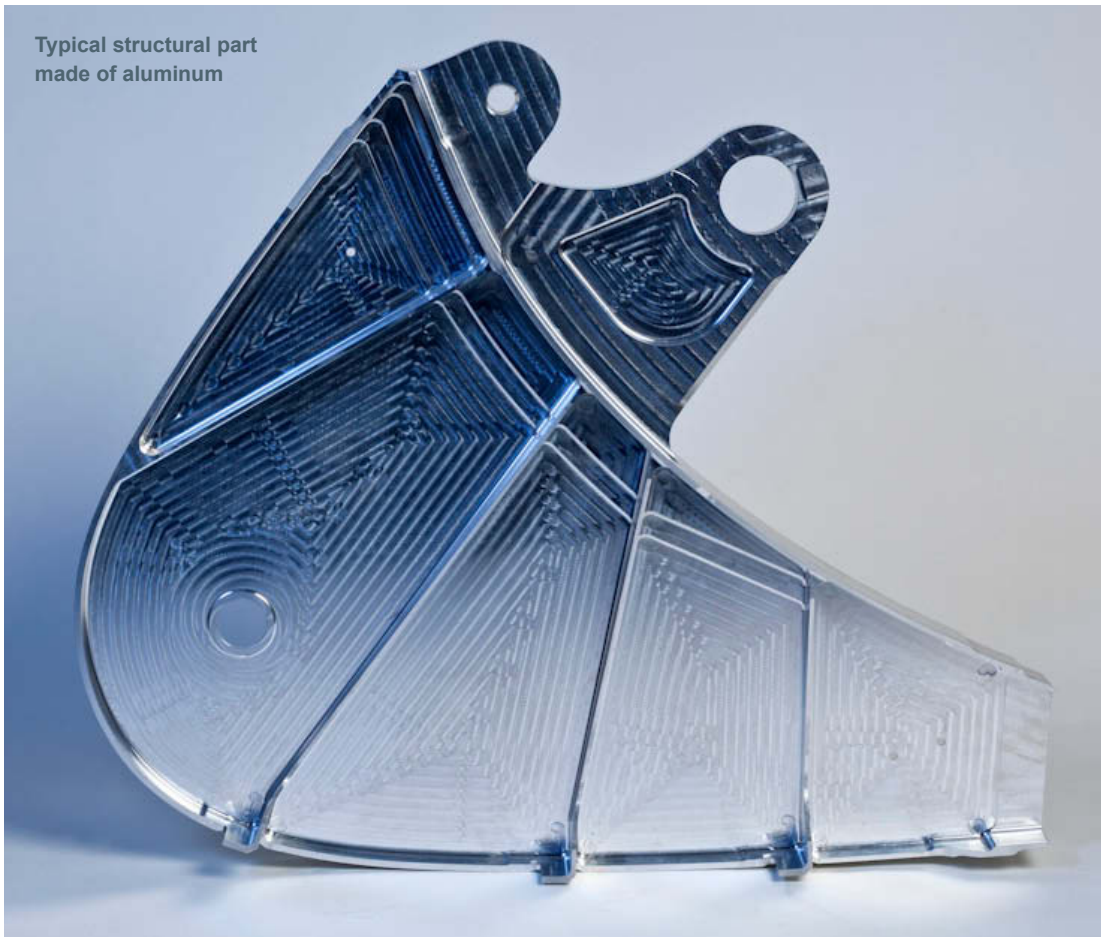
OPEN MIND Cuts a Path To Success In The UK Aero Industry

The global aerospace industry is undoubtedly at the leading edge of innovation and technology and CAM/CAD developers OPEN MIND Technologies AG is leading the field in this industry with the innovations developed at its Wessling headquarters in Germany. Proving its authority in the sector, OPEN MIND is the leading supplier of CAM solutions in the UK aerospace market.

Why is the UK aerospace industry such a key market for OPEN MIND? Firstly, the UK aerospace industry accounts for 17% of global market share, making the UK the largest aerospace industry in Europe, and globally only second to the USA. With 2,600 UK companies employing over 230,000 staff in the aerospace market, the sector generates over £30bn of UK revenue, 75% of which was exported.

By 2032, it is estimated that 29,000 new large civil airliners, 24,000 business jets and 5,800 regional aircraft will be required - valued at over US$5 trillion. Overall, this is a potential market value of around US$600bn for the UK over the next 20 years. The industry is of such importance to the UK economy that the government is committing £10bn over the next ten years to developing the industry. With key players such as GE, GKN, Airbus, Rolls Royce, Bombardier Aerospace, Augusta Westland, BAE Systems and many other globally renowned names manufacturing in the UK; OPEN MIND is working closely with many of these leading OEM's and subcontract suppliers alike.

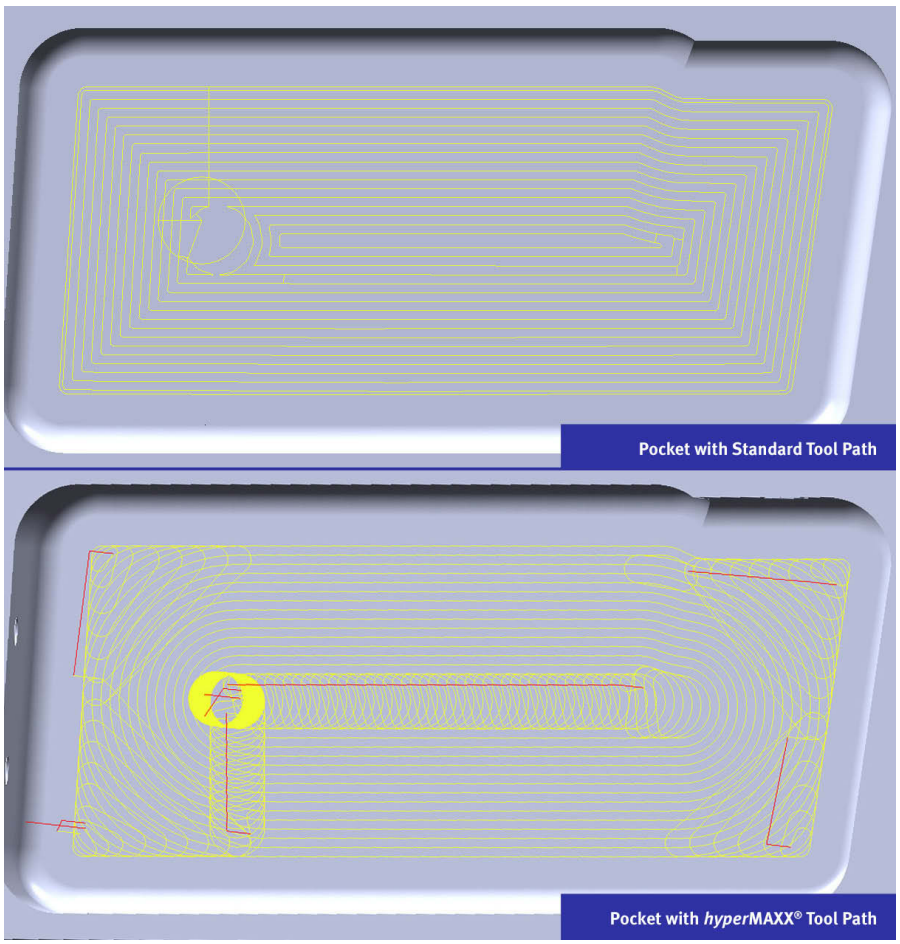


Typical structural part made of aluminum

Working with Dormer Tools whose UK facility is based adjacent to the AMRC, OPEN MIND installed its *hyper*MILL® and the *hyper*MAXX® high performance roughing module to enhance the productivity benefits of Dormer cutting tools. Dormer Tools have selected specific 'Technology Partners' to enhance the capabilities of its productivity centre department. Among the technology partners are Sandvik Coromant, Kelch, System 3R, Heller, Hexagon Metrology and OPEN MIND – a culmination of leading manufacturers that enables Dormer to conduct customer surgeries, technical projects, customer and staff training.

Always at the forefront of technology, the Dormer engineers were flabbergasted by the *hyper*MILL® *hyper*MAXX® high performance roughing cycle from OPEN MIND. As Dormer Tools Machining Applications Engineer, Mr Matt Johnson comments: "I was invited by an OPEN MIND engineer to supply tooling for a demonstration piece at Warwick University and witness the benefits of the *hyper*MAXX® package. Using OPEN MIND's *hyper*MILL®, the previous machining time for the 18mm deep pocket in the 316 stainless steel part was 25 minutes. I supplied our S356 solid carbide end mill and changed the cutting parameters to slightly reduce feeds and speeds, but machine the full 18mm depth in one pass as opposed to the previous program that used three 6mm deep passes. This strategy reduced the cycle time. Then the OPEN MIND engineer turned on the *hyper*MAXX® roughing cycle and asked me to treble the recommended Dormer feed and almost double the speed rates for the cutter."

Efficient machining of an engine case with *hyper*MAXX®

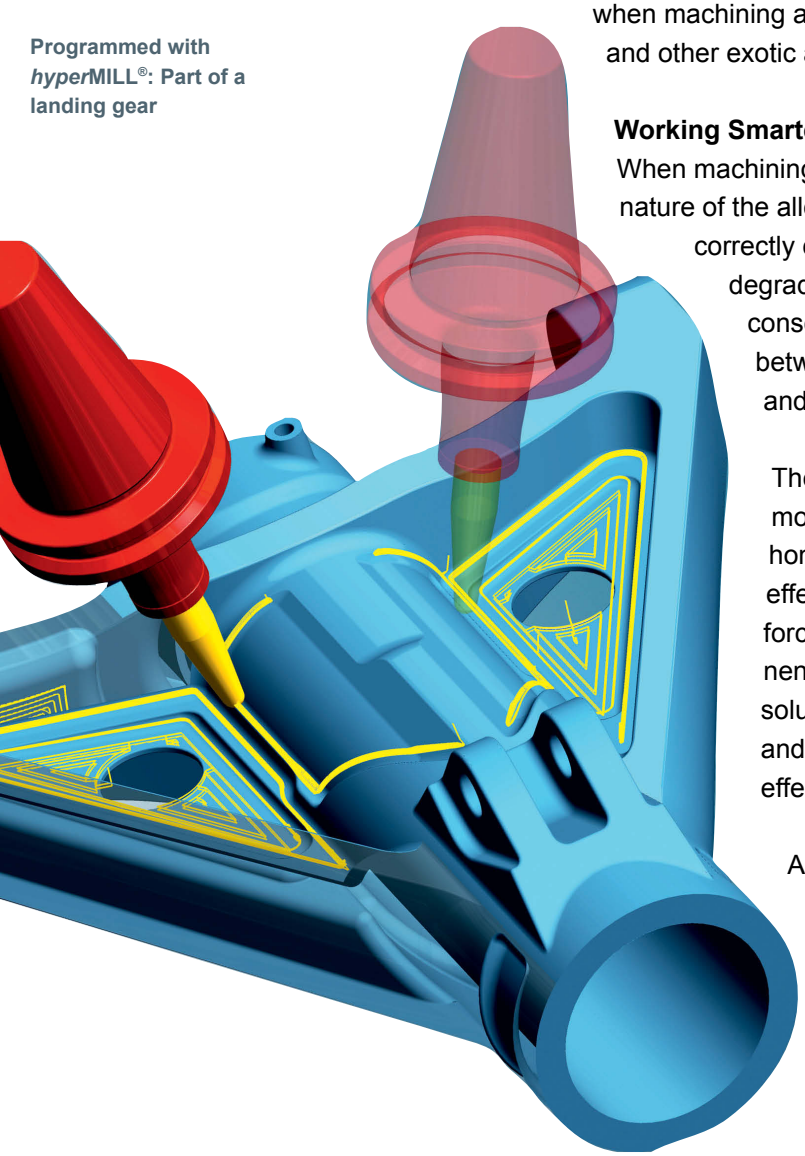


Most cutting tool manufacturers measure productivity benefits by calculating the Q_{Max} value for the machining cycle, this cubic (cm/min) value is the Depth of Cut X Step Over X Feed divided by 1,000. "In this demo the original Q_{Max} value was 17.1ccm/min, using the Dormer 12mm cutter at the recommended parameters resulted in a Q_{Max} value of 30ccm/min, a significant gain. However, when the *hyper*MAXX® module was turned on, it gave us a value of 108ccm/min, a staggering 280% improvement. Compared to the first test piece, the result was a 630% improvement," says Mr Johnson.

“We are currently machining a structural wing component from titanium for an OPEN MIND and Dormer customer. Like the OPEN MIND customer, we are using the same Dormer S357 12mm carbide cutter with a 3mm radius and we extended tool life from 30 minutes to over 2 hours – a tool life improvement of over 200%. The only difference is that we are using *hyper*MAXX®.”

With regard to the production of the structural aerospace part, the customer was taking 40 hours to machine two sides of the component, this is now 10 hours with *hyper*MAXX®. As Mr Johnson states: “The aerospace subcontractor has a contract to produce over 150 parts that was taking close to a week to machine each part. To demonstrate cycle time reduction with *hyper*MAXX®, one pocket was previously machined in 40 minutes. Dormer is now milling the pocket in 3 minutes. To achieve such a result and simultaneously improve tool life is exceptional.”

The implementation of *hyper*MAXX® at the test facility within the AMRC is yielding significant benefits for aerospace subcontractors and OEM‘s alike, especially when machining aerospace grade materials such as 6LV-4 titanium, Inconel and other exotic austenitic alloys.



Programmed with *hyper*MILL®: Part of a landing gear

Working Smarter – The Right Tools and Toolpaths For The Job.

When machining difficult aerospace grade materials, the hard and abrasive nature of the alloys generate significant heat. It is this heat, when not correctly controlled and distributed evenly and carefully that rapidly degrades the cutting edge and reduces the tool lifespan; the consequence is that the manufacturer often has a trade off between maintaining productivity levels and excessive tool wear and its associated costs.

There are many techniques for machining challenging parts in modern highly refined aerospace materials, for many the time honoured ‘Slow and steady’ approach is no longer cost effective leading to lost orders or very slim profit margins, forcing many to decline to quote for the manufacture of components that are well within their production capabilities. The solution is to work smarter, adapt and apply modern toolpaths and tooling to open the door to producing these parts cost effectively.

As the global aerospace industry strives for weight reduction in component parts more and more, the shape of the part becomes more organic, closely shaped to the form of the surface it mates too. To enable machine shops to improve productivity levels, OPEN MIND has worked closely with the most innovative cutting tool manufacturers in the UK to bring the concept of barrel tools to

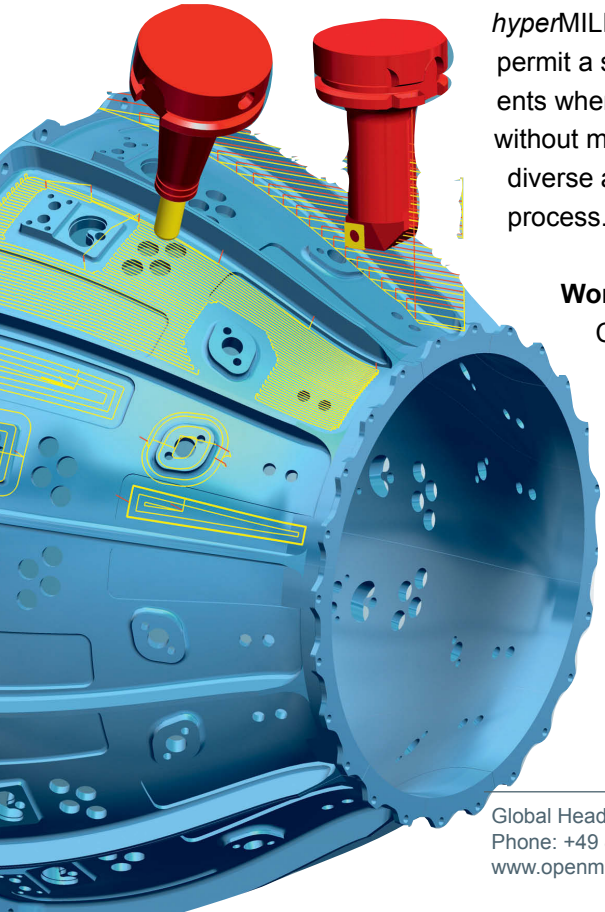
market. The barrel tool concept is a type of ballnose end mill cutter with an excessively large radius ground on the flank. For example, a 10mm diameter ball nosed cutter will have a 5mm end radius whereas a 10mm barrel cutter may have a radius of 20, 50 or even 100mm.

The benefit to the manufacturer in using these types of cutters to machine the curved surface is that the step over value of the barrel cutter versus the ballnose cutter can exceed 20 times. The result is an increased contact area between cutting tool and work piece, reducing the number of machining passes to generate the surface to the required tolerance. The tool therefore has a longer life span as the material is cut evenly and smoothly over the long contact area, better metal removal rates, reduced cycle time and a smarter more cost effective solution.

Until recently the benefit of the barrel tool has not been fully realised as the concept has not been supported by CAM software vendors, this lack of programming support restricts what is possible within the modern machine shop. It was restricting the ability of manufacturers to look beyond the traditional methods and use new technology and calculate step-over rates that will give a significant manufacturing advantage. OPEN MIND's *hyper*MILL® now leads the way in supporting these new tool forms along with the established traditional tools, giving the user increased programming flexibility and power for better manufacturing processes.

During the development phase of the barrel tool support within *hyper*MILL®, OPEN MIND UK has worked with Yamazaki Mazak UK and specific aerospace customers to highlight the benefits of the barrel tools. On one aerospace component the cycle time was reduced from 1 hour 40 minutes to just 20 minutes, in 304L stainless steel.
*hyper*MILL® 2014 already supports 3 different types of barrel tools in 5 axis cycles to permit a simple user friendly programming process for machining complex components where the floor or wall or both floor and wall combinations must be machined without mismatch. These combined with lens cutters and traditional tooling give a diverse arsenal of tools to machine complex parts in a more efficient manufacturing process.

High requirements for production: The machining of an engine case



Working With Advanced Materials

Carbon Fibre is increasingly commonplace in the aerospace industry and this material is delivering a multitude of complex issues for aerospace manufacturers that are machining and building structures from this material. Used on its own and in composite sandwich and honeycomb structures this material is extremely diverse and the benefits in weight saving and structural stress loading will only see its future use grow.

Once again, OPEN MIND is at the forefront of this technology, working with a globally renowned company that builds wing structures. Assembly of carbon fibre structures such as fuselage and wings that undergo

considerable stress are undoubtedly critical elements of all aircraft. By nature, carbon fibre is a layered composite and if the wing assembly components do not join with 100% flatness, the overlaying laminate will not bind correctly and stress and pressure will lead to catastrophic failure. Working with a wing manufacturer to automate this laborious and complex production process, OPEN MIND UK worked with a 3rd party company to digitally scan the structures and then reverse engineer the mating surfaces of the assembly to deliver a unique set of matching parts for each structure.

By scanning the structure, acquiring a digital image comprised of millions of points per cm and then uploading the file to the server, OPEN MIND UK's team compiled machining templates within its *hyper*MILL® CAM package exploiting the CPF Automation functions embedded within the hyperMILL interface that work in conjunction with the feature technology to create a simple solution that produces parts that are unique to the scanned surface, in essence 'Bespoke parts' for every surface at the touch of a button for the wing manufacturer. This guarantees a 100% success rate without the human intervention – this process was once dependent upon the advanced skill levels of the staff. However, with *hyper*MILL® 'Automation' and 'Feature Recognition' OPEN MIND has removed the human error element from this most vital of processes.