

Peter Hartland of Acorn Quality Services (left) with Richard Day, founder of ECM Developments



Chemical reactions

Steed Webzell visits one of the world's few independent Nadcap-approved specialists in electrochemical machining, ECM Developments, discovering a field of largely untapped capability and potential

Electrochemical machining could be one of the metalworking industry's best kept secrets, especially with erosion rates that are said to be 7-10 times faster than die-sink electro-discharge machining (EDM). Among the world's most successful electrochemical machining companies is Lincoln-based ECM Developments Ltd (<https://is.gd/facane>), which this year celebrates its 10th anniversary.

The operation is headed up by founder and managing director Richard Day, who first became involved with electrochemical machining in 1978, during employment with Pera Technology, a product development organisation based in Melton Mowbray, Leicestershire. Conducting R&D work and feasibility studies for member companies, Day also became involved with contract work for aerospace companies. Pera closed its electrochemical machining facility in the late eighties, and although Day stayed with the company, he held on to the idea of one day launching his own business specialising in this niche process. His vision became reality

in 2008, when he formed ECM Developments Ltd.

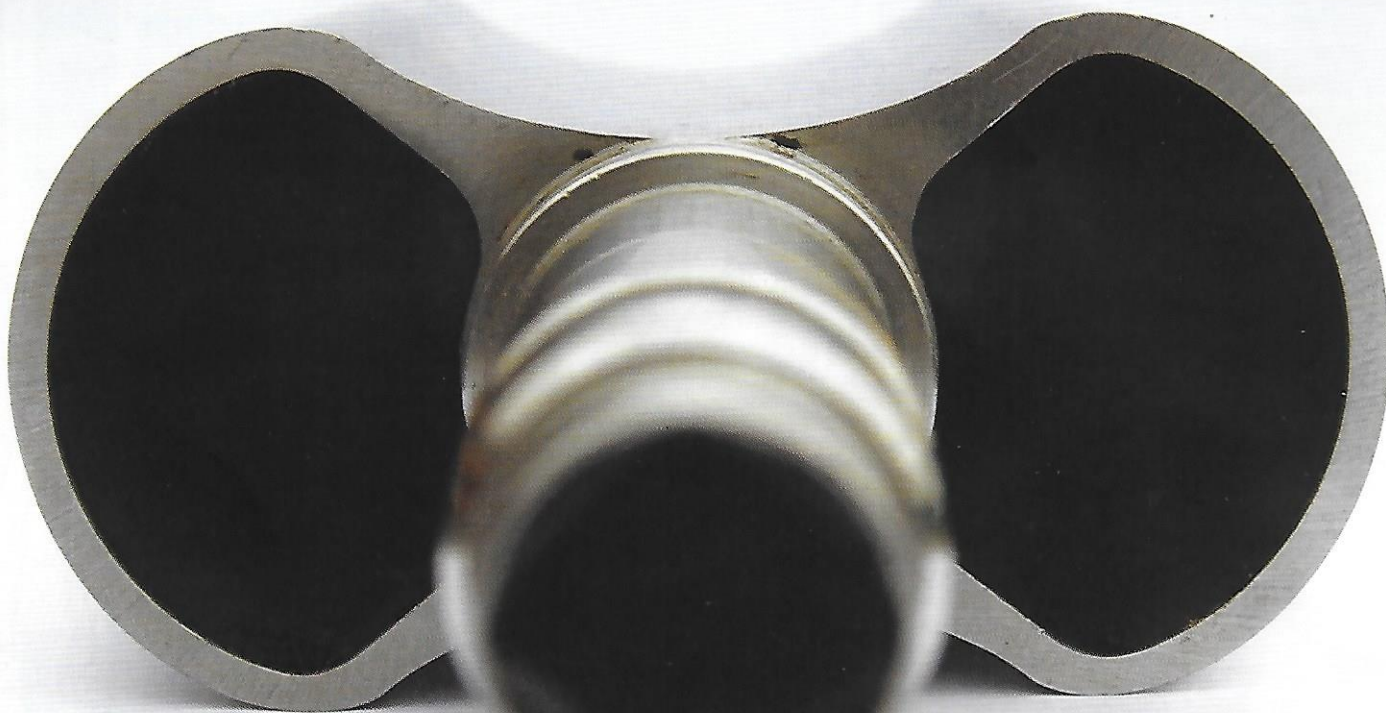
"Electrochemical machining is a specialist technology that allows manufacturers to achieve things beyond the capabilities of conventional manufacturing processes," he says, "so I knew there would be demand."

Day bought some of Pera's electrochemical machining equipment, purchasing the rest from EMS in Leicester, which, following the retirement of its owner, is no longer trading. However, if Day wanted to work for aerospace companies without having to rely on waivers, he had to improve on the company's somewhat "rudimentary" quality policy.

"We were approached by one of the world's largest suppliers of aerospace and defence products, and knew we needed to get AS9100 as soon as possible," he says. "The customer came to see us and said they needed safety-critical parts for a military combat aircraft. Quality certification became a priority."

Day promptly contacted the Midlands Aerospace Alliance and obtained a MAS (Manufacturing Advisory Service) grant that helped the company implement a superior quality system (albeit one that was somewhat onerous and extensive for the size of the business), which in turn saw ECM Developments gain AS9100 Rev C in five months. Quality management has since been aided by the input of Peter Hartland, director at Birmingham-based consultancy Acorn Quality Services, who helped pare down the quality system to suit the firm's specific needs as a small enterprise and police it on a monthly basis to ensure it continues to match the expectations of BSI auditors.

Along with AS9100 Rev C, ECM Developments also required Nadcap accreditation for the electrochemical machining process, which was again successfully achieved with input from Acorn Quality Services. According to Day, ECM Developments is one of only two independent (non-OEM) companies in the whole of Europe to hold Nadcap for



ECM simultaneously produces two kidney-shaped holes on parts for military combat aircraft

electrochemical machining, and one of just four in the world.

By his own admission, the founder says that although he does not have the very latest kit, his company is very practical and competent. ECM Developments can design and manufacture tooling from scratch, and offer consultancy and troubleshooting, as well as accredited ECM production services. Taking a hands-on approach, Day says that he can get a process working effectively to ensure parts are produced to drawing, every time.

"Aside from aerospace, we are interested

in promoting the process into new areas," he states. "For this reason, we have also done a lot of work on etching very difficult materials, which has caught some chemical etching specialists unawares, as we can etch much deeper than them. We've also completed work with the universities at Cambridge and Durham on chemical flow reactor plates in difficult alloys, and collaborated with two well-known, UK-based compact heat-exchanger companies. Other work to date has included filtration industry applications, processing motor components for energy recovery units and work for

armaments manufacturers. Turbine blisk production is another area we have been involved with and which we are keen to develop further, particularly for the very small nickel-alloy blades needed in the hot-section of the engine."

Aerospace, for now, remains core business at ECM Developments. The military jet parts produced by the company spin at ultra-high rpm. Supplied to Day in a high added value, precision CNC machined condition, each part requires three electrochemical machining operations.

The first operation is the creation of two

Involvement in Innovate UK projects

ECM Developments has a strong interest in R&D and ECM process innovation and application, and has participated in two Innovate UK projects (60-70% funded) over the past four years. One concerned the finishing of parts produced by additive manufacturing techniques (in difficult alloys), while the other project focused on heat exchangers.

The company took the lead role on the additive manufacturing project, which was conducted in unison with the MTC in Coventry, as the academic partner, and Newbury-based rapid prototyping and 3D printing specialist 3T RPD. At the centre of the project was the electrochemical surface finishing of aerospace parts produced using additive manufacturing. The project sought to establish a better alternative to conventional finishing techniques, such as

tumbling and blasting, for components made from superalloys.

Four-axis finishing, using a special electrode, successfully 'polished' each surface to deliver proof of concept at the end of the two-year project. ECM Developments is now pursuing further links with the additive manufacturing industry to help the ECM process infiltrate this rapidly growing market segment.

The Innovate UK heat-exchanger project was conducted with a manufacturer and Imperial College London, and focused on the production of a novel heat exchanger from a difficult-to-machine metal that could not be chemically etched to a satisfactory standard. This is where the etching capability of ECM came to the fore, and proved highly successful. The project has just reached its conclusion, with the potential for a larger project in the future.

large 'kidney' holes (approximately 70 mm deep by 25 mm diameter) in a challenging metal, the specification of which has never been revealed to Day, beyond "some form of exotic stainless steel". The resulting thin-walled, flat-bottomed cavities are produced simultaneously in 90 minutes, with wall thickness and geometric form being maintained to tight tolerances.

The second operation is the conversion of a pre-drilled hole into a 30 mm deep square drive, while the final operation is the introduction of a side pocket relief in each of the two kidney holes. Every operation is documented throughout the entire manufacturing and inspection process, and each part is fully traceable by serial number.

ECM Developments has three EMS EMFORM plunge machines (2,000 – 3,000 A) for electrochemical machining operations, currently running one machine dedicated to each operation on the aerospace parts, although the machine that produces the

square drive hole is also available for other work. Among further machines housed at ECM is a 200 Amp EMBUR electrochemical deburring machine that can be used to remove burrs from gun-drilled cross holes in subsea manifolds and valve bodies, for example. A number of special-purpose rigs complete the workshop, which are used for customer-specific R&D work.

STRESS-FREE MACHINING

"Electrochemical machining, which uses sodium nitrate electrolyte and copious amounts of current, does not induce stress into the workpiece, functions regardless of material hardness, does not produce burrs or swarf, and will not work-harden the component," explains Day. "Anyone with a difficult superalloy or stainless steel part to produce will benefit, particularly those faced with producing challenging geometries or deep, thin-walled sections."

For anyone wondering how

electrochemical machining stacks up against EDM, there are a number of fundamental differences. For instance, no electrode wear, pock-marking or surface cratering is created by electrochemical machining, which offers closely controlled erosion of the material. According to Day, electrochemical machining will erode material 7-10 faster than die-sink EDM, with tolerances akin to those of CNC milling.

The company, which has now joined the Midlands Aerospace Alliance, maintains its focus on continuous improvement and quality, and has recently transitioned to AS9100 Rev D. Looking ahead, the founder says he would love to invest in the latest CNC pulse-based (rather than his existing DC-based) ECM technology, but confesses it is beyond budget at present. In the meantime, the company has developed links with a company offering pulse-based ECM machines to see what opportunities they can explore together. ■

Speaking up for etching of a different kind

Photochemical etching specialist Precision Micro (<https://is.gd/ofawup>) has over 50 years' experience in the activity, with the technology especially at home in the automotive sector. Here, the company says, it has been adopted by many of the leading premium and luxury automotive OEMs, due to its ability to produce highly aesthetic complex mesh patterns and high definition surface engraving.

In the manufacture of speaker grilles, photo etching allows OEMs to move away from the use of thick woven aluminium wire, which was often the go-to material for such applications, and adds aesthetic and functional advantages such as facilitating the manufacture of thinner grilles with superior rigidity, higher durability and greater open areas with finer apertures.

Precision Micro has had a long-standing supply partnership with automotive OEMs, tier-one, and tier-two manufacturers, producing speaker grilles for models including Jaguar XJ, Mercedes C-Class and Rolls-Royce Wraith. Today, the company is producing in excess of one million speaker grilles each month and is one of the only suppliers in the world with the etch capacity to cater for current and

forecast future demand, it claims.

Custom speaker grilles are just one of the ways that photo etching can give automotive interior design engineers the freedom to explore new opportunities. The specialist also works with a number of automotive companies looking to manufacture tactile

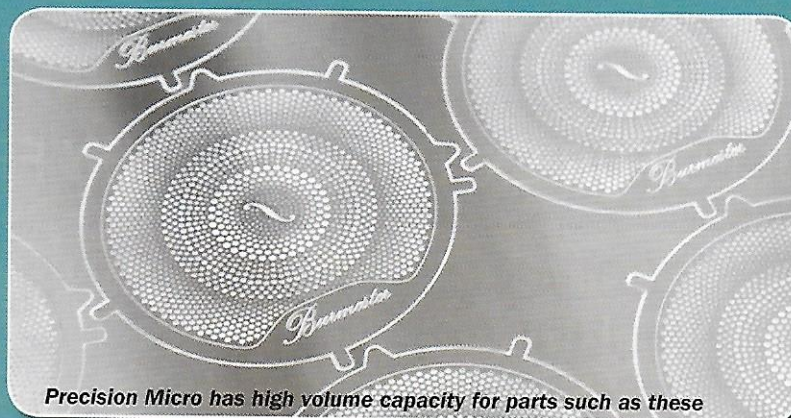
fascias, steering and gear knob inlays, dials and tread plates.

Dashboard fascias can be manufactured from 0.1-1 mm thick aluminium, steel or titanium, with photochemical etching being used to surface engrave and emboss intricate, blemish-free tactile surfaces.

Customers pay by the sheet, so there is no limit on design

complexity. As one of the few suppliers to offer sheets to 600 by 1,500 mm in size, Precision Micro says it can guarantee "economic volume supply".

For tread plates, photo etching can incorporate sharp aperture and directional mesh patterns for backlighting, and the plates can be personalised with owners' names or signatures, which is uneconomic when employing traditional pressing technologies.



Precision Micro has high volume capacity for parts such as these