

Meeting the volume challenge

Growing demand from car manufacturers has led to Prodrive's composites manufacturing business moving from motorsport-sized batches to runs of several thousand for major car producers. *CiM* visited its facility in Milton Keynes to find out how it is re-inventing its processes to prepare for higher volumes.

The automotive industry looks set to become the biggest consumer of carbon composites worldwide, and it might happen fairly quickly! When BMW announced its new 'i-brand' electric vehicle platforms in July, it highlighted developments in composites as part of their strategy to reduce vehicle weight. In an electric vehicle, weight reduction provides critical extra range. As the emissions challenge continues to grow, manufacturers are now also willing to pay more to save weight in conventional-engined vehicles too.

Today, the cost of manufacturing in carbon composites means that only very expensive hand-assembled vehicles use structural carbon in any volume. While there is a huge amount of low cost carbon composite and 'carbon lookalike' material produced for cars, this is almost exclusively used for interior trim applications where there is no force loading and the finish is protected. Other applications tend to be for low-volume specialist and aftermarket components where the high level of differentiation or the weight saving alone can justify the high costs.

Prodrive is well known for its motorsport activities – including running the LMP and GT Aston Martin Racing programme, Ford Performance Racing in the Australian V8 Supercar Series and Mini's WRC team – but the latest contracts won by the automotive technology specialist are significant because they show that the limitations to using carbon composites on road cars are starting to lift. Three manufacturers of luxury and sports cars have now commissioned Prodrive's specialist manufacturing division to supply carbon composite parts for 5,000 vehicles over six years, in contracts worth more than £10 million.

Exterior motives

The two manufacturers of luxury cars are using carbon components for the exterior of their cars for the first time, having previously only used carbon for decorative interior trim. These parts range in size from door mirrors and bumper inserts to rear

diffusers and sill extensions. All of these parts will be unpainted, presenting the composite weave as the finished, visual surface. For the sports car manufacturer, Prodrive will produce the full carbon interior trim, as well as substantial external subassemblies.

The factory at Milton Keynes has traditionally been part of the motorsport industry, manufacturing parts for the teams that Prodrive operates as well as for customer cars and F1 teams. As with Prodrive's machine and fabrication operation in Banbury it has highly skilled people crafting complex products from expensive materials. It can deliver exactly what is needed extremely quickly, but at a price.

With the three new automotive contracts and established relationships with defence, marine and aerospace customers, Prodrive's composites business now has an order book sitting at more than £40 million and what it sees as a refreshing challenge: how to step up volumes without compromising the quality and service that has led to this success.

Intelligent expansion

"It would have been easy to simply expand the factory, but that would not have addressed the fundamental challenge," explains Prodrive's composites manager Ian Handscombe. "Clearly we did need more space, but the key to making this a sustainable, high quality business is to take this opportunity to work on improving our processes and finding new ways of helping our skilled people to work more efficiently."

The first step was to recognise that the motorsport side of the business required significantly different skills to the new, higher volume business. "We physically separated the two activities to allow each one to use processes and skills optimised for their unique characteristics. They require different mentalities too, and we didn't want either to become less effective by having to compromise," says Handscombe.

The biggest investment has been in two additional high spec autoclaves, together worth around £800,000. The larger unit accepts parts up to 2m diameter by 4.3m long; the other 1.5m by 2.3m long. As well as allowing substantial panels to be manufactured in one piece, they open up new possibilities that could further improve high volume production efficiency. With 350°C and 200psi now available, the use of thermoplastic composites becomes possible, with much faster cycle times and easier recycling.

Crossing through the expanded mould making area, £0.5 million worth of 5-axis milling machine has been installed complete with vacuum clamping and dust extraction. It takes only 20 minutes to trim a large post-mould component that previously took four hours by hand. The machine also supports the pattern makers, reducing external spend on machining and bringing control in-house. "Supplementing the manual processes with appropriate automation has increased throughput, allowed us to ensure consistently high first-time quality, and we have reduced waste by around a third," explains Handscombe.

A second machine for NC cutting of prepreg sheet is being introduced, with CAD software to create optimised nesting of pre-cuts direct from component CAD data. The NC machine also allows automated cutting of thicker material, up to 2mm, to reduce the number of layers required. "This is one of the enablers for the manufacture of body-in-white (vehicle body) components," says Handscombe. "It's more efficient and gives us a surface that is ready for painting."

An enlarged manual trimming and fitting workshop handles those jobs unsuitable for automation; a dedicated lacquering



► Kris Meeke takeš the Mini WRC for a spin in Finland



► Prodrive is turning young, willing local people into skilled composites engineers



► New machinery from Belotti has added large capacity 5-axis milling

unit with a sand-blasting facility to prepare parts has been commissioned and a second clean room has been added, with the prospect of a third in the near future. All together, floor area has more than doubled to 32,000ft².

Fit for purpose

This investment in facilities is mirrored by an investment in people. By mid-2012, direct headcount will have more than doubled to 140, bringing with it the challenge of recruiting suitable candidates. The solution, says Handscombe, is to identify people with the right attitude, then equip them with the necessary skills through training. "Effectively, we are taking young, capable people from the Job Centres and turning them into skilled composites operators."

Prodrive's training process is based on the 'buddy' system using on the job training in a cell-based structure, under the mentorship of the cell leader. Exceptionally able staff can then progress to cell leader positions or to the motorsport facility, which continues in a separate unit, using more traditional methods and requiring a greater variety of skills. "In the new, higher volume process, an operator always makes the same part. This improves consistency and simplifies training," says Handscombe. "In the motorsport unit, volumes are lower and operators must be able to create a wide range of components."

The new cell structure is part of Prodrive's Lean manufacturing ethos, which is based on the well-known 5S principles: Sort, Set, Shine, Standardise and Sustain. One example of this is its vacuum bagging procedure. Previously, bags were created by hand from sheet on a roll - a solution that is ideal when volumes are low and variety is high. Now however it uses bespoke bags, created in volume for each component type and ready-sealed at one end.

Volume production

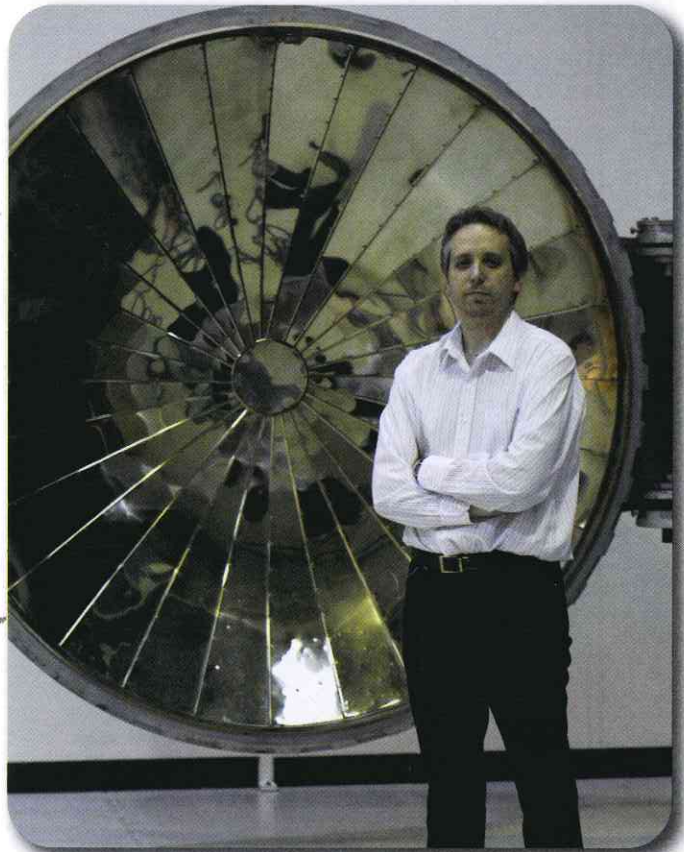
Prodrive's recent expansion makes it one of the largest UK suppliers of high quality carbon composite components. Growth has been driven by the automotive industry, but Handscombe sees opportunities in other industries too. "There are opportunities for us to grow our aerospace and defence business," he says. "Because we are linked to Prodrive's design and development team, we can take a fresh look at how to take time and cost out of meeting its technical goals. For example, we can use carbon to produce early stage prototype tooling that is cheaper than the traditional methods and which can be modified as the design evolves."

Prodrive is also investigating resin transfer moulding (RTM) for aerospace applications. The attraction of RTM as an out of autoclave process which presents no size limit on parts is balanced by the risk of increased process variability. "The process is a perfect complement to our motorsport expertise as we have substantial experience in creating the type of complex geometry components that use RTM's characteristics to increase integration, simplify manufacturing and improve reliability," says Handscombe. The firm will have accreditation to the ISO/TS 16949 automotive quality standard by the end of the year and the aerospace specific AS9100 by the end of 2012.

In many respects, the developments at Prodrive echo what is the dawn of a new era for the composites industry and in the automotive industry in particular, where an industry commitment and desire for these materials mean that process replaces craft skills and quality is designed-in rather than lovingly created by hand. "It's a new way of thinking about composite manufacture," concludes Handscombe.



▶ RTM will be a key part of Prodrive's future aerospace offering



▶ Prodrive's composites manager Ian Handscombe

Prodrive Composites will be exhibiting at The Composites Engineering Show on stand 912.

▶ www.prodrive.com