

# Hercules Propellers

**Ian Waller visits Hercules Propellers and sees how cutting-edge technology combines with traditional skills to improve the performance of Permit aircraft**

**H**Rupert, Just to let you know how, after about seven hours' use, the prop is performing slightly better than before, climb approx 15% better and about 10kt better in the cruise for 100rpm lower than before. Also, it seems that I'm using 15lph instead of 18 before. And it's smoother, less vibration. So, one very satisfied customer here as you may gather. Best Regards, Roger'.

Those are impressive figures: an improved rate of climb, a faster cruise at lower revs and using less fuel in the process. Which pilot wouldn't want a piece of that? OK, it's not available to all and even those lucky enough to benefit might not see quite such impressive figures, but they're certainly worth a closer look.

Which led me to a slightly rundown looking trading estate just outside Stroud, a town more famous for being the home of Britain's first organic café (apparently) than aviation innovation. But take a left under an old stone bridge, ignore the signs for the farm and you soon find yourself at Hercules Propellers, an aviation oasis among metal containers and resting mopeds that combines traditional skills and techniques with ground-breaking technology and innovation.

My host for the day is owner Rupert Wassey, an energetic and instantly likeable character with an infectious enthusiasm for aviation. A former aviation engineer working for the likes of AeroSuperBatics and crop-spraying concerns in the States, on aircraft ranging from Stearman to Citation, he has always, he explains, been inventing things, something influenced no doubt by having a dad who was a successful engineer. He has a natural curiosity for everything around him.

"After working in property for a while, I was looking for a new challenge," he explains in the relative quiet of his office, our conversation being regularly punctuated by the noise of the compressor in the workshop next door and snoring of Gyp, his collie dog, snoozing in his bed under Rupert's desk.

"I'd bought a Flitzer a while ago but it wasn't right. It just wasn't getting the expected rpm or the flying speed that I'd hoped for. So I started looking into propeller design and started to realise that no one propeller is going to be exactly the same for two different aircraft, even if they're the same make and model. After all, everyone's aircraft is unusual to some degree.

"So I started talking to an aerodynamicist on an aviation forum and we put our heads together and came up with a design concept."

## Props for a purpose

Rupert explained that his concept is based on the fact that a propeller should be customised to take in a number of considerations, including the airframe, the engine and even what the owner uses the aircraft for. "For example, we've recently worked on a propeller for a Cub syndicate that operates from a small farm strip, with bigger guys who wanted to optimise take-off performance. So

for that design we adjusted the chord and pitch, and the way the pitch is distributed about the propeller in order to fine-tune it to optimise rpm and take-off performance."

It's here, among the piles of wood chippings and the smell of glue that the technology takes over. It's also at this point that Rupert asks **FLYER** photographer Ed Hicks to be careful about exactly what he shows on the photos. While Rupert clearly embraces the traditional, his pride is clear as he gives us a tour of the computer programs that he developed; these turn the facts and figures supplied by customers into a multi-layered, three-dimensional representation of the perfect propeller for a specific aircraft. It's a product that, as Rupert puts it, guarantees to get performance levels to where they should be.

"There is a lot more to propeller design than diameter and pitch. We gauge what we consider the optimum performance figures should be, from a combination of the information we receive from the customers, from the aircraft's original handbooks and from talking to other owners and pilots of similar aircraft, so that we can compare real figures with those from the handbooks. The result is that we produce a unique product that is ideally suited to the aircraft owner's needs."

By way of an example, Rupert chooses a Jodel 140 that its owner reports is underperforming. "The programme we've developed allows us to input the current figures for speed, cruise and climb performance, and compare those to what we consider the aircraft should be delivering. From there we can produce the design to deliver."

Rupert added that in most cases the hub of a new propeller will be the same size and shape as the one it's replacing, meaning that the same mounting bolts can be used.



**FLYER Editor Ian Waller (right) inspects a display example of a propeller during the early stages of development.**



“The result is quite beautiful and undeniably tactile”





"It's a different method of design, a step apart from simply creating a standard pattern and putting that onto a copying machine. We use the analogy of a suit from Marks & Spencer, which will be good and you'll live with it, but it won't necessarily be the perfect fit in every area. Then you can go to Savile Row where you can choose the fabric, the cut, the colour, as well as deciding on the exact type of occasions when you want to wear it, have your dimensions measured exactly and have a suit that is perfect for you.

"Of course, there are limits. For the owner of a Jodel 140 that's seriously underperforming due to the homemade propeller that perhaps they inherited from a previous owner, there's probably a lot that we can achieve. For the RV owner who currently gets 199kt but thinks they should be getting 200 – and we do get them – we might reply that you've got optimum performance and there's nothing more that we can do."

**Above: while the CNC machine makes some early in-roads into the laminated beech, George Simoni (left) skillfully polishes a nearly-finished propeller**



### LAA approval

Once the design is complete, it requires LAA approval, which Rupert explained is a matter of the owner filling in a LAA Mod 4 propeller change form and sending it off to the LAA.

Andy Draper, LAA Design Engineer, later told me that each individual propeller installation on an LAA aircraft requires specific LAA approval except in the case where it appears on a Propeller Type List (PTL/1) for the particular airframe/engine combination in question. These may be found on the LAA website ([www.laa.uk.com](http://www.laa.uk.com)) and new types are being introduced regularly.

"If the propeller does not appear on the relevant PTL/1 then, as Rupert said, an application to change the propeller needs to be made using our Mod 4 form, submitted along with the fee of £45. Provided that the match is assessed by one of the LAA engineers as being suitable for flight test, authorisation for such is issued in the form of a Permit Flight Release Certificate (PFRC), which has a validity of no more than 30 days but is renewable on request.

"Once the test pilot has established that the aircraft is performing satisfactorily, a flight test at max gross weight is carried out to the flight test schedule that was sent out with the PFRC. This is then submitted for approval and if found acceptable, a Modification Approval certificate is issued to the applicant along with an amended copy of the aircraft's *Operating Limitations* document.



The second stage of the CNC cutting process gives a much smoother finish to the propeller



You can see more photos from this feature on the iPad edition of *FLYER* and on the Editorial Extras section of the *FLYER* forum at [forums.flyer.co.uk](http://forums.flyer.co.uk)



"Time to mod approval depends on many factors, but a straightforward prop change mod can be accomplished within a week if workload allows."

### On the beech

From the computer screen it's a short move into the main workshop where Rupert's only employee, George Simoni, is spreading Aerodux glue onto a neatly piled and clamped stack of beech, fresh from the thicknesser. You might well have seen George at this year's LAA Rally, helping out on the Eindecker display, offering his expertise gained from currently building an example of that aircraft in his workshop just a mile or so away from Hercules HQ. It was also one of his propellers on the LAA exhibit – something probably given away by its maker's regular polishing of the gleaming wood finish.

"The construction is quite traditional," explains Rupert. "Propeller construction is something that you want to be absolutely certain about. An engine failure is bad enough, a prop failure will be even worse."

"At the moment, we produce about three propellers a week. With more people and extra machines, we could probably increase that to around 10, but that's not really what we're about, not at the moment at least."

Of all the aviation maintenance facilities and workshops that I've visited, one of the common themes is that in just about each example, there's either a complete or part-built classic car or motorbike in the corner as a distraction for those rare quiet hours. At RGV's Gloucestershire



**Left: George applying the Aerodux glue before the beech sections are clamped together. Below left: Rupert demonstrating the innovative design programme. Below: as well as building new propellers, Hercules can replicate existing designs, something that is particularly popular with owners looking to maintain the historic accuracy of their aircraft**



HQ it's a brace of Minis under a ground-up restoration; at Enstone Flying Club it's a fire engine or two; here at Hercules it's a gorgeous, single-cylinder 500cc 'bitsa' motorbike – bits of this and bits of that, largely based around a Royal Enfield Bullet, something that Rupert often uses for his daily commute to work across the surrounding fields.

Also stealing a little bit of workshop space, albeit up in the rafters, is the fuselage of that Flitzer Rupert mentioned earlier, ready, so he explains, for reassembly, when he gets the chance...

Back to the propellers: Rupert explains that of the four main woods that are most suitable for propellers – mahogany, beech, birch and maple – he uses beech due to a combination of quality and availability. "Mahogany is better, but it's a banned substance which you can't import, and beech is very nearly as good. I'd love to say that I use British beech, but the quality and price of the German product is too good to ignore."

With the wood cut and planed, it's over to George who glues the planks together before clamping them under a set pressure for up to 10 hours (fewer in the warm summer days) for



**While the cutting process is effective, it's also an undeniably wasteful process**



**That's one way of demonstrating the strength of the Hercuthane edging**



## PROPELLERS

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the glue to set. The clamp, like most other tools in the Hercules workshop – including the CNC (computer numerical control) cutting bed – has been made by Rupert; “You can’t buy propeller-making tools,” he explains.

From the press, the wood is transferred to the CNC machine, with the design for that particular propeller waiting on an adjacent PC. The CNC machine works with a beguiling, steady rhythm that you can’t help but become entranced by – even George and Rupert admit to still being distracted by its motion. The machine starts with a rough cut of the design, its tungsten carbide-tipped cutters working smoothly through the laminated layers, gradually revealing an identifiable shape. Between two and three hours later, Rupert enters a new program, changes the cutter, and the machine moves to a slower, steadier mode, taking the design to an almost-finished shape.

“To be honest, it’s a very inefficient process with 90% of the wood being removed during this cutting process,” admits Rupert. However, it’s also a method that over the years Rupert has modified to do the very best job possible.

#### Hercuthane secrets

It’s at this stage that another unique aspect of the Hercules propeller is introduced. Holding up an ageing example from a Tiger Moth, Rupert explained, “Here you can see the traditional brass insets along the leading-edge of the propeller, something that many manufacturers used for years. The problem here is that the



brass can crack, dent and break.” Rupert’s solution is a product he calls Hercuthane. He won’t tell us much more about the construction of this product, but he’s more than happy to demonstrate its qualities by dramatically whacking the edge of a propeller on one of the workbenches and then proudly pointing out the lack of marks or dents.

Next, it’s off to another workshop where George brings the final finish out of the propeller before it’s sent away for painting. Hercules is unique in offering a variety of colour options, including one designed to give the propellers

**Below: Rupert with an original Tiger Moth propeller alongside the replica recently completed in the workshop. Bottom: one of the final jobs is to make sure that each propeller is perfectly balanced**

the look of mahogany. Then back at the workshop, the blades are balanced, polished and ready for delivery. In all, on average a six-week journey from one end of the factory to completion of the other.

The result is quite beautiful and undeniably tactile – you can’t help but want to stroke the smooth surface. “For most customers it’s about performance,” comments Rupert, before adding, “The fact that it looks so good is the cherry on the cake.”

While the focus of Hercules’ work is innovation, occasionally the team is also called upon to replicate propellers, more than often for historic aircraft that the owners want to keep as authentic as possible. “A good example of this is the work that we do for the Shuttleworth Collection,” explained Rupert. He’s even produced a few dummy props for country pubs and the likes to put above mantelpieces, although it’s not an area he’s really looking to push.

With a basic price tag of £830 to £2,300, a Hercules Propeller isn’t necessarily a cut-price investment, but then that’s not really the point. These products are a unique blend of traditional and the technical, something that will help your aircraft reach its potential while also looking really good. And that is an impressive combination. ■

