



Hercules founder Rupert Wasey with one of his company's new, all-British Spitfire propellers

Building a better blade – in Britain

Improved, high-performance propellers are now made in the Spitfire's home country, thanks to the triumph of a small British aviation company

Words: Bob Grimstead **Photos:** Hercules Propellers

Rupert Wasey is not only extremely industrious in having developed and grown his thriving Gloucestershire-based Hercules Propeller company over a dozen years, but he is also very patriotic. For a long time he had been annoyed that post-war Spitfire propeller blades were all made either in Germany or occasionally in the Czech Republic. On several occasions warbird operators approached him for propellers, but he had to explain that he needed proper drawings before he could even consider their production.

As often happens, Serendipity joyously intervened. In 2015 nearby former propeller-making, and now advanced composites company, Permalis of Gloucester was refurbishing their premises. During this process the decision was made to dispose of their huge archive of propeller drawings, which filled chests full of wide drawers. During a corridor conversation, somebody mentioned “Did you know there’s a propeller-making company nearby in Stroud? Maybe they would like to take a look?”

So Rupert got a call, “We’re going to chuck out this lot, would

you like to see them first?” He didn’t need asking a second time, and so whizzed over to their factory. There he was shown more than 100 beautiful full-sized drawings on linen sheets protected by celluloid acetate. They were not blueprints, but the actual pen-and-ink originals from which blueprints are later copied. These drawings included those for many propeller types including for Austers, many Miles models, WWII Cubs and even Wallis autogyros.

Rupert was volubly amazed. He even spotted the drawing of a propeller for the one-off Britten-Norman BN-1 low-winged single-seater. “Can I keep a few?”

“We’re chucking them out; you can have the lot if you want.”

So Rupert carefully carried this priceless hoard to his car and brought them back safely to his office. Later perusing his newfound trove in more detail, with mounting excitement he spotted plans for the blades on a Spitfire Mk VII (these were also used on the Mk IX). *The original drawings!*

Thanks to this magnificent discovery, Rupert got Dowty-Rotol interested. They also allowed him access to their archives, including their drawings

for the steel adaptor that screws on to the blade root, plus their instruction books containing much technical text including information on the fitting, balancing and maintenance of their propellers.

The task of obtaining CAA approval has been Herculean, because they insisted on working to the assumption that all Rupert’s propellers were to a completely new design, despite his making them from the original drawings and using precisely identical original materials, still sourced from the original supplier, Permalis. Structural comparison tests were made on both existing Spitfire propellers and the new-build ones to confirm the strength of today’s Hercules propellers meets or exceeds that of the vintage ones.

Among other things, Rupert had to carry out a blade-root pull test. Never daunted, he made a massive hundred-ton hydraulic press which eventually proof loaded a sample Hercules blade to 74 tons including the calculated in-flight bending loads. This was well beyond the requirements of a 200% reserve factor, to fulfil the most critical demand—the highly unlikely 21st →



Using a huge lathe bought especially to do the job, a thread is cut in the blade root



Blade shaped in Hercules's CNC milling machine

Century eventuality of a full-throttle Spitfire spin.

So at last Hercules was given the go-ahead to make some real, flying blades. For this Rupert created 3D CAD models for Hercules's famous, purpose-built CNC milling machine. The finished blades have to be threaded at the root to take the aforesaid screw-on steel adaptor, so Rupert also purchased a huge lathe specifically for this process.

After machining, these blades are carefully hand-sanded to their final dimensions and statically balanced against counterbalance weights to extremely fine tolerances (just walking past the balancing rig can cause the blades to swing around). Following that, they are aerodynamically balanced. This facilitates small variations in pitch angles (in mere minutes of arc) to compensate for any tiny manufacturing errors, so that all four blades will provide the same, symmetrical thrust. Spitfire prop blades were always balanced as a matched set and could not be separated or have a single blade replaced without a complete re-balancing. As it turned out, the Hercules manufacturing process is so accurate that this is not necessary and all their blades can be marked 'normal'.



ABOVE: the static balancing rig is so sensitive, it can be disturbed by someone walking past - Hercules now produces propeller blades so precisely matched that sets from different batches can be mixed

Originally all contemporary blades were covered in a protective celluloid acetate film. This is nasty flammable stuff and effectively impossible to obtain nowadays. Dowty currently uses a system developed by Indestructible Paints of Birmingham, who have developed a modern, very tough, slightly flexible paint system which is highly impact resistant.

Then a satin black epoxy finish is applied on top of that. This is a great improvement over the original coating while still appearing totally authentic.

The colour of a disc decal on each blade's root denoted the relevant manufacturer and unit serial number: Hordern-Richmond's colour was green. Since the war, blades imported from overseas have all had large,

Hordern-Richmond

Thanks to the generosity of fellow aviation enthusiast, the Duke of Richmond, a few years ago Rupert was able to adopt the 1937 trade name of Hordern-Richmond. For those who don't know, Edmund Hordern was a 'wealthy superstar 1930's aviator' and former Heston Aircraft Company test pilot.

The ninth Duke of Richmond (the current Duke's grandfather) subsequently joined with him and they ventured into aeroplane construction with the neat little Continental A40-powered Autoplane twin, photos of which can still be seen in the Goodwood Flying School pilots' lounge. The war intervened so they merged with Lang Propellers of Weybridge

to manufacture Rotol-designed propellers during the war. Incidentally, Rotol was a joint venture between ROLLS Royce and BRISTOL Aero Engines, thus the combined name.

But by the early fifties, with the advent and supremacy of jets, the market for big piston propellers was shrinking, so in 1953/4 Hordern-Richmond sold out to their main competitor Permali (who then manufactured the compressed wood material Jabroc, which they supplied to Rotol, while Hordern-Richmond used their own, but similar Hydulignum, now produced by Permali).

Since the Hercules name has become so well-known in the aviation world, Rupert has decided his Hordern-Richmond



Owned by Hercules, the Hordern-Richmond brand now encompasses a range of luxury aviation memorabilia

trade mark will uniquely remain the brand name for his sideline in aviation memorabilia, including fountain pens,

rollerballs and pencils turned from original, wartime Spitfire propeller blades. See www.hordernrichmond.com

yellow root discs and other writing. This is unsightly and not authentic. Since they own the H-R trademark, the discs Hercules applies are green, but smaller, more subtle, and properly genuine.

The CAA wanted instrumented flight testing, and Dowty also recommended this, despite the utter validity of Hercules's new blades. So twelve strain gauges were mounted on to each blade of a set of four and connected into a purpose-built circuit board. Mark Bennet 'a genius engineer in BA systems' designed the logging systems to record in-flight strain information on a micro SD card and battery hidden within the spinner. He also wrote the software to analyse it. Then everything had to be balanced anew, of course.

Rupert says that Peter Monk was brilliant in loaning his Mk IX Spitfire TA805 *The Spirit of Kent* for this work. The CAA was unflinchingly helpful, so they were actually able to accomplish the whole thing in a single day, initially undertaking static ground runs four times, while facing towards each of the cardinal compass points. Then runs were accomplished up and down Biggin's old east-west runway with four blokes sitting on the Spitfire's tail as it twisted and turned its way along the taxiway.

Mark downloaded these readings while Dowty's Mike Token was simultaneously analysing this data in real time during the running. He returned Dowty's approval, which the CAA promptly approved themselves, and they immediately sent the Permit to Fly, enabling Pete Kynsey to fly it there and then. Off he went, still with the instrumentation and data log fitted, flying a complex test schedule including sideslips, aerobatics and a Vne dive to well over 300mph. Data was logged throughout this flight, and after the landing PK said "That prop is so smooth!"

Dowty were very happy with the results so the CAA granted Hercules approval for manufacture under UK CAA A8-21 design and production approval number AI/10077/16P. *The Spirit of Kent* is still being



flown from time to time and all subsequent pilots have agreed that its new Hercules propeller is smoother than any other they have encountered. Former post-war Spitfire props had a reported resonance rev band, the rpm varying according to the individual propeller, but Rupert's Hercules props have no such restriction. Again, Hoffman

ABOVE: the period correct manufacturer's green disc marking at last reappears on Spitfire propellers, the serial number of the blade appearing under those of the other blades in the matched set

props have rpm and horsepower constraints, but the new Hercules ones don't because they have been made to the original specs and fully tested.

The Dowty SB used to say that if operators can't get original Rotol blades, then Hoffmann 'replica' blades could be substituted, but that's now been amended to include Hercules blades. Rupert is currently working towards producing three-blade sets for earlier marks of Spit and five-bladers for the bigger Griffon-powered models. He would like to start making Hurricane propellers, but of course that market is much smaller and Hurricanes now mostly use modified DC-3/C-47 props. Nevertheless Hercules has their drawings so it is a possibility in the future.

Meanwhile, Spitfire propellers have to be fully overhauled every six years or 350 hours with three-yearly bearing checks, so Hercules is setting up an overhaul facility and applying for approval right now. In the process they are working towards machining new hubs and overhauling complete prop assemblies, so very soon you'll be able to buy a complete, brand, spanking new British Spitfire propeller assembly direct from them. Who says we have no aviation manufacturing in England?



Test aircraft for Hercules's new propeller blades, Mk IX Spitfire TA805 *The Spirit of Kent*