

# 2013 News.....



Jaba Chat

April 2013

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2013 is shaping up to be a busy year for Jabiru as a number of new products reach the market. New scimitar composite propellers will grab plenty of attention but there have also been significant changes to the established range of Jabiru Engines which promise improvements across the board.

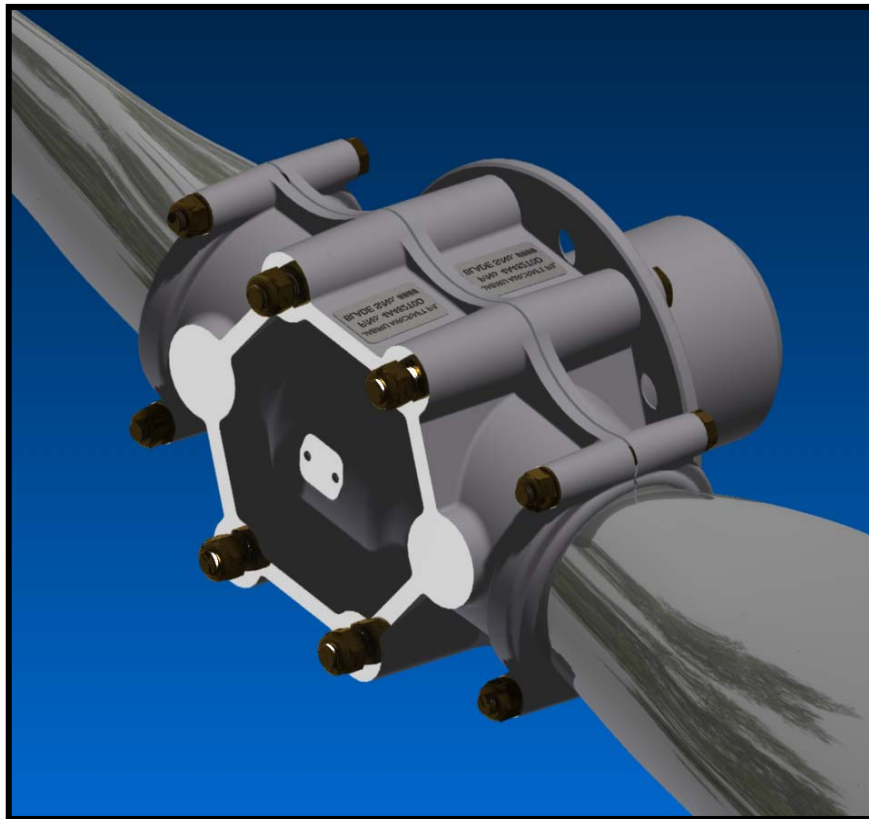


It's been an open secret for the last few years that Jabiru have been working on a scimitar propeller design for use with their aircraft and engines – Attendees of the talk given by Jabiru Director Rodney Stiff at Temora 2011 heard how work was progressing on a radical injection-moulded plastic design while sharp eyed attendees to fly-ins in the years since have spotted various prototypes gracing the front of the Jabiru test aircraft. “Don't hold your breath” we were told when we asked how long until we could buy one – experimental aviation in the twenty-teens being such that no sensible manufacturer would consider putting anything on the market until it has been tested and documented to a standard exceeding that of fully certified products from just a few years ago. But now, finally, it's close. Time to take a breath and see what's in store...

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The final design retains the distinct “scimitar” bladeform seen on the prototypes, finished in black fibreglass – not carbonfibre as you might think at first glance. “Boo, Boring!” I hear the geeks in the back yell. Well, no actually: one of the many prototypes tested was full carbon composite and while it performed well, it had vibration issues. The fibreglass blades are not as stiff as the carbon, allowing them a little more flex while damping vibration to acceptable levels. The blades have in-built leading edge protection and are rated to survive as much rain as you can throw at them – in VFR operational limits of course.



The hub is somewhat unusual. First, it is designed to attach the propeller to the engine using just 4 of the 6 bolts normally used for a Jabiru engine. Obviously the bolts are bigger than those used on the Jabiru fixed pitch wooden propellers and there are still 6 large stainless steel drive pins between the propeller and the engine to transmit torque loads: 2 are hidden underneath the blades and don't have bolts passing through them. Anyone uneasy about the strength of those 4 bolts can rest easy – during testing a wooden prototype using the same hub design (with a completely different blade design) failed and lost one entire blade at 3,050RPM.





The resulting out-of-balance centrifugal loads were in the order of 3,000kg and the rest of the hub didn't budge while the pilot made a successful emergency landing.

The second unusual feature of the hub is the material: 6061-T6 Aluminium is common enough and is beloved by engineers everywhere for its strength, stiffness and corrosion resistance. But it is normally seen in an extruded or rolled form: in the Jabiru propeller the hub is actually forged – starting as a piece of flat plate about 25mm thick it is pressed into the shape required then finished with CNC-machining. Forgings are broadly accepted as a gold standard for metallic parts: the process shapes the internal crystals of the metal in ways which follow the shape of the part, improving strength and fatigue resistance.

Jabiru says one of the surprises with the new design was how it responded to pitch adjustments: the old wooden propellers on most 2200 engines were 42" pitch. The first adjustable propellers were set to this and performance was so-so. Dropping the pitch to 40" helped a bit... 38" was better still and 36" turned out to be the sweet spot for the J170 airframe. Despite 6" less pitch than the wooden propeller the speed at the same cruise RPM was a little higher with the new blade. Black magic? No, just an accurate, efficient composite blade which does not twist in flight as much as its wooden counterpart.

The Jabiru Engineers were at pains to dissuade potential operators from increasing the pitch in search of higher cruise speeds – their testing showed minimal gain in cruise speed coupled with reduced climb rate, increased engine temperatures and more stress on the engine. Propellers being fitted to Jabiru Aircraft will come set at the recommended pitch setting from the factory while the Propeller Technical Manual will provide guidance to operators of Jabiru Engines in other airframes for setting up the propeller to suit their particular aircraft. Jabiru say that maintenance requirements for the propellers will be about on par with the wooden types – details were still being decided as this was written.

All very nice, but how does it fly? Very well, thank you for asking. The scimitar shape looks good and reduces tip drag while improving thrust. The lightweight blades are precision balanced and use variations of the classic "Clark Y" profile proven to give good performance. Back to back testing used a J120 aircraft fitted with a 2200 engine and compared the new design with a Jabiru 2-bladed wooden propeller. When set correctly the new prop gave higher RPM on take-off, better climb rates, cruised at slightly higher speed at cruise RPM and provided a noticeable increase to top speed at full power.



Manifold pressures at cruise RPM were slightly lower which was reflected in a slight drop in fuel consumption. One-up circuits in this little rocket were great fun as climb rates regularly hit 1,000fpm—not bad from 80hp! In all cases the new prop ran smooth and clean with much reduced drumming and low frequency vibration.

Flying the J170 equipped with the same propeller was a more laid-back experience as the big, stable airframe cruised around, serenely doing its best to ignore the unsettled gusty conditions. True airspeed (as indicated by the Dynon D180 instrument) was consistently 100 knots at a comfortable 2840 RPM while acceleration and climb rates were both clearly improved. In both airframes there was a feeling that the engine was doing it easy in the cruise and this is supported by the numbers: propeller set to achieve 2950 RPM on take-off, increasing to 3250 RPM during a full-power straight-and-level run, a 2850 RPM cruise is clearly using a relatively small power percentage. A flight in the passenger's seat of the J430 fitted with the 3300 version of the propeller (it's a different blade part number with increased area and different planform) showed it to be similarly smooth and efficient with the same ability to allow higher RPM on take-off, higher RPM at full power straight and level and slightly improved speed at cruise RPM.

Traditionally Jabiru Aircraft have been loath to approve the use of ground adjustable propellers on their engines as the direct drive of the engine made it particularly important that the blade not have any nasty vibration resonances. The answer, in the end, was to develop their own design in collaboration with a well-known Australian propeller manufacturer. Testing of the new propeller has been extensive, using the ASTM F2506-10 design standard as a basis but going further in some areas. Amongst other tests, a blade root was loaded to twice the maximum in-service centrifugal load and required to support that load for a full hour. A separate "test to destruction" showed that the blade will actually support about 4 times the maximum in-service load (in the order of 15,000kg) before failing – and even then the hub & blade root assembly was undamaged. Another test propeller spent well over 10 hours operating at redline RPM to demonstrate that it could support the combination of high RPM with engine vibration. In all, various prototypes have between them logged a total of around 500 flight hours in development. Combine this with all the time spent in design and documentation and you can see that this has been a major engineering project and a serious investment by Jabiru in improving their product.



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The 2200 and 3300 version of the propeller will be available in limited numbers by the time you read this and will initially be approved for use on LSA and experimental category models. Jabiru say that pricing will be a little higher than their wooden propellers (which will continue to be available) but will reflect Jabiru's philosophy of reasonable pricing to keep more people flying. It's been a while in coming but it seems that the new propellers may well have been worth the wait!

