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TALE OF A SCIMITAR
Trying Out Whirl Wind's New Blade

There's a lot to like about Whirl Wind's new scimitar prop blade for the Rotax.

BY TOM WILSON

Conventional wisdom says word of mouth is the best advertising, and in the case of Whirl Wind Propellers, it might also be the fastest. The El Cajon, California, company released a new scimitar prop blade for Rotax 912/914 engines last winter, and within a week I was hearing great things about it.

It started when Ron Attig—whose hangar is just two rows down from Whirl Wind's Gillespie Field headquarters—fitted the new blades to his remarkably clean RANS S-7. Performance increased immediately by what looked like 10%, and so the jungle telegraph commenced to pounding. In fact, a visit by Attig to friend Mark Alderson in nearby Fallbrook, California, convinced Alderson to fit the blades to his meticulously built S-7. When Alderson offered to run before-and-after testing, I agreed to take a look at the new blade installation to see if there really would be an improvement.

Mark Alderson checks his pitch setting via the static rpm of his Rotax 912-powered RANS S-7 for the first time with Whirl Wind blades. Even without instrumented testing, it was clear the RANS gained meaningful performance with the new blades.

Hollow as a Chocolate Rabbit

To get the straight scoop on the Whirl Wind blades, I visited with company owner Jim Rust. He explained that the new blades are carbon fiber and glass pre-pregs, built with a hollow center for extreme lightness. Weight reduction is highly sought after by the Light Sport Aircraft crowd, which is busy counting grams to squeeze under the maximum 1320-pound limit, and at 1.6 pounds per blade, Whirl Wind believes these are the lightest Rotax 912/914 blades available.

Of course, after sweating blood for reduced blade weight, Rust reports that LSA owners overwhelmingly opt for three blades over Whirl Wind's two-blade Rotax offering because the three-blade is a little quieter and looks better.

Also, mainly for noise reduction, Rust gave the new blades a scimitar sweep, but this also aligns with the main, er, thrust of Whirl Wind's design philosophy, which is optimizing the load distribution across the blades via the taper ratio "like the elliptical wing on a Spitfire," Rust said. Furthermore, the thin, swept tips increase the critical Mach number of the blade, reducing drag. Less drag means less load on both the prop and the engine, and thus increased performance and reduced mechanical "pain" on the blade.

While the swept tips and higher critical Mach number are important, Rust said it's largely the more efficient load distribution generating the Whirl Wind prop's efficiency. By spreading the thrust load more evenly, blade twisting is lessened, and the tip drag associated with less efficient designs is reduced. Given the long moment tip drag has on the blade root and crankshaft, it's understandable how more efficient employment of the blade near the critical outer third could mean better performance.

Rust emphasized that it takes the strength of carbon fiber to take advantage of his blade's design. Wood is not strong enough, and metal gets too thin and weak at the tip, so composite is required.

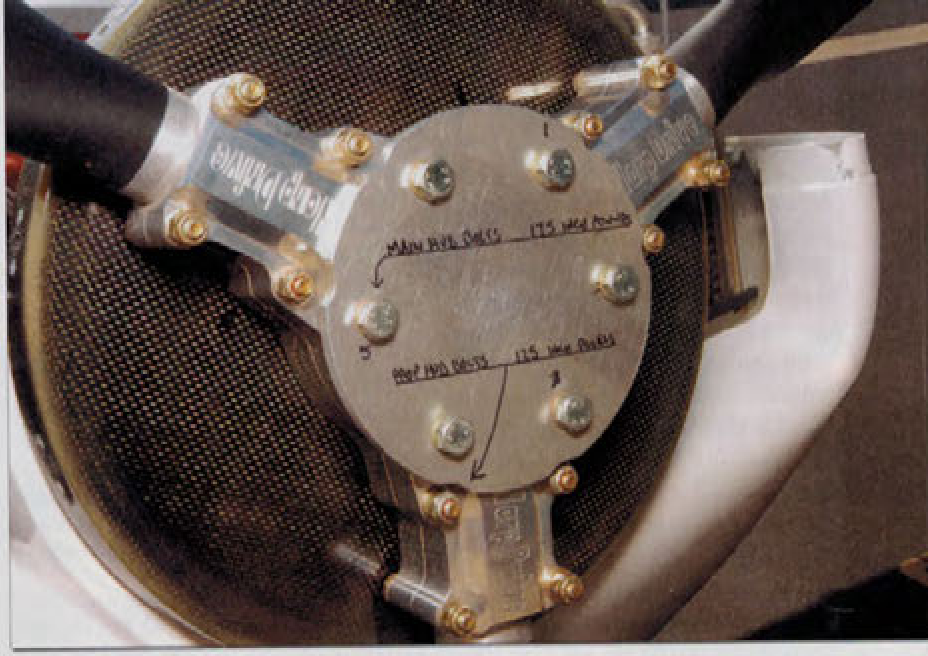
Testing

To sample the new Whirl Wind blades, I followed along as Alderson and Attig exchanged Alderson's stock Warp Drive blades for the Whirl

Laid side by side, the different design philosophies of the Warp blade (left) and Whirl Wind blade are apparent. The Whirl Wind blades are $375 apiece, $1125 for a set of three, or $1550 for the complete propeller assembly—hub, hardware and blades. The Warp Drive blade pictured runs $190, or $330 with optional cut-back tips, nickel leading edges and white tips. A complete three-blade Warp prop assembly is just $865 with standard blades or $1105 with the upgraded blades. Because the Whirl Wind blades were a direct swap into his existing Warp Drive hub, Alderson opted for three blades. This means he has three spare blades in case of a nose-over disaster or for use wherever maximum ground clearance is an issue.

There's no confusing the angular Warp Drive blades with the organic sweep of the Whirl Winds, which lend unusual appeal to the S-7's otherwise all-business looks. The Warp Drive is no anvil, but the new Whirl Winds are lightweight at approximately 11 pounds for the entire propeller assembly—hub and three blades. About 22.5° of pitch gives the standard 5800 rpm Rotax redline.

Photos: Tom Wilson



After removing the upper cowl and spinner during the blade swap, Alderson simplified prop maintenance by marking his Warp Drive hub with the torque specs for both the attachment and clamping bolts.

Wind units. Alderson also performed a careful set of baseline and post-change test flights to document his S-7's performance.

Please note that while Whirl Wind makes a propeller assembly—hub and blades—for the Rotax engine, Alderson retained his Warp Drive hub, changing just the blades.

There's little more to say about changing the blades than is reported in the photos and captions. The basics are to remove the prop from the airframe, split the clamshell prop hub, lift out the old blades, drop in the new blades, reinstall the prop on the airframe, set the ground-adjustable blade pitch, and that's it. The ground-adjustable hub is dead simple—nothing more than a carefully machined clamp, really—so the majority of the work is simple nut-and-bolt stuff.

The only non-wrench work is setting the blade angle, but a digital level and the gauge supplied by Whirl Wind take the mystery out of that as well. In all, I'd plan on a day to swap blades, which allows for setting blade angle and a quick verification flight. As with all ground-adjustable props, there's a good chance you'll want to tweak the blade angle once after putting a few hours on the new prop assembly.

Results

Alderson used his onboard GPS, altimeter and stopwatch to run repeated two-way passes at 3500 feet over an 8-mile course to check cruise performance. Climb rate was measured starting at a stabilized 5000-rpm cruise at 2000 feet, then rolling in the elevator and full throttle to maintain 75 mph, which is the Warp Drive's best rate of climb speed.

Admittedly, this wasn't calibrated NASA or CAFE testing, but wind and temperature variables were minimized by running the tests within days of each other during a benign period of calm Southern California winter weather,

With the prop unbolted from the Rotax, Alderson (left) and Attig quickly split the hub. It's helpful to have a second pair of hands or a large bench, because once the upper hub half is removed, the blades are free to fall out.

Assembling the new blades in the Warp Drive hub was just as easy as taking the original blades out. The new blades simply lay into the lower hub half, and the upper hub half is bolted to it. Whirl Wind says it isn't necessary, but Attig preferred new hardware, so the assembly came out looking factory fresh.

When reattaching the prop, torque the six prop-to-flange bolts to 175 inch-pounds, but just snug the blade clamp bolts at first. Jim Rust at Whirl Wind points out that his blades use electroformed nickel leading edges for the best possible abrasion resistance. The nickel edge is not bent over a form, but built up via plating on a tool and then bonded to the blade. This is a difficult, slow, high-end process, Rust said, the sort of thing more normally found on turboprop blades.

Next, the blade being set is leveled laterally. A simple bubble level works fine for this.

Whirl Wind supplies this plywood gauge with every blade set. It features a fence set at a precise 90° to the main body of the gauge, which allows easy alignment of the tool used to read out the blade angle—in this case, Attig's digital level.

Setting blade pitch requires finding level while the aircraft sits in a three-point attitude, an easy task when Attig whipped out his Craftsman Digital Torpedo Level. Of course, any sort of masonry or framing tricks and tools can be used to find angles, but the programmable level makes short work of the job.

with the altitude corrected for the local barometric reading.

As it turned out, the barometer readings were 30.05/30.06 inHg for Warp testing and 30.06/30.07 inHg for the Whirl Wind. Winds were calm, the outside air temperature within 2° F during all tests, aircraft weight monitored and altitude held to within 50 feet over the 8 miles. Despite minor variables, the differences between the two sets of prop blades left little doubt about their relative efficiency.

Cruise Speed

RPM	Warp	Whirl Wind	% Gain
4500	87	96	10.3
5000	97	107	10.3
5200	101	111	9.9
WOT	111	120	8.1

Climb

2000-3000 ft.	68 sec.	61 sec.	10.3

Note: Speeds are given in mph. WOT = wide open throttle; WOT rpm is 5700 rpm for the Warp Drive and 5600 rpm for the Whirl Wind.

Blade Maintenance

There is no preventative maintenance to speak of with Whirl Wind's carbon-fiber blades. For its ground-adjustable props, the company suggests propeller disassembly at each annual inspection to allow eyeballing for chafing and cracks. There is no TBO, just the inspection requirement. If any cracks, bubbles or delaminating is found, the blade should be rejected.

As with any propeller, over-speeding is a concern. If 10% over-sped (2750 rpm x 1.1 = 3025 rpm), then the blades must be inspected. If over-sped 20% (2750 rpm x 1.2 = 3300 rpm), then the blades must be removed from service. The speeds given are propeller, not engine rpm; the 912 ULS Rotax employs a 1:2.43 reduction ratio should you need to perform the calculations.

—T.W.

Here Alderson is setting blade pitch using the digital level rubber-banded to the Whirl Wind plywood gauge. The digital level eliminates all guesswork, reading out the blade angle directly. It's best to rotate the blade from the root because the blade tips are so thin and flexible. It's difficult to impossible to get all three blade angles exact to a tenth of a degree, but a quarter-degree accuracy is good enough. Attig said his blades measured 22.4°, 22.5° and 22.6°, and the prop runs just fine. When the angle is set, torque the clamp bolts to 125 inch-pounds and recheck the angle; readjust if it moved.

Jim Rust holds one of the many blade designs built in his Southern California facility. Whirl Wind Propellers is the composite shop for both Whirl Wind Propellers and Whirl Wind Aviation in Ohio. If Rust looks familiar, it may be because his Wittman Tailwind was featured on the January 2011 cover of this magazine.

Whirl Wind: Two Companies

Interestingly, there are two Whirl Wind companies selling propellers. Whirl Wind Propellers—which makes the blades detailed in this article—is based in El Cajon, California, and specializes in fixed and ground-adjustable composite props for Continental, Lycoming, Jabiru and Rotax engines, plus airboats and M-14 radial engines. It is where LSA, Van's RV, CubCrafters and other Experimental builders tend to flock.

The other company is Whirl Wind Aviation, based in Austinburg, Ohio. It is a joint venture with Whirl Wind Propellers and handles all constant-speed business. Hot aerobatic, go-fast, cross-country machines and some Van's RV owners are among its customers. Both companies use the same blade design philosophy.

—T.W.

The Whirl Wind root section is a hair larger in diameter than the Warp Drive's, so minor relieving of the spinner blade openings is necessary. Minor, meaning 1/16 inch. It takes longer to measure and lay out the trim lines on the spinner than it does to buzz off the offending composite with a burr. Should you need a spinner, Whirl Wind offers 9-inch, 9.75-inch and 11.3-inch composite spinners with a "street price" of $335.

Notable is the gain in both climb and cruise; this is not a case of testing a climb prop versus a cruise prop. The Whirl Wind also went faster at WOT while turning 100 fewer rpm, another sign of efficiency.

Alderson has continued to monitor his S-7's performance through formal testing and reports that the initial test results are repeatable. His next step will be to flatten the pitch slightly in hopes of gaining climb performance without sacrificing much in cruise speed, but that exam had not been performed by our deadline.

Subjectively, Alderson and his wife noted increased smoothness, less noise and greater thrust at idle while taxiing. Alderson's home field has an uphill taxiway to the runup area, and previously, slightly increased rpm was needed to power up to the runup area, but with the new prop the RANS makes the trip at idle. Whirl Wind may just be on to something for the Rotax crowd.