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Sean Saddler and his Highlander



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LEGACY

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Classic Concept Meets Modern Manufacturing

Skywheels rotor blades back better than ever

BY BETH E. STANTON



IN THE EARLY 1980S, Jim McCutchen was on a mission to create a rotor blade for the experimental kit gyroplane market that encompassed both enhanced safety and performance characteristics. Since gyroplane rotors are in autorotation 100 percent of the time, high-inertia rotor blades are desirable to help maintain rpm.

After painstaking design and testing, Jim began manufacturing his Skywheels composite rotor blades in 1985. The Skywheels high-inertia rotor system stores energy, providing a safety margin in unloaded scenarios such as a downdraft or pilot-induced error. With their stability, predictability, and steep turn capability, the Skywheels were compared to “power steering in the sky” by pilots.

Between 1985 and 2001, 3,000 sets (6,000 blades) of Skywheels rotor systems were produced. Through the years, Skywheels established a reputation for excellence and earned a loyal following.



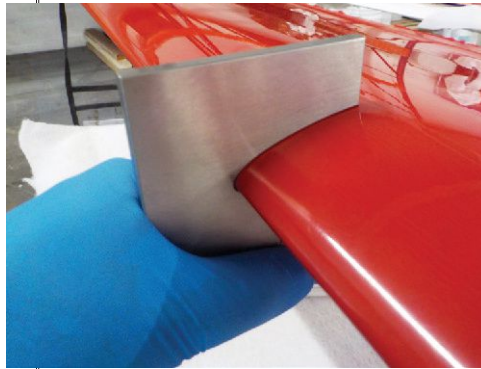
Joe Covelli and Bill Smrtic

OUT AND BACK

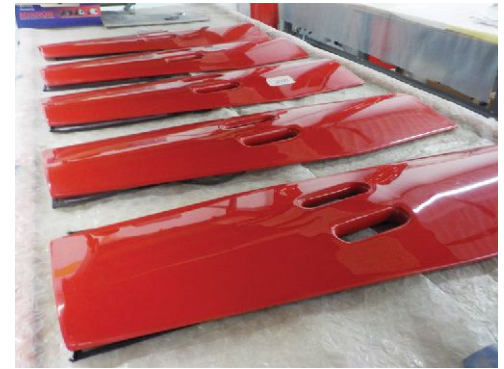
Rotorcraft veteran Jim Lezie acquired the company in 2001, mainly for personal research purposes for his amphibious gyroplane. He manufactured the blades for a couple of years and then halted production. Unsure if Skywheels would ever be manufactured again, some pilots purchased gyroplanes outfitted with Skywheels, kept the rotor blades for themselves, and then resold the gyroplane minus the rotors.

In 2018, Joe Covelli, EAA 1083144, purchased the Skywheels name, original tooling, and test equipment with the goal of bringing the product back to market. While conducting a nationwide search for manufacturing options for rotor blades identical to the original Skywheels design, Joe happened across Blackhawk Aerospace Composites in Morgantown, Kentucky.

The folks at Blackhawk were surprised to hear from Joe since their business model is developing and manufacturing products



Visual check using the leading-edge profile gauge.



Center sections of rotor blades and hardware ready for installation.

to AS9100 international standards for large players in the aerospace industry. The AS9100 standard is a set of guidelines for implementing a quality management system for use by the aviation, space, and defense industries.

Impressed with Joe's pitch and intrigued with a new opportunity, Blackhawk co-founders Kaylah West and Bill Smrtic, EAA

Lifetime 1172969, decided to partner with Skywheels and branch out into experimental general aviation.

"We're now manufacturing parts at a company that's basically following aerospace standards," Joe said. "I don't think there's another entity in the gyroplane world that is manufacturing to that level of quality assurance."



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BACK IN THE BEGINNING

Almost 40 years ago, Jim McCutchen researched the strength, weight, and fatigue properties of aluminum versus composite rotor blades. He concluded that molded fiberglass composite maintained a more accurate airfoil profile and exhibited superior fatigue characteristics. Jim engineered Skywheels rotor blades to exceed FAR Part 27 requirements for normal category rotorcraft.

For data collection and ground testing, Jim cut the roof off a 1969 Pontiac LeMans and outfitted it with vertical and horizontal scales that measured lift and drag, respectively. In a series of creative ground tests, “Gyrocar” sped down the road with rotor blades spinning. Jim repeatedly attempted to induce failure by conducting radical maneuvers that could never actually be attained in a gyroplane. Even with the tips approaching supersonic speed, the blades never failed.

BACK IN THE AIR

After partnering with Blackhawk in October 2019, Joe’s goal was to produce Skywheels rotor blades to the same high-quality standards as the originals. Using the same process, materials, production molds, and test equipment, new blades were fabricated and static spin tested. Two pilots familiar with Skywheels flight-tested the new rotors during the summer of 2020.

“I’ve trained students on these blades for hundreds of hours over the years,” CFI and Skywheels test pilot Greg Bradley, EAA 740663, said. “Man, they nailed it. These blades are a joy to fly.”

The new rotors not only met but actually exceeded the flight performance characteristics of the originals.

“We were kind of surprised because we were doing everything the way we had been shown by the original designer,” Bill said.

As the Blackhawk team reviewed its processes, it realized the improvements were due to advancements in manufacturing hardware and software.

“The technology advancement that we’re seeing here is the precision and reproducibility of what’s being made,” Bill said. “Because, in the past, these blades were only as great and as accurate as what they could measure.”

BACK TO THE FUTURE

“Back in 1985, when they were building these, if they wanted to make sure that something was straight or didn’t have any twist in it, they would lay a straight edge on there,” Bill said. “And they would look at it and try to tell as best they could that there were no warps or bends to the tool and call it straight and call it good.”

Today at Blackhawk, coordinate measuring machine (CMM) equipment measures the physical geometrical characteristics of an object. A robotic FaroArm with a laser scanner at the tip can probe different points on the surface of a part or tool, measuring in increments to 1/1,000 of an inch, and compare them to a 3D computer model.

To start, the Blackhawk team built a couple of rotor blade sets from the original tooling and inspected them to AS9100 standards. After discerning slight variations and deviations, it corrected the tooling to perfectly optimize it to the original design.

“What we’re seeing in terms of the production line is less variability from blade to blade. We are a lot more consistent,” Bill said. “The blades are being inspected to a higher quality standard. It takes what was already a good design and just naturally improves on it.”



The team at Blackhawk Aerospace holding one of the first Skywheels rotor blade sets manufactured at their facility.

BACK AROUND

The original Skywheels spin test platform had to be anchored to the pavement outside and could operate only in good weather conditions. “It was really funny that the most high-tech part of the original spin-up machine was a 2-foot-long piece of 1/8-inch diameter all-thread [rod] extending down from below the rotor head,” Bill said.

As blades spun up to 300 rpm, any balance issue would be revealed by vibration in the all-thread rod.

“You actually sit on a wooden board on this metal frame underneath the blade,” Bill said. “I got to where I knew what the blade was doing regardless of what the all-thread was doing by feeling it in the seat of my pants.”

Skywheels recently purchased digital quality control equipment for blade spin-up balance and tracking. Cameras and computer software monitor blade rpm and tracking with high levels of sensitivity. The system pinpoints the location and amount of weight required to balance a blade. The machine-learning software memorizes optimal balance and becomes more precise with additional use.

BACK IN ACTION

The year prior to purchasing Skywheels, Joe became the owner and president of Air Command gyroplane company. After observing Blackhawk’s technical abilities and developing a close working relationship with its management, engineering, and production staff, it made sense to Joe to also bring the manufacture of the gyroplane kits to Blackhawk.

To support the partnership, Blackhawk purchased a 21,000-square-foot building in December 2020. Skywheels and Air Command will have 5,000 square feet of dedicated space for its operation in the new facility.

After serving business, commercial, and military aviation for more than a decade, Blackhawk is pleased with its new endeavor.

“It’s a great opportunity being able to get out of our comfort zone and branch off and do some experimental stuff and then rotorcraft on top of that,” Bill said.

The two previous owners of Skywheels, Jim McCutchen and Jim Lezie, continue to be involved in bringing Skywheels back to market and are pleased that their project is in good hands. Joe reported that gyroplane enthusiasts are excited to see Skywheels offered and supported again.

“It’s a privilege to offer the Skywheels rotors again to the sport-flying gyroplane market after an 18-year production hiatus,” he said. *EAA*

Beth E. Stanton, EAA 1076326, majored in English because it involved the least amount of math. She finds it hilarious that now she is a pilot and writes stories about airplanes and technical stuff. She can be reached at bethstanton@gmail.com.